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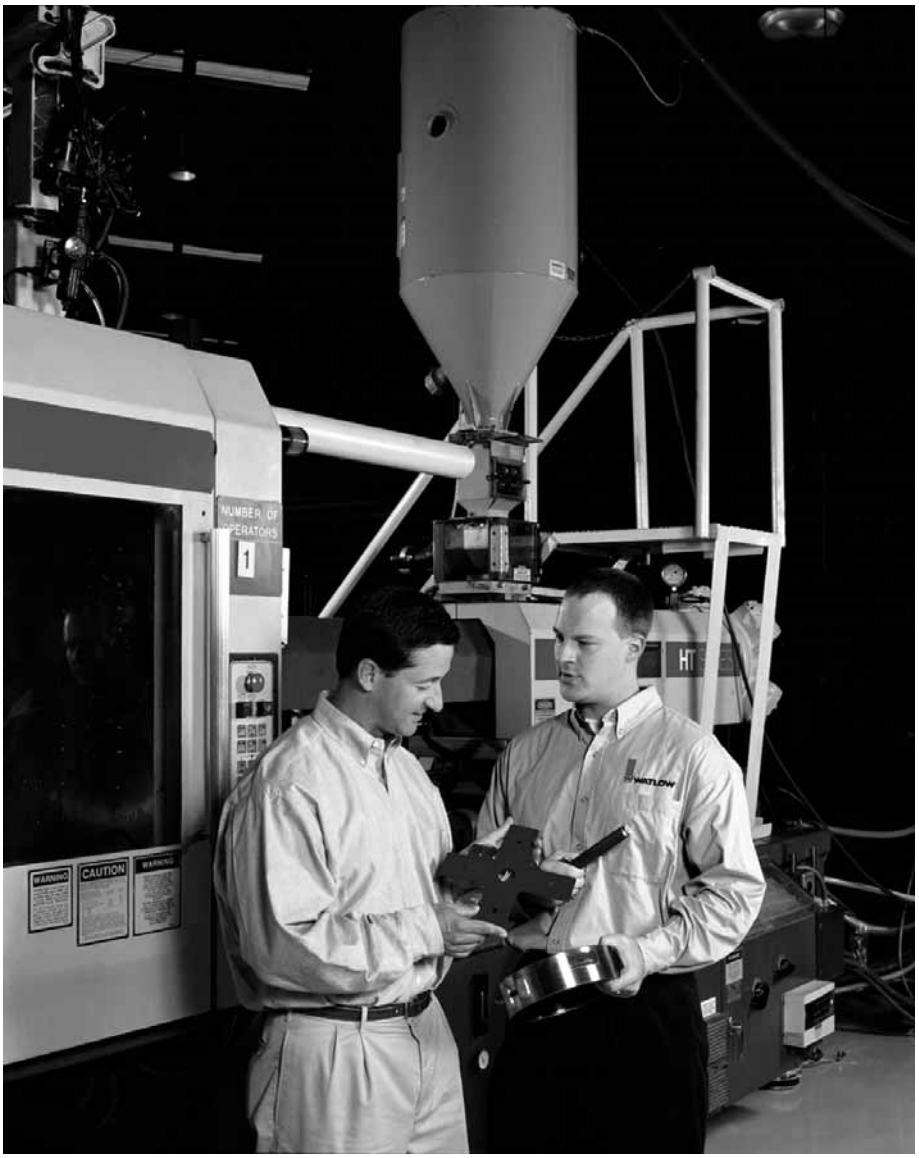
Industry Segment Overviews

Plastics Processing



Selecting the right auxiliary equipment can assist the plastics processor's goal of higher productivity and greater yields. It is more than just the cost of heaters, sensors or controllers; it's performance that counts.

With Watlow's thermal components processors can count on less downtime due to increased heater reliability; and a reduction in operating costs due to energy conservation - both of which help achieve greater output. Watlow has provided plastic processors with product innovations for injection molding, thermoforming and extrusion operations and blow molding for more than 50 years.

Quality, innovation and reliability are the hallmarks of our family of heaters, sensors and controllers. Watlow provides not only traditional thermal solutions, but also innovative, high-performance technologies to meet the specific processing demands of industries such as automotive, medical and packaging, requiring highly-engineered resins and tight tolerances.

Whether OEM, custom or captive processor - Watlow has your thermal solution with our traditional products, new technologies, engineering services and global manufacturing capabilities.

Industry Segment Overviews

Injection Molding

Injection molding is the most versatile of all plastics processing methods and is used to make a wide variety of products. Watlow provides a broad range of heaters, sensors and controllers for various applications.

Applications include:

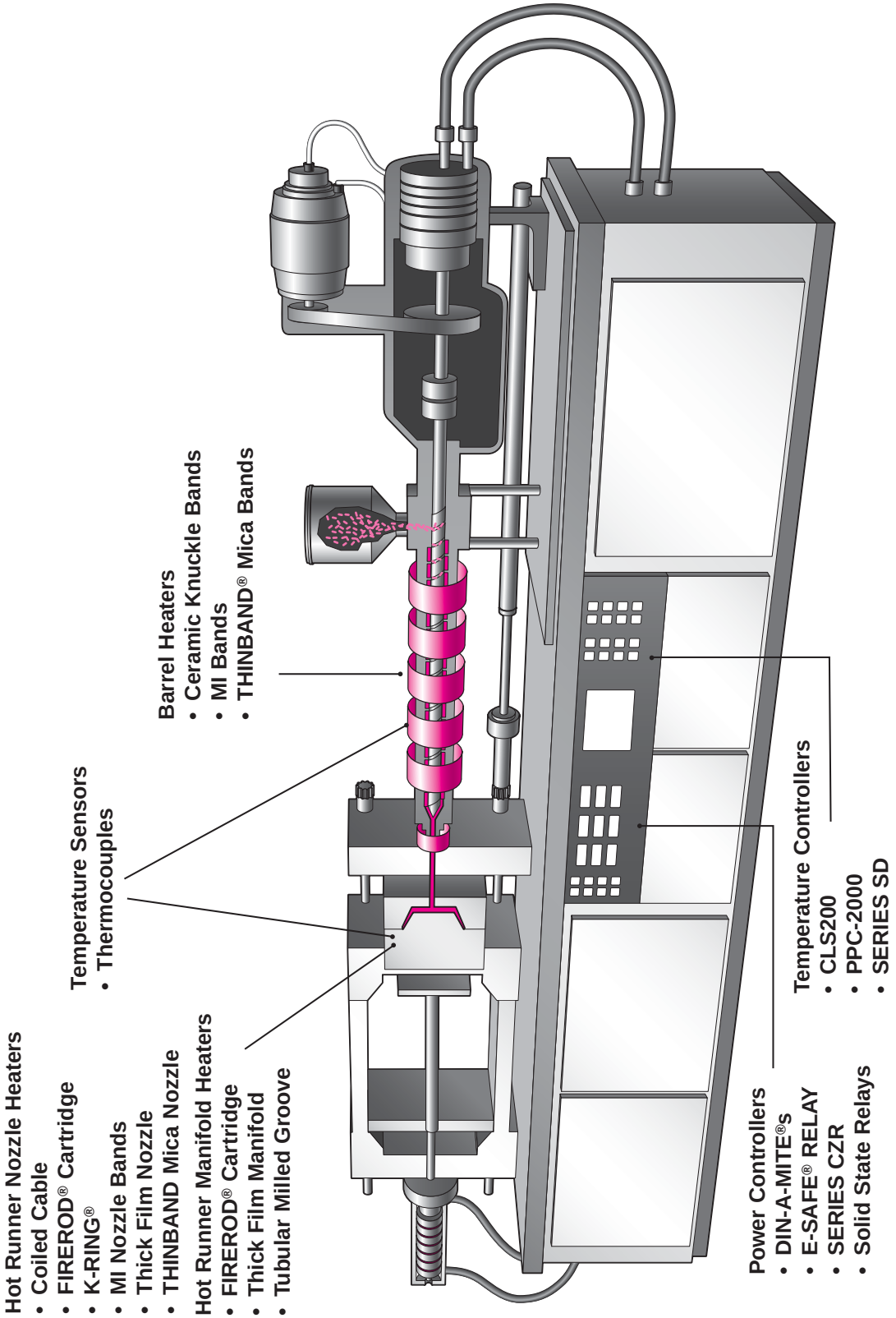
- Automotive
- Consumer products
- Medical, dental equipment
- Small appliances, hand tools
- Agricultural, lawn equipment
- Containers and closures
- Aircraft, aerospace
- Personal care products
- Computer, business and office equipment
- Electrical, electronics
- Furniture, fixtures
- Recreation, toys and sporting goods
- Communications equipment
- Food service, institutional products
- Packaging
- Transportation
- Building, construction

Products like our barrel heaters are ideal for highly engineered or filled resins that require higher temperatures and tighter tolerances. Regardless of your machine tonnage, Watlow has the product to fit your need, such as:

- Multiple barrel heaters
- Sprue heaters
- Temperature controllers
- Mercury-free power switching devices
- Temperature sensors

Industry Segment Overviews

Injection Molding



Industry Segment Overviews

Extrusion

Product quality begins upstream. Regardless of your extrusion system, Watlow's family of thermal solutions provides the high-performance, reliability and accuracy needed to optimize your process.

Whether OEM or end-user, many of today's applications require process control data as well as history documentation to comply with various policies and regulations. Many processors proactively seek products that offer both traceability and product repeatability. Watlow's product solutions bridge the gap by providing evidence of overall product quality, assuring process repeatability and shortening overall startup time.

Watlow has the heaters, sensors and controllers for your extrusion process:

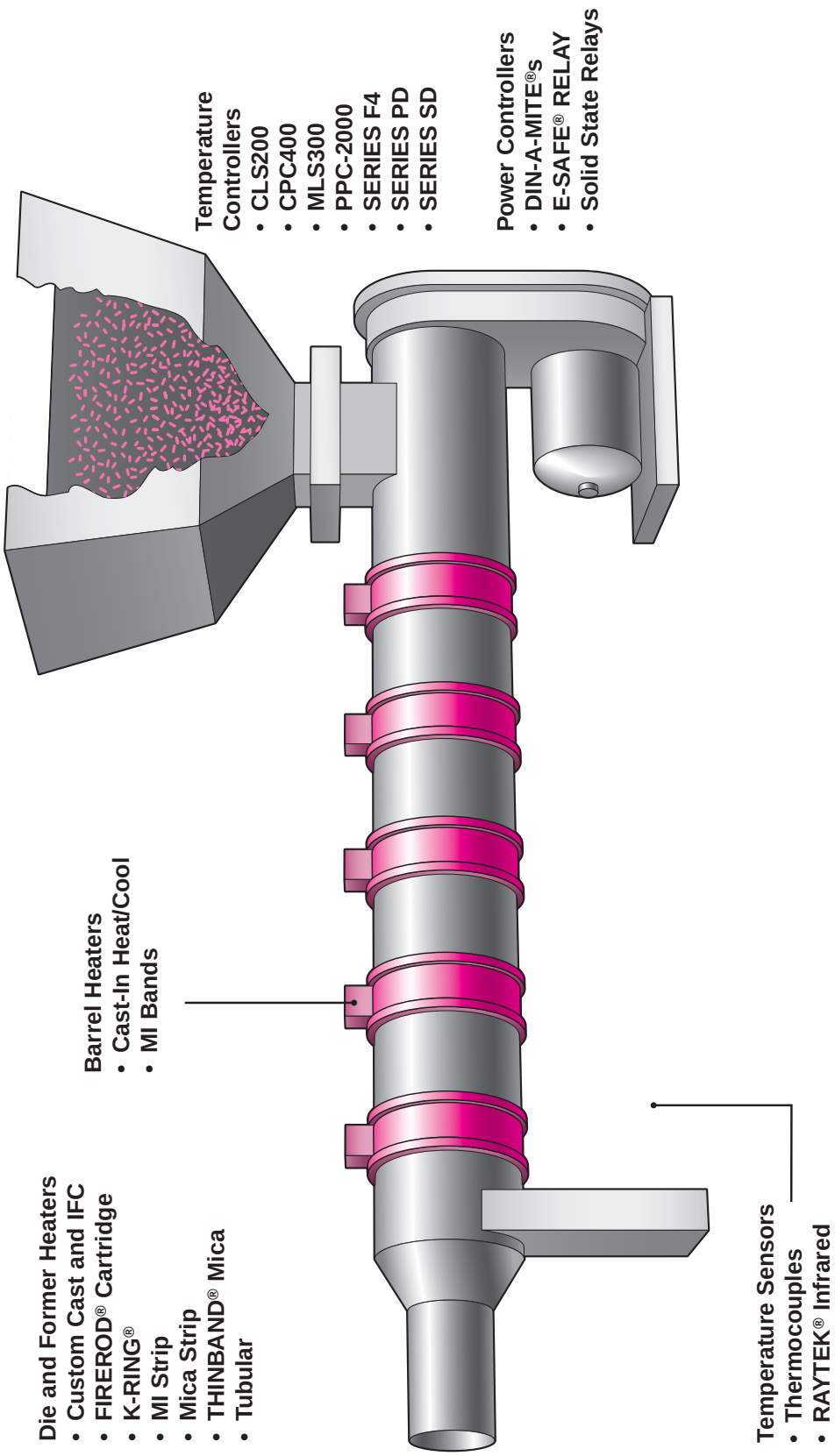
- Blown film and cast film
- Profile, shapes and rods
- Flat sheet and web extrusion
- Wire and cable coating
- Pipe tubing and conduit extrusion

Applications include:

- Larger diameter band heaters for single- or multi-layer blown film dies
- PPC-2000 for advanced extrusion control and system rebuilds
- High- and low-watt density cartridge heaters for a variety profile and shape dies
- SERIES SD controllers with Palm PDA for a low-cost data acquisition interface
- Cast-in and a variety of band heaters for traditional barrel heating
- Strip heaters for versatile surface die and former heating
- A comprehensive offering of mercury-free power controllers
- Traditional and hand-held temperature sensors

Industry Segment Overviews

Extrusion



Industry Segment Overviews

Thermoforming

In recent years, thermoforming part design has developed rapidly and become more multifaceted. Because the thermoforming process offers advantages such as superior finished part quality and the ability to form large parts, processors are:

- investing in larger and faster machines
- expanding both upstream and downstream services

Although thermoforming consists of a broad range of materials, material thicknesses and processing levels, Watlow can help optimize your process. Whether you require a 'sealed face' heater to keep sheet/roll contaminants away from the element while offering ease-of-cleaning and longer life, or overall precise process control, Watlow's family of heater, temperature sensor and controller solutions can meet your needs.

Regardless of the application, Watlow has the solution to meet your need:

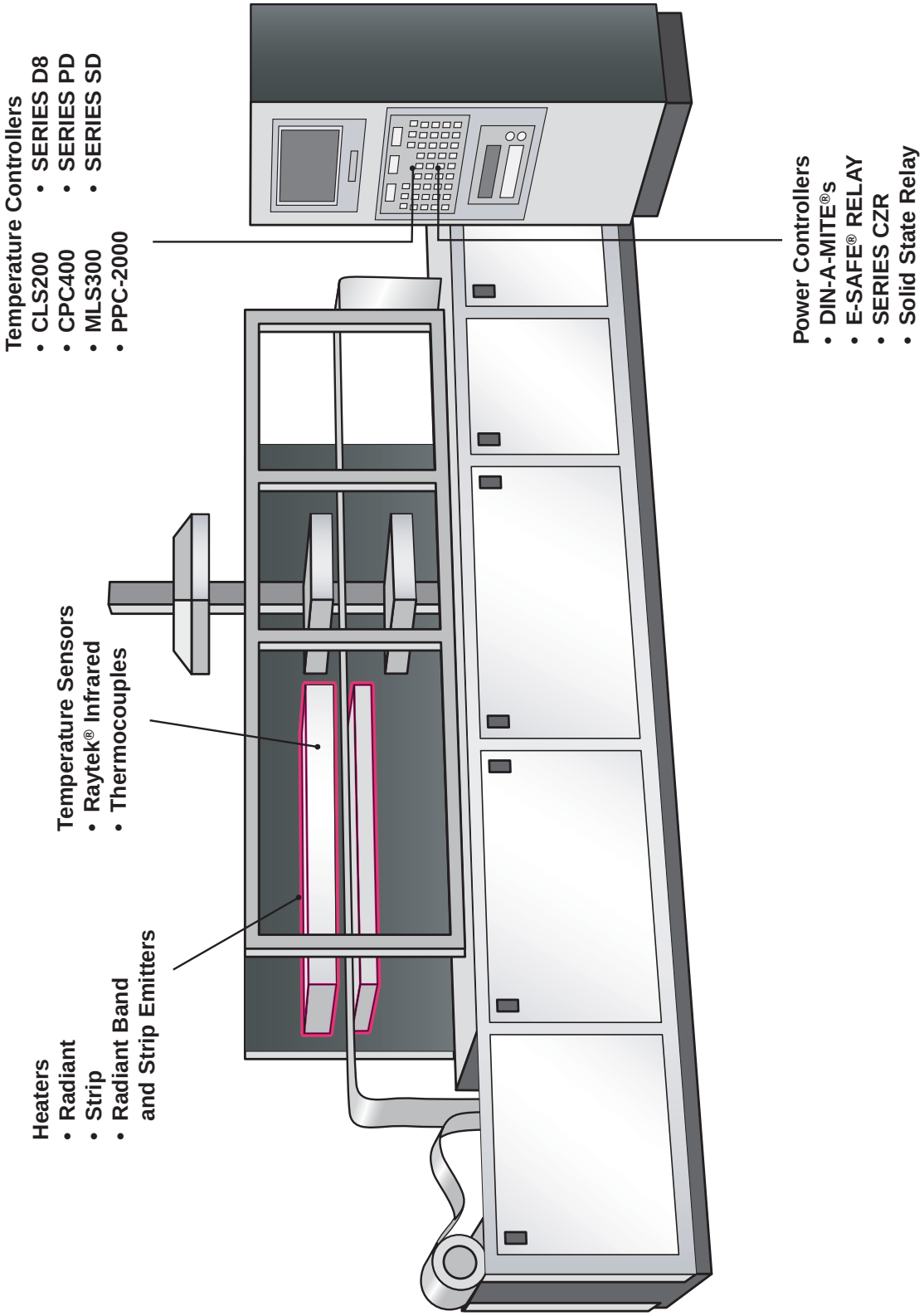
- Heaters- Radiant, Strip and Tubular
- Control System Controllers- CLS200, CPC400, MLS300, PPC-2000 and SERIES SD/PD
- Power Controllers- DIN-A-MITE®, E-SAFE®, SERIES CZR and Solid State Relays
- Sensors- Infrared non-contact and other Richmond products

Applications include:

- Vacuum forming
- High definition thermoforming
- Pressure assisted thermoforming
- Drape forming
- Press forming
- Line bending

Industry Segment Overviews

Thermoforming



Industry Segment Overviews

Blow Molding

Blow molding is the art and science of making the hollow plastic containers that are indispensable parts of everyday life. Common processing techniques such as extrusion, stretch blow, injection and co-extrusion are all utilized in forming these parts.

Whether it is a diverse and complex part that requires high performance such as an elastically functional automotive component; or a high-volume hollow piece such as a single-serve PET water bottle, the front-end blow molding process still requires an exacting thermal solution.

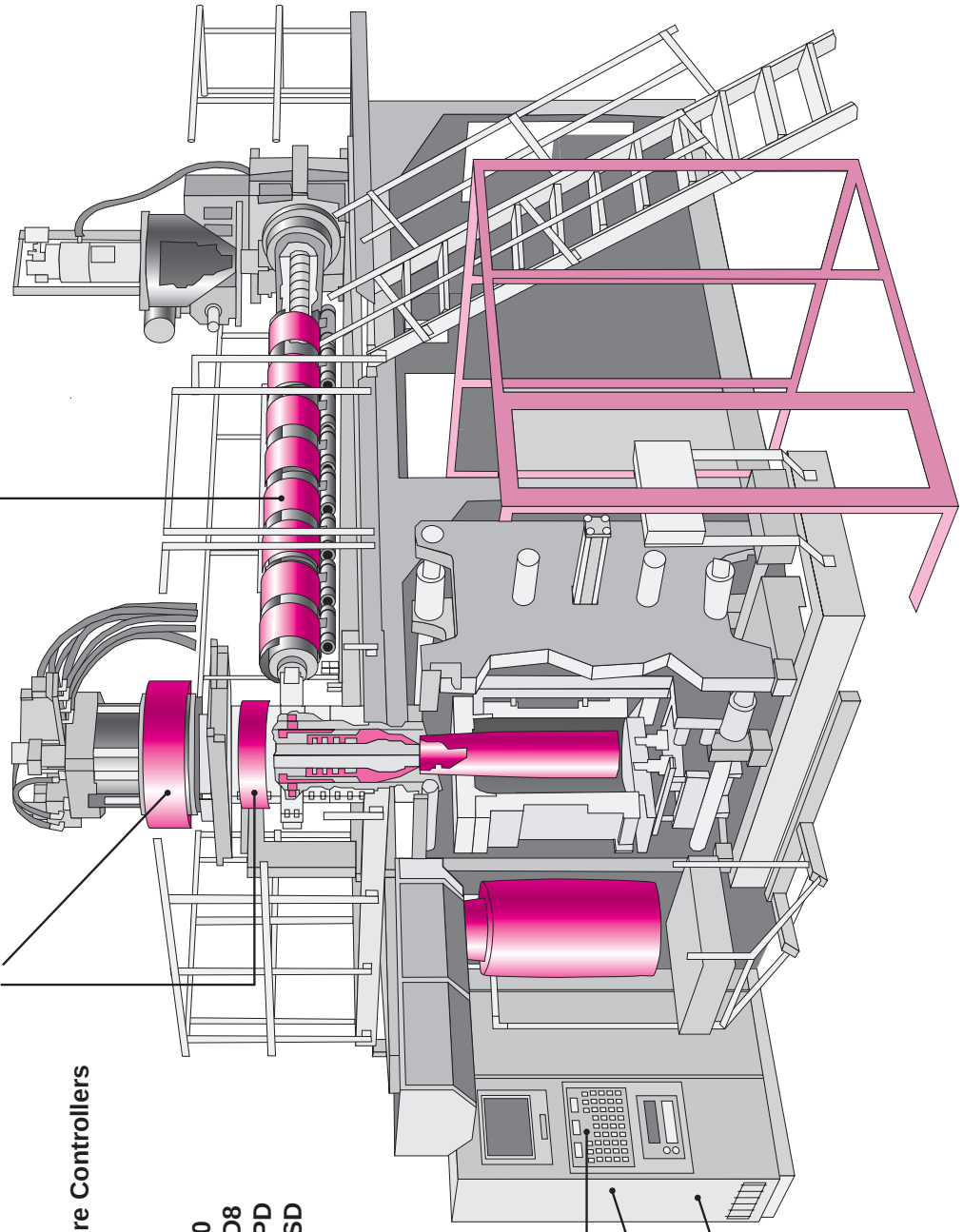
Regardless of your resin choice or final part shape, Watlow has an extensive offering of heaters, sensors and controllers to meet the application requirements.

Applications include:

- Automotive components
- Double-walled cases and toner cartridges
- Food and beverage packaging
- Medical feeding containers
- Specialty consumer containers for:
  - Personal care products
  - Household products
  - Aggressive chemicals
- Sporting goods
- Toys

Industry Segment Overviews

Blow Molding



Barrel Heaters
- Heat/Cool Cast-Ins
- MI Bands
- Mica Bands
- Radiant
- THINBAND® Mica Bands

Band Heaters
- FIREROD® Cartridge
- MI Bands
- Mica Bands
- Radiant
- THINBAND®

Temperature Controllers
- CLS200
- CPC400
- MLS300
- PPC-2000
- SERIES D8
- SERIES PD
- SERIES SD

Power Controllers
- DIN-A-MITE®s
- E-SAFE RELAY
- SERIES CZR

Communications
- Ethernet
- DeviceNet™

Temperature Sensors
- Thermocouples

Barrel Heaters

Watlow's Family of Barrel Heater Solutions

Watlow offers a full line of barrel heaters for the plastics industry. While every Watlow heater has a unique set of qualities, each Watlow barrel heater is designed with the needs of plastics processors in mind. Whether you require high performance, high temperature, high watt density, or all of these, Watlow has the heater to best fit your application.

Watlow's family of barrel heaters include:

- Ceramic knuckle heaters
- MI band heaters
- THINBAND® mica heaters

These barrel heaters are ideally suited to meet the demands of today's new resins and provide a wide range of benefits including:

- High performance materials such as Watlow's exclusive mineral insulation and high temperature ceramics which contribute to excellent insulation and long heater life
- Aluminized and stainless steel sheaths resulting in corrosion resistance
- Flexible designs ensuring easy installation and removal

Applications

- Injection molding machines
- Extrusion equipment
- Blown film dies

Barrel Heater Termination and Clamping Options

Termination Options

Watlow offers a large selection of termination styles providing the opportunity to customize the heater to a particular application for improved performance. Some termination choices include, but are not limited to, Post Terminals, Stainless Steel Braids, Flexible Lead Wire, Flexible Stainless Steel Hose and European Style Plugs (Horizontal and Vertical).

Clamping Options

In addition to Watlow's offering of various termination styles, we also offer a variety of clamping options. Some of these clamping options are, but are not limited to, Tig Welded Barrel Nuts, Low Profile Clamp Bars, Clamping Pads and HV Wedge-Lok.

For more information on Watlow's line of barrel heaters, contact your local Watlow representative.

Barrel Heaters

Ceramic Knuckle Band

Ceramic knuckle band heaters are designed to provide high-performance barrel heating at temperatures up to 760°C (1400°F). This level of performance is achieved from the ceramic knuckles that provide excellent insulation and long heater life.

The construction of the ceramic knuckle heater includes interlocking ceramic blocks with resistance wires threaded through holes within the ceramic. This method provides superior heat distribution across the band, resulting in a uniformly heated surface. Ceramic knuckle heaters are specifically engineered and manufactured with three layers:

- Aluminized steel sheath layer improves mechanical protection to heater and resists corrosion.
- Ceramic fiber layer provides thermal insulation, energy conservation and minimizes heat loss.
- Ceramic knuckle layer provides mechanical protection and electrical insulation to the resistance element, which increases heater life and conducts or radiates the heat to the surface.

Performance Capabilities

- 760°C (1400°F) maximum operational temperatures
- Watt densities up to 45 W/in^2

Features and Benefits

Ceramic insulator

- Allows for high temperature operation
- Provides longer heater life
- Accurate heating

Aluminized steel cover

- Provides excellent protection from abrasion

Radiation or conduction heat transfer

- Ensures dependable heat transfer method

Standard Construction

- Aluminized sheath
- Clamp tabs
- Post terminals

Applications

- Injection molding barrels
- Extruder barrels
- Blown film dies

Barrel Heaters

Ceramic Knuckle Band

Specifications

Electrical

Resistance tolerance: -10 percent (+5 percent)

Wattage tolerance: +10 percent (-5 percent)

Maximum watt density: 114 W/cm^2 (45 W/in^2)

Maximum operating temperature: 760°C (1400°F)

Mechanical

Overall thickness: 12.7 mm (0.5 in.)

Minimum width: 38.1 mm (1.5 in.)

Maximum width: 246 mm (9.69 in.)

Minimum I.D.: 50.8 mm (2 in.)

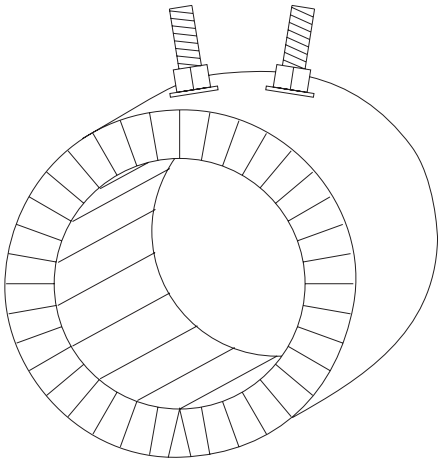
Maximum I.D.: 381 mm (15 in.)*

Width tolerance: ±3.175 mm (0.125 in.)

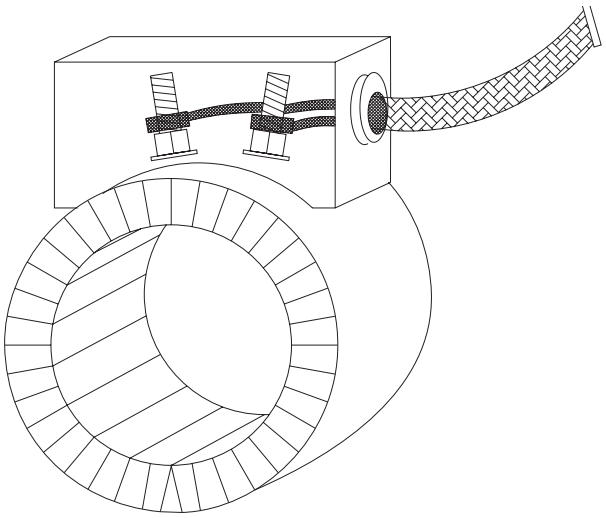
Standard gap: 6.35 mm (0.25 in.)

*One piece construction

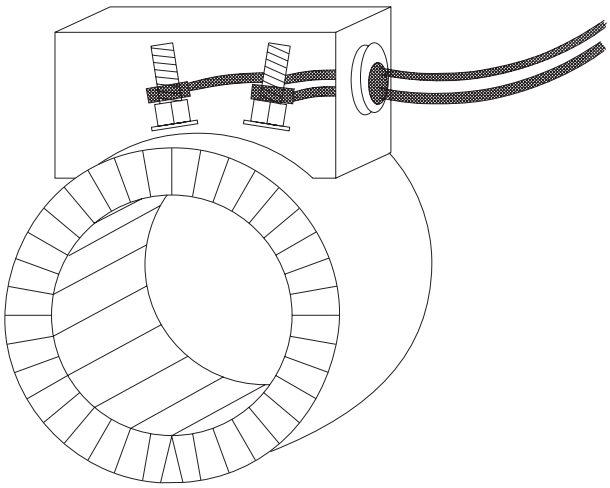
Termination Options



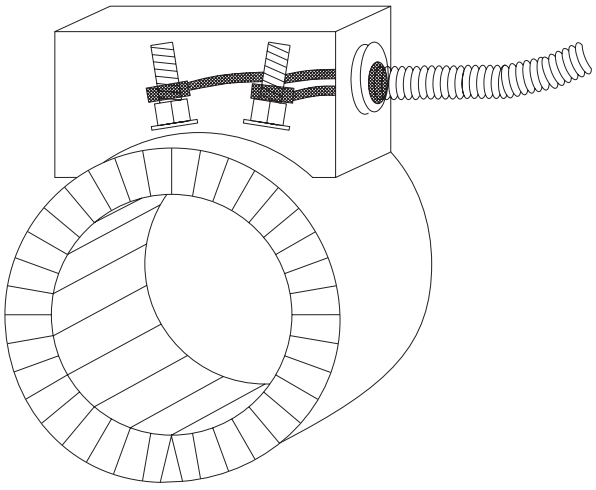
Post Terminals are the standard termination, providing quick connection with ring or fork connectors or buss strips, ¼ -20 inch thread and includes double nuts and washers. Standard terminal location is 180° from gap.



Stainless Steel Braid method includes a loose metal braid that is welded to the terminal box with a coupler. This provides excellent abrasion protection and flexibility. Leads are attached to posts with ring connectors.



Flexible Lead Wire exits tangential to heater and includes leads connected to the post terminals with ring connectors. This termination method requires a terminal box.



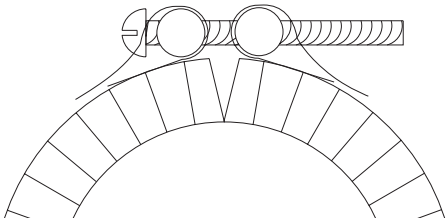
Flexible Stainless Steel Hose is welded to the terminal box with a coupler. This terminal option provides superior mechanical protection where lead abrasion is a problem. Leads are attached to posts with ring connectors.

Note: These are all standard termination options, for special constructions please consult factory.

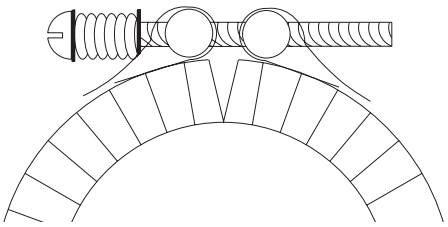
Barrel Heaters

Ceramic Knuckle Band

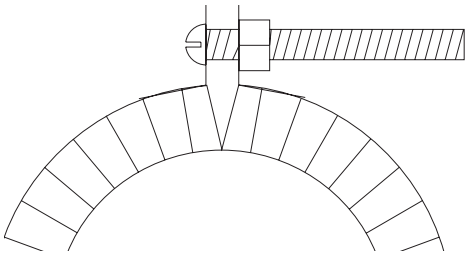
Clamping Options



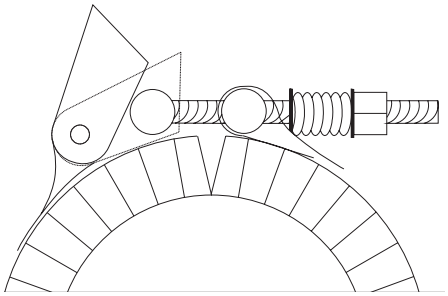
Barrel Clamps are used in applications where access for instrumentation is required. Includes an oversized gap.



Spring Loaded Barrel Clamps help to compensate for the thermal expansion of metals.



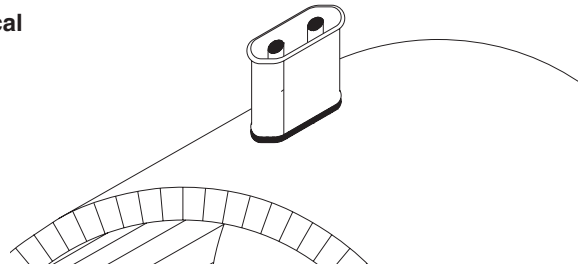
Clamp Tabs are a standard clamping option that offer a uniform clamping force across the heater width.



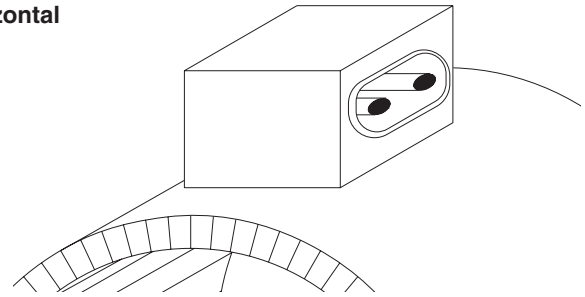
Latch And Trunion Clamps provide a quick clamp option. Clamping force is similar to barrel clamps and a spring is included to allow for thermal expansion of metals.

European Style Plugs provide a simple and safe way to apply power. The combination of high temperature male and female quick disconnect plug assemblies eliminate all live exposed terminals and electrical wiring. When ordering, specify vertical or horizontal European Plug.

Vertical



Horizontal



Physical Limitations

Options	I.D.				Width				Terminals	Clamp
	Min.		Max.		Min.		Max.			
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)		
One piece	64	(2.5)	381	(15)	38	(1.5)	254	(10)	—	—
Partial coverage	178	(7)	—	—	38	(1.5)	248	(9.75)	—	Except clamp tabs
Clamp tabs	64	(2.5)	381	(15)	38	(1.5)	254	(10)	—	—
Barrel nuts	102	(4)	—	—	38	(1.5)	254	(10)	—	—
Spring loaded barrel nuts	102	(4)	—	—	38	(1.5)	254	(10)	—	—
Latch and trunion clamps	76	(3)	—	—	38	(1.5)	254	(10)	—	—
Stud terminals	—	—	—	—	—	—	254	(10)	—	—
Flexible leads	64	(2.5)	—	—	64	(2.5)	254	(10)	—	—
SS hose leads	64	(2.5)	—	—	64	(2.5)	254	(10)	—	—
SS braided leads	64	(2.5)	—	—	64	(2.5)	254	(10)	—	—
Terminal box	64	(2.5)	—	—	64	(2.5)	254	(10)	—	—
Holes and notches	64	(2.5)	—	—	64	(2.5)	254	(10)	—	—
Ceramic cover	51	(2)	—	—	38	(1.5)	254	(10)	Post	—
Terminal clamp	76	(3)	—	—	64	(2.5)	248	(9.75)	Post with terminal box	—
European Plug both vertical and horizontal	64	(2.5)	—	—	51	(2)	254	(10)	—	—

— No restrictions.
Note: These are all standard clamping options, for special constructions please consult factory.

Barrel Heaters

Ceramic Knuckle Band

Options:

Terminal box provides protection for electrical connections in hazardous environments.

Partial coverage helps heating of large pipes and covers large diameters with two or more sections. Dimensional drawings are required when ordering.

T/C bracket ⅜ NPT necessary for instrumentation. A dimensional drawing is required when ordering.

Holes and notches necessary for instrument access, etc. Heater must be 63.5 mm (2.5 in.) minimum width and 63.5 mm (2.5 in.) minimum I.D.; dimensional drawing required when ordering.

Ceramic terminal covers provide easy installation and protect electrical connections on each individual terminal.

Other Options:

- Dual voltage (factory approval required)
- Stainless steel sheath
- Ground stud
- Ground lead
- Three-phase voltage (factory approval required)

Ceramic Band Heater Check List:

- The surface where a heater will be mounted must be clean and the heater maintained free of all contaminants that might cause a short circuit in the heater (typically conductive liquids).
- To prevent overheating, Watlow recommends installing an appropriate temperature controller and checking the correct performance of the thermocouple.
- Do not use in environments containing combustible gases or vapors.
- Keep all electrical connections properly protected to avoid electrical hazards to machine operators.
- Do not over tighten clamps to the point where serrated side folds begin to collapse. Ceramic band heaters utilize radiation heating and excessive force may break ceramic insulators.

Quick Ship

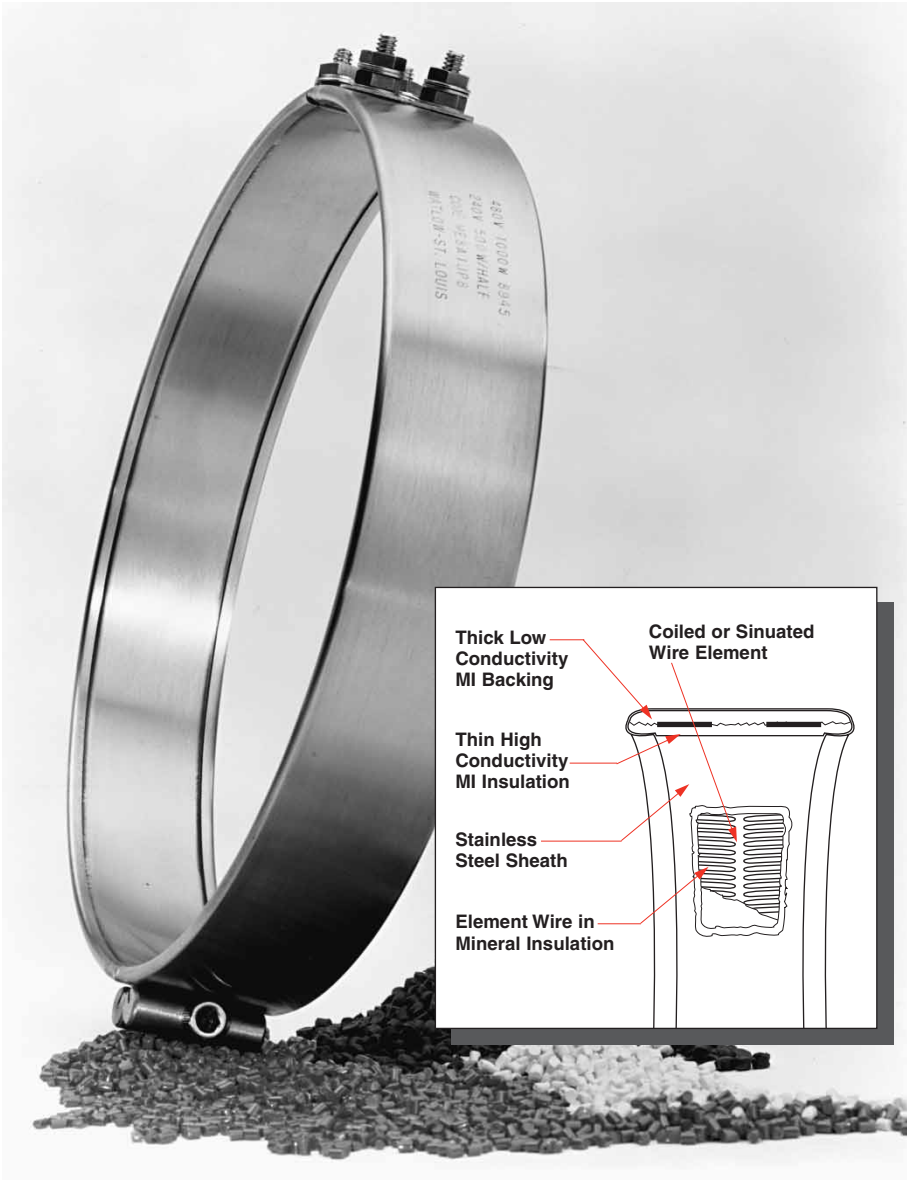
- *Same day shipment on all stock heaters with post terminals or Type B leads.*

Barrel Heaters

MI Band

The MI Band is a high performance heater. Its performance and name are derived from Watlow's exclusive mineral insulation—a material that has much higher thermal conductivity than the mica and hard ceramic insulators used in conventional heaters.

A thin layer of the "high" thermal conductive MI material is used to electrically insulate the element wire from the inside diameter of the heater sheath. A thicker, "low" thermal conductivity layer backs up the element wire, directing the heat inward towards the part that is being heated. The result is more efficient heat transfer...a performance solution that lowers element wire temperatures and increases heater life.



Performance Capabilities

- Heater operating temperatures to 760°C (1400°F)
- Watt densities to 35.6 W/cm^2 (230 W/in^2) available on small diameter nozzle bands
- Watt densities to 15.5 W/cm^2 (100 W/in^2) available on large diameter barrel bands

Features and Benefits

- **Operating temperatures to 760°C (1400°F)** make it possible to safely melt even the newest resins, like Peek™, Teflon®, Ultem® and Zytel®.
- **Higher watt densities than any other barrel heater** contribute to faster heat-up and through-put to increase productivity.
- **High thermal conductivity of MI and low mass construction** give almost instant response to temperature control. This performance solution eliminates thermal lag and temperature overshoot associated with ceramic knuckle heaters.
- **Stainless steel cover as well as side fold design** resist contamination by overflow of plastic or other free-flowing materials. Side folds turn to the inside diameter rather than the outside diameter.
- **Permanently attached clamp bars** eliminate cumbersome clamping straps, which makes installation easier.

Applications

- Injection molding barrels

Teflon® and Zytel® are registered trademarks of E.I. du Pont de Nemours & Company.

Ultem® is a registered trademark of General Electric.

Peek™ is a trademark of Victrex plc.

Barrel Heaters

MI Band

Applications and Technical Data

The Physical Limitations of Variations table below shows the availability of widths, inside diameters and terminations for Watlow's MI Band heaters. To make sure the available terminations will meet your application needs, refer to the illustrations of termination types on page 22.

If you need to exceed the limitations shown, contact your Watlow sales engineer or authorized distributor.

Physical Limitations of Variations

Widths mm	Widths (in.)	I.D. Available—mm (in.) 1 pc. Construction Minimum mm	Minimum (in.)	Maximum mm	Maximum (in.)	Expandable Minimum mm	Minimum (in.)	Maximum mm	Maximum (in.)	2 pc. Construction Minimum mm	Minimum (in.)	Maximum mm	Maximum (in.)	Available Terminations
25.4	(1)	25.4	(1)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	255.6	(14)	All
34.9	(1⅜)	25.4	(1)	76.2	(3)	76.2	(3)	152.4	(6)	76.2	(3)	152.4	(6)	All
38.1	(1½)	25.4	(1)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All
50.8	(2)	31.8	(1¼)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All
63.5	(2½)	31.8	(1¼)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All
76.2	(3)	31.8	(1¼)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All
88.9	(3½)	44.5	(1¾)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All - Except 90° "B" Leads
101.6	(4)	50.8	(2)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All
114.3	(4½)	57.2	(2¼)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All
127.0	(5)	63.5	(2½)	355.6	(14)	76.2	(3)	355.6	(14)	76.2	(3)	711.2	(28)	All - Except 90° "B" Leads
139.7	(5½)	69.85	(2¾)	355.6	(14)	76.2	(3)	355.6	(14)	101.6	(4)	711.2	(28)	Post Terminals, SLE
152.4	(6)	76.2	(3)	355.6	(14)	76.2	(3)	355.6	(14)	101.6	(4)	711.2	(28)	All
177.8	(7)	N/A		N/A		101.6	(4)	355.6	(14)	N/A		N/A		Post Terminals

General Limitations:

- Maximum width of 25 mm (1 in.) diameter heater is 38 mm (1.5 in.) wide
- Maximum heater width = 3x heater diameter
- Minimum I.D. for Type B, C, E and H leads = 25 mm (1 in.)
- Minimum I.D. for Type B—90 degree leads = 28 mm (1.125 in.)
- Maximum lead amps: 8.5A per pair
- Maximum amps (post terminals): 30A per pair

Standard Gaps:

- ≤ 76.2 mm (3 in.) = 3 mm (0.125 in.) nominal
- 76.2 mm (3 in.) ≤ 152.4 mm (6 in.) = 3 mm (0.25 in.) nominal ± 3 mm (0.125 in.)
- 152.4 mm (6 in.) ≤ 355.6 mm (14 in.) = 9.52 mm (0.375 in.) nominal ± 3 mm (0.125 in.)
- > 355.6 mm (14 in.) = 12.7 mm (0.5 in.) nominal ± 6.3 mm (0.25 in.)

Barrel Heaters

MI Band

Applications and Technical Data

Calculating Watt Density

Watt density is the amount of wattage per square inch of heated area. To determine watt density, divide the total wattage by the heated area.

$$\text{Watt Density} = \frac{\text{Total Watts}}{\text{Heated Area}}$$

To apply this equation we must define the term "heated area."

Heated area is the total contact surface of the heater less areas of no heat that are found around terminals, mounting holes, etc.

Heated Area =
Total Contact Area - No-Heat Area

To calculate the heated area:

1. Locate the **no-heat factor** from the chart below that corresponds to the type of heater being considered.

Type	Factor (in.)
1 pc. lead unit Type B, C, H, E or 90°B	(1.37)
1 pc. post terminal	(1.60)
2 pc. expandable post term	(3.18)
2 pc. expandable lead unit	(3.00)

2. To use the formula below, insert the no heat factors, diameter and width (in inches).

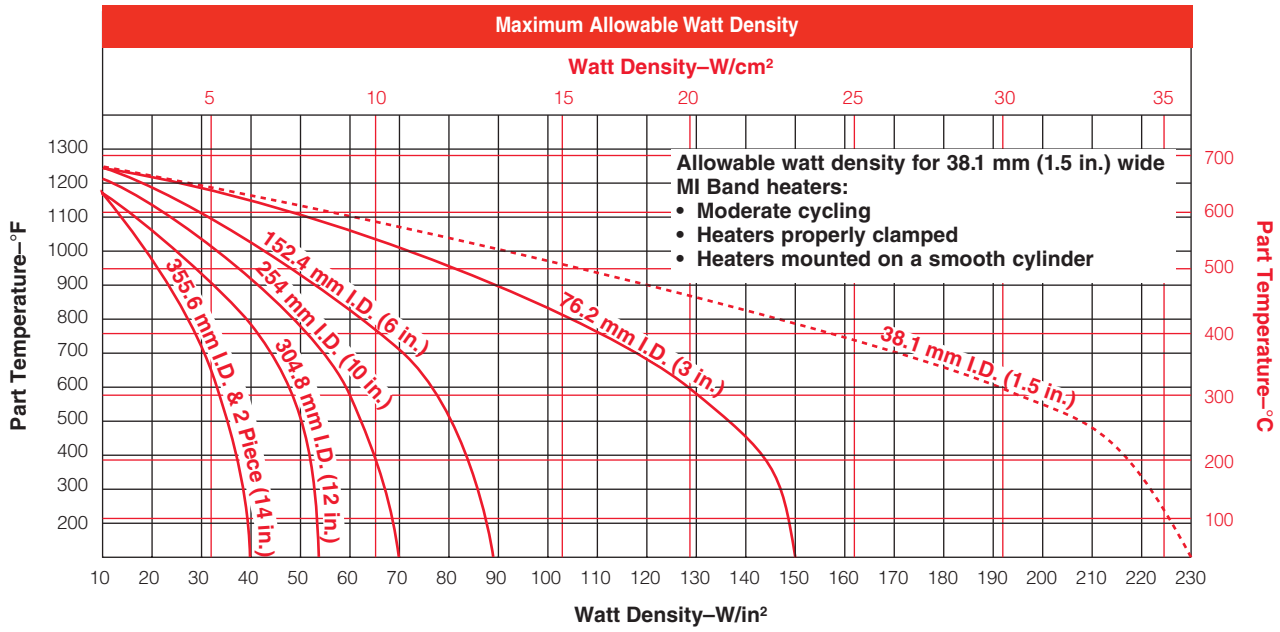
Heated Area =
(3.14 x Diameter - No-Heat Factor) x Width

Maximum Allowable Watt Density

The following derating factors apply to the Maximum Allowable Watt Density chart, which are shown in both metric and inch base for convenience. Please review these factors and the chart to determine the correct watt density curve for your application.

Derating Factors:

- For units over 51 mm (2 in.) in width, multiply watt density by 0.8.
- In applications where unusual operating conditions are present, such as irregular mounting surfaces, contact the Watlow factory in St. Louis, Missouri, for watt density limitations.
- For two-piece units used in vertical applications, refer to Clamping Matrix Application Guide, page 21.
- For applications where insulating blankets are used, multiply W/cm² (W/in²) by 0.75.



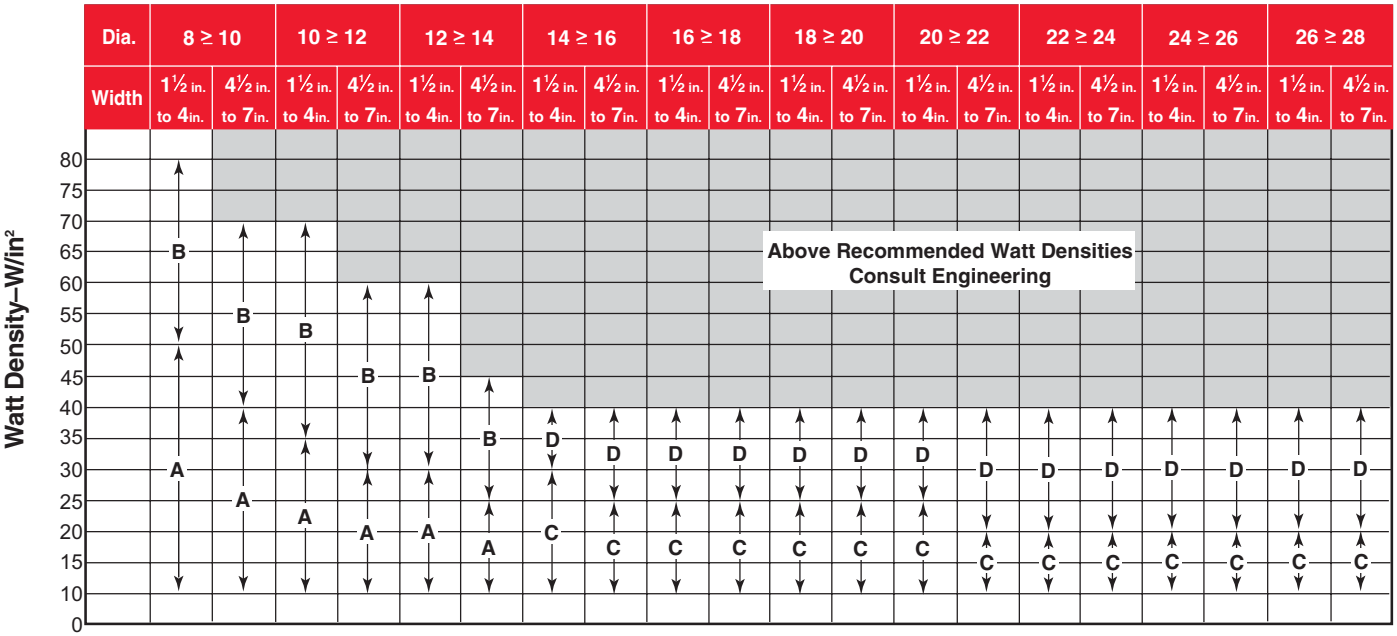
Barrel Heaters

MI Band

Applications and Technical Data

- Review Watt Density chart on page 20 to ensure that the application does not exceed the maximum watt density at operating temperature after applying derating factors.
- Locate clamping guideline for unit diameter, width and watt density.
- Description of guideline letters are below.
- **Note:** Upward arrows are up to and not including specified watt density. Downward arrows are greater than or equal to specified watt density.

MI Barrel Clamping Matrix Application Guide



A = Standard clamping, expandable or one piece construction
B = Spring clamps, expandable or one piece construction
C = Spring clamps, at one gap, welded barrel nuts at other gap
D = Spring clamps, spring clamps at both gaps

Width	Clamp Points at Each Gap
≥ 127 mm (5 in.)	3
≥ 76.2 mm (3 in.)	2
< 76.2 mm (3 in.)	1

MI Installation Procedures - For Standard Product

1. Install heaters over a clean surface.
2. After installing the unit, begin to tighten the clamp screw. The standard clamping screw is 6.35 mm-508 x 31.75 mm (0.25 in.-20 x 1.25 in.), nickel plated allen head cap screw. Begin tightening the clamp bars. If the clamp bars appear not to have seated, tap the clamp bars with a small hammer to insure the bars are well seated in the angle formed by the 60 degree bent tab and the heater.
3. If the bar has multiple screws, alternately tighten the screws at 10 lb-in. as you would the lug nuts on a car wheel to insure even loading.
4. Torque all screws to approximately 80 lb-in. (9-N-M).
5. When installing terminal lugs, torque the top nuts to 15-20 lb-in. or 2.26 N meters.

Barrel Heaters

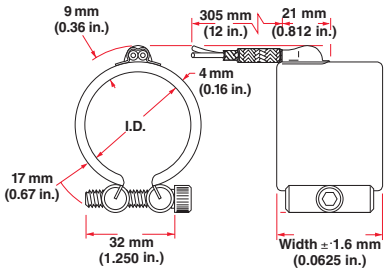
MI Band

Termination Variations

Leads Type B, Type B—90 degree Rotation,Type B—180 degree Rotation or Type C: Two fiberglass-insulated lead wires exit in a single metal braid for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than braid. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **type** and **length.**

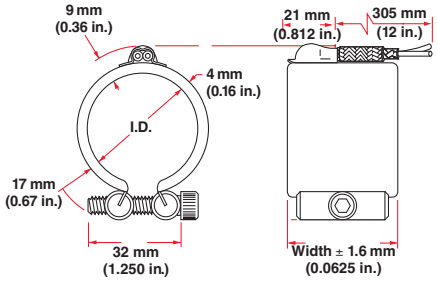
Type B

Stock



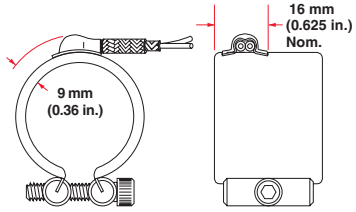
Type B—180 Degree Rotation

Stock



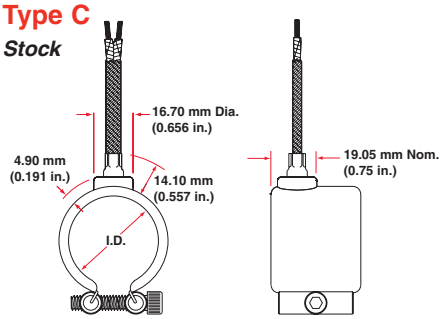
Type B—90 Degree Rotation

Non-Stock



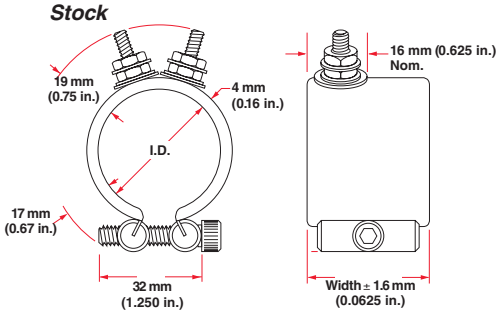
Type C

Stock



Post Terminals

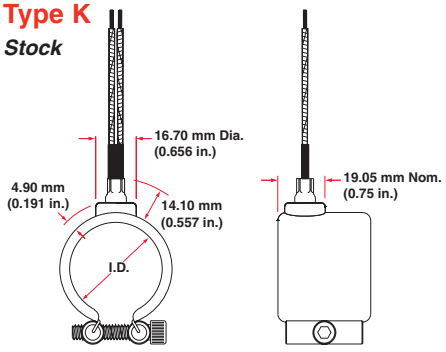
Stock



Post terminals provide optimum connections. Screw thread is 10-24. To order, specify **post terminals**.

Type K

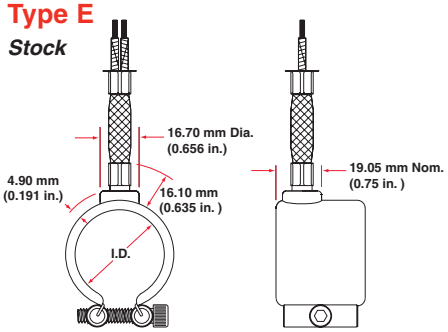
Stock



Type K: Flexible lead wires exit vertically from the heater. These leads can be bent adjacent to the heater for a quick and easy connection. To order, specify **Type K** and **length**.

Type E

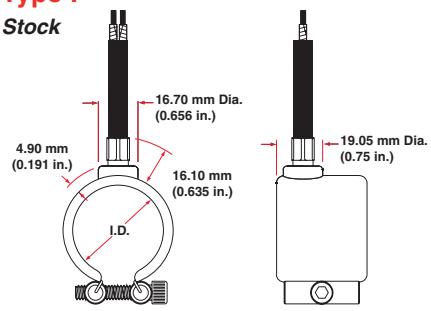
Stock



Type E: Loose metal braid encloses two fiberglass leads for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than braid. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **Type E** and **length.**

Type F

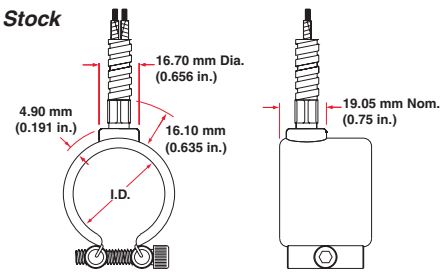
Stock



Type F: Loose fiberglass sleeving encloses two fiberglass leads for additional insulation protection where high temperature or minor abrasion is present. Leads are 51 mm (2 in.) longer than the sleeving. To order, specify **Type F** and **length**.

Type H

Stock

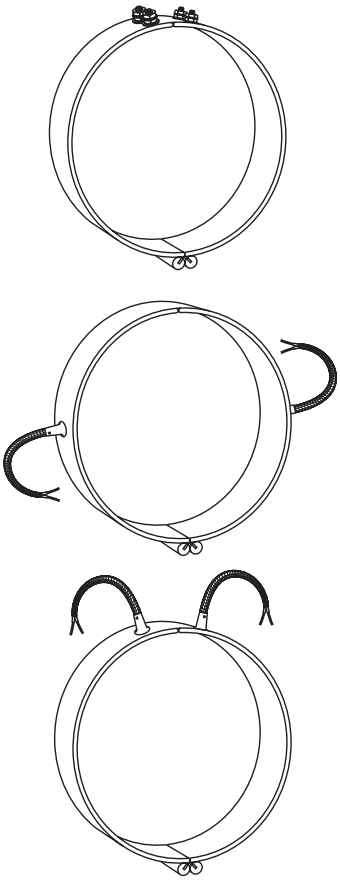


Type H: A flexible steel hose encloses the leads for maximum abrasion protection. Leads are 51 mm (2 in.) longer than hose. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **Type H** and **length.**

Barrel Heaters

MI Band

Variations



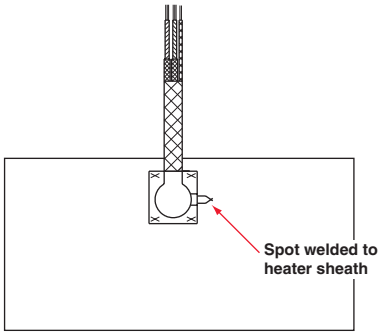
38 mm (1.5 in.) wide and greater

Lead Wire

Heaters rated at less than 250V~(ac) use UL® approved lead insulation for operations to 250°C (480°F) as standard. Lead insulation UL® rated for operation to 450°C (840°F) is available for high temperature applications where the leads are shrouded or enclosed with the heater. These leads are available in any of the Type B with loose braid as well as Types E, F and H lead configurations. All heaters rated at more than 250V~(ac) use this wire. When ordering, specify **450˚C (850°F) wire.**

Thermocouple

ASTM Type J or K internal thermocouples are available on lead Type B with loose braid. The thermocouple junction, which is welded inside the lead cap or spot-welded to heater sheath, provides a signal for measuring relative heater temperature.

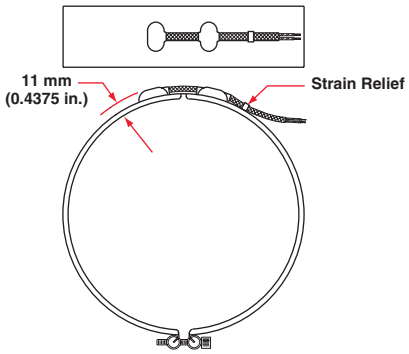


Expandable Heaters With and Without Leads

Expandable heaters are two-piece units with a common top metal that allows the heater to expand open to the full diameter of the barrel. On expandable bands, each half will be one half of the total wattage. Plus, on both expandable and two-piece bands, each half will be rated at full operating voltage, unless otherwise specified.

MI Band heaters 38 mm (1.5 in.) wide or greater will have post terminals located next to the expansion joint. Leads may be located anywhere along the circumference except near the gap and at the expansion joint. Two sets of leads are required.

On 25 mm (1 in.) wide MI Band heaters, post terminals will be located 90 degrees from the expansion joint. Leads may be located anywhere along the circumference except near the gap and at the expansion joint. Two sets of leads are required. To order, specify **expandable.**



Type SLE

Two fiberglass lead wires exit a single tightly woven metal braid at right angle on the expandable construction verses two sets of leads. Minimum diameter capabilities is 100 mm (4 in.). Minimum width capabilities is 38 mm (1.5 in.). To order, specify **Type SLE** and **length.**

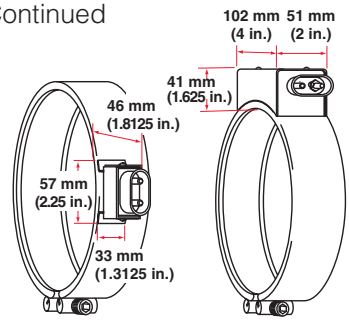
UL® is a registered trademark of Underwriter's Laboratories, Inc.

Barrel Heaters

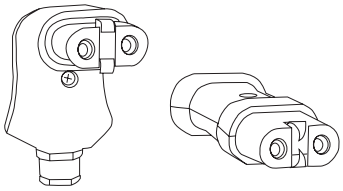
MI Band

Variations

Continued



Vertical **Horizontal**



Right Angle **Straight**

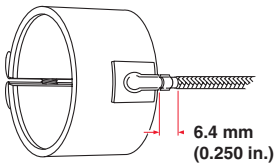
Code# N6027AF049 **Code# N6027ZZ028**

High Temperature "Quick Disconnect" European Style Plugs

These plugs provide the simplest and safest way to apply power to barrel heaters. The combination of high temperature male and female quick disconnect plug assemblies eliminates all live exposed terminals and electrical wiring that can be a potential hazard to employees or machine. Maximum 15 amps at 240V~(ac), maximum volts 240. To order, specify **vertical** or **horizontal** European Plug.

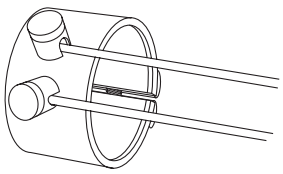
High Temperature "Quick Disconnect" European Style Female Adapters

Available as an accessory item that must be used in conjunction with high temperature "quick disconnect" European Style Plugs. To order, specify code number **N2027AF049** or **N6027ZZ028** and quantity.



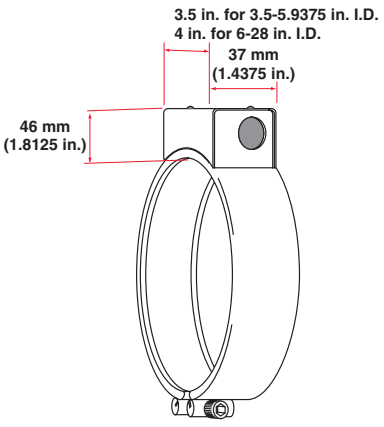
Heavy Duty Strain Relief

Heavy duty strain relief is recommended for applications where there is great stress or continued flexing of the leads. The strain relief is available on Type B, Type B—90 degree and Type B—180 degree leads only. To order, specify **heavy duty strain relief.**



Ceramic Terminal Cover

Ceramic covers, with openings for leads, are screwed on to post terminals, providing a convenient, economical insulator. To order, specify code number **Z-4918** and **quantity.**



Metallic Terminal Box

Metallic terminal boxes are available from stock on 89 mm x 38 mm (3.5 in. inside diameter x 1.5 in. wide) or larger heaters. Terminal boxes, which attach directly to the heater, act as a safety feature by covering the terminals. Conduit may be attached to the box through 22 mm (0.875 in.) diameter holes in the ends of the box. Two piece heaters require two boxes. To order, specify **terminal box.**

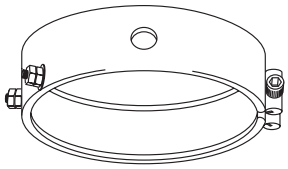
Oversized terminal boxes are available on heaters 51 mm (2 in.) and wider. Consult a Watlow representative.

Barrel Heaters

MI Band

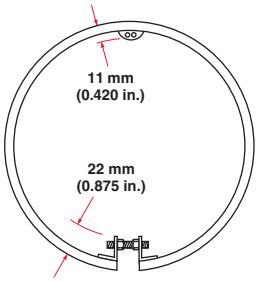
Variations

Continued



MI Band Heater With Holes

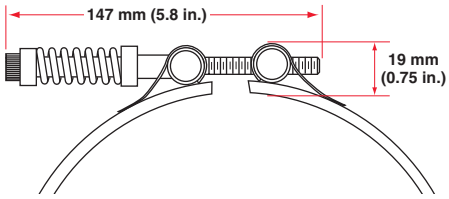
MI Band heaters with holes are available on all widths except 25.4 mm (1 in.) wide. Consult the Watlow factory in St. Louis, Missouri for hole sizes and location restraints. To order, specify **hole size** and **location.** 76.2 mm (3 in.) inside diameter minimum.



Outside Diameter Heater

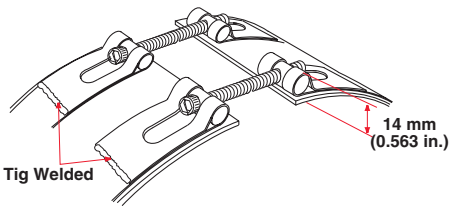
Two fiberglass insulated lead wires rated to 450°C (840°F) exit a metal braid 180 degrees opposite from gap, Type B outside diameter designed and constructed to mate with inside diameter of cylinders. To order, specify **outside diameter** heater. Note that 76.2 mm (3 in.) is the minimum cylinder I.D.

Clamping Variations



Tig Welded Barrel Nuts With Spring Loaded Clamping

Welded barrel nuts with spring loaded clamping are used during start-up to maintain a tight heater fit on large barrels. This clamping variation is standard for all MI Barrel heaters that are greater than 355 mm (14 in.) in diameter and 38 mm (1.5 in.) or greater in width. Refer to MI Barrel Clamping Matrix Application Guide, page 21. For smaller diameter heaters, this is an option and must be ordered separately. To order, specify **spring loaded clamping.**

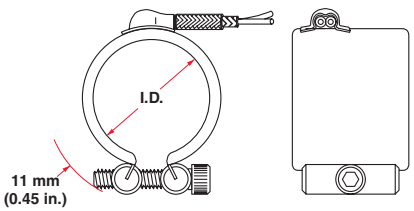


Tig Welded Barrel Nuts

An ideal way to provide access for instrumentation is to specify an oversized gap between the heater ends. If the clamp bar screw interferes with the positioning of the instrumentation device, welded barrel nuts are recommended. To order, specify **tig welded barrel nuts** and **gap dimension** when ordering.

Low Profile Tig Welded Barrel Nuts

Low profile barrel nuts are available on all widths. Low profile barrel nuts have a clearance of 10 mm (0.406 in.). To order, specify **low profile tig welded barrel nuts**.



Low Profile Clamp Bars

Low profile clamp bars are available on both one 25 mm (1 in.) and 38 mm (1.5 in.) wide heaters, for wider widths consult factory. The bars are 6 mm (0.25 in.) diameter with an 8-32 screw. To order, specify **low profile clamp bars.**

Barrel Heaters

MI Band

MI Stock Product

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Construction	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Termination	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.
25.4	(1)	25.4	(1)	1pc	120	100	9.4	(61)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN2**
		25.4	(1)	1pc	120	150	14.2	(92)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN1**
		25.4	(1)	1pc	120	200	18.9	(122)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN3**
		25.4	(1)	1pc	240	200	18.9	(122)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN4**
		38.1	(1½)	1pc	120	200	10.8	(70)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN4**
		38.1	(1½)	1pc	240	200	10.8	(70)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN3**
		38.1	(1½)	1pc	120	300	16.4	(106)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN2**
		38.1	(1½)	1pc	240	300	16.4	(106)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN1**
		38.1	(1½)	1pc	240	400	21.8	(141)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN5**
31.8	(1¼)	25.4	(1)	1pc	120	250	16.1	(104)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN2**
		25.4	(1)	1pc	240	250	16.1	(104)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN1**
		25.4	(1)	1pc	240	300	19.2	(124)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN3**
		38.1	(1½)	1pc	120	350	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN2**
		38.1	(1½)	1pc	240	350	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN1**
		38.1	(1½)	1pc	240	450	17.3	(112)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN3**
31.8	(1¼)	25.4	(1)	1pc	120	200	9.6	(62)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN4**
		25.4	(1)	1pc	240	200	9.6	(62)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN3**
		25.4	(1)	1pc	120	300	14.4	(93)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN2**
		25.4	(1)	1pc	240	300	14.4	(93)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN1**
		25.4	(1)	1pc	240	400	19.3	(125)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN5**
		38.1	(1½)	1pc	120	300	9.0	(58)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN1**
		38.1	(1½)	1pc	240	300	9.0	(58)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN3**
		38.1	(1½)	1pc	240	300	10.0	(64)	Post	0.09	(0.2)	Stock	**MB1J1JP4**
		38.1	(1½)	1pc	240	450	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN2**
		38.1	(1½)	1pc	240	450	14.8	(96)	Post	0.09	(0.2)	Stock	**MB1J1JP6**
		38.1	(1½)	1pc	240	600	17.9	(116)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN4**
		50.8	(2)	1pc	240	300	6.5	(42)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN2**
		50.8	(2)	1pc	240	450	8.8	(57)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN1**
		50.8	(2)	1pc	240	900	19.3	(125)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN3**
		76.2	(3)	1pc	240	350	4.8	(31)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN2**
		76.2	(3)	1pc	240	500	7.0	(45)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN1**
		76.2	(3)	1pc	240	1000	16.1	(104)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN3**

CONTINUED

Barrel Heaters

MI Band

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Construction	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Termination	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.
44.5	(1¾)	38.1	(1½)	1pc	120	300	7.7	(50)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN2**
		38.1	(1½)	1pc	240	300	7.3	(47)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN1**
		38.1	(1½)	1pc	240	700	17.0	(110)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN3**
		50.8	(2)	1pc	240	750	13.3	(86)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1N2AN1**
50.8	(2)	25.4	(1½)	1pc	120	350	11.3	(73)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN2**
		25.4	(1½)	1pc	240	350	11.3	(73)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN1**
		25.4	(1½)	1pc	240	450	14.5	(94)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN3**
		38.1	(1½)	1pc	240	400	8.2	(53)	Type B,C,E or H	0.14	(0.3)	Stock	**MB2A1JN1**
		38.1	(1½)	1pc	240	1000	20.4	(132)	Type B,C,E or H	0.14	(0.3)	Stock	**MB2A1JN2**
		50.8	(2)	1pc	240	750	11.3	(73)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2A2AN1**
		50.8	(2)	1pc	240	1200	19.3	(125)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2A2AN2**
57.2	(2¼)	63.5	(2½)	1pc	240	1000	11.2	(72)	Type B,C,E or H	0.23	(0.5)	Stock	**MB2E2JN1**
63.5	(2½)	25.4	(1)	1pc	240	400	9.7	(63)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2J1AN1**
		38.1	(1½)	1pc	240	500	7.7	(50)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2J1JN1**
76.2	(3)	25.4	(1)	1pc	240	400	8.4	(54)	Post	0.14	(0.3)	Stock	**MB3A1AP1**
		38.1	(1½)	1pc	240	500	6.2	(40)	Post	0.18	(0.4)	Stock	**MB3A1JP1**
		38.1	(½)	2pc exp	230/460	525	8.2	(53)	Post	0.18	(0.4)	Stock	**ME3A1JP10**
88.9	(3½)	50.8	(2)	1pc	240	800	6.5	(42)	Post	0.32	(0.7)	Stock	**MB3J2AP2**
92.1	(3⅝)	38.1	(1½)	2pc exp	230/460	650	7.9	(51)	Post	0.23	(0.5)	Stock	**ME3L1JP5**
101.6	(4)	38.1	(1½)	2pc exp	230/460	625	6.7	(43)	Post	0.27	(0.6)	Stock	**ME4A1JP11**
		38.1	(1½)	2pc exp	230/460	725	7.8	(50)	Post	0.27	(0.6)	Stock	**ME4A1JP12**
		38.1	(1½)	1pc	240	800	7.4	(48)	Post	0.27	(0.6)	Stock	**MB4A1JP2**
114.3	(4½)	63.5	(2½)	1pc	240	1250	6.2	(40)	Post	0.45	(1.0)	Stock	**MB4J2JP1**
127.0	(5)	38.1	(1½)	2pc exp	240/480	1000	8.1	(52)	Post	0.36	(0.8)	Stock	**ME5A1JP8**
133.4	(5¼)	38.1	(1½)	2pc exp	230/460	600	4.5	(29)	Post	0.32	(0.7)	Stock	**ME5E1JP9**
		38.1	(1½)	2pc exp	240/480	1000	7.4	(48)	Post	0.36	(0.8)	Stock	**ME5E1JP1**
		76.2	(3)	2pc exp	230/460	1700	6.2	(40)	Post	0.68	(1.5)	Stock	**ME5E3AP5**
139.7	(5½)	38.1	(1½)	2pc exp	240/480	1000	7.1	(46)	Post	0.40	(0.9)	Stock	**ME5J1JP1**
152.4	(6)	38.1	(1½)	2pc exp	240/480	1000	6.4	(41)	Post	0.40	(0.9)	Stock	**ME6A1JP2**
165.1	(6½)	38.1	(1½)	2pc exp	240/480	1250	7.3	(47)	Post	0.45	(1.0)	Stock	**ME6J1JP5**
171.5	(6¾)	38.1	(1½)	2pc exp	230/460	815	4.5	(29)	Post	0.40	(0.9)	Stock	**ME6N1JP6**
		38.1	(1½)	2pc exp	230/460	1000	5.6	(36)	Post	0.40	(0.9)	Stock	**ME6N1JP7**
		101.6	(4)	2pc exp	230/460	2600	5.4	(35)	Post	1.1	(2.5)	Stock	**ME6N4AP2**
		127.0	(5)	2pc exp	230/460	3700	6.2	(40)	Post	1.5	(3.2)	Stock	**ME6N5AP3**
		152.4	(6)	2pc exp	230/460	3750	5.1	(33)	Post	1.7	(3.8)	Stock	**ME6N6AP5**
177.8	(7)	38.1	(1½)	2pc exp	240/480	1250	6.6	(43)	Post	0.50	(1.1)	Stock	**ME7A1JP4**
190.5	(7½)	38.1	(1½)	2pc exp	240/480	1500	7.3	(47)	Post	0.50	(1.1)	Stock	**ME7J1JP4**
193.7	(7⅝)	76.2	(3)	2pc exp	230/460	1800	4.3	(28)	Post	1.0	(2.2)	Stock	**ME7L3AP1**
203.2	(8)	38.1	(1½)	2pc exp	240/480	1250	5.7	(37)	Post	0.54	(1.2)	Stock	**ME8A1JP4**
228.6	(9)	38.1	(1½)	2pc exp	240/480	1500	6.0	(39)	Post	0.64	(1.4)	Stock	**ME9A1JP1**
241.3	(9½)	76.2	(3)	2pc exp	230/460	3000	5.7	(37)	Post	1.2	(2.6)	Stock	**ME9J3AP2**
285.8	(11¼)	76.2	(3)	2pc exp	230/460	2400	3.7	(24)	Post	1.5	(3.2)	Stock	**ME11E3AP2**
		127.0	(5)	2pc exp	230/460	5100	4.8	(31)	Post	2.4	(5.2)	Stock	**ME11E5AP1**

How to Order

To order your stock MI Band heater, specify:

- Quantity
- Watlow code number
- Options
- Lead type and length, or terminal type configuration (If code number has an “N” as the last letter in the code, you must specify termination type and lead length. 305 mm (12 in.) leads will be supplied unless otherwise specified).

Availability

Stock: Same day shipment on MI Band heaters with post terminals or 305 mm (12 in.) Type B leads. Longer lead lengths or other terminations will ship next day.

Made-to-order: If stock units do not meet application needs, Watlow can manufacture MI Band heaters to special requirements. Please consult a Watlow sales engineer or authorized distributor.

Barrel Heaters

Special Mica Band

For over 80 years, Watlow has been solving complex and unique application problems with standard mica band heaters. Watlow is continuously improving design and application knowledge through engineering expertise and experience with numerous OEM and end-user applications.

This has resulted in the development of many specialty variations in construction resulting in the best heat solutions. This catalog contains a sampling of what can be done. Please contact a local Watlow sales engineer or distributor for custom applications.

Performance Capabilities

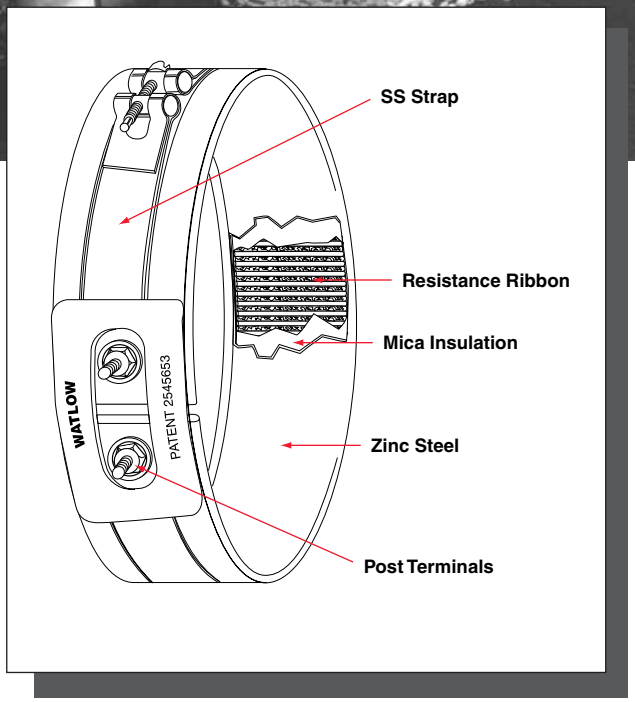
- Sheath temperatures to 480°C (900°F)
- Watt densities to 7.0 W/cm^2 (4.5 W/in^2)

Features and Benefits

- **UL® component recognition** available for applications up to 480°C (900°F) sheath temperature.
- **Patented clamping strap** assures efficient heat transfer.
- **Low mass design** allows fast heat-up and quick response.
- **Design variations** provide user convenience and heater protection.

Applications

- Injection molding barrels
- Extruders



Barrel Heaters

Special Mica Band

Applications and Technical Data

Operating Factors

Use as a low watt density rating as the application permits. A close match of the heat supplied to the actual requirements will reduce temperature overshoot, reduce cycling and increase the life of any band heater used.

Calculate the **safe maximum wattage** for the heater using:

Heated Area x Maximum Watt Density

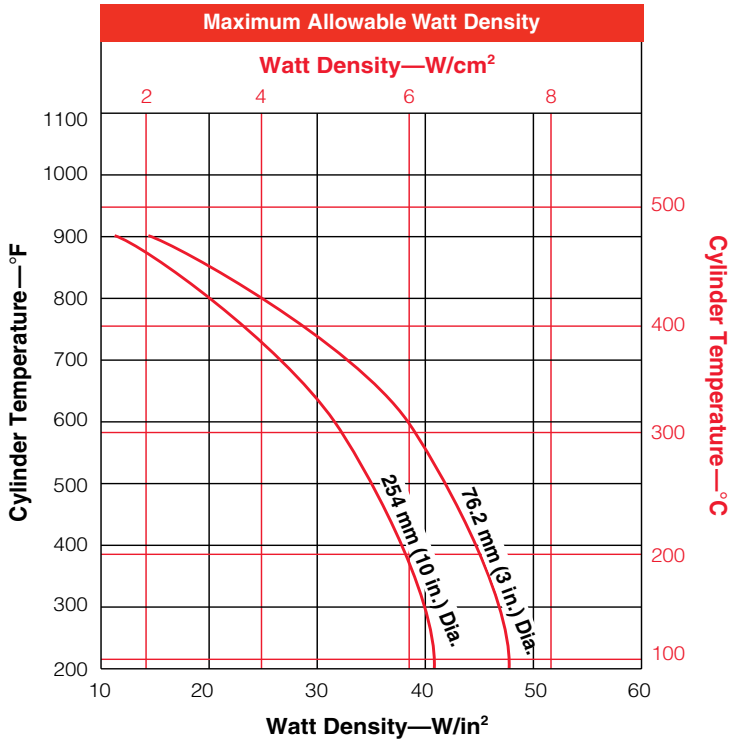
Calculate the **heated area** of the band heater by subtracting the no-heat area from the total area in contact with the cylinder (3.14 x I.D. x width). Subtract the no-heat area at the terminals (from table) and any additional no-heat area caused by holes, slots or oversize gaps.

Determine the maximum watt density of the heater from the graph on this page. The curves are based on narrow heaters mounted on a smooth, steel cylinder. Apply the necessary correction factors:

- For heaters 57 mm (2.25 in.) to 127 mm (5 in.) wide, multiply watt density by 0.8.
- For high expansion cylinders (aluminum or brass), reduce the watt density by 0.46 W/cm² (3 W/in²).
- For heaters 63.5 to 127 mm (2.25 in. to 5 in.) wide installed on a high expansion cylinder, reduce watt density by a total of 0.46 W/cm² (3 W/in²) only.
- For regular cylinder surfaces other than smooth, machined finish, reduce watt density by 0.46 W/cm² (3 W/in²).
- For heaters that will be insulated or enclosed, contact Watlow for specific watt densities.

No-Heat Area for Special Mica Band (Post Terminals)

Heater Type	Heater Size		No-Heat Area at Terminals mm (in.)
	Diameter mm (in.)	Width mm (in.)	
One Piece	50.8 (Less than 2)	152.4 (Up to 6)	25.4 (1 x width)
	50.8 (2 or more)	76.2 (Up to 3)	38.1 (1.5 x width)
		76.2 (More than 3)	25.4 (1 x width)
Two Piece	76.2 (3 or more)	76.2 (Up to 3)	76.2 (3 x width)
		76.2 (More than 3)	50.8 (2 x width)



Barrel Heaters

Special Mica Band

Physical Limitations of Variations

Check the table to be certain the variations and lead arrangements being ordered are available on the heater size required. If you need to exceed any limitations please contact a Watlow representative.

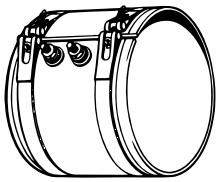
Physical Limitations of Variations

Heater Type	Diameter				Width			
	Min.		Max.		Min.		Max.	
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)
1 pc.	33.3	(1 5/16)	559	(22)	15.8	(5/8)	381	(15)
2 pc.	76.2	(3)	1117	(44)	15.8	(5/8)	381	(15)
Expandable:								
Narrow	44.4	(1 3/4)	—	—	25.4	(1)	76.2	(3)
Wide	44.4	(1 3/4)	—	—	50.8	(2)	152.4	(6)
O.D. heater:								
1 pc.	76.2	(3)	559	(22)	25.4	(1)	76.2	(6)
2 pc.	76.2	(3)	1117	(44)	25.4	(1)	76.2	(6)
Type K leads	19.05	(3/4)	—	—	15.8	(5/8)	381	(15)
Type L leads	19.05	(3/4)	—	—	19.05	(5/8)	381	(15)
Type E leads	38.1	(1 1/2)	559	(22)	19.05	(5/8)	381	(15)
Type F leads	38.1	(1 1/2)	559	(22)	19.05	(5/8)	381	(15)
Type H leads	38.1	(1 1/2)	559	(22)	19.05	(5/8)	381	(15)
Type B leads	38.1	(1 1/2)	559	(22)	19.05	(5/8)	381	(15)
Post terminal:	33.3	(1 5/16)	—	—	25.4	(1)	381	(15)
Type A leads	19	(3/4)	—	—	19	(3/4)	381	(15)
Type C leads	33.3	(1 5/16)	—	—	25.4	(1)	381	(15)
Terminal box	88.9	(3 1/2)	—	—	34.9	(1 3/8)	381	(15)
Plug w/bracket	76.2	(3)	—	—	88.9	(3 1/2)	381	(15)
3-phase	—	—	—	—	76.2	(3)	381	(15)
European Plug:								
1 pc. vertical	33.3	(1 5/16)	559	(22)	25.4	(1)	381	(15)
1 pc. horizontal	76.2	(3)	559	(22)	50.8	(2)	381	(15)
2 pc. vertical	76.2	(3)	1117	(44)	25.4	(1)	381	(15)
2 pc. horizontal	76.2	(3)	1117	(44)	50.8	(2)	381	(15)
HV Wedge-Lok	2.5.4	(1)	76.2	(3)	25.4	(1)	76.2	(6)
Clamping tabs	50.8	(2)	—	—	25.4	(1)	381	(15)
Welded Barrel Nuts								
1 pc.	50.8	(2)	559	(22)	25.4	(1)	381	(15)
2 pc.	101.6	(4)	1117	(44)	25.4	(1)	381	(15)

Note: Some combinations of maximum and minimums cannot occur on the same heater.

Standard gap is 6.35 mm (0.25 in.)

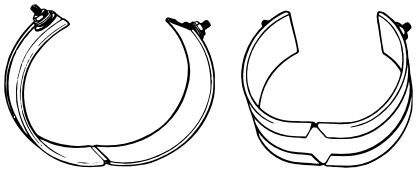
Variations



Different Widths

The 38 mm (1.5 in.) wide heater is the most efficient due to maximum clamping action. Heaters are available in widths from 16 mm (0.625 in.) to 381 mm (15 in.).

Multiple clamping straps are provided for heaters more than 76 mm (3 in.) wide.



Expandable Heaters

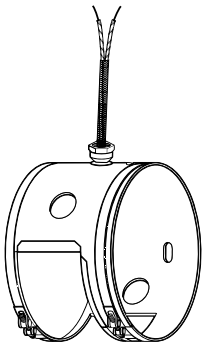
Heaters 76 mm (3 in.) wide or less are constructed with a notched sheath. Heaters wider than three inches are constructed with an expansion seam. These heaters are shipped open and should not be closed and reopened more than twice. To order, specify **expandable.**

Barrel Heaters

Special Mica Band

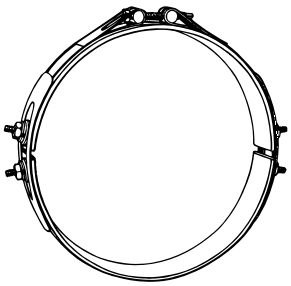
Variations

Continued



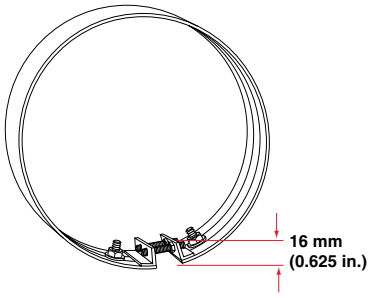
Holes and Notches

An economical way to provide access for instrumentation is to specify an oversize gap between the heater ends. Holes and notches in the sheath should be specified only when all the cylinder surfaces adjacent to the hole or notch must be heated. When required, holes may be provided in nearly any location as long as there is at least 25 mm (1 in.) between the hole and one side of the heater. Standard hole sizes up to 51 mm (2 in.) diameter. For proper hole and/or notch location, a **dimensional drawing is required.**



Two Piece Band Heaters

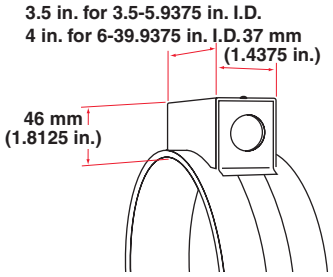
Two-piece construction is available on heaters 76 mm (3 in.) or greater in diameter. Heaters three inches wide or less with post terminals have one terminal on each end. Heaters over three inches wide with post terminals have the two terminals side by side on one end. On two-piece units with leads, also specify the power supply voltage. The power supply voltage is the voltage to which the heater will be wired. For example, a two-piece band that is 240V~(ac) per half may be wired in series to a 480V~(ac) power supply. In this case the band heater lead wire insulation must be rated for 480V~(ac). To order, specify **two piece band heater,** with **volts** and **watts per half** and **power supply voltage**.



Outside Diameter

This variation is specially designed and constructed to heat the inside diameter of cylinders, i.e., large diameter blown film dies. All the terminations and mounting hardware are located on the I.D. of the heater.

Consult Watlow for available sizes and terminations. Option available as standard mica construction only. To order, specify **outside diameter** heater.



Metallic Terminal Box

Terminal boxes are attached to the heater to cover the terminals for an added safety feature. Conduit may be attached to the box through 22 mm (0.875 in.) diameter holes in the ends of the box. Terminal box is available on two piece heaters. When ordering, specify **terminal box.**

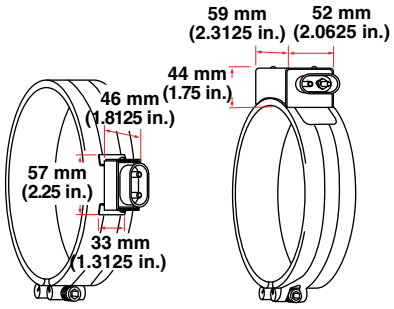
See page 30 for minimum/maximum dimensional requirements.

Barrel Heaters

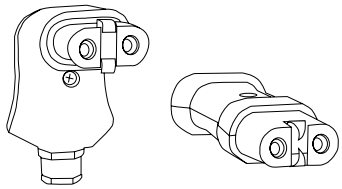
Special Mica Band

Variations

Continued



Vertical **Horizontal**



Right Angle
Code # N6027AF049

Straight
Code # N6027ZZ028

High Temperature "Quick Disconnect" European Style Plugs

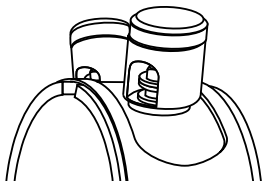
These plugs provide the simplest and safest way to apply power to band heaters. The combination of high temperature male and female quick disconnect plug assemblies eliminates all live exposed terminals and electrical wiring that can be a potential hazard to employees or machine. Maximum amps 15 at 240V~(ac), maximum volts 240. To order, specify **vertical** or **horizontal** European Plug.

High Temperature "Quick Disconnect" European Style Female Adapters

Available as an accessory item that must be used in conjunction with high temperature "quick disconnect" European Style Plugs. Specify code number **N6027AF049** or **N6027ZZ028** and quantity.

Ceramic Terminal Covers

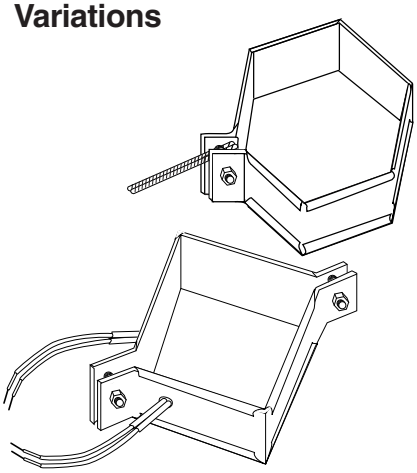
Stock Option



Code # Z-4918

A convenient and economic way to insulate post terminals. Sized for standard length posts. 10-24 screw thread size. These are supplied as an accessory item and shipped separately. Specify **Z-4918** and quantity.

Special Construction Variations



Square, Rectangular and Hex Bands

Square and rectangular heaters are made in either one or two-piece construction. These units are ideal for heating dies on plastic extruders, or the barrels of twin screw extruders. Hex-shaped heaters are commonly used on the hex shaped portion of the nozzle injection molding machines. Hex-shaped heaters are made to exact customer specifications. To order, specify **square** or **rectangular** heaters. A dimensional drawing is required.

See page 30 for minimum/maximum dimensional requirements.

Barrel Heaters

Special Mica Band

Special Construction Variations

Continued

Square, Rectangular and Hex Bands (continued)

Clamping Styles

The preferred clamping style is illustrated in Figure 1 showing bent-up flange clamping. This clamping style applies a uniform clamping force at the corners.

Figure 2 shows bent-up flanges or built-in strapping bracket at the side.

The least preferred clamping style is shown in Figure 3. The one-piece heater does not apply a uniform clamping force.

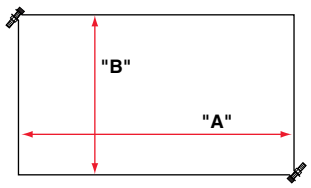


Figure 1

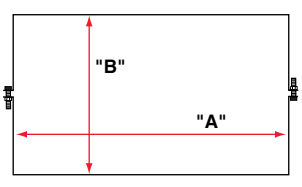


Figure 2

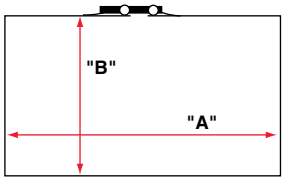
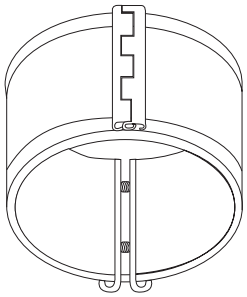


Figure 3

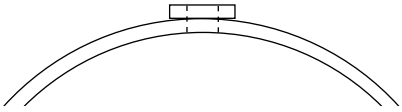
Hinged Two-Piece Band

The hinged, two-piece band heater is connected with a reinforced hinge. It can be opened and closed as often as necessary resulting in easy installation and removal.

To order, specify **hinged two-piece band** and watts and volts per each half.



Thermocouple Coupling



The thermocouple coupling simplifies the installation of an external thermocouple with a threaded fitting. The standard location for the coupling is 90 degrees from the gap.

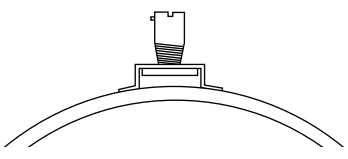
Standard bushing sizes available are:

NPT Size in.	Depth in.	Height in.
0.5 - 27	9/16	5/8
0.25 - 20	3/4	11/16
0.375 - 18	7/8	5/8

To order, specify **thermocouple coupling**.

Bayonet Adapter

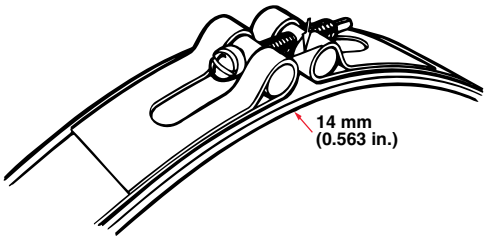
The bayonet adapter simplifies the installation of an external thermocouple with a bayonet adapter. The standard location for the adapter is 90 degrees from the gap. To order, specify **bayonet adapter**.

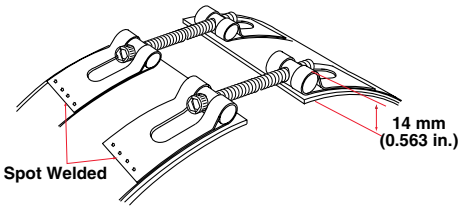


Barrel Heaters

Special Mica Band

Clamping Variations





Standard and Low-Profile Clamping Strap

The standard clamping strap requires 14 mm (0.563 in.) clearance above the heated surface, at the barrel nuts. When clearance is limited, smaller barrel nuts can be used which require only 9 mm (0.375 in.) clearance. The clearance required by the clamping screw depends on the screw length and the diameter of the heater. The low-profile clamping strap is standard on units less than 45 mm (1.375 in.) wide and utilizes a 13 mm (0.5 in.) wide strap. Consult Watlow for more information. To order, specify **low-profile clamping strap.**

Welded Barrel Nuts

An ideal way to provide access for instrumentation is to specify an oversized gap between the heater ends. If the clamp strap interferes with the positioning of the instrumentation device, welded barrel nuts are recommended. Maximum gap is 25 mm (1 in.) Specify **welded barrel nuts** and **gap dimension** when ordering.

See page 30 for minimum/maximum dimensional requirements.

Barrel Heaters

Special Mica Band

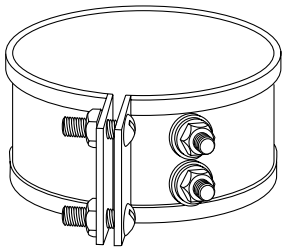
Clamping Variations

Continued

Non-Stock Option

Clamping Tabs

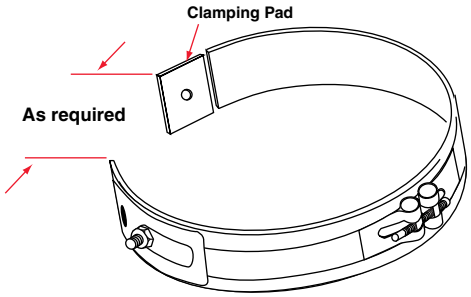
Tabs—or lock-up flanges—are available. However, the special mica band heater and strap design provides superior clamping and improved heat transfer and should be used whenever possible. To order, specify **clamping tabs**.



Clamping Pads

Clamping pads have a hole to allow easy fastening to machine barrel. Clamping pads are used when an obstruction hinders a standard clamping strap from fitting completely around the machine barrel.

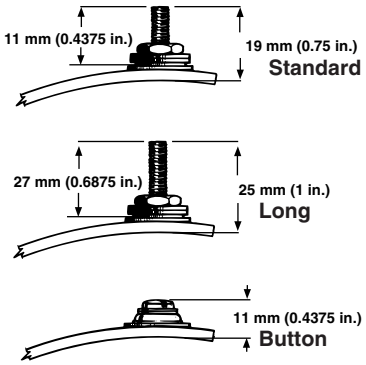
To order, specify **clamping pads** and **degrees coverage**.

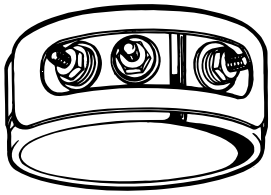


Termination Variations

Post Terminal Options

Standard post terminals have a threaded length of 11 mm (0.4375 in.) and require 19 mm (0.75 in.) clearance from the cylinder. Terminals with 17 mm (0.6875 in.) threaded lengths are available that require one inch of clearance. Button terminals require only 11 mm (0.4375 in.) clearance. Maximum amperage for post terminals is 35 amps. To order, specify **standard, long** or **button** terminals.





Three Terminal Construction

A third terminal can be added to provide dual voltage or three-heat operation. Or, it can be connected to the sheath for easy grounding.

Standard terminal location on heaters 76 mm (3 in.) wide or less is one terminal at each end of the heater centered on the width. On heaters three inches wide or wider, the terminals are located side-by-side on one end. Special terminal locations are available. To order, specify **dual voltage** or **three-heat operation.**

Quick Ship

- *Same day shipment on more than 1000 variations of THINBAND heaters.*

Barrel Heaters

THINBAND® Mica

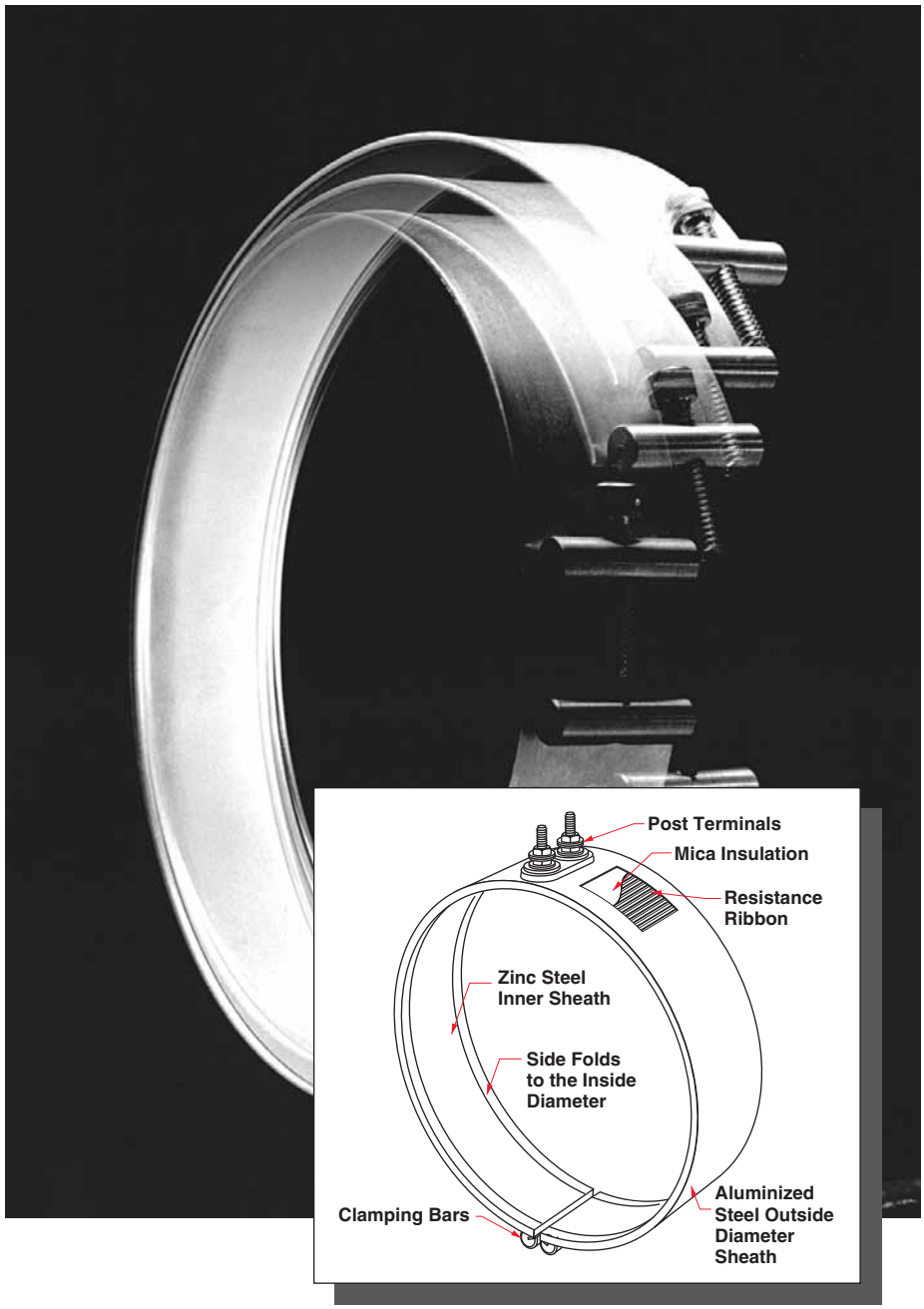
The THINBAND® heater is Watlow's patented redesign of the mica band. THINBAND heaters deliver fast and install easily, keeping costs down and machines running.

Performance Capabilities

- Sheath temperatures to 480°C (900°F)
- Watt densities to 8.5 W/cm^2 (55 W/in^2)

Features and Benefits

- **New flexible, one-piece design** makes installation faster on plastic processing equipment because the heater can be opened to the full diameter of the barrel without internal damage. The THINBAND heater can be installed on a barrel without removing other band heaters already in place.
- **Same day shipment** on more than 1000 variations of THINBAND lead attachments is due to Watlow's exclusive Lead Adapter—or LA—manufacturing method. Customers can reduce inventories and costly downtime.
- **Only one set of leads or terminals** is needed on the THINBAND heater, unlike the two sets required on the cumbersome two-piece replacement barrel heaters with straps.



- **QUICK CLAMP** opens to fit over barrels and snaps in place with one easy flip of its latching lever. No need to remove other heaters.
- **Permanently attached clamping bars.**
- **Contamination resistance.** No folds on outside of heater.

Applications

- Injection molding machines
- Extruders
- Blown film dies

Barrel Heaters

THINBAND Mica

Applications and Technical Data

Operating Factors

Use as low a watt density rating as your application permits. A close match of the heat supplied to the actual requirements will reduce temperature overshoot, reduce cycling and increase the life of any band heater you use.

Calculate the **safe maximum wattage** for your heater using:

Heated Area x Maximum Watt Density

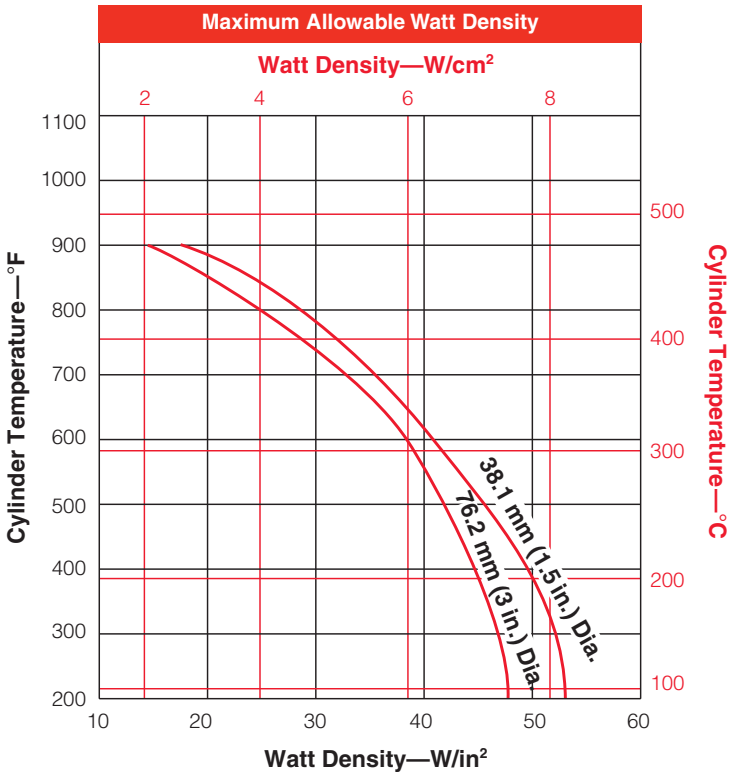
Calculate the **heated area** of your barrel heater by subtracting the no-heat area from the total area in contact with the cylinder (3.14 x I.D. x width). Subtract the no-heat area at the terminals (from table) and any additional no-heat area caused by holes, slots or oversize gaps.

Determine the maximum watt density of your heater from the graph on this page. The curves are based on narrow heaters mounted on a smooth, steel cylinder. Apply the necessary correction factors:

- For heaters 57 mm (2.25 in.) to 127 mm (5 in.) wide, multiply watt density by 0.8.
- For high expansion cylinders (aluminum or brass), reduce the watt density by 0.46 W/cm² (3 W/in²).
- For heaters 57 mm to 127 mm wide (2.25 in. to 5 in.) installed on a high expansion cylinder, reduce watt density by a total of 0.46 W/cm² (3 W/in²) only.
- For regular cylinder surfaces other than smooth, machined finish, reduce watt density by 0.46 W/cm² (3 W/in²).
- For heaters that will be insulated or enclosed, contact Watlow for specific watt densities.
- For units greater than 355 mm (14 in.) diameter, consult recommended clamping graph on page 39.
- For units used in vertical applications, consult factory for application assistance.

No-Heat Area for THINBAND (All Terminations)

Heater Type	Heater Size				No-Heat Area at Terminals	
	Diameter		Width			
	mm	(in.)	mm	(in.)	mm	(in.)
One Piece	63.5	(Less than 2.5)	177.8	(Up to 7)	25.4 (1) x width	
Two Piece	127	(5 or more)	76.2	(More than 3)	50.8 (2) x width	



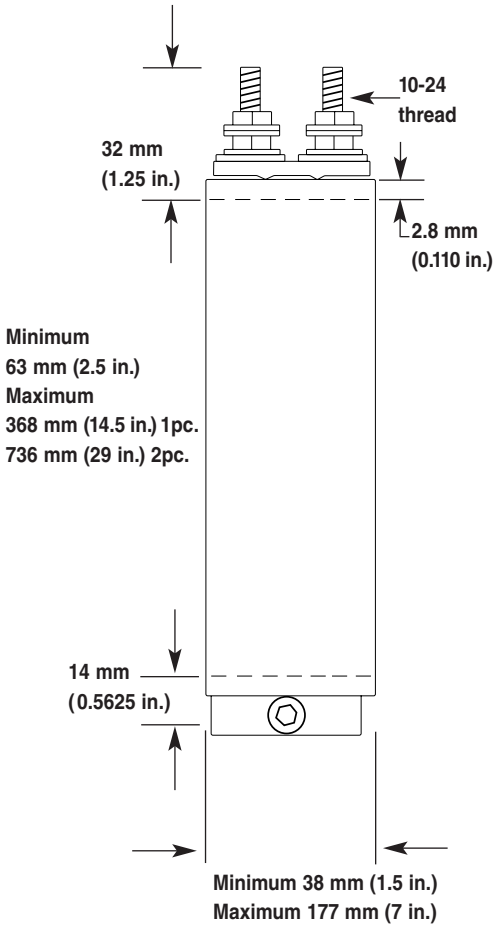
Barrel Heaters

THINBAND Mica

Physical Limitations of Lead Variations

Check the table to be certain the variations and lead arrangements you order are available on the heater size you require. If you need to exceed any limitations please contact a Watlow representative.

THINBAND Barrel



Physical Limitations of Lead Variations

Heater Type	Diameter				Width			
	Min.		Max.		Min.		Max.	
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)
1 pc. const.	25.4	(1)	368.3	(14½)	38.1	(1½)	177.8	(7)
2 pc. const.	127.0	(5)	736.6	(29)	38.1	(1½)	177.8	(7)
Nozzle								
Type A	25.4	(1)	101.6	(4)	25.4	(1)	152.4	(6)
Type L	25.4	(1)	101.6	(4)	25.4	(1)	152.4	(6)
Barrel								
Type T	63.5	(2½)			38.1	(1½)	177.8	(7)
Type H	63.5	(2½)			38.1	(1½)	177.8	(7)
Type F, FR	63.5	(2½)			38.1	(1½)	177.8	(7)
Type E	63.5	(2½)			38.1	(1½)	177.8	(7)
Type C, BR	63.5	(2½)			38.1	(1½)	177.8	(7)
Type K, KR	63.5	(2½)			38.1	(1½)	177.8	(7)
Terminal Box	88.9	(3½)			38.1	(1½)	177.8	(7)
European Plug								
1 pc. vertical	63.5	(2½)	368.3	(14½)	38.1	(1½)	177.8	(7)
1 pc. horizontal	63.5	(2½)	368.3	(14½)	38.1	(1½)	177.8	(7)
Welded Barrel Nuts								
1 pc.	63.5	(2½)	368.3	(14½)	38.1	(1½)	177.8	(7)

Note: Some combinations of maximums and minimums cannot occur on the same heater. Check the table to be certain the variations and lead arrangements you order are available on the heater size you require. If you need to exceed any limitations, please contact your Watlow representative.

Standard gap is 9.53 mm (0.375 in.) between clamp bars.

Barrel Heaters

THINBAND Mica

Barrel Heater
QUICK CLAMP Option

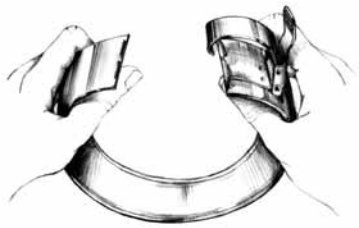
With QUICK CLAMP, the THINBAND heater can be secured tightly in place in a matter of seconds. The spring-loaded clamp secures the heater tightly around the barrel with an easy flip of the lever.

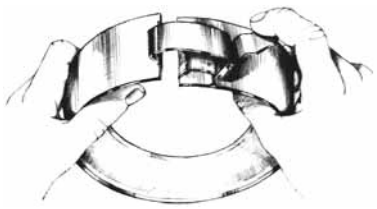
Features and Benefits

- THINBAND with QUICK CLAMP fits over barrels and snaps in place with easy flip of its latching lever.
- Hot change-outs are completed in seconds.
- Spring tensioned clamp keeps the THINBAND heater tight against barrel—won't loosen over time.
- Ideal for vertical applications.
- Available on selected stock and made-to-order THINBAND barrel heaters—minimum 100 mm (4 in.) diameter, 38 mm (1.5 in.) width.
- Standard gap is 12.7 mm (0.5 in.).

QUICK CLAMP eliminates tools, loose parts and hassle

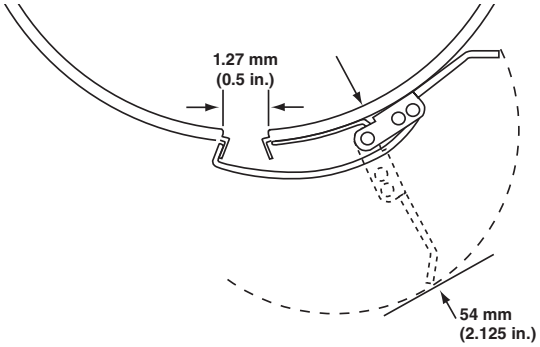
- THINBAND opens up to fit over barrel. There is no need to remove other heaters.
- One easy flip of the latching lever and QUICK CLAMP shuts, completing installation.





Clearance Dimensions

Width Range mm	Width Range (in.)	Number of Quick Clamps	Distance Between Clamps mm	Distance Between Clamps (in.)
38.1 to 69.3	(1½) to (2 1⁄16)	1	NA	
69.9 to 94.8	(2¾) to (3 1⁄16)	2	12.7	(½)
69.9 to 120.1	(3¾) to (4 1⁄16)	2	25.4	(1)
120.6 to 145.5	(4¾) to (5 1⁄16)	3	12.7	(½)
146.1 to 145.5	(5¾) to (7)	3	25.4	(1)



Recommended Clamping Options

THINBAND Barrel Products

Clamp Bars

Clamp Bars
Or QUICK CLAMP above 101.6 mm (4 in.) diameter

QUICK CLAMP
For 2 piece:
Clamp bar at other gap

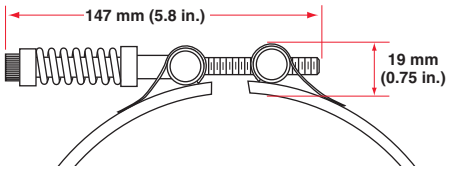
Coil Spring
For 2 piece only:
Clamp bar at other gap

Notes: Widths 101.6 mm (4 in.) and over add 50.8 mm (2 in.) to diameter then reference chart clamp selection.

Barrel Heaters

THINBAND Mica

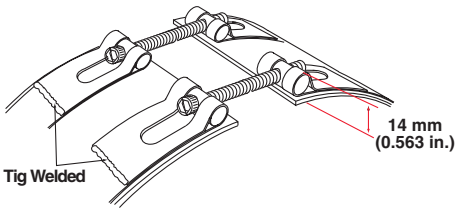
Barrel Heater Clamping Variations



Tig Welded Barrel Nuts With Spring Loaded Clamping

Tig welded barrel nuts with spring loaded clamping are used during start-up to maintain a tight heater fit on large barrels. Stainless steel top metal is required.

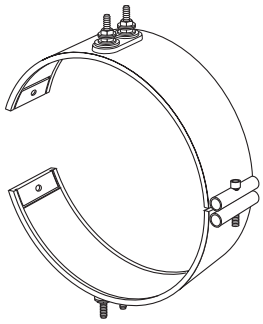
Refer to the THINBAND recommended clamping graph on page 39. This option is mandatory on vertical applications. To order, specify **spring loaded clamping.**



Tig Welded Barrel Nuts

An ideal way to provide access for instrumentation is to specify an oversized gap between the heater ends. If the THINBAND clamp bar screw interferes with the positioning of the instrumentation device, tig welded barrel nuts are recommended. Stainless steel top metal is required. Maximum gap is 25 mm (1 in.). Specify **tig welded barrel nuts** and **gap dimension** when ordering.

Non-Stock Option

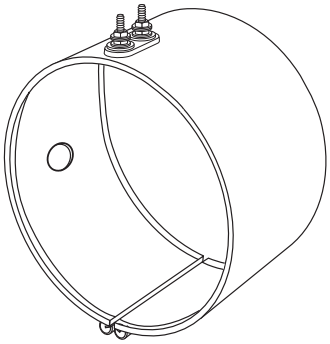


Clamping Pads

Clamping pads are used when an obstruction would prevent a standard full circumferential heater from fitting completely around a machine barrel. The clamping pads have a hole to allow easy fastening to the machine barrel. **Dimensional drawing required** when ordering.

Variations

Non-Stock Option



Holes

An economical way to provide access for instrumentation is to specify an oversized gap between the heater ends. A hole in the sheath should be specified only when all the cylinder surface adjacent to the hole must be heated. **When required, one hole may be provided in nearly any location as long as there is at least 25 mm (1 in.) between the hole and one side of the heater. Standard hole sizes up to 51 mm (2 in.) diameter.** Consult factory for limitations. For proper hole location, a **dimensional drawing is required.**

Barrel Heaters

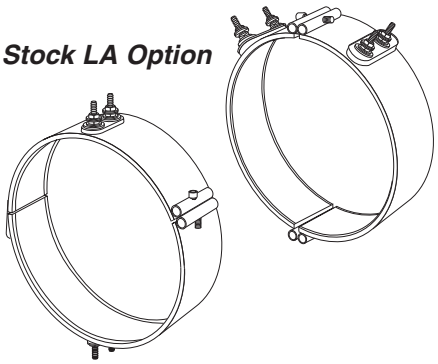
THINBAND Mica

Barrel Heater Variations

Continued

Non-Stock Option

Stock LA Option

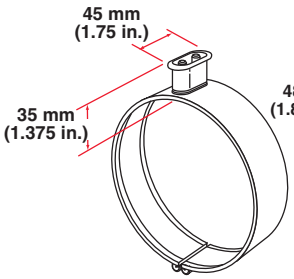


Two-Piece Barrel Heaters

Two-piece construction is available on heaters 127 mm (5 in.) or greater in diameter. Heaters 38 mm (1.5 in.) wide and greater with post terminals have the two terminals side-by-side.

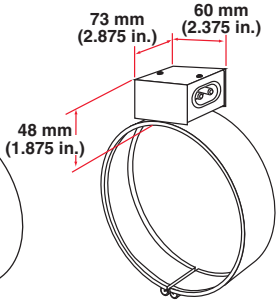
Note: When ordering two-piece barrel heaters, specify the **volts** and **watts per half.** On two-piece units with leads, you must also specify the **power supply voltage.** Example: a two-piece barrel that is 240V~(ac) per half may be wired in series to a 480V~(ac) power supply. In this case the barrel heater lead wire insulation must be rated for 480V~(ac). Available from stock by combining two one-piece heaters to create a large diameter. Terminations will be 90 degrees from each gap. **QUICK CLAMP** must be supplied at one gap when ordering.

Stock Option



Vertical

Stock Option

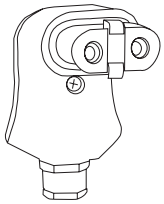


Horizontal

High Temperature "Quick Disconnect" European Style Plugs

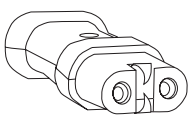
They provide the simplest and safest way to apply power to barrel heaters.The combination of high temperature male and female quick disconnect plug assemblies eliminates all live exposed terminals and electrical wiring that can be a potential hazard to employees or machine. Maximum 15 amps at 240V~(ac), maximum volts 240. When ordering, specify **vertical** or **horizontal European Plug.**

Stock Option



Right Angle
Code # N6027AF049

Stock Option



Straight
Code # N6027ZZ028

High Temperature "Quick Disconnect" European Style Female Adapters

Available as an accessory item that must be used in conjunction with high temperature "quick disconnect" European Style Plugs. Specify code number **N6027AF049** or **N6027ZZ028** and quantity.

See page 38 for minimum/maximum dimensional requirements.

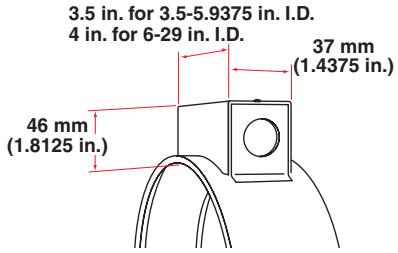
Barrel Heaters

THINBAND Mica

Barrel Heater Variations

Continued

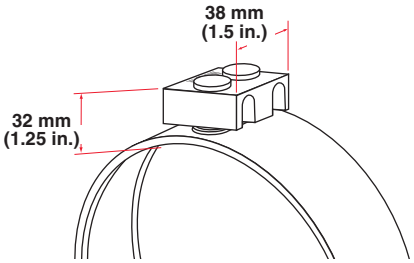
Stock Option



Metallic Terminal Box

Available on heaters of 88 mm (3.5 in.) diameter or larger. Terminal boxes are attached to the heater to cover the terminals for an added safety feature. Conduit may be attached to the box through 22 mm (0.875 in.) diameter holes in the ends of the box. Terminal box is available on one or two piece stock THINBAND heaters. When ordering, specify **terminal box.**

Stock Option



Code # Z-4919

Ceramic Terminal Covers

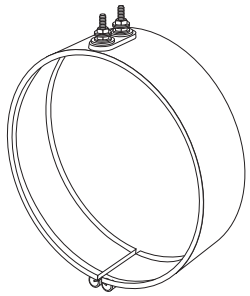
A convenient and economic way to insulate post terminals. Sized for standard length posts. 10-24 screw thread size. These are supplied as an accessory item and shipped separately. Specify code number **Z-4919** and quantity.

Metric Clamp Bars and Screws

Metric hardware is available on made-to-order THINBAND heaters with post terminals and clamp bars. The post terminal thread size is M5X.8. The screw for the clamp bar will be M6X1.0 socket head cap screw. When ordering, specify **metric hardware** required.

Terminations

Stock LA Option



See page 38 for minimum/maximum dimensional requirements.

Type T

Post terminals provide a quick connection with ring or fork connectors, or buss strips. Threaded 10-24 studs or optional metric (M5X.8) are provided with double nuts and washers. Post terminals have a threaded length of 14 mm (0.5625 in.) and require 32 mm (1.25 in.) clearance from the cylinder. Maximum amperage for post terminals is 35 amps and they can withstand up to (61.0 Newton-Meter) 45 in-lbs of torque. The increased torque is possible due to the unique add-on lead cap design, which makes the cap a separate entity from the heater. This means all of the torque carrying capability is maintained within the cap design, allowing the terminal hardware to be torqued to a specific setting and tested prior to connection to the heater.

The welded electrical connection to the heater is superior to crimped or staked connections which can loosen and oxidize during operation.

To order, specify **Type T.**

Barrel Heaters

THINBAND Mica

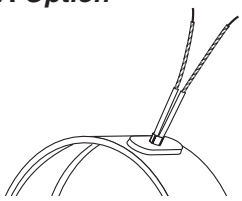
Barrel Heater Terminations

Continued

Heaters rated at less than 250 volts use UL® approved lead insulation for operations to 250˚C (482˚F) as standard. Lead insulation UL® rated for operation to 450˚C (850˚F) may be required in high temperature applications where the leads are shrouded or enclosed with the heater. All heaters rated at more than 250V~(ac) use this wire.

Type K

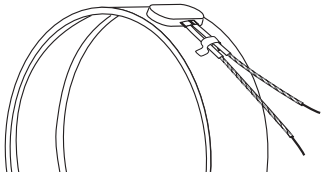
Stock LA Option



Flexible lead wires exit vertically from the heater. These leads can be bent adjacent to the heater for a quick and easy connection. To order, specify **Type K** and length.

Type KR

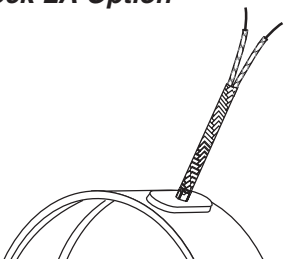
Stock LA Option



Same specifications as Type K except lead wires exit at right angle. To order, specify **Type KR** and length.

Type C

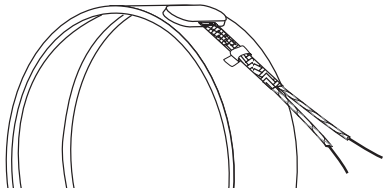
Stock LA Option



Two fiberglass lead wires exit a single tightly woven metal braid for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than the braid. To order, specify **Type C** and length.

Type BR

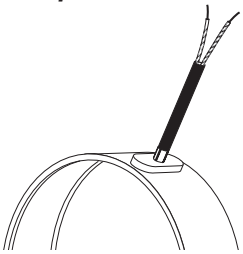
Stock LA Option



Same specifications as Type C except lead wires exit at right angle. To order, specify **Type BR** and length.

Type F

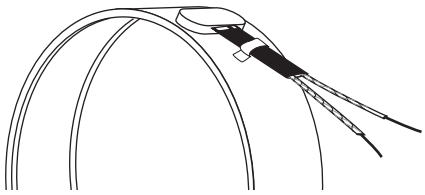
Stock LA Option



Loose fiberglass sleeving encloses two fiberglass leads for additional insulation protection where high temperature or minor abrasion is present. Leads are 51 mm (2 in.) longer than the sleeving. To order, specify **Type F** and length.

Type FR

Stock LA Option



Same specifications as Type F except lead wires exit at right angle. To order, specify **Type FR** and length.

See page 38 for minimum/maximum dimensional requirements.

Barrel Heaters

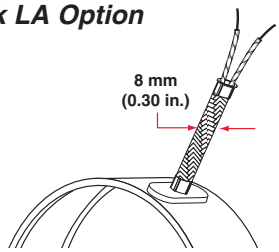
THINBAND Mica

Barrel Heater Terminations

Continued

Type E

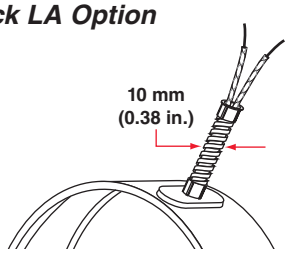
Stock LA Option



Loose metal braid encloses two fiberglass leads for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than the braid. To order, specify **Type E** and length.

Type H

Stock LA Option



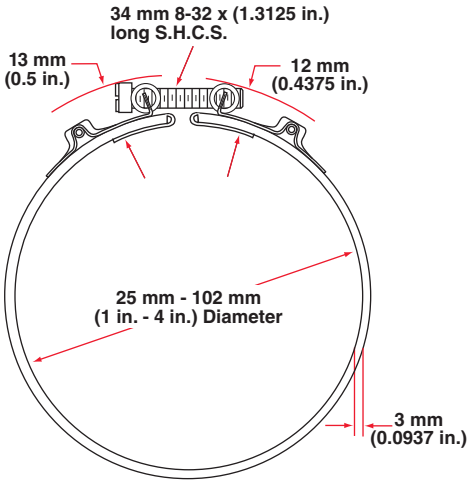
A stainless steel, flexible conduit encloses the leads for superior mechanical protection where lead abrasion is a particular problem. Leads are 51 mm (2 in.) longer than the conduit. To order, specify **Type H** and length.

Ground Wire or Terminal Stud

18 gauge uninsulated ground wire is available on all lead types except post terminals and Type C leads. A 10-24 ground terminal stud has a threaded length of 17 mm (1.0625 in.). Studs are welded to the sheath and are provided with a green nut and washer. To order, specify **uninsulated ground wire** or **terminal stud.**

THINBAND Nozzle Heater Terminations

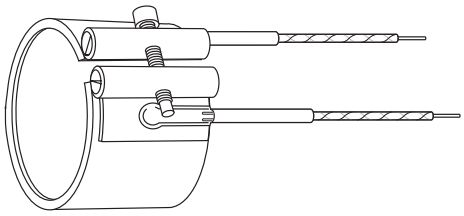
- **One to four inch diameter**
- **One to six inches wide**



See page 38 for minimum/maximum dimensional requirements.

Type L

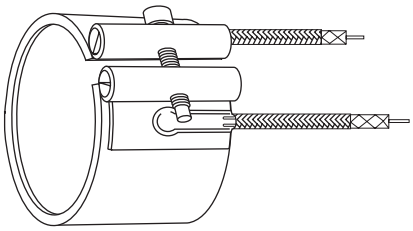
Stock Option



Flexible lead wires with fiberglass sleeves exit the nozzle heater on both sides of the gap. The heater sheath encloses the ends for protection against contamination. To order, specify **Type L.**

Type A

Stock Option



Especially designed for nozzle heaters. A galvanized metal braid over the fiberglass insulated leads provides strength and protection. The heater ends are enclosed to protect against melted plastic and contaminants. This arrangement permits 25 mm (1 in.) and wider nozzle heaters to be placed flush against a flange. Available on nozzle sizes only. To order, specify **Type A.**

Barrel Heaters

THINBAND Mica

How to Utilize Watlow's Universal THINBAND Barrel Stock Program

Various diameters and widths of Watlow's unique patented flexible THINBAND barrel heaters are available with LA terminations for shipment faster than any in the market because of Watlow's unique stocking program.

Watlow stocks THINBAND barrel heaters ranging in diameters from 76.2 to 228.6 mm (3 to 9 in.) in 6.35 mm (0.25 in.) and widths in 38.1 mm (1.5 in.), 50.8 and 76.2 mm (2 and 3 in.). Watlow can combine these sizes, creating a two-piece assembly ranging from 228.6 to 457.2 mm (9 to 18 in.) in diameter, and any combination between 76.2 and 457.2 mm (3 and 18 in.) as a two-piece assembly. This versatility should satisfy almost any requirements whether millimeter or inch size barrels.

Regarding possible slight wattage differences from your original heater to your THINBAND replacement, you must keep in mind that about 80 percent of the wattage is required to bring the barrel up to temperature. The 20 percent remaining is used to offset radiation and convection heat losses. So, if you have a 550 watt heater there is no harm in using a 500 or 600 watt stock THINBAND barrel heater.

There are three approaches to receive a THINBAND combination from stock. To illustrate, let's examine a customer who needs a 254 mm (10 in.) diameter heater but neither the size or width needed is in stock.

Solutions:

#1) Take two 127 mm (5 in.) diameter heaters and curve to a 254 mm (10 in.) diameter. Please note that a QUICK CLAMP has to be added order for the heater to fit. This heater is offered next day delivery.

#2) Take two THINBANDs as noted in #1 but mix each diameter. For example, 101.6 mm (0.25 in.) and 152.4 mm (6 in.) diameter or a 120.6 mm (4.75 in.) diameter with a 133.3 mm (5.25 in.) diameter equal 254 mm (10 in.). Again you need a QUICK CLAMP. This heater is also offered next day delivery.

#3) Take two THINBANDs as in #1 or #2 but subtract a 6.35 mm (0.25 in.) to the diameter and supply without the QUICK CLAMP for same day delivery. For example for a 254 mm (10 in.) diameter, any combination of 248 mm (9.75 in.) should be supplied to fit the 254 mm (10 in.) diameter requirement. The reason you have to reduce your selection size by a 6.35 mm (0.25 in.) is to ensure a gap when tightening the clamp bars otherwise you will run out of gap and the bars will touch before you can tighten the heater completely to the barrel. This is only necessary when QUICK CLAMP is not included.

Installation Procedures

1. Install heaters over a clean surface.
2. After installing the unit, begin to tighten the clamp screw. The clamping screw is 0.25 inch-20 x 1.25 inch, allen head cap screw. Begin tightening the clamp bars. If the clamp bars appear not to have seated, tap the clamp bars with a small hammer to insure the bars are well seated in the angle formed by the 60 degree bent tab and the heater.
3. If the bar has multiple screws, alternately tighten the screws as you would the lug nuts on a car wheel to insure even loading.
4. Torque all screws to approximately (9 N-M) 8 lb-in.
5. Take a soft rubber mallet and tap gently around the circumference of the heater while tightening the screws. This will ensure the heater fit to the barrel is maximized without any air gaps.
6. When installing terminal lugs, torque the top nuts to 30 in-lbs. The bottom nut should not be touched as it is factory torqued to 45 in-lbs. at assembly.
7. Retighten the heater after the heater has operated for a short time. Always make adjustments when the heater and cylinder are cold.

Barrel Heaters

THINBAND Mica

Stock Product List

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.	Former Code No.
23.8	(15⁄16)	50.8	(2)	240	175	7.0	(45)	1	Mica Band–12 in. Type K	0.09	(0.2)	Stock	**BOS2AK1**	–
25.4	(1)	25.4	(1)	120	100	6.8	(44)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1A1**	**B1A1AN1**
		25.4	(1)	240	100	6.8	(44)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1A2**	**B1A1AN2**
		25.4	(1)	120	125	8.5	(55)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1A3**	**B1A1AN3**
		25.4	(1)	240	125	8.5	(55)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1A4**	**B1A1AN4**
		38.1	(1½)	120	150	6.8	(44)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1J1**	**B1A1JN1**
		38.1	(1½)	240	150	6.8	(44)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1J2**	**B1A1JN2**
		38.1	(1½)	120	200	9.1	(59)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1J3**	**B1A1JN3**
		38.1	(1½)	240	200	9.1	(59)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1A1J4**	**B1A1JN4**
31.8	(1¼)	15.9	(⅝)	120	100	8.4	(54)①	1	Mica Band–12 in. Type A	0.09	(0.2)	Stock	**B1EOLA1**	–
		38.1	(1¼)	120	125	5.1	(33)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1E1E1**	**B1E1EN1**
		38.1	(1¼)	240	125	5.1	(33)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1E1E2**	**B1E1EN2**
		38.1	(1¼)	240	75	3.1	(20)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1E1E4**	**B1E1EN3**
		38.1	(1¼)	240	250	10.4	(67)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1E1E3**	**B1E1EN4**
		76.2	(3)	240	150	2.5	(16)	1	THINBAND–Type A or L	0.22	(0.5)	Stock	**STB1E3A1**	**B1E3AN1**
		76.2	(3)	240	250	4.2	(27)	1	THINBAND–Type A or L	0.22	(0.5)	Stock	**STB1E3A2**	**B1E3AN2**
		76.2	(3)	240	300	5.1	(33)	1	THINBAND–Type A or L	0.22	(0.5)	Stock	**STB1E3A3**	**B1E3AN3**
34.9	(1⅜)	25.4	(1)	120	140	6.4	(41)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1G1A1**	**B1G1AN1**
		50.8	(2)	240	300	7.9	(51)①	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1G2A1**	**B1G2AK1**
		88.9	(3½)	240	200	2.6	(17)	1	THINBAND–Type A or L	0.27	(0.6)	Stock	**STB1G3J1**	**B1G3JA1**
		88.9	(3½)	240	250	3.3	(21)	1	THINBAND–Type A or L	0.27	(0.6)	Stock	**STB1G3J2**	**B1G3JA2**
38.1	(1½)	22.2	(⅞)	240	100	4.8	(31)	1	Mica Band–Type A or L	0.09	(0.2)	Stock	**B1JORN1**	–
		25.4	(1)	120	100	4.0	(26)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1J1A1**	**B1J1AN1**
		25.4	(1)	240	100	4.0	(26)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1J1A2**	**B1J1AN2**
		25.4	(1)	120	150	6.0	(39)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1J1A3**	**B1J1AN3**
		25.4	(1)	240	150	6.0	(39)	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1J1A4**	**B1J1AN4**
		25.4	(1)	120	200	8.0	(52)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1J1A5**	**B1J1AN5**
		25.4	(1)	240	200	8.0	(52)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1J1A6**	**B1J1AN6**
		25.4	(1)	240	150	6.2	(40)	1	Mica Band–Post Terminals Only w/Strap	0.09	(0.2)	Stock	**B1J1AP2**	–
		31.8	(1¼)	240	250	8.0	(52)①	1	THINBAND–Type A or L	0.09	(0.2)	Stock	**STB1J1E1**	**B1J1EN1**
		38.1	(1½)	120	200	5.4	(35)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J1J1**	**B1J1JN1**
		38.1	(1½)	240	200	5.4	(35)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J1J2**	**B1J1JN2**
		38.1	(1½)	120	250	6.6	(43)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J1J3**	**B1J1JN3**
		38.1	(1½)	240	250	6.6	(43)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J1J4**	**B1J1JN4**
		38.1	(1½)	120	275	7.4	(48)①	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J1J5**	**B1J1JN5**
		38.1	(1½)	240	275	7.4	(48)①	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J1J6**	**B1J1JN6**
		38.1	(1½)	240	300	8.0	(52)①	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J1J7**	**B1J1JN7**
		38.1	(1½)	240	200	5.6	(36)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1J1JP3**	–
		38.1	(1½)	240	200	6.7	(43)	1	Mica Band–36 in. Black Glass 90° from Gap	0.14	(0.3)	Stock	**B1J1JX1**	–
		38.1	(1½)	240	250	7.0	(45)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1J1JP4**	–
		38.1	(1½)	120	275	7.6	(49)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1J1JP5**	–
		38.1	(1½)	240	275	7.6	(49)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1J1JP6**	–

CONTINUED

① Watt density is above Watlow recommendations at some common molding temperatures.

Barrel Heaters

THINBAND Mica

Stock Product List

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.	Former Code No.
38.1	(½)	50.8	(2)	240	300	6.0	(39)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1J2A1**	**B1J2AN1**
		50.8	(2)	240	300	6.2	(40)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1J2AP1**	**–**
		63.5	(2½)	240	400	6.5	(42)	1	THINBAND–Type A or L	0.23	(0.5)	Stock	**STB1J2J1**	**–**
		63.5	(2½)	240	400	6.7	(43)	1	Mica Band–36 in. Type C 90° from gap	0.23	(0.5)	Stock	**B1J2JC1**	**–**
		76.2	(3)	240	350	4.6	(30)	1	THINBAND–Type A or L	0.27	(0.6)	Stock	**STB1J3A1**	**B1J3AN1**
		76.2	(3)	240	500	6.7	(43)	1	THINBAND–Type A or L	0.27	(0.6)	Stock	**STB1J3A2**	**B1J3AN2**
		76.2	(3)	240	800	10.7	(69)①	1	THINBAND–Type A or L	0.27	(0.6)	Stock	**STB1J3A3**	**B1J3AN3**
		101.6	(4)	240	600	6.0	(39)	1	THINBAND–Type A or L	0.27	(0.6)	Stock	**STB1J4A1**	**–**
41.3	(1⅝)	31.8	(1¼)	240	250	7.6	(59)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1L1EP1**	**–**
		31.8	(1¼)	240	300	9.1	(59)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1L1EP2**	**–**
		108.0	(4¼)	120	550	4.6	(30)	1	Mica Band–Post Terminals Only w/Strap	0.32	(0.7)	Stock	**B1L4ER1**	**–**
44.5	(1¾)	25.4	(1)	240	175	6.0	(39)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1N1AP1**	**–**
		38.1	(1½)	240	150	3.4	(22)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1N1J1**	**B1N1JN1**
		38.1	(1½)	120	200	4.5	(29)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1N1J2**	**B1N1JN2**
		38.1	(1½)	240	200	4.5	(29)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1N1J3**	**B1N1JN3/4**
		38.1	(1½)	240	225	5.0	(32)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1N1J5**	**B1N1JN5**
		38.1	(1½)	240	250	5.6	(36)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1N1J6**	**B1N1JN6**
44.5	(1¾)	38.1	(1½)	120	300	6.7	(43)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1N1J7**	**B1N1JN7**
		38.1	(1½)	240	300	6.7	(43)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1N1J8**	**B1N1JN8**
		38.1	(1½)	240	200	4.6	(30)	1	Mica Band–72 in. Type C	0.14	(0.3)	Stock	**B1N1JC3**	**–**
		38.1	(1½)	240	300	6.8	(44)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1N1JP5**	**–**
47.6	(1⅞)	25.4	(1)	240	140	4.3	(28)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB1R1A1**	**B1R1AL1**
		25.4	(1)	240	200	6.4	(41)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B1R1AP1**	**–**
50.8	(2)	38.1	(1½)	120	300	6.5	(42)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2A1JP1**	**–**
		38.1	(1½)	240	300	6.5	(42)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2A1JP2**	**–**
54.0	(2⅛)	25.4	(1)	120	200	5.3	(34)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB2C1A1**	**B2C1AN1**
		52.8	(2)	240	200	2.6	(17)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB2C2A1**	**B2C2AN1**
57.2	(2¼)	22.2	(⅞)	120	215	6.7	(43)	1	Mica Band–Type A or L	0.14	(0.3)	Stock	**B2E0RN1**	**–**
		25.4	(1)	120	250	7.0	(45)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2E1AP1**	**–**
		25.4	(1)	240	250	7.0	(45)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2E1AP2**	**–**
		50.8	(2)	240	525	7.3	(47)①	1	Mica Band–Post Terminals Only w/Strap	0.27	(0.6)	Stock	**B2E2AP1**	**–**
		63.5	(2½)	240	500	5.9	(38)	1	Mica Band–36 in. Type K w/sleeving	0.27	(0.6)	Stock	**B2E2JK1**	**–**
60.3	(2⅜)	25.4	(1)	240	100	2.6	(17)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2G1AP1**	**–**
		25.4	(1)	240	250	6.5	(42)	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2G1AP2**	**–**
		25.4	(1)	240	275	7.1	(46)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2G1AP3**	**–**
63.5	(2½)	25.4	(1)	120	300	7.3	(47)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2J1AP1**	**–**
		25.4	(1)	240	300	7.3	(47)①	1	Mica Band–Post Terminals Only w/Strap	0.14	(0.3)	Stock	**B2J1AP2**	**–**
		38.1	(1½)	240	200	2.9	(19)	1	THINBAND–Type A or L	0.14	(0.3)	Stock	**STB2J1J1**	**B2J1JN1**
		38.1	(1½)	120	300	4.8	(31)	1	THINBAND–All LA Options, except A or L	0.14	(0.3)	Stock	**STB2J1J8**	**B2J1JP1**
		38.1	(1½)	240	300	4.8	(31)	1	THINBAND–All LA Options, except A or L	0.14	(0.3)	Stock	**STB2J1J9**	**B2J1JP2**
		38.1	(1½)	120	350	5.7	(37)	1	THINBAND–All LA Options, except A or L	0.14	(0.3)	Stock	**STB2J1J10**	**B2J1JP3**
		38.1	(1½)	240	350	5.7	(37)	1	THINBAND–All LA Options, except A or L	0.14	(0.3)	Stock	**STB2J1J11**	**B2J1JP4**
		60.3	(2⅜)	240	550	6.0	(39)	1	THINBAND–All LA Options, except A or L	0.14	(0.3)	Stock	**STB2J2G1**	**B2J2GP1②**
		73.0	(2⅞)	240	650	5.9	(38)	1	THINBAND–All LA Options, except A or L	0.14	(0.3)	Stock	**STB2J2R1**	**B2J2RP1②**

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① Watt density is above Watlow recommendations at some common molding temperatures.
② Mica Band-Post-thermocouple hole at gap, THINBAND replacement does not include thermocouple hole at gap.

Barrel Heaters

THINBAND Mica

Stock Product List

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.	Former Code No.
63.5	(2½)	101.6	(4)	240	850	5.0	(32)	1	THINBAND–All LA Options, except A or L	0.45	(1.0)	Stock	**STB2J4A2**	**B2J4AP1**②
		127.0	(5)	240	1150	5.4	(35)	1	THINBAND–All LA Options, except A or L	0.54	(1.2)	Stock	**STB2J5A3**	**B2J5AP1**②
		203.2	(8)	240	1800	5.1	(33)	1	Mica Band–Post–T/C Hole at gap	0.91	(2.0)	Stock	**B2J8AP1**	–
69.9	(2¾)	38.1	(1½)	240	400	5.3	(34)	1	THINBAND–Type A or L	0.18	(0.4)	Stock	**STB2N1J1**	**B2N1JN1**
76.2	(3)	25.4	(1)	240	200	3.6	(23)	1	THINBAND–Type A or L	0.18	(0.4)	Stock	**STB3A1A2**	**B3A1AN1**
		25.4	(1)	240	250	4.5	(29)	1	THINBAND–Type A or L	0.18	(0.4)	Stock	**STB3A1A3**	**B3A1AN2**
		25.4	(1)	240	300	5.4	(35)	1	THINBAND–Type A or L	0.18	(0.4)	Stock	**STB3A1A4**	**B3A1AN3**
		25.4	(1)	240	300	5.9	(38)	1	Mica Band–Post Terminals Only w/Strap	0.18	(0.4)	Stock	**B3A1AP1**	–
		25.4	(1)	240	350	6.8	(44)	1	Mica Band–Post Terminals Only w/Strap	0.18	(0.4)	Stock	**B3A1AP2**	–
		25.4	(1)	240	400	7.7	(50)①	1	Mica Band–Post Terminals Only w/Strap	0.18	(0.4)	Stock	**B3A1AP4**	–
		38.1	(1½)	240	400	4.8	(31)	1	THINBAND–Type A or L	0.23	(0.5)	Stock	**STB3A1J5**	**B3A1JN1**
		38.1	(1½)	120	600	7.3	(47)①	1	THINBAND–Type A or L	0.23	(0.5)	Stock	**STB3A1J6**	**B3A1JN2**
		38.1	(1½)	240	400	5.0	(32)	1	THINBAND–All LA Options, except A or L	0.23	(0.5)	Stock	**STB3A1J1**	**B3A1JP1/C1**
		38.1	(1½)	240	450	5.6	(36)	1	THINBAND–All LA Options, except A or L	0.23	(0.5)	Stock	**STB3A1J2**	**B3A1JP2**
		38.1	(1½)	120	500	6.2	(40)	1	THINBAND–All LA Options, except A or L	0.23	(0.5)	Stock	**STB3A1J3**	**B3A1JP3**
		38.1	(1½)	240	500	6.2	(40)	1	THINBAND–All LA Options, except A or L	0.23	(0.5)	Stock	**STB3A1J4**	**B3A1JP4**
		50.8	(2)	240	500	4.6	(30)	1	THINBAND–All LA Options, except A or L	0.36	(0.8)	Stock	**STB3A2A1**	**B3A2AP1**
		50.8	(2)	240	600	5.6	(36)	1	THINBAND–All LA Options, except A or L	0.36	(0.8)	Stock	**STB3A2A2**	**B3A2AP2**
		63.5	(2½)	240	650	5.1	(33)	1	THINBAND–All LA Options, except A or L	0.36	(0.8)	Stock	**STB3A2J7**	**B3A2JP1**
		76.2	(3)	240	750	4.7	(30)	1	THINBAND–All LA Options, except A or L	0.46	(1.0)	Stock	**STB3A3A18**	–
79.4	(3⅛)	25.4	(1)	240	400	7.4	(48)①	1	Mica Band–Post Terminals Only w/Strap	0.18	(0.4)	Stock	**B3C1AP1**	–
82.6	(3¼)	38.1	(1½)	240	400	4.5	(29)	1	THINBAND–All LA Options, except A or L	0.23	(0.5)	Stock	**STB3E1J1**	**B3E1JP1**
		50.8	(2)	240	500	4.2	(27)	1	THINBAND–All LA Options, except A or L	0.33	(0.7)	Stock	**STB3E2A41**	–
		76.2	(3)	240	650	3.7	(24)	1	THINBAND–All LA Options, except A or L	0.50	(1.0)	Stock	**STB3E3A10**	–
88.9	(3½)	25.4	(1)	120	300	5.0	(32)	1	Mica Band–36 in. Type C	0.23	(0.5)	Stock	**B3J1AC1**	–
		38.1	(1½)	120	400	4.2	(27)	1	THINBAND–All LA Options, except A or L	0.23	(0.5)	Stock	**STB3J1J1**	**B3J1JP1**
		38.1	(1½)	240	500	5.1	(33)	1	THINBAND–All LA Options, except A or L	0.23	(0.5)	Stock	**STB3J1J2**	**B3J1JP3/P2**
		50.8	(2)	240	650	5.1	(33)	1	THINBAND–All LA Options, except A or L	0.32	(0.7)	Stock	**STB3J2A1**	**B3J2AP1**
		63.5	(2½)	240	750	4.6	(30)	1	THINBAND–All LA Options, except A or L	0.36	(0.8)	Stock	**STB3J2J1**	**B3J2JP1**
		76.2	(3)	240	750	3.9	(25)	1	THINBAND–All LA Options, except A or L	0.54	(1.1)	Stock	**STB3J3A31**	–
95.3	(3¾)	25.4	(1)	240	350	5.3	(34)	1	Mica Band–Post Terminals Only w/Strap	0.23	(0.5)	Stock	**B3N1AP1**	–
		25.4	(1)	120/240	350	6.2	(40)	2	Mica Band–Post Terminals Only w/Strap	0.23	(0.5)	Stock	**B3N1AP2**	–
		38.1	(1½)	240	700	6.7	(43)①	1	THINBAND–All LA Options, except A or L	0.27	(0.6)	Stock	**STB3N1J1**	**B3N1JP1**
		50.8	(2)	240	600	4.4	(28)	1	THINBAND–All LA Options, except A or L	0.38	(0.8)	Stock	**STB3N2A17**	–
		63.5	(2½)	240	850	5.1	(33	1	THINBAND–All LA Options, except A or L	0.45	(1.0)	Stock	**STB3N2J1**	**B3N2JP1**
		76.2	(3)	240	900	4.4	(28)	1	THINBAND–All LA Options, except A or L	0.58	(1.2)	Stock	**STB3N3A5**	–
101.6	(4)	25.4	(1)	240	625	8.5	(55)①	1	Mica Band–Post Terminals Only w/Strap	0.32	(0.7)	Stock	**B4A1AP1**	–
		38.1	(1½)	240	550	5.0	(32)	1	THINBAND–All LA Options, except A or L	0.27	(0.6)	Stock	**STB4A1J1**	**B4A1JP1/2**
		38.1	(1½)	240	750	6.5	(43)	1	THINBAND–All LA Options, except A or L	0.27	(0.6)	Stock	**STB4A1J2**	**B4A1JP4**
		38.1	(1½)	240	650	5.7	(37)	1	THINBAND–All LA Options, except A or L	0.27	(0.6)	Stock	**STB4A1J3**	**B4A1JP3**
		50.8	(2)	240	550	3.7	(24)	1	THINBAND–All LA Options, except A or L	0.36	(0.8)	Stock	**STB4A2A1**	**B4A2AP1**
		50.8	(2)	240	800	5.4	(35)	1	THINBAND–All LA Options, except A or L	0.36	(0.8)	Stock	**STB4A2A2**	**B4A2AP2**
		76.2	(3)	240	1000	4.5	(29)	1	THINBAND–All LA Options, except A or L	0.58	(1.2)	Stock	**STB4A3A31**	–

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① Watt density is above Watlow recommendations at some common molding temperatures.
② Mica Band-Post-thermocouple hole at gap, THINBAND replacement does not include thermocouple hole at gap.

Barrel Heaters

THINBAND Mica

Stock Product List

I.D. mm (in.)	Width mm (in.)	Volts	Watts	Watt Density W/cm² (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg (lbs)	Avail.	Code No.	Former Code No.
107.9 (4¼)	38.1 (1½)	240	550	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB4E1J13**	–
	50.8 (2)	240	700	4.4 (28)	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB4E2A20**	–
	76.2 (3)	240	900	3.7 (24)	1	THINBAND–All LA Options, except A or L	0.58 (1.2)	Stock	**STB4E3A9**	–
114.3 (4½)	25.4 (1)	240	350	4.3 (28)	1	Mica Band–Post Terminals Only w/Strap	0.27 (0.6)	Stock	**B4J1AP1**	–
	38.1 (1½)	240	650	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB4J1J1**	**B4J1JP2/3**
	38.1 (1½)	240	400	3.1 (20)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB4J1J2**	**B4J1JP1**
	50.8 (2)	240	500	2.9 (19)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB4J2A1**	**B4J2AP1**
	63.5 (2½)	240	1000	5.4 (35)	1	THINBAND–All LA Options, except A or L	0.45 (1.0)	Stock	**STB4J2J1**	**B4J2JC1**
	76.2 (3)	240	1200	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.58 (1.2)	Stock	**STB4J3A26**	–
120.7 (4¾)	38.1 (1½)	240	600	4.5 (29)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB4N1J1**	–
	38.1 (1½)	480	600	4.5 (29)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB4N1J2**	–
	38.1 (1½)	240	650	4.8 (31)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB4N1J3**	**B4N1JP2**
	50.8 (2)	240	800	4.5 (29)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB4N2A11**	–
	50.8 (2)	480	800	4.5 (29)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB4N2A12**	–
	76.2 (3)	240	1100	4.1 (26)	1	THINBAND–All LA Options, except A or L	0.64 (1.4)	Stock	**STB4N3A12**	–
	76.2 (3)	480	1100	4.1 (26)	1	THINBAND–All LA Options, except A or L	0.64 (1.4)	Stock	**STB4N3A13**	–
123.8 (4⅞)	38.1 (1½)	240	900	6.5 (42)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB4R1J1**	**B4R1JP1**
	50.8 (2)	240	650	3.6 (23)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB4R2A1**	**B4R2AP1**
	50.8 (2)	240/480	760	4.3 (28)	2	Mica Band–Post (2 on 1)	0.41 (0.9)	Stock	**B4R2AR1**	–
	50.8 (2)	240	760	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB4R2A2**	–
	50.8 (2)	480	760	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB4R2A3**	–
127.0 (5)	38.1 (1½)	240	700	5.0 (32)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB5A1J1**	**B5A1JP1/2**
	38.1 (1½)	240	900	6.4 (41)	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB5A1J2**	**B5A1JP3**
	50.8 (2)	240	900	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB5A2A27**	–
	50.8 (2)	480	900	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB5A2A28**	–
	76.2 (3)	240	850	3.1 (20)	1	THINBAND–All LA Options, except A or L	0.64 (1.4)	Stock	**STB5A3A5**	**B5A3AP1**
	82.6(3.25)	240	1250	4.0 (26)	1	THINBAND–All LA Options, except A or L	0.68 (1.5)	Stock	**STB5A3E1**	**B5A3ER1**
130.2 (5⅛)	38.1 (1½)	240	900	6.5 (42)①	1	THINBAND–All LA Options, except A or L	0.32 (0.7)	Stock	**STB5C1J2**	**B5C1JP1**
133.4 (5¼)	25.4 (1)	240	500	5.1 (33)	1	Mica Band–72 in. (Type C-180° from ⅜ in. gap)	0.32 (0.7)	Stock	**B5E1AC1**	–
	38.1 (1½)	240/480	600	4.6 (30)	2	Mica Band–Post Terminals Only w/Strap	0.36 (0.8)	Stock	**B5E1JP2**	–
	38.1 (1½)	240	600	4.0 (26)	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB5E1J1**	**B5E1JP1**
	38.1 (1½)	480	600	6.7 (43)①	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB5E1J5**	–
	38.1 (1½)	240	1000	6.7 (43)①	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB5E1J2**	**B5E1JP3**
	50.8 (2)	240	1000	5.1 (33)①	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB5E2A1**	**B5E2AP1**
	76.2 (3)	240	1200	4.08 (26)		THINBAND–All LA Options, except A or L	0.64 (1.4)	Stock	**STB5E3A14**	–
	76.2 (3)	480	1200	4.08 (26)	1	THINBAND–All LA Options, except A or L	0.64 (1.4)	Stock	**STB5E3A15**	–
139.7 (5½)	38.1 (1½)	240	800	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB5J1J1**	**B5J1JP1/2**
	38.1 (1½)	240	900	5.7 (37)	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB5J1J2**	**B5J1JP3**
	50.8 (2)	240	1000	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB5J2A23**	–
	50.8 (2)	480	1000	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB5J2A24**	–
	76.2 (3)	240	1500	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.72 (1.6)	Stock	**STB5J3A19**	–
	76.2 (3)	480	1500	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.72 (1.6)	Stock	**STB5J3A20**	–
146.0 (5¾)	38.1 (1½)	240	750	4.47 (29)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB5N1J17**	–
	38.1 (1½)	480	750	4.47 (29)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB5N1J18**	–

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① Watt density is above Watlow recommendations at some common molding temperatures.

Barrel Heaters

THINBAND Mica

Stock Product List

I.D. mm (in.)	Width mm (in.)	Volts	Watts	Watt Density W/cm² (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg (lbs)	Avail.	Code No.	Former Code No.
146.0 (5¾)	50.8 (2)	240	1000	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.46 (1.0)	Stock	**STB5N2A5**	–
	50.8 (2)	480	1000	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.46 (1.0)	Stock	**STB5N2A6**	–
	76.2 (3)	240	1500	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB5N3A8**	–
	76.2 (3)	480	1500	4.65 (30)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB5N3A9**	–
152.4 (6)	34.9 (1⅜)	120/240	950	6.7 (43)①	2	Mica Band–Post Terminals Only w/Strap	0.41 (0.9)	Stock	**B6A1GP1**	–
	38.1 (1½)	240	600	3.4 (22)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB6A1J1**	**B6A1JP1**
	38.1 (1½)	240	850	5.0 (32)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB6A1J2**	**B6A1JP2/3**
	38.1 (1½)	240	1000	5.7 (37)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB6A1J3**	**B6A1JP4**
	50.8 (2)	240	1000	4.31 (28)	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB6A2A36**	–
	50.8 (2)	480	1000	4.31 (28)	1	THINBAND–All LA Options, except A or L	0.36 (0.8)	Stock	**STB6A2A37**	–
	38.1 (2½)	240	1450	5.3 (34)	1	THINBAND–All LA Options, except A or L	0.68 (1.5)	Stock	**STB6A2J3**	**B6A2JP1**
	76.2 (3)	240/480	1400	4.2 (27)	2	Mica Band–Post (2 on 1)	0.73 (1.6)	Stock	**B6A3AR1**	–
	76.2 (3)	240	1400	4.0 (26)	1	THINBAND–All LA Options, except A or L	0.73 (1.6)	Stock	**STB6A3A1**	–
	76.2 (3)	480	1400	4.0 (26)	1	THINBAND–All LA Options, except A or L	0.73 (1.6)	Stock	**STB6A3A2**	–
158.8 (6¼)	38.1 (1½)	240	850	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB6E1J10**	–
	38.1 (1½)	480	850	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB6E1J11**	–
	50.8 (2)	240	1000	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.46 (1.0)	Stock	**STB6E2A5**	–
	50.8 (2)	480	1000	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.46 (1.0)	Stock	**STB6E2A6**	–
	76.2 (3)	240/480	1500	4.5 (29)	2	Mica Band–Post (2 on 1)	0.82 (1.8)	Stock	**B6E3AR1**	–
	76.2 (3)	240	1500	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB6E3A1**	–
	76.2 (3)	480	1500	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB6E3A2**	–
160.3 (6⅜)	76.2 (3)	240/480	1250	3.9 (25)	2	Mica Band–Post Terminals Only w/Strap	0.82 (1.8)	Stock	**B6F3AP1**	–
	76.2 (3)	240	1250	3.4 (22)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB6F3A1**	–
	76.2 (3)	480	1250	3.4 (22)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB6F3A2**	–
165.1 (6½)	38.1 (1½)	240	900	4.8 (31)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB6J1J1**	**B6J1JP1/2**
	38.1 (1½)	240	950	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.41 (0.9)	Stock	**STB6J1J2**	**B6J1P3**
	50.8 (2)	240	1000	3.9 (26)	1	THINBAND–All LA Options, except A or L	0.54 (1.2)	Stock	**STB6J2A1**	**B6J2AP1**
	76.2 (3)	240	1400	3.7 (24)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB6J3A13**	–
	76.2 (3)	480	1400	3.7 (24)	1	THINBAND–All LA Options, except A or L	0.82 (1.8)	Stock	**STB6J3A14**	–
168.3 (6⅝)	114.3 (4½)	240	2300	4.0 (26)	1	THINBAND–All LA Options, except A or L	1.27 (2.8)	Stock	**STB6L4J1**	**B6L4JR1**
171.5 (6¾)	38.1 (1½)	240	1000	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.45 (1.0)	Stock	**STB6N1J1**	**B6N1JP2**
	38.1 (1½)	240	750	3.9 (25)	1	THINBAND–All LA Options, except A or L	0.45 (1.0)	Stock	**STB6N1J2**	**B6N1JP1**
	38.1 (1½)	240	1150	5.9 (38)	1	THINBAND–All LA Options, except A or L	0.45 (1.0)	Stock	**STB6N1J3**	**B6N1JP3**
	50.8 (2)	240	1300	5.0 (32)	1	THINBAND–All LA Options, except A or L	0.59 (1.3)	Stock	**STB6N2A1**	**B6N2AP1/2**
	76.2 (3)	240	2000	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.90 (2.0)	Stock	**STB6N3A7**	–
	76.2 (3)	480	2000	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.90 (2.0)	Stock	**STB6N3A8**	–
177.8 (7)	38.1 (1½)	240	950	4.6 (30)	1	THINBAND–All LA Options, except A or L	0.45 (1.0)	Stock	**STB7A1J1**	**B7A1JP1**
	38.1 (1½)	240	1100	5.4 (35)	1	THINBAND–All LA Options, except A or L	0.45 (1.0)	Stock	**STB7A1J2**	**B7A1JP2**
	50.8 (2)	240	1100	4.1 (26)	1	THINBAND–All LA Options, except A or L	0.59 (1.3)	Stock	**STB7A2A16**	–
	50.8 (2)	480	1100	4.1 (26)	1	THINBAND–All LA Options, except A or L	0.59 (1.3)	Stock	**STB7A2A17**	–
	76.2 (3)	230/460	1650	4.3 (28)	2	Mica Band–Post (2 on 1)	0.91 (2.0)	Stock	**B7A3AR1**	–
	76.2 (3)	230	1650	4.0 (26)	1	THINBAND–All LA Options, except A or L	0.91 (2.0)	Stock	**STB7A3A1**	–
	76.2 (3)	460	1650	4.0 (26)	1	THINBAND–All LA Options, except A or L	0.91 (2.0)	Stock	**STB7A3A2**	–

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① Watt density is above Watlow recommendations at some common molding temperatures.

Barrel Heaters

THINBAND Mica

Stock Product List

I.D. mm (in.)	Width mm (in.)	Volts	Watts	Watt Density W/cm² (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg (lbs)	Avail.	Code No.	Former Code No.
196.8 (7¼)	38.1 (1½)	240	1000	4.2 (30)	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB7E1J9**	–
	38.1 (1½)	480	1000	4.2 (30)	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB7E1J10**	–
	50.8 (2)	240	1200	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.65 (1.5)	Stock	**STB7E2A10**	–
	50.8 (2)	480	1200	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.65 (1.5)	Stock	**STB7E2A11**	–
	76.2 (3)	240	1800	4.2 (27)	1	THINBAND–All LA Options, except A or L	1.00 (2.2)	Stock	**STB7E3A3**	–
	76.2 (3)	480	1800	4.2 (27)	1	THINBAND–All LA Options, except A or L	1.00 (2.2)	Stock	**STB7E3A4**	–
190.5 (7½)	25.4 (1)	120/240	700	5.4 (35)	2	Mica Band–Post Terminals Only w/Strap	0.45 (1.0)	Stock	**B7J1AP1**	–
	38.1 (1½)	240	1000	4.6 (30)	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB7J1J1**	**B7J1JP1**
	38.1 (1½)	240	1200	5.4 (35)	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB7J1J2**	**B7J1JP2**
	50.8 (2)	240	1200	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.90 (2.0)	Stock	**STB7J2A13**	–
	50.8 (2)	480	1200	4.2 (27)	1	THINBAND–All LA Options, except A or L	0.90 (2.0)	Stock	**STB7J2A14**	–
	76.2 (3)	240/480	1800	4.3 (28)	2	Mica Band–Post (2 on 1)	1.08 (2.4)	Stock	**B7J3AR1**	–
	76.2 (3)	240	1800	4.2 (27)	1	THINBAND–All LA Options, except A or L	1.08 (2.4)	Stock	**STB7J3A1**	–
	76.2 (3)	480	1800	4.2 (27)	1	THINBAND–All LA Options, except A or L	1.08 (2.4)	Stock	**STB7J3A2**	–
196.8 (7¾)	38.1 (1½)	240	1000	4.5 (29)	1	THINBAND–All LA Options, except A or L	0.58 (1.2)	Stock	**STB7N1J10**	–
	38.1 (1½)	480	1000	4.5 (29)	1	THINBAND–All LA Options, except A or L	0.58 (1.2)	Stock	**STB7N1J11**	–
	50.8 (2)	240	1300	4.4 (28)	1	THINBAND–All LA Options, except A or L	0.95 (2.1)	Stock	**STB7N2A2**	–
	50.8 (2)	480	1300	4.4 (28)	1	THINBAND–All LA Options, except A or L	0.95 (2.1)	Stock	**STB7N2A3**	–
	76.2 (3)	240	2000	4.5 (29)	1	THINBAND–All LA Options, except A or L	1.10 (2.3)	Stock	**STB7N3A22**	–
	76.2 (3)	480	2000	4.5 (29)	1	THINBAND–All LA Options, except A or L	1.10 (2.3)	Stock	**STB7N3A23**	–
203.2 (8)	38.1 (1½)	240	950	4.0 (26)	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB8A1J1**	**B8A1JP1**
	38.1 (1½)	240/480	1200	5.6 (36)	2	Mica Band–Post Terminals Only w/Strap	0.50 (1.1)	Stock	**B8A1JP3**	–
	38.1 (1½)	240	1200	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB8A1J2**	**B8A1JP2**
	38.1 (1½)	480	1200	5.1 (33)	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB8A1J3**	–
	38.1 (1½)	240	1400	6.0 (39)①	1	THINBAND–All LA Options, except A or L	0.50 (1.1)	Stock	**STB8A1J4**	**B8A1JP4**
	50.8 (2)	240	1500	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.65 (1.5)	Stock	**STB8A2A20**	–
	50.8 (2)	480	1500	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.65 (1.5)	Stock	**STB8A2A21**	–
	76.2 (3)	240/480	2250	5.1 (33)	2	Mica Band–Post (2 on 1)	1.18 (2.6)	Stock	**B8A3AR1**	–
	76.2 (3)	240	2250	4.8 (31)	1	THINBAND–All LA Options, except A or L	1.18 (2.6)	Stock	**STB8A3A1**	–
	76.2 (3)	480	2250	4.8 (31)	1	THINBAND–All LA Options, except A or L	1.18 (2.6)	Stock	**STB8A3A2**	–
209.6 (8¼)	38.1 (1½)	240	1100	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.58 (1.2)	Stock	**STB8E1J5**	–
	38.1 (1½)	480	1100	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.58 (1.2)	Stock	**STB8E1J6**	–
	50.8 (2)	240	1500	4.7 (30)	1	THINBAND–All LA Options, except A or L	1.10 (2.3)	Stock	**STB8E2A8**	–
	50.8 (2)	480	1500	4.7 (30)	1	THINBAND–All LA Options, except A or L	1.10 (2.3)	Stock	**STB8E2A9**	–
	76.2 (3)	240	2000	4.2 (27)	1	THINBAND–All LA Options, except A or L	1.25 (2.6)	Stock	**STB8E3A10**	–
	76.2 (3)	480	2000	4.2 (27)	1	THINBAND–All LA Options, except A or L	1.25 (2.6)	Stock	**STB8E3A11**	–
	101.6 (4)	240/480	3000	4.8 (31)	2	Mica Band–Post Terminals Only w/Strap	1.36 (3.0)	Stock	**B8E4AP1**	–
	101.6 (4)	240	3000	4.6 (30)	1	THINBAND–All LA Options, except A or L	1.36 (3.0)	Stock	**STB8E4A1**	–
	101.6 (4)	480	3000	4.6 (30)	1	THINBAND–All LA Options, except A or L	1.36 (3.0)	Stock	**STB8E4A2**	–
215.9 (8½)	38.1 (1½)	240	1200	4.8 (31)	1	THINBAND–All LA Options, except A or L	0.55 (1.2)	Stock	**STB8J1J1**	**B8JIJP1**
	38.1 (1½)	480	1200	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.55 (1.2)	Stock	**STB8J1J21**	–
	50.8 (2)	240	1600	4.8 (31)	1	THINBAND–All LA Options, except A or L	0.73 (1.6)	Stock	**STB8J2A1**	**B8J2AP1**
	50.8 (2)	480	1600	4.7 (30)	1	THINBAND–All LA Options, except A or L	0.73 (1.6)	Stock	**STB8J2A12**	–
	76.2 (3)	240	2500	5.0 (32)	1	THINBAND-Post Terminals Only	1.10 (2.4)	Stock	**STB8J3A14**	–

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① Watt density is above Watlow recommendations at some common molding temperatures.

Barrel Heaters

THINBAND Mica

Stock Product List

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.	Former Code No.
215.9	(8½)	76.2	(3)	480	2500	5.0	(32)	1	THINBAND–All LA Options, except A or L	1.10	(2.4)	Stock	**STB8J3A15**	–
222.3	(8¾)	38.1	(1½)	240	1200	4.7	(30)	1	THINBAND–All LA Options, except A or L	0.61	(1.3)	Stock	**STB8N1J10**	–
		38.1	(1½)	480	1200	4.7	(30)	1	THINBAND–All LA Options, except A or L	0.61	(1.3)	Stock	**STB8N1J11**	–
		50.8	(2)	240	1600	4.7	(30)	1	THINBAND–All LA Options, except A or L	0.68	(1.5)	Stock	**STB8N2A10**	–
		50.8	(2)	480	1600	4.7	(30)	1	THINBAND–All LA Options, except A or L	0.68	(1.5)	Stock	**STB8N2A11**	–
		76.2	(3)	240/480	2000	4.2	(27)	2	Mica Band–Post (2 on 1)	1.22	(2.7)	Stock	**B8N3AR1**	–
		76.2	(3)	240	2000	3.9	(25)	1	THINBAND–All LA Options, except A or L	1.22	(2.7)	Stock	**STB8N3A1**	–
		76.2	(3)	480	2000	3.9	(25)	1	THINBAND–All LA Options, except A or L	1.22	(2.7)	Stock	**STB8N3A2**	–
228.6	(9)	38.1	(1½)	240	1300	5.0	(32)	1	THINBAND–All LA Options, except A or L	0.59	(1.3)	Stock	**STB9A1J1**	**B9A1JP1**
		38.1	(1½)	240/480	1500	6.2	(40)①	2	Mica Band–Post Terminals Only w/Strap	0.59	(1.3)	Stock	**B9A1JP3**	–
		38.1	(1½)	240	1500	5.7	(37)①	1	THINBAND–All LA Options, except A or L	0.59	(1.3)	Stock	**STB9A1J2**	**B9A1JP2**
		38.1	(1½)	480	1500	5.7	(37)①	1	THINBAND–All LA Options, except A or L	0.59	(1.3)	Stock	**STB9A1J3**	–
		50.8	(2)	240	1800	5.1	(33)	1	THINBAND–All LA Options, except A or L	0.68	(1.5)	Stock	**STB9A2A1**	**B9A2AP1**
		50.8	(2)	480	1800	5.1	(33)	1	THINBAND–All LA Options, except A or L	0.68	(1.5)	Stock	**STB9A2A20**	–
		76.2	(3)	240	2500	4.7	(30)	1	THINBAND-Post Terminals Only	1.18	(2.6)	Stock	**STB9A3A18**	–
		76.2	(3)	480	2500	4.7	(30)	1	THINBAND–All LA Options, except A or L	1.18	(2.6)	Stock	**STB9A3A19**	–
244.3	(9½)	50.8	(2)	240	1800	5.0	(32)	1	THINBAND–All LA Options, except A or L	0.77	(1.7)	Stock	**STB9J2A1**	**B9J2AP1**
		76.2	(3)	240/480	2000	3.7	(24)	2	Mica Band-Post (2 on 1)	1.27	(2.8)	Stock	**B9J3AR1**	–
		76.2	(3)	240	2000	3.6	(23)	1	THINBAND–All LA Options, except A or L	1.27	(2.8)	Stock	**STB9J3A1**	–
		76.2	(3)	480	2000	3.6	(23)	1	THINBAND–All LA Options, except A or L	1.27	(2.8)	Stock	**STB9J3A2**	–
244.5	(9⅝)	76.2	(3)	240/480	3000		(37)	2	Mica Band–Post Terminals Only w/Strap	1.22	(2.7)	Stock	**B9L3AP2**	–
		76.2	(3)	480	3000	5.3	(34)	1	THINBAND–All LA Options, except A or L	1.27	(2.8)	Stock	**STB9L3A4**	–
247.7	(9¾)	50.8	(2)	240	2000	5.3	(34)	1	THINBAND–All LA Options, except A or L	0.86	(1.9)	Stock	**STB9N2A1**	**B9N2AP1**
254.0	(10)	38.1	(1½)	240	1400	4.8	(31)	1	THINBAND–All LA Options, except A or L	0.68	(1.5)	Stock	**STB10A1J1**	**B10A1JP1**
260.4	(10¼)	101.6	(4)	240/480	3000	3.9	(25)	2	Mica Band–Post Terminals Only w/Strap	1.77	(3.9)	Stock	**B10E4AP1**	–
279.4	(11)	38.1	(1½)	240	1600	5.0	(32)	1	THINBAND–All LA Options, except A or L	0.77	(1.7)	Stock	**STB11A1J1**	**B11A1JP1**
		50.8	(2)	240	2000	4.6	(30)	1	THINBAND–All LA Options, except A or L	0.95	(2.1)	Stock	**STB11A2A1**	**B11A2AP1**
304.8	(12)	50.8	(2)	240/480	2300	5.1	(33)	2	Mica Band–Post Terminals Only w/Strap	1.04	(2.3)	Stock	**B12A2AP2**	–

① Watt density is above Watlow recommendations at some common molding temperatures.

How to Order

To order stock THINBAND or standard mica barrel, specify:

- Watlow code number
- Termination type(s)
- Lead lengths
- Quantity

Note:

- Post terminals are provided unless otherwise specified.
- On Types A, L and K, 305 mm (12 in.) in lead length will be supplied unless otherwise specified.
- On Types E, C, F and H, 356 mm (14 in.) in lead length will be supplied unless otherwise specified.
- On Types A, E, C, F and H, leads will be 51 mm (2 in.) longer than the protective covering unless otherwise specified.
- All LA termination options will be 180 degrees from the gap unless otherwise specified.

  Stock LA termination options can only be supplied with LA termination 180 degrees from the gap.
- For THINBAND heaters higher than 8.5 amps, consult Watlow.

Availability

- **Stock:** Same day shipment
- **Made-to-Order:** If our stock units do not meet your application needs, Watlow can manufacture to your special requirements. Please consult your sales engineer or authorized distributor for price and delivery of made-to-order items.

Barrel Heaters

OEM Cross Reference For Barrel Heaters

Cincinnati Milacron

Cincinnati Milacron Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
326330	**ME5A1JP10**	5	1 ½	240/480	580	Post
326331	**ME6J1JP6**	6 ½	1 ½	240/480	1000	Post
326332	**ME7J1JP5**	7 ½	1 ½	240/480	900	Post
326333	**ME8A1JP8**	8	1 ½	240/480	1000	Post
326335	**ME10A1JP1**	10	1 ½	240/480	1200	Post
326336	**ME11A1JP2**	11	1 ½	240/480	1480	Post
326338①	**ME8A1JP9**	8	1 ½	240/480	800	Post
326340	**ME9A1JP9**	9	1 ½	240/480	1100	Post
326341	**ME9J1JP6**	9 ½	1 ½	240/480	1000	Post
326342	**ME13A1JP4**	13	1 ½	240/480	1400	Post
326344	**ME14J1JP2**	14 ½	1 ½	240/480	1480	Post
326346	**ME5A1JP11**	5	1 ½	240/480	770	Post
326347	**ME7A1JP6**	7	1 ½	240/480	1000	Post
3901993①	**B1J4AX2**	1 ½	4	120	500	51 in. dual SS braided leads
3953682	**ME5J1JP6**	5 ½	1 ½	240/480	600	Post
3961105	**ME12A1JP1**	12	1 ½	240/480	1480	Post
3994402	**B5R5EX1**	5 ⅞	5 ¼	240/480	2350	Post
3994523	**B7J7EX2**	7 ½	7 ¼	240/480	5000	Post
5021019	**B9H2AX1**	9 7/16	2	240/480	1700	Post
5021021	**B8B4AX1**	8 1/16	4	240/480	2100	Post
5021022①	**B8B9EX1**	8 1/16	9 ¼	240/480	4900	Post
5021232	**B11P2AX1**	11 13/16	2	240/480	2200	Post
5021233	**B11P3JX1**	11 13/16	3 ½	240/480	3900	Post
5021234	**B8H3JX1**	8 7/16	3 ½	240/480	2800	Post
5021428①	**B4S2GX2**	4 15/16	2 ⅜	240/480	1200	Post
5022010	**B6J5JX2**	6 ½	5 ½	240/480	3000	Post
5022015	**B5J4JX1**	5 ½	4 ½	240/480	1700	Post
5024377	**B10H2AX1**	10 7/16	2	240/480	2000	Post
5024378	**B10H3JX1**	10 7/16	3 ½	240/480	3300	Post
5024379	**B8H5JX1**	8 7/16	5 ½	240/480	3800	Post
5025500	**B5J4JX2**	5 ½	4 ½	240/480	2500	Post
5027465①	**B13A2JX6**	13	2 ½	240/480	3000	Post
5027466	**B13A4NX1**	13	4 ¾	240/480	5000	Post
5033192	**ME13A2JP1**	13	2 ½	240/480	3000	Post
5033194	**ME9H4AP1**	9 7/16	4	240/480	4000	Post
5034485	**ME9H3AP2**	9 7/16	3	240/480	2400	Post
5034486	**ME9H2AP2**	9 7/16	2	240/480	1600	Post
5034487	**ME8B3AP1**	8 1/16	3	240/480	2000	Post
5035117	**ME8B4AP1**	8 1/16	4	240/480	2650	Post
5035761	**ME11A4AP1**	11	4	230/460	3500	Post

CONTINUED

① Available in limited quantities. Contact the factory for delivery information.

Barrel Heaters

OEM Cross Reference For Barrel Heaters

Cincinnati Milacron

Cincinnati Milacron Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
5038858	**ME5R5AP3**	5 7/8	5	240/480	2350	Post
5039028	**ME8H5AP1**	8 7/16	5	240/480	3250	Post
5039197	**ME6J5AP1**	6 1/2	5	240/480	3000	Post
5039239	**ME7J3AP2**	7 1/2	3	240/480	2325	Post
5039247①	**ME9H3AP3**	9 7/16	3	240/480	2300	Post

HPM/New Britain

HPM/ New Britain Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
146-503	**B2E0RA1C**	2 1/4	7/8	120	215	60 in. dual SS braided leads
155-1187	**B4S2AH1A**	4 15/16	2	240/480	800	18 in. flexible hose and leads
155-1188	**B4S3AH2B**	4 15/16	3	240/480	1200	20 in. flexible hose and leads
155-730	**B4R5AH1A**	4 7/8	5	240/480	1520	36 in. flexible hose and leads
155-731	**B4R10AH1B**	4 7/8	10	240/480	2250	44 in. flexible hose and leads
155-732	**B4R4SH1A**	4 7/8	4 15/16	240/480	1100	48 in. flexible hose and leads
220-1532	**B6N2EH1A**	6 3/4	2 1/4	240/480	1200	48 in. flexible hose and leads
300-1512	**B8E3AH1A**	8 1/4	3	240/480	1950	49 in. flexible hose and leads
300-1513	**B8E5NH5A**	8 1/4	5 3/4	240/480	3750	49 in. flexible hose and leads
300-1514	**B5E2AH2A**	5 1/4	2	240/480	850	49 in. flexible hose and leads
375-0042	**B6N4NH1A**	6 3/4	4 3/4	240/480	2500	48 in. flexible hose and leads
C2-008-490A	**B4S4AH1B**	4 15/16	4	240/480	1500	48 in. flexible hose and leads
C2-008-491A	**B4S3AH2**	4 15/16	3	240/480	1200	48 in. flexible hose and leads
C63-3142	**B4E2NH1B**	4 1/4	2 3/4	240/480	950	43 in. flexible hose and leads
EA2005730	**B1A1NA1A**	1	1 3/4	120	230	60 in. dual SS braided leads

CONTINUED

① Available in limited quantities. Contact the factory for delivery information.

Barrel Heaters

OEM Cross Reference For Barrel Heaters

HPM/New Britain

HPM/ New Britain Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
EA2201532	**B6N2EH1A**	6 ¾	2 ¼	240/480	1200	48 in. flexible hose and leads
EA2201600	**B3N1JH1A**	3 ¾	1 ½	480	400	48 in. flexible hose and leads
EA3001512	**B8E3AH1A**	8 ¼	3	240/480	1950	49 in. flexible hose and leads
EA3001513	**B8E5NH5A**	8 ¼	5 ¾	240/480	3750	49 in. flexible hose and leads
EA3001514	**B5E2AH2A**	5 ¼	2	240/480	850	49 in. flexible hose and leads
EA3750042	**B6N4NH1A**	6 ¾	4 ¾	240/480	2500	48 in. flexible hose and leads
EC1460403	**B2E0RA1C**	2 ¼	⅞	120	215	60 in. dual SS braided leads
EC1463096	**B4E2NH2A**	4 ¼	2 ¾	240/480	950	36 in. flexible hose and leads
EC1550732	**B4R4SH1A**	4 ⅞	4 15/16	240/480	1100	48 in. flexible hose and leads
EC2008490	**B4S4AH1H**	4 15/16	4	240/480	1500	82 in. leads/72 in. flexible hose
EC2008491A①	**B4S3AH2G**	4 15/16	3	240/480	1200	82 in. leads/72 in. flexible hose

① Available in limited quantities. Contact the factory for delivery information.

Mitsubishi

Mitsubishi Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
US207060T	**STB5J5A8-T**	5 ½	5	240	1900	Post
US207060W	**STB6A5J3-T**	6	5 ½	240	2400	Post
US207099C	**STB2C1A7-XX7**	2 ⅛	1	220	250	74 in. dual SS braided leads
US207101M	**STB5A5J1-T**	5	5 ½	240	2000	Post
US207159R	**STB5A2G1-T**	5	2 ⅜	240	950	Post

Natco

Natco Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
CR12202-1	**B7B3JP1**	7 1/16	3 ½	240/480	1200	Post
CR12202-2	**B7B3JP2**	7 1/16	3 ½	240/480	1650	Post
CR12202-5	**B6F3AP1**	6 5/16	3	240/480	1250	Post
CR12202-10	**B12J4AP1**	12 ½	4	240/480	3000	Post
CR12202-11	**B12J3JP2**	12 ½	3 ½	240/480	3000	Post
CR12202-13	**B9L3AP2**	9 ⅝	3	240/480	2000	Post
CR12202-16	**B8E4AP1**	8 ¼	4	240/480	3000	Post
CR12202-18	**B10E4AP1**	10 ¼	4	240/480	3000	Post

Barrel Heaters

OEM Cross Reference For Barrel Heaters

Nissei

Nissei Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
8H1601107-51	**B06F04FE-268**	6 5/16	4 5/16	230/460	1800	60 in. single SS braided leads
8H0300451-04	**B01D01NB-276**	1 3/16	1 3/4	220	170	36 in. single SS braided leads
8H0500501-02	**B01S01SE-275**	1 15/16	1 15/16	220	320	84 in. single SS braided leads
8H1000701-51	**B03S02NE-273**	3 15/16	2 3/4	220	720	96 in. single SS braided leads
8H1061807-51	**B04C07BE-271**	4 1/8	7 1/16	230/460	2000	36 in. single SS braided leads
8H1200687-53	**B04N02ME-270**	4 3/4	2 1/16	230/460	900	48 in. single SS braided leads

Reed

Reed Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
RC-159088-C	**B1N2AG2**	1 3/4	2	240	300	144 in. fiberglass leads
RC-159088-D	**B1N2AG1**	1 3/4	2	480	300	144 in. fiberglass leads
RC-159089-L	**B7J3AG2**	7 1/2	3	480	1400	144 in. fiberglass leads
RD-128613	**B6A3AR1**	6	3	230/460	1400	Post
RD-129890	**B4R2AR1**	4 7/8	2	240/480	760	Post
RD-132322	**B7A3AR1**	7	3	230/460	1650	Post
RD-158900-B	**B5A3AX1**	5	3	240/480	1200	Post
RD-159337-B	**B6J2JX1**	6 1/2	2 1/2	240/480	1200	Post
ZE-600475-FD	**B4N3AX1**	4 3/4	3	240/480	1100	Post
ZE-600600-FF	**B6A3AX9**	6	3	240/480	1400	Post
ZE-600700-FG	**B7A3AX1C**	7	3	240/480	1650	Post
ZE-600800-FJ	**B8A3AX6**	8	3	240/480	1900	Post
ZE-600875-FK①	**B8N3AX6**	8 3/4	3	240/480	2000	Post

① Available in limited quantities. Contact the factory for delivery information.

Barrel Heaters

OEM Cross Reference For Barrel Heaters

Toshiba

Toshiba Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
316M3602	**B04F04PX-291**	4 5/16	4 13/16	240/480	1830	Post
333M0003	**B06F04JR-289**	6 5/16	4 1/2	480	2430	Post
333M0005	**B12D03GR-287**	12 3/16	3 7/8	240/480	3500	Post
333M0008	**B06J03CR-286**	6 1/2	3 1/8	480	1740	Post
333M0012①	**B06R04CR-284**	6 7/8	4 1/8	240/480	2420	Post
333M3903	**B06F04JR-289**	6 5/16	4 1/2	480	2430	Post
333M3905	**B12D03GR-287**	12 3/16	3 7/8	240/480	3500	Post
333M3908	**B06J03CR-286**	6 1/2	3 1/8	480	1740	Post
333M3912	**B06R04CR-284**	6 7/8	4 1/8	240/480	2420	Post
333M4001	**B08H02GP-283**	8 7/16	2 3/8	480	1700	Post
333M4002①	**B08M02KP-282**	8 1/16	2 9/16	240/480	1900	Post
333M4105①	**B04C02NC-279**	4 1/8	2 3/4	220	160	20 in. single SS braided leads
3382G6015	**B2D1GC1**	2 3/16	1 3/8	240	300	67 in. single SS braided leads
3383G017	**B3J3SP1**	3 1/2	3 15/16	240	1180	Post
3383G057	**B4F4AP1**	4 5/16	4	240	1500	Post
3383G058	**B4F3CP1**	4 5/16	3 1/8	240	1160	Post
3383G0812	**B4M5NP1**	4 1/16	5 3/4	240	2300	Post
3383G1207①	**B6F5MP1**	6 5/16	5 1/16	240	3000	Post
3383G129	**B6F6EP1**	6 5/16	6 1/4	240	3380	Post
347L50	**B3K3GP3**	3 9/16	3 3/8	240	955	Post
348L7102	**B1J1NC1**	1 1/2	1 3/4	240	320	39 in. single SS braided leads
348L7103	**B3C1GC1**	3 1/8	1 3/8	240	530	39 in. single SS braided leads
382G5107①	**B1D1DC1**	1 3/16	1 3/16	240	170	78 in. single SS braided leads
382G5603①	**B1S1AC2**	1 15/16	1	240	200	48 in. single SS braided leads
382G6008①	**B2C1AC5**	2 1/8	1	240	215	67 in. single SS braided leads
382G6009	**B2C1AC5B**	2 1/8	1	240	215	55 in. single SS braided leads
382G6102	**B2F1NC1**	2 5/16	1 3/4	240	500	86 in. single SS braided leads
382G6904	**B2G1GC1**	2 3/8	1 3/8	240	240	19 in. single SS braided leads
383G0101	**B3J3FP1**	3 1/2	3 5/16	240	910	Post
383G0502	**B4F3JP1**	4 5/16	3 1/2	240	1210	Post
383G0802	**STB4M4L1-T**	4 1/16	4 5/8	240	1760	Post
383G1101	**B6F2GR1**	6 5/16	2 3/8	480	1100	Post
383G1102①	**B6F2GR2**	6 5/16	2 3/8	240	1100	Post
383G1105	**B6F3JR1**	6 5/16	3 1/2	240	1600	Post
383G1203	**B6F6AP1**	6 5/16	6	240	3000	Post
383G1211	**B6F7FP1**	6 5/16	7 5/16	240	3900	Post
383G4505	**B6J4FR1**	6 1/2	4 5/16	240	2400	Post
383G4510①	**B11A8BR1**	11	8 1/16	240/240	6700	Post
383G4512	**B10A6RR1**	10	6 7/8	240/480	5500	Post
383G4515	**B8E5MR2**	8 1/4	5 1/16	240	4720	Post

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① Available in limited quantities. Contact the factory for delivery information.

Barrel Heaters

OEM Cross Reference For Barrel Heaters

Toshiba

Toshiba Code No.	Watlow Code No.	I.D. in.	Width in.	Volts	Watts	Termination
383G452	**B6R3KR1**	6 7/8	3 9/16	240/240	2100	Post
383G4601	**B8H2GP1**	8 7/16	2 3/8	240	1700	Post
383G4601	**B08H02GP-283**	8 7/16	2 3/8	480	1700	Post
383G4602	**B8M2KP1**	8 1/16	2 9/16	480	1900	Post
383G4602	**B08M02KP-282**	8 1/16	2 9/16	240/480	1900	Post
383G4603	**B10E2SP2**	10 1/4	2 15/16	240	2600	Post
383G4604	**B12D3FP1**	12 3/16	3 5/16	240	3500	Post
383G4605	**B14D4FP1**	14 3/16	4 5/16	240/240	5200	Post
383G4606	**B12P3SP2**	12 3/16	3 15/16	240	4300	Post
383G4701	**STB4F1K1-CX2**	4 5/16	1 9/16	240	401	20 in. single SS braided leads
39742592	**B9A2JX2**	9	2 1/2	240/480	1785	Post, dual voltage
44H21132W	**B1G0NA1**	1 3/8	3/4	240	85	40 in. dual SS braided leads
97680614	**B3J2NP1**	3 1/2	2 3/4	240	940	Post
9768371W①	**B5R6AP1**	5 7/8	6	240	2810	Post
98821109	**B2A1AA10**	2	1	240	180	47 in. dual SS braided leads
9882114W	**B2D1AA2**	2 3/16	1	240	200	78 in. dual SS braided leads

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Barrel Heaters

Problem Solvers

Watlow Solutions To Common Barrel Heater Problems

Torque Details for Barrel Heater Screws

If barrel heater clamp screws are snapping off during maintenance, screws are being tightened beyond their limits. Please reference chart to the right for installation information.

MI, THINBAND and Mica Clamp Torque Chart

	Nickel Plated, Dry Standard	Nickel Plated, Anti-Seize	Black Oxide, Dry	Black Oxide Anti-Seize
Clamp Screw Size	**Torque (in.-lb)**	**Torque (in.-lb)**	**Torque (in.-lb)**	**Torque (in.-lb)**
UNC #6-32	30	20	20	15
UNC #8-32	40	30	25	20
UNC #10-24	55	35	35	30
UNC 1/4-20	80	55	50	45
UNC 1/4-20 w/springs	40	40	N/A	N/A
M6-1	80	55	50	45
M5-0.8	60	40	35	35

Problem	Heater Solution
Heaters glow red on startup before reaching barrel set point.	1. Wiring Considerations: • If heaters are dual voltage, check wiring to ensure that heater halves are wired in series for higher voltage installation. • Check incoming voltage for over voltage condition. 2. Installation Considerations: • Since most heaters transfer heat through conduction, it is essential that heaters fit tightly to the machine barrel. Check installation instructions to ensure that heaters are clamped to torque values indicated. See MI, THINBAND and Mica Clamp Torque Chart above: • Ensure that dirt and grit are removed prior to installation. Any foreign matter under the heater will interfere with proper heat conduction. 3. Thermal Considerations: • Review application and clamping graphs to ensure heater watt density is not excessive. • Examine machine to evaluate thermal mass in a particular zone. High thermal mass can conduct heat away from zone being heated, driving up heater temperature as heater expands away from barrel.

Barrel Heaters

Problem Solvers

Watlow Solutions To Common Barrel Heater Problems

Problem	Heater Solution
Lead wires burn out prematurely.	• Ensure that lead wires have adequate insulation ratings for the temperature of the application. GGS leads are rated for 250°C (482°F) while MGT leads are rated at 450°C (232°F). • If thermal insulation is used, make sure to exit the leads away from the thermal insulation as close to the heater as possible. • If leads are touching the backside of heater, make sure there is adequate space for air circulation between the heater surface and lead wire. • Heater leads can self-heat and should be derated if amperage is at the limit of the lead wire and there is significant bundling in an enclosed channel. Check the derating table below.

Wire Ampacity Derating Based on Ambient Temperature

Ambient Temp ˚C	Wire Insulation Rating		Ambient Temp. ˚F
	250˚C	450˚C	
41-50	1.00	1.00	106-122
51-60	1.00	1.00	124-140
61-70	1.00	1.00	142-150
71-80	1.00	1.00	160-176
81-90	0.96	1.00	177-194
91-100	0.94	1.00	195-212
101-120	0.87	0.98	213-248
121-140	0.79	0.95	249-284
141-160	0.72	0.93	285-320
161-180	0.54	0.90	321-356
181-200	0.39	0.86	357-392
201-225	...	0.82	393-438
226-250	...	0.76	439-482
251-275	...	0.72	483-527
276-300	...	0.60	528-572
301-325	...	0.61	573-617
326-350	...	0.54	618-662
351-375	...	0.46	663-707
376-400	...	0.38	708-752

Barrel Heaters

Problem Solvers

Watlow Solutions To Common Barrel Heater Problems

Problem	Heater Solution
Machine has GFI protection and trips on machine startup.	Many mineral insulated barrel heaters can pick up moisture if they are not treated with a moisture retardant. This moisture will easily be driven out of an unsealed heater as it heats without causing damage. Check the machine GFI to see if it is adjustable to a higher but safe current leakage value setting to override until heaters dry out. This usually takes no more than a few minutes. If you know ahead of time that insulation resistance is low and nuisance GFI tripping can occur, heaters may be baked or dried at 121°C (250°F) for two to three hours. When GFIs are known to be required in advance, specify the Watlow Euro Norm or moisture resistant option at no additional cost. Note that Euro Norm construction refers to specifications required to pass the European standard EN-60204.
Controllability of plastics process. Processing temperature set point continually over shoots causing poor product quality. Part or all of this problem may be traced to heaters used in the process.	First, examine the type of barrel heating present and if the machine has insulation applied directly over the heaters to reduce heat loss from the machine. The following points influence temperature control and should be considered in barrel heating. • Heavy ceramic knuckle heaters with excessive insulation can lead to temperature control difficulties in some applications. As the barrel becomes more insulated, the control thermocouple can be satisfied by the shearing action of the screw which will generate sufficient British Thermal Units (BTUs) to melt the plastic resin. In some cases, there is no ability to cool the process as there typically is in extruder applications and the temperature of the process can over shoot. • When temperature over shoot is present, consider replacing the ceramic knuckle heater with a thermally efficient MI barrel. The MI has extremely good heat transfer characteristics and responds quickly to make up heat requirements. • Consider eliminating insulation that is directly on the heat source. As an alternate approach, install insulation inside the machine cover if space permits. This will maintain heat without applying insulation directly on the heater bands. If desired, a cover can be made in multiple sections which can be vented if over shoot occurs.

Barrel Heaters

Case History

DJ/Nypro Energy Assessment

Problem:

DJ/Nypro, a Louisville, Kentucky injection molder, needed to increase energy savings and reduce operational costs during production. The company used a 750-ton Toshiba injection molding machine and was seeking a more efficient heating solution than their current mica band heaters.

Solution:

Watlow's MI Band heaters provide exceptional heat transfer, high watt densities and prolonged heater life. To prove their efficiency, Watlow performed an energy assessment of the MI band heaters in comparison to DJ/Nypro's mica heaters. Both heaters received resistance tests to insure that they had the same volts and watts. For simplicity, calculations were based on a 24-hour-a-day, 7-day-a-week operation with an electricity cost of $0.0404 per kilowatt hour.

Testing:

Testing started with the mica bands already in place on the injection molding machine. Ten were installed on the barrel and three more were on the transition, not including the nozzle bands. The goal was to first analyze start-up time and temperature rise and then analyze energy usage during a normal run. Since the mold- an automobile sunroof- was new for the plant- figures were not established on the quantity of sunroofs produced in a normal run.

The thermocouples and controllers that were already installed on the barrel for barrel temperature monitoring were used in the testing procedures. A surface temperature probe measured the outside surface temperature of the mica and MI Bands. A power analyzer was used for voltage and consumption measurements. The analyzer was connected to the main power leads supplied to the Toshiba injection molding machine. The power analyzer continuously reads the input voltage and current and computes power factor and actual power used in a given time.

The power connections consisted of voltage taps on all three-phases plus a leakage indication on the center leg and a true ground determination from the plant ground. Portable coil transformers were used to determine current usage.

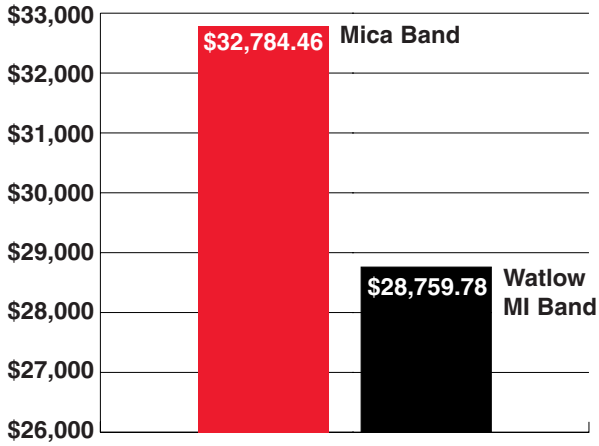
The first day of testing included running the part with an 80-second cycle time running at a barrel temperature of 280°C (540°F).

Results:

The test results showed 12.26 percent yearly energy savings with the use of Watlow's MI Band heaters over mica bands. Using this rate to calculate electricity usage (savings based on a 24-hour-a-day, seven-day-a-week, 52-weeks-per-year usage) the annual savings would be $4,024.68 at $0.0404 per kilowatt hour. Considering the cost of a new set of heaters, payback would be achieved in less than seven and a half months.

While the electrical savings are very significant, there are also very real long-term savings from downtime due to faulty heaters. DJ/Nypro also realized benefits from the simplified set up of the MI Band heaters that resulted in reduced down time.

Annual Machine Power Consumption



$3.7258 Mica cost/hr X 24 hrs/day X 7 days/wk X 52 wks/yr
= **$32,784.46 Mica Band Annual Electric Cost**

$3.2921 MI cost/hr X 24 hrs/day X 7 days/wk X 52 wks/yr
= **$28,759.78 MI Band Annual Electric Cost**

Watlow's MI Band heaters saved DJ/Nypro
$4,024.68 per year in power consumption.

Barrel Heaters

Case History

Bolt Heaters Help Attach Platens to Injection Molding Machine

Problem:

An original equipment manufacturer needed to heat the bolts used to hold platens in their injection molding machines. To effect proper tension, the 182 cm by 7.6 cm (6-foot by 3-in.) bolt and nuts needed to be quite tight.

Solution:

The manufacturer packaged Watlow FIREROD® bolt heaters with each injection molding machine. Correct torque was achieved by sliding the heaters through the middle of the bolts and heating them to 95°C (200°F). This elongated the bolts by as much as 12.5 mm (0.5 in.). When the nuts were turned tight and the heaters were removed, the bolts cooled and shrank, tightening even further.

Customers now benefit during initial set up as well as reassembly when the molds are changed out at the completion of production runs. The OEM credits the Watlow FIREROD bolt heaters with the increase in equipment sales.

Hot Runner Nozzle Heaters

Watlow's Family of Hot Runner Nozzle Heater Solutions

Watlow offers a full line of hot runner nozzle heaters for the plastics industry. While every Watlow heater has a unique set of capabilities, each Watlow hot runner nozzle heater is designed with the needs of plastics processors in mind. Whether you require high performance, high temperature, high watt density, or all of these, Watlow has the heater to best fit your application.

Watlow's family of hot runner nozzle heaters includes:

- Band heaters
- Cartridge heaters
- Coiled Cable heaters
- Easy Cable heaters
- K-RING® and mini K-RING heaters
- Thick Film heaters

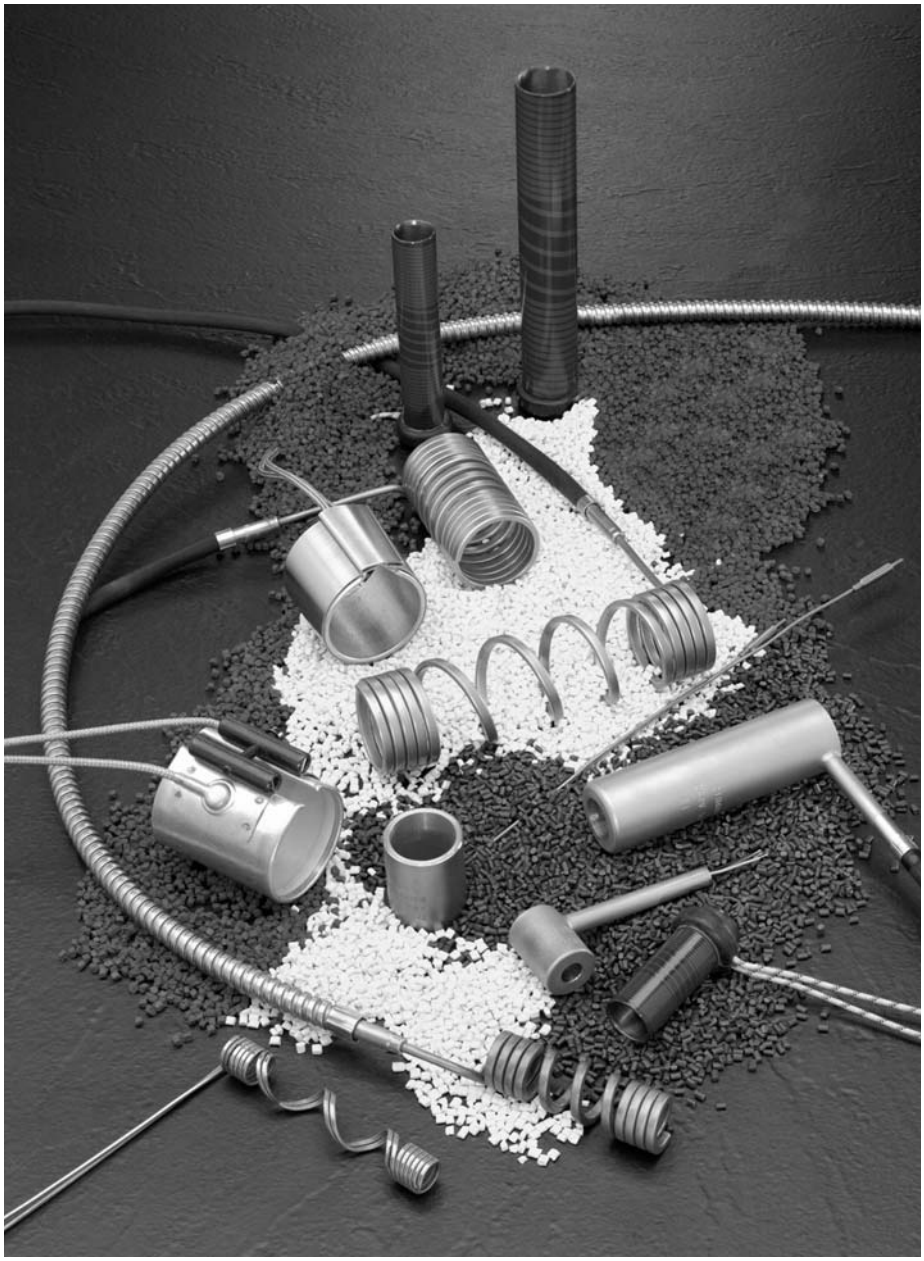
These nozzle heaters are ideally suited to meet the demands of today's new resins and provide a wide range of benefits including:

- Corrosion resistance
- Flexible designs ensuring easy installation and removal
- Moisture resistant designs

Terminations and Clamping Options

- **Termination Options**

  Watlow offers a large selection of termination styles providing the opportunity to customize the heater to a particular application for improved performance. Some termination choices include, but are not limited to, Post Terminals, Stainless Steel Braids, Flexible Lead Wire and Flexible Stainless Steel Hose.



- **Clamping Options**

  In addition to Watlow's selection of various termination styles, we also offer a variety of clamping options for nozzle bands. Some of these clamping options include, but are not limited to, Tig Welded Barrel Nuts, Low profile Clamp Bars, Clamping Pads and HV Wedge-Lok.

Applications

- Hot runner molds

For more information on Watlow's line of nozzle heaters, contact your local Watlow representative.

Hot Runner Nozzle Heaters

Coiled Cable

The versatile Watlow cable heater can be formed to a variety of shapes as dictated by its many applications. Cable heaters are small diameter, high performance units, fully annealed and readily bent to a multitude of configurations.

The heater can be formed into a compact coiled nozzle heater for use on plastic injection molding equipment supplying a full 360 degrees of heat with optional distributed wattage.

Different applications require different construction methods, including one, two, three or four resistance wires; parallel coil or straight wire; drawn or swaged sheaths; with or without internal thermocouples; leads exiting from one or both ends, and round, rectangular or square cable sheaths.

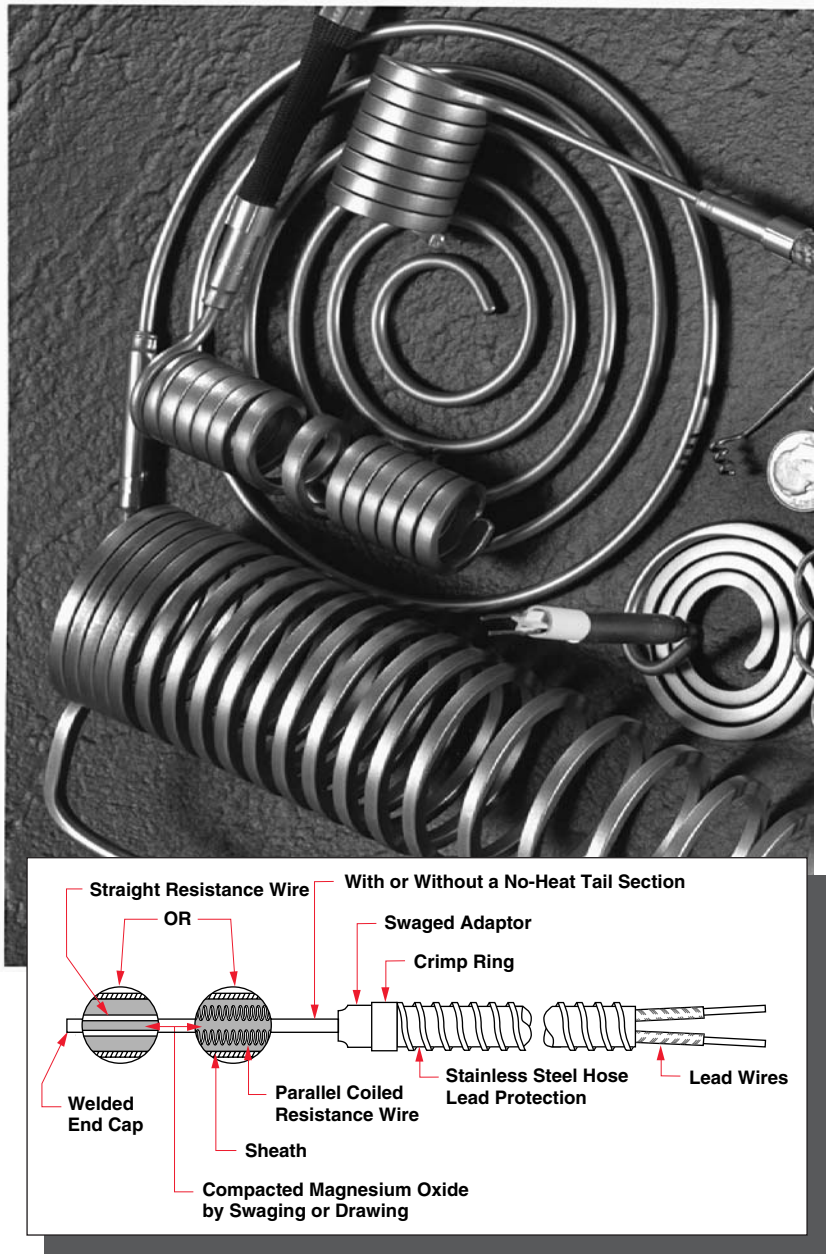
Whatever the application, the Watlow cable heater can be shaped to fit your application needs.

Performance Capabilities

- Continuous operating temperatures to 650°C (1200°F) with intermittent operating periods achieving up to 815°C (1500°F). Dependent on type of element wire used.
- Sheath watt densities on the cable to 4.65 W/cm^2 (30 W/in^2), and as high as 11.62 W/cm^2 (75 W/in^2) within factory approved conditions.

Features and Benefits

- **High ductility** allows the heater to be cold-formed into almost any shape.
- **The heaters low mass** allows for quick response to both heating and cooling.
- **Standard 304 stainless steel,** optional 316L stainless steel or Inconel® 600, provide high temperature corrosion and oxidation resistance along with ideal thermal expansion properties.



- **The heater sheath can be brazed** allowing the permanent attachment of mounted fittings to the heater. Consult factory for additional information.
- **Ranging from 1 mm (0.040 in.) to 5 mm (0.188 in.) diameter,** the cable heater packs a lot of heat into a tiny space. Lengths range from 19 mm (0.75 in.) to over 2134 cm (70 ft).
- **Internal construction options** allow internal thermocouples and no-heat sections. (Not available in all sizes.)

Applications

- Plastic injection molding nozzles
- Hot runner molds

Inconel® is a registered trademark of Special Metals Corporation.

Hot Runner Nozzle Heaters

Coiled Cable

- Sealed against contamination
- Low profile, ideal for limited space applications
- 360 degree heat pattern provides even heating

Mini-Cable

- Hermetic seal prevents moisture in adapter area
- 304 stainless steel axial access clamp provides easy installation

Coiled Cable Nozzle

Mini-Cable Nozzle

Coiled Cable Nozzle Heater: 23.87 mm (0.94 in.) diameter round and 2.59 x 2.59 mm (0.102 x 0.102 in.) square
(with ±5 percent wattage tolerance)

Coil I.D. mm	(in.)	Coil Width mm	(in.)	Volts	Watts	Lead Length mm	(in.)	Stocked with Thermocouple*	Cable Type	Watlow Code Number
19.05	(¾)	25.4	(1)	230	125	914.4	(36)	No	Round	**94PC30A1A**
19.05	(¾)	25.4	(1)	230	125	914.4	(36)	No	Square	**102PS28A2B**
19.05	(¾)	25.4	(1)	230	125	1828.8	(72)	No	Round	**94PC30A1D**
19.05	(¾)	25.4	(1)	230	125	1828.8	(72)	No	Square	**102PS28A2A**
19.05	(¾)	25.4	(1)	230	250	914.4	(36)	No	Round	**94PC30A2A**
19.05	(¾)	25.4	(1)	230	250	914.4	(36)	No	Square	**102PS28A1B**
19.05	(¾)	25.4	(1)	230	250	1828.8	(72)	No	Round	**94PC30A2D**
19.05	(¾)	25.4	(1)	230	250	1828.8	(72)	No	Square	**102PS28A1A**
19.05	(¾)	25.4	(1)	230	250	914.4	(36)	Yes	Round	**94PC30A4A**
19.05	(¾)	25.4	(1)	230	250	914.4	(36)	Yes	Square	**102PS28A4A**
22.23	(⅞)	25.4	(1)	230	250	914.4	(36)	No	Square	**102PS32A1A**

All units have Teflon® insulated power leads and fiberglass insulated thermocouple leads as indicated.

Mini-Cable Nozzle Heater: 1.47 mm (0.058 in.) diameter round (with ±5 percent wattage tolerance)

Coil I.D. mm	(in.)	Coil Width mm	(in.)	Volts	Watts	Lead Length mm	(in.)	Stocked with Thermocouple*	Cable Type	Watlow Code Number
19.05	(¾)	240	(1)	240	268	1828.8	(72)	No	Round	**Z5969**
19.05	(¾)	240	(1)	240	149	1828.8	(72)	No	Round	**Z5968**

Note: An **optional** Type "J" thermocouple can be externally spotwelded to the sheath.

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Hot Runner Nozzle Heaters

Coiled Cable OEM Cross Reference

DME

DME Code Number	Watlow Code Number	Volts	Watts
Straight-Shot Heater with Type J Thermocouple			
SSTC-31	**125CS42A1A**	120	300
SSTC-31-90	**125CS42A3A**	120	300
SSTC-32	**125PS35A1A**	240	300
SSTC-32-90	**125PS35A3A**	240	300
SSTC-42	**125PS21A1A**	240	460
SSTC-42-90	**125PS21A3A**	240	460
Heated Nozzle Locator with Type J Thermocouple			
SSTC-62-90	**125PS14A1A**	240	250
SSTC-72-90	**125PS17A1A**	240	250
Gatemate			
SCH0001	**125PS53A1A**	240	315
SCH0002	**125PS31A6A**	240	315
SCH0003	**125PS13A3A**	240	225
SCH0060	**125PS19A8A**	240	250
SCH0061	**125PS26A13A**	240	300
SCH0062	**125PS35A25A**	240	350
SCH0063	**125PS39A7A**	240	400
SCH0064	**125PS46A3A**	240	425
SCH0065	**125PS58A4A**	240	500
SCH0066	**125PS65A7A**	240	500
SCH3141	**125PS14A12A**	120	315
SCH3142	**125PS18A8A**	240	315
SCH3242	**125PS30A16A**	240	315

Hot Runner Nozzle Heaters

Coiled Cable OEM Cross Reference

DME

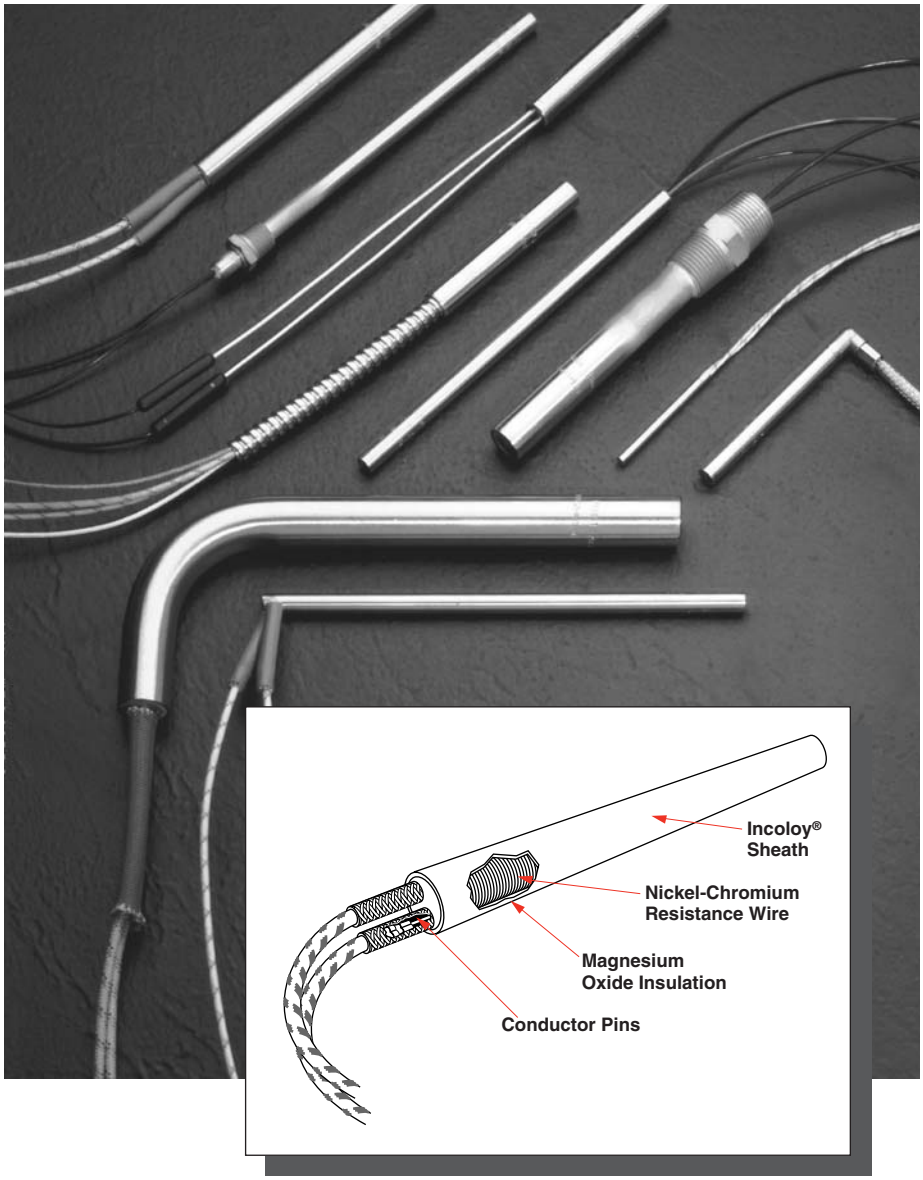
DME Code Number	Watlow Code Number	Volts	Watts
Hot One			
SCH0081	**125PS21A22A**	240	300
SCH0082	**125PS25A10A**	240	350
SCH0083	**125PS30A23A**	240	400
SCH0084	**125PS35A27A**	240	425
SCH0085	**125CS40A4A**	240	500
SCH0086	**125CS51A5A**	240	500
SCH0087	**125CS58A5A**	240	550
SCH0088	**125PS29A9A**	240	400
SCH0089	**125PS34A12A**	240	450
SCH0090	**125PS38A4A**	240	550
SCH0091	**125CS47A5A**	240	700
SCH0092	**125CS52A6A**	240	800
SCH0093	**125CS59A4A**	240	900
SCH0094	**125CS80A3A**	240	1000
SCH0095	**125CS93A3A**	240	1100
SCH0096	**125CS102A3A**	240	1000
SCH0097	**125CS127A3A**	240	1030
SCH0098	**125CS149A6A**	240	1100
SCH0099	**125CS149A5A**	240	1100
SCH0100	**125CS168A3A**	240	1200
SCH0101	**125CS218A6A**	240	1200
SCH0102	**125CS218A5A**	240	1200

Hot Runner Nozzle Heaters

FIREROD® Cartridge

The Watlow FIREROD® revolutionized the heating element industry in 1954 when it was patented as the first swaged cartridge heater. With premium materials and tight manufacturing controls, the FIREROD heater continues to provide superior heat transfer, uniform temperatures and resistance to oxidation and corrosion even at high temperatures.

Cartridge heaters are available from Watlow in both high- and low-watt density units and are traditionally used as insertion heaters for molds and hot runner nozzles. The wattage distribution can be configured to yield a uniform heat profile and the overall superior construction allows for rapid heat dissipation into the mold or nozzle construction.



Performance Capabilities

- Temperatures to 760°C (1400°F) on Incoloy® sheath
- Temperatures to 540°C (1000°F) on optional stainless steel sheath
- Watt densities to 62 W/cm^2 (400 W/in^2)

Features and Benefits

- **Nickel-chromium resistance wire,** precisely wound and centered in the unit assures even, efficient distribution of heat to the sheath.
- **Conductor pins** metallurgically bonded to the resistance wire ensure trouble-free electrical continuity.
- **Magnesium oxide insulation of specific grain and purity,** swaged to the proper density, results in high dielectric strength and contributes to faster heat-up.
- **Incoloy® sheath** resists oxidation and corrosion from many chemicals, heat and atmospheres.
- **Minimal spacing between the element wire and sheath** results in lower internal temperature, giving you the ability to design with fewer or smaller heaters that operate at higher watt densities.
- **UL® and CSA approved flexible stranded wires,** with silicone-fiberglass oversleeve, insulate the wires to temperatures of 250°C (480°F).
- **Patented Lead Adapter (LA) method** allows same day shipment on more than 150,000 configurations of stock FIREROD heaters and lead combinations.

Applications

- Hot runner nozzles
- Molds

Incoloy® is a registered trademark of Special Metals Corporation.

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

Hot Runner Nozzle Heaters

FIREROD Cartridge

Applications and Technical Data

Tolerances

Diameter:

1 inch units: ±0.076 mm (±0.003 in.)

All other units: ±0.0508 mm (±0.002 in.)

Length:

All units to 115 mm (4.5 in.) long: ±2.4 mm (±.0937 in.)

3.2 mm (0.125 in.) diameter units over 75 mm (4.5 in.) long: ±3 percent

All other units over 115 mm (4.5 in.) long: ±2 percent

Wattage:

3.2 mm (0.125 in.) units: +10 percent, -15 percent

All other units: +5 percent, -10 percent

Resistance:

3.2 mm (0.125 in.) units: +15 percent, -10 percent

All other units: +10 percent, -5 percent

Resistance changes with temperature. There are three circumstances under which resistance can be measured:

1. Room temperature (before use): nominal ohms are 90 percent of Ohm's law calculation.
2. Room temperature (after use): nominal ohms are 95 percent of Ohm's law calculation.
3. At temperature (during use): depending on application nominal ohms are approximately 100 percent of Ohm's law.

Camber:

Units to 300 mm (12 in.) long: 0.005 inch per six inch length. Standard camber tolerance varies as the square of the length, in feet, is multiplied by 0.020 inches. For example, a 36 inch FIREROD has a camber tolerance of 0.020 inches X $(3)^2$ = 0.180 inches. Normally, slight camber does not present a problem since the heater will flex enough to fit into a straight, close fit hole.

Component Recognition File Numbers

UL® component rated to 240V~(ac) (file number E52951)

CSA component rated to 240V~(ac) (file number LR7392)

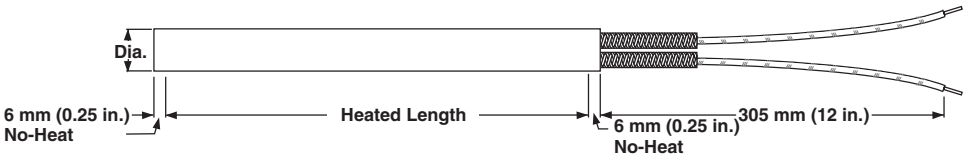
VDE component rated to 240V~(ac) (file number 10062-4911-0006)

Note: Not all options are covered.

Electrical Data

The Electrical Data table will assist you in selecting the correct FIREROD heater for your application, according to available voltage, amperage and wattage.

Please note, some combinations of minimum and maximum wattages are not available on the same heater diameter. Also, if you need to exceed limitations shown, contact your Watlow sales engineer or authorized distributor.



Number Of Circuits ⑤		
Diameter inches	1-phase	3-phase
¾	3	1
1	5	2

FIREROD Diameter inches	Volts Max.	Amp Max. ①	Minimum Watts@120V② Heater Length			Maximum Watts				
			25 mm (1 in.)	38 mm (1.5 in.)	50 mm (2 in.)	120V 1-phase	240V 1-phase	480V 1-phase	240V 3-phase	480V 3-phase
⅛	240	3.1	—	8	5	360	720	—	—	—
¼	240	4.4⑥	100	55	40	525	1050	—	—	—
⅜	240	6.7	65	35	25	800	1600	—	④	—
½	240	9.7	40	25	20	1,160	2,320	—	④	—
⅝	480	23.0	35	20	15	2,760	5,520	11,000	④	—
¾	480	23.0	30	15	10	2,760③	5,520	11,000	9,550	19,100
1	480	23.0	—	15	10	2,760③	5,520	11,000	9,550③	19,100③

① Determined by the current carrying capacity of internal parts and standard lead wire.

② Determined by the limitation of space for resistance winding. For minimum wattage of 240V~(ac) multiply value by four.

③ Higher wattages are available using more than one set of power leads. Multiply the wattage from the table by the applicable factor.

④ Consult the Watlow factory in St. Louis, Missouri, for data.

⑤ On 19.05 mm (0.75 in.) diameter units, either three single- phase circuits or one three-phase Delta or Wye circuit is available. On one inch diameter units, either five single-phase or two three-phase Delta circuits are available.

⑥ For 6.35 mm (0.25 in.) units with thermocouple maximum amperage is 3.1.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Maximum Allowable Watt Density

For metric watt density conversion see Metric FIREROD Cartridge, pages 104 and 105.

The following four charts detail maximum allowable watt densities for applications involving metal heating or steam, air and gas heating. Please review these respective charts and applicable data to determine the correct watt density for your application.

Correction Factors:

Also note, these graphs depict FIRERODs used in steel parts. Therefore, for either stainless steel or aluminum and brass, refer to applicable correction factors:

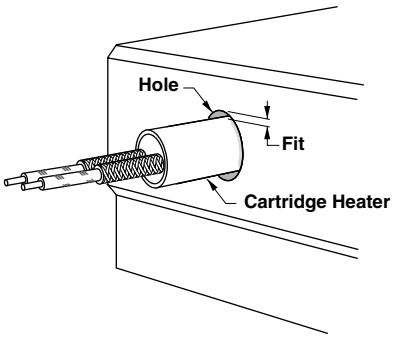
① For stainless steel, enter the graph with a fit 0.04 mm (0.0015 in.) larger than actual.

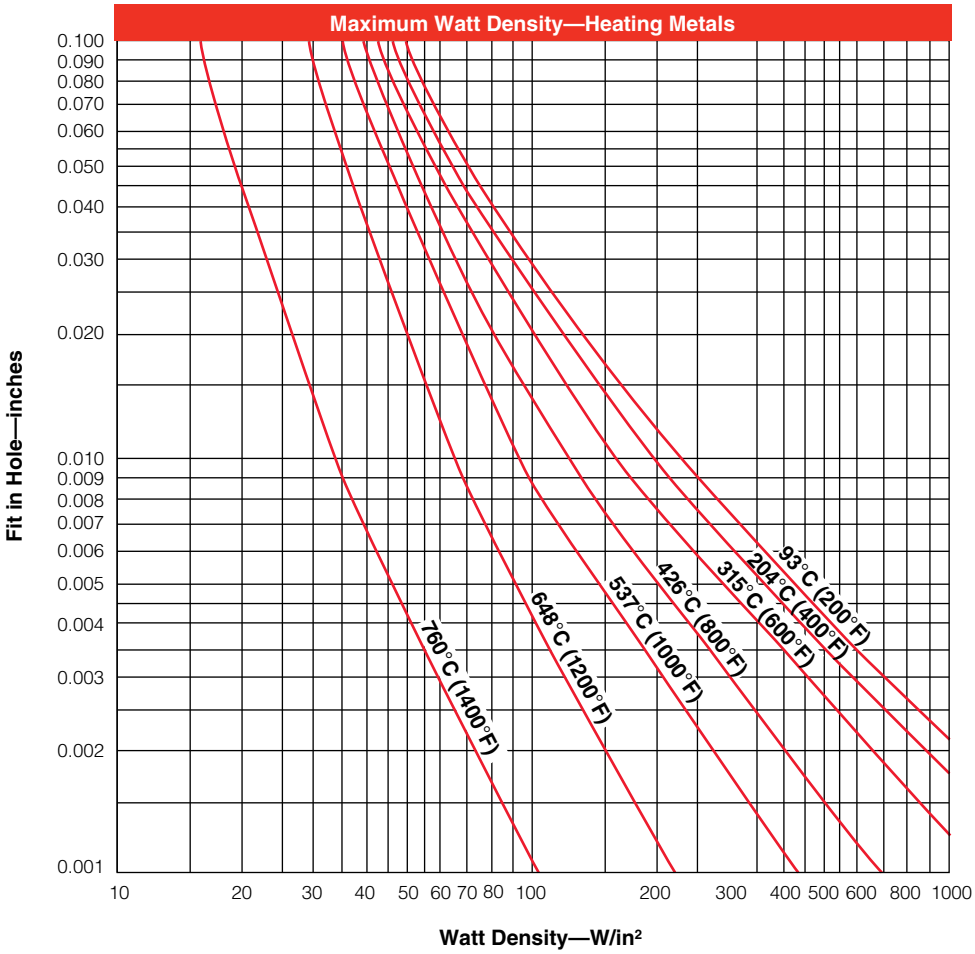
② For aluminum and brass, enter the graph with a temperature 38°C (100°F) above actual temperature.

Heating Metals

The Maximum Watt Density—Heating Metals chart will tell you either the maximum hole fit or recommended watt density of the heater. Enter the chart with either known variable, part fit in hole dimension or W/in². Then find the application temperature by reading up or over on the chart.

If the fit of the heater in the hole dimension is not known, it is easily determined. Subtract the minimum diameter of the FIREROD (nominal diameter minus tolerance) from the maximum hole diameter. For example, take a hole diameter of 0.500 minus a heater diameter of 0.496 ±0.002 inch. The hole fit would be 0.006 inch. For FIREROD heaters in square holes or grooves, contact your Watlow sales engineer or authorized distributor for the fit in hole dimension.



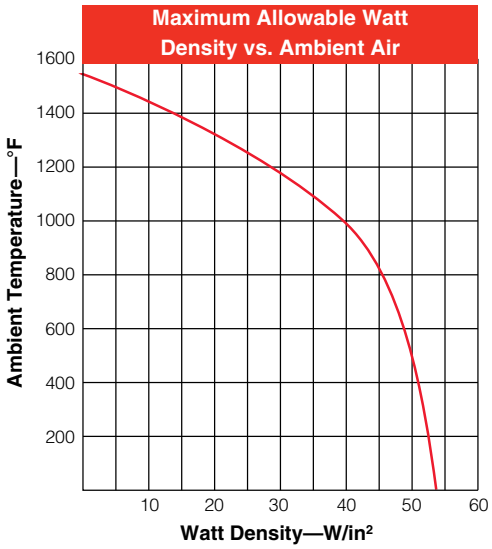


Hot Runner Nozzle Heaters

FIREROD Cartridge

Maximum Allowable Watt Density
Continued

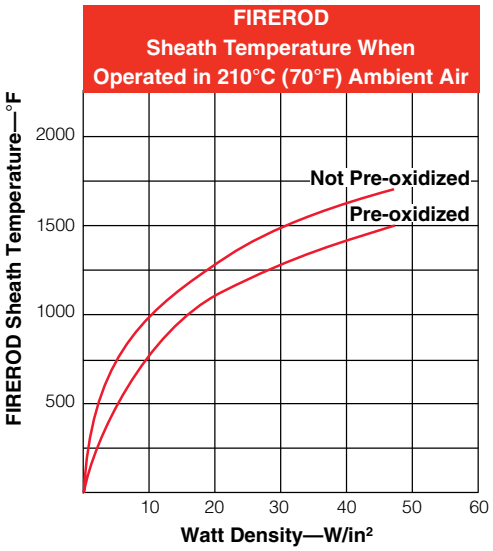
Heating Steam, Air and Gases



Watt Density vs Ambient Air Temperature

The Watt Density vs Ambient Air Temperature graph shows the maximum allowable watt density when one FIREROD is operated in air or similar gas.

For FIRERODs grouped in a single row, with no less than one diameter between elements, multiply value from graph by 0.95. When a reflector is placed behind the heaters, multiply the maximum allowable watt density value from the graph by 0.85.

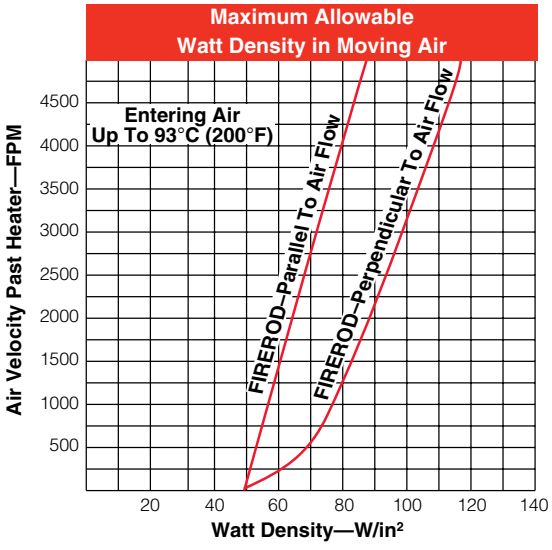


Sheath Temperature in Ambient Air

The Sheath Temperature in Ambient Air graph indicates the watt density required to bring a pre-oxidized FIREROD to a given sheath temperature when operated in 20°C (70°F) ambient air.

At 6.8 W/cm² (44 W/in²), the sheath temperature would be 790°C (1450°F). At this temperature, one year life would be expected, provided that cycling is not too frequent.

Higher temperatures would result in reduced heater life.



Watt Density in Moving Air

The Watt Density in Moving Air graph gives the maximum allowable watt density of a FIREROD in moving air.

The air movement is expressed in feet per minute (FPM). If the air flow is known in cubic feet per minute (CFM), divide the CFM by the net free area around the heater (ft²). The net free area is the total area of the enclosure minus the area occupied by the heater.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Lead and Diameter Information

Lead Specifications

Heater Diameter inches	Standard Lead Gauge Fiberglass	Lead Wire Size Tolerance Fiberglass	Standard Lead Gauge Teflon®	Lead Wire Size Tolerance Teflon®	Standard Stainless Steel Hose I.D.	Standard Stainless Steel Braid I.D.
1/8	24	0.044 - 0.058	24 solid	0.036 - 0.044	1/8	1/8
1/4	22	0.079 - 0.093	22	0.046 - 0.054	1/8	1/8
3/8	22	0.079 - 0.093	20	0.054 - 0.062	7/32	1/4
1/2	18	0.095 - 0.109	20	0.054 - 0.062	9/32	1/4
5/8	18	0.095 - 0.109	18	0.064 - 0.074	3/8	1/4
3/4	18	0.095 - 0.109	14	0.087 - 0.101	1/2	3/8
1	18	0.095 - 0.109	14	0.087 - 0.101	N/A	N/A

Lead length tolerances: 25.4 mm to 914 mm = -12.7 mm, +38 mm; > 914.4 mm to 1828.8 mm = -25.4 mm, + 76.2 mm; > 1828.8 mm = ±101.6 mm (1 in. to 36 in. = -0.5 in., +1.5 in.; > 36 in. to 72 in. = -1, +3 in.; > 72 in. = ±4 in.)

Stainless steel hose and braid tolerances: same as lead wire.

Units constructed with 480 volts require MGT leads. If connecting heaters in series above 300 volts, MGT leads are also required.

Ratings: GGS, 300V, 250°C (480°F)
MGT, 600V, 450°C (840°F)
Teflon®, 600V, 205°C (400°F)
Silicone Rubber, 600V, 150°C (300°F)

Lead Gauge	Nickel Ampacity	N.C.C. Ampacity	SPC/NPC
26	2.5	4.2	6.0
24 stranded	3.1	5.2	7.5
24 solid	3.1	5.2	7.5
22	4.4	7.2	10.5
20	N/A	N/A	14.0
18	7.6	12.6	18.0
16	9.7	16.1	23.0
14	12.5	21.0	30.0
12	16.8	28.0	40.0

Dimensional Data

The Dimensional Data table gives minimum/maximum lengths for available FIREROD diameters.

FIREROD Diameter			Length			
Nominal inches	Actual mm	(in.)	Minimum mm	(in.)	Maximum mm	(in.)
1/8	3.10	(0.122)	32	(1/8)	305	(12)
1/4	6.25	(0.246)	22	(7/8)	915	(36)
3/8	9.42	(0.371)	22	(7/8)	1,220	(48)
1/2	12.60	(0.496)	22	(7/8)	1,520	(60)
5/8	15.77	(0.621)	25	(1)	1,830	(72)
3/4	18.95	(0.746)	25	(1)	1,830	(72)

Indicates **recommended** maximum length; however longer lengths are available.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Non LA Stock

Modification Coding

Watlow offers heaters in various diameters, lengths and volt-wattage combinations that are ready for shipping. Stock heaters are listed on pages 90-101. Any stock heaters can have basic modifications made and shipped the same day. These modifications include flanges, threaded fittings, locating rings, elbows, couplers, ceramic beads and leads. The following is a list of all available non-LA modifications and their code numbers.

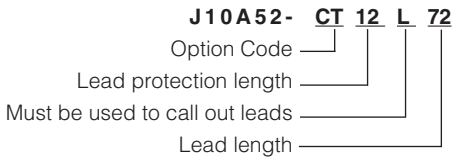
Mounting Option Codes

BA	Small flange FS–available on 6.35 mm (0.25 in.), 9.525 mm (0.375 in.), 12.7 mm (0.5 in.)
BB	Medium flange FM–available on 6.35 mm (0.25 in.), 9.525 mm (0.375 in.), 12.7 mm (0.5 in.), 15.875 mm (0.625 in.), 19.05 mm (0.75 in.)
BC	Large flange FL–available on 15.875 mm (0.625 in.), 19.05 mm (0.75 in.)
BD	Locating rIng–available on 6.35 mm (0.25 in.), 9.525 mm (0.375 in.), 12.7 mm (0.5 in.), 15.875 mm (0.625 in.), 19.05 mm (0.75 in.)
BE	Single brass fitting
BF	Double brass fitting
BG	Single stainless steel fitting
BH	Double stainless steel fitting
BY	Stainless steel reversed
BZ	Brass reversed

Lead Protection Option Codes

CC	Straight coupler — BX
CD	Right angle elbow — BX
CE	Straight coupler — stainless steel hose
CF	Right angle elbow — stainless steel hose
CJ	Straight coupler — BX — solder coupler to heater
CK	Straight coupler — BX — solder coupler to BX
CL	Straight coupler — BX — solder coupler to BX and heater
CM	Right angle elbow — BX — solder elbow to heater
CN	Right angle elbow — BX — solder elbow to BX
CP	Right angle elbow — BX — solder elbow to BX and heater
CR	Straight coupler — stainless steel hose — solder coupler to heater
CS	Straight coupler — stainless steel hose — solder coupler to hose
CT	Straight coupler — stainless steel hose — solder coupler to hose and heater
CU	Right angle elbow — stainless steel hose — solder elbow to heater
CV	Right angle elbow — stainless steel hose — solder elbow to hose
CW	Right angle elbow — stainless steel hose — solder elbow to hose and heater
CX	Straight coupler — stainless steel braid — 31.75 mm (0.125 in.) diameter only
CY	Straight coupler — stainless steel hose — 31.75 mm (0.125 in.) diameter only

Example:



Pin Option Codes

AA	Short pins 7.937 mm (0.3125 in.)
AB	Medium pins 15.87 mm (0.625 in.)
AC	Long pins 44.45 mm (1.75 in.)
AD	Stagger pins
AE	Ceramic beads 12.7 mm (0.5 in.)
AF	Ceramic beads 19.05 mm (0.75 in.)
AG	Ceramic beads 25.4 mm (1 in.)
AH	Ceramic beads 28.1 mm (1.25 in.)
AJ	Ceramic beads 31.75 mm (1.5 in.)

Note: Mounting options are located on the last 6.35 mm (0.25 in.) of all non-LA stock units.

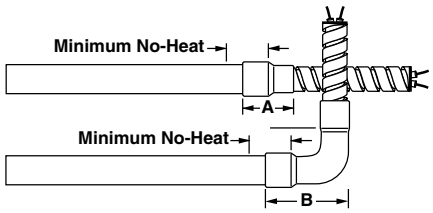
Hot Runner Nozzle Heaters

FIREROD Cartridge

Non LA Stock

Termination Options

Modified Stock Straight and Right Angle Galvanized BX Conduit



Galvanized BX conduit equals stainless steel hose in its abrasion protection. The conduit is attached with either a crimped-on straight or 90 degree elbow copper coupling which overlaps the heater sheath.

The 6 mm (0.25 in.) diameter FIRERODs use stainless steel hose instead of conduit. On 25 mm (1 in.) diameter FIRERODs, only flexible galvanized hose is used.

Modified Stock units may be ordered either with copper coupler/elbow and BX conduit or stainless steel hose. To order, specify **BX conduit** or **stainless steel hose** as well as straight or right angle coupler, conduit/hose length and lead lengths.

Unless specified, 305 mm (12 in.) hose or conduit is supplied. Leads are 51 mm (2 in.) longer than hose.

BX Conduit

Coupler utilizes BX conduit or SS hose.

Heater Diameter		Straight A Dimension		Right Angle B Dimension		BX O.D.		Hose O.D.	
mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)
6	(¼)	22	(⅞)	27	(1 1⁄16)	— ① —		10	(⅜)
10	(⅜)	25	(1)	35	(1⅜)	13	(½)	10	(⅜)
13	(½)	30	(1 3⁄16)	41	(1⅝)	14	(9⁄16)	13	(½)
16	(⅝)	32	(1¼)	52	(2 1⁄16)	14	(9⁄16)	16	(⅝)
19	(¾)	38	(1½)	54	(2⅛)	14	(9⁄16)	16	(⅝)

① 6 mm (0.25 in.) diameter unit uses SS hose only.

Galvanized BX conduit is available on Modified Stock units. It is also available on Stock/Standard FIRERODs in combination with LA swaged-in flexible leads, as well as LA Teflon® and silicone rubber seals and leads.

On Modified Stock, insert length = overall length of heater - 6.35 mm (0.25 in.).

Note: If the heater diameter you need is not shown on the chart, Watlow will manufacture to your specifications.

Quick Ship • *Same day shipment on many stock options.*

Hot Runner Nozzle Heaters

FIREROD Cartridge

LA Stock

Termination Options

Patented LA—or Lead Adapter—Modification Method

538°C (1000°F) maximum on LA cap

Watlow has developed a patented Lead Adapter (LA) program for customers in need of heaters quickly. The LA program takes a stock heater and adds leads and lead protection, if requested. The LA adder has a standard 305 mm (12 in.) of protection and 356 mm (14 in.) of leads, but additional length can be added. The leads and protection can also be attached in a right angle configuration for applications with restricted space.

LA configurations are permanently attached to the heater. Most configurations can be ordered with no-heat extensions. These can also have mounting options including flanges, threaded fittings or locating rings.

LA adders can be used on either stock heaters or made-to-order heaters. The LA adders usually take one to three days to ship.

To configure a FIREROD with swaged-in leads, Watlow:

- Connects lead wire to pins in base heater.
- Places an LA cap over the lead end of the heater.
- Swages the heater to produce a rugged unit with swaged-in leads.

LA options available on 10 mm (0.375 in.) to 19 mm (0.75 in.) diameters.

Note: Limited LA options available on 6 mm (0.25 in.) diameter.

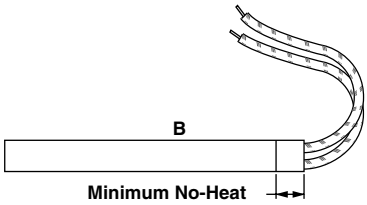
Maximum temperature of LA cap is 538°C (1000°F) except for MI leads option.

Hot Runner Nozzle Heaters

FIREROD Cartridge

LA Stock

Termination Options

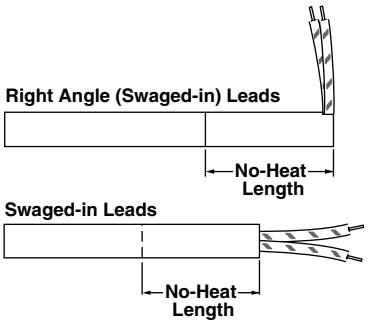


LA Swaged-in Flexible Leads

LA swaged-in flexible leads are used in applications where a high degree of flexing exists or the leads must be bent sharply adjacent to the heater without exposing or breaking the conductor. The stranded wire leads are connected internally and exit through the lead end. The overall length of the heater is extended by 6 mm (0.25 in.).

To order, specify **length adder code E** bringing the total disk end no-heat to 14 mm (0.5625 in.)

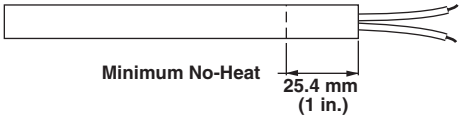
This LA option is not available on 3 mm (0.125 in.) diameter. On 3 mm (0.125 in.) diameter FIRERODs, leads are connected externally using a solid conductor lead wire. If stranded wire is desired on 3 mm (0.125 in.) diameter units, consult factory.



No-Heat Extensions

No-heat extensions are recommended in applications where leads may be exposed to excessive heat, thus requiring a cooler lead end. Also used when heat is not required along the entire length of the FIREROD.

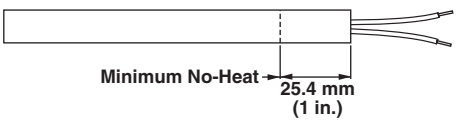
No-heat extensions are available for most LA stock options in diameters of 9, 13, 16 and 19 mm (0.375, 0.5, 0.625 and 0.5 in.). These extensions are designed to provide a total no-heat length of 25, 38, 51 or 65 mm (1, 1.5, 2 or 2.5 in.) at the lead end of stock FIRERODs only. Consult factory for available LA options.



LA Teflon® Seal and Leads

LA Teflon® seal and leads protect the heater against moisture/contamination from lubricating oil, cleaning solvents, plastic material or fumes and organic tapes. This seal is effective to 205°C (400°F) under continuous operation.

Please note when ordering this option, that a minimum no-heat section is required to allow for construction. Additional no-heat may be required to keep the seal below effective temperatures. The minimum lead end no-heat is one inch. The LA cap adds 19 mm (0.75 in.) to the overall length of the heater. To order, specify **option code T**.



LA Silicone Rubber Seal and Leads

LA silicone rubber seal and leads protect the heater against moisture/contamination from lubricating oil, cleaning solvents, plastic material or fumes and organic tapes. This seal is effective to 230°C (450°F) under continuous operation.

Please note when ordering this option, that a minimum no-heat section is required to allow for construction. Additional no-heat may be required to keep the seal below effective temperatures. The minimum lead end no-heat is one inch. The LA cap adds 19 mm (0.75 in.) to the overall length. To order, specify **option code P**.

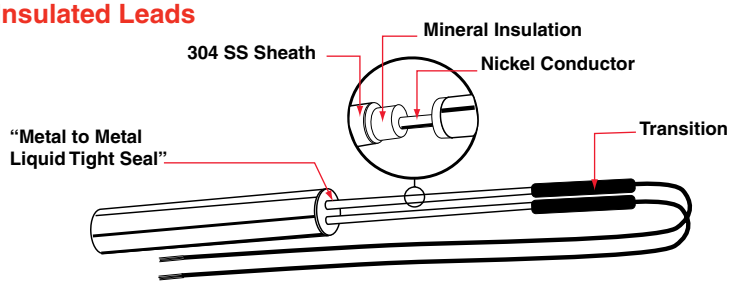
Hot Runner Nozzle Heaters

FIREROD Cartridge

LA Stock

Termination Options
Continued

Mineral Insulated Leads



MI leads handle both high temperatures and contamination, and resist other problems like abrasion and excessive vibration. The metal seal and swaged-in, formable MI cable leads are capable of handling temperatures up to 815°C (1500°F). In addition, the lead end seal resists moisture and other forms of contamination, including plastic drool/flash, gases, oils, solvents and water.

Features and Benefits

- **Increased heater life**
- **Less down time**
- **No need for a soft start** due to moisture penetration
- **Ability to use a cartridge heater where not possible before**
- **Abrasion and vibration resistant**
- **Able to be formed or bent** to fit the contours of wiring raceways
- **No additional insulation of lead wires is needed** to protect against high temperatures
- **Lead cables and seal will not out-gas** in vacuum environments

The Watlow FIREROD with the patented MI lead and seal option is covered by a two-year limited warranty. This extended warranty for this product only applies to manufacturing defects or failures due to over-temperature or product failure due to contamination.

This LA option is also available as a manufactured item. Specify MI leads and seal, as well as volts, watts, cable length, lead length and type. 152 mm (6 in.) of MI cable and 305 mm (12 in.) of Teflon® leads will be supplied unless otherwise specified. To order, specify **option code J.**

Applications

- Injection molding
- Vacuum forming

Heater Diameter inches	Maximum Current amps	Conductor Diameter inches	Cable Diameter inches	Transition Diameter inches	Cable Length min max inches	Minimum Bend Radius	Maximum Voltage inches	Length Adder
⅜	7.0	0.044	0.108	0.230	6 72	0.225	240	G (⅜)
½	7.0	0.044	0.108	0.230	6 72	0.225	240	K (9⁄16)
⅝	9.7	0.062	0.138	0.250	6 72	0.280	240	L (⅝)
¾	9.7	0.062	0.138	0.250	6 72	0.280	240	L (⅝)

The above information pertains to standard FIREROD heaters. However, variations in these parameters may be accommodated to suit specific customer needs.

Technical Data

Max. temp. of cable: 815°C (1500°F)

Max. temp. of cable to lead transition: 149°C (300°F) *(where flexible leads attach to cable)*

Cable sheath material: 304 SS

Conductor material: Nickel

Maximum voltage: 240V

Lead Types

Teflon® (205°C/400°F) – T

Silicone Rubber (150°C/300°F) – S

GGS (250°C/480°F) – No code

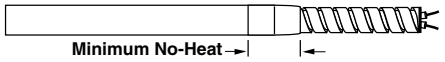
MGT (450°C/840°F) – H

Hot Runner Nozzle Heaters

FIREROD Cartridge

LA Stock

Straight Protection Options

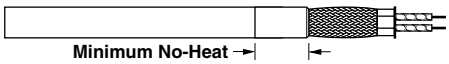


LA Straight Stainless Steel Hose

LA straight stainless steel hose provides the best protection against abrasion from sharp edges. It also offers ease of handling and wiring in abrasive environments. Unless specified, a 305 mm (12 in.) hose is supplied. Leads are 51 mm (2 in.) longer than hose.

Minimum lead end no-heat required is 19 mm (0.75 in.). Option adds 13 mm (0.5 in.) to overall length on stock units.

To order, specify **option code H**.



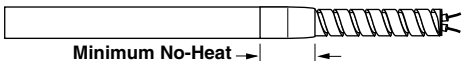
LA Straight Stainless Steel Braid

LA straight stainless steel braid is designed to protect leads from abrasion against sharp edges. It is the most flexible of Watlow's protective lead arrangements.

Unless specified, a 305 mm (12 in.) braid is supplied. Leads are 51 mm (2 in.) longer than braid.

Minimum lead end no-heat required is 19 mm (0.75 in.). Option adds 13 mm (0.5 in.) to overall length on stock units.

To order, specify **option code C**.

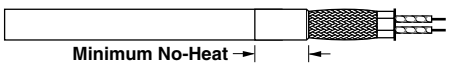


LA Straight Stainless Steel Hose with Teflon® Leads and Seal

LA straight stainless steel hose with Teflon® leads and seal provides the ultimate combination of abrasion protection and a moisture resistant seal. Unless specified, a standard 305 mm (12 in.) hose is supplied. Leads are 51 mm (2 in.) longer than hose.

Minimum lead end no-heat required is 25 mm (1 in.). Option adds 19 mm (0.75 in.) to overall length on stock units.

To order, specify **option code G**.



LA Straight Stainless Steel Braid with Teflon® Leads and Seal

LA straight stainless steel braid with Teflon® leads and seal provides Waltow's most flexible lead protection with a moisture resistant seal. Unless specified, a 305 mm (12 in.) braid is supplied. Leads are 51 mm (2 in.) longer than the braid.

Minimum lead end no-heat required is 25 mm (1 in.). Option adds 19 mm (0.75 in.) to overall length on stock units.

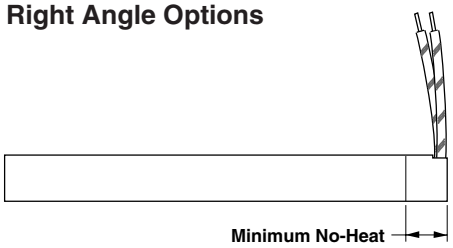
To order, specify **option code F**.

Hot Runner Nozzle Heaters

FIREROD Cartridge

LA Stock

Right Angle Options



LA Right Angle Leads

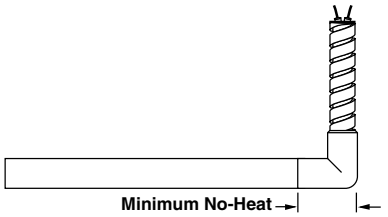
LA right angle leads are used in applications with a high degree of flexing and when space limitations are critical. Stranded lead wires are connected internally (swaged-in) and exit at a 90 degree angle at the end of the heater.

To order, specify **option code R**.

To order right angle leads with Teflon® leads and seals, specify **option code B**.

Minimum No-Heat Required inches					
Dia.	¼	⅜	½	⅝	¾
Inches	11⁄16	⅝	11⁄16	11⁄16	11⁄16

Note: Option is not available on 6 mm (0.25 inch) diameter.



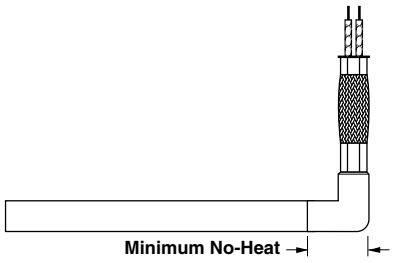
LA Right Angle Stainless Steel Hose

LA right angle stainless steel hose is provided for wiring convenience. Like the LA straight stainless steel hose, it protects leads from abrasion against sharp edges. Unless specified, 305 mm (12 in.) hose is supplied. Leads are 51 mm (2 in.) longer than hose.

To order, specify **option code W**.

Minimum No-Heat Required inches					
Dia.	¼	⅜	½	⅝	¾
Inches	N/A	1	1	1	1⅛

Note: Option is not available on 6 mm (0.25 in.) diameter.



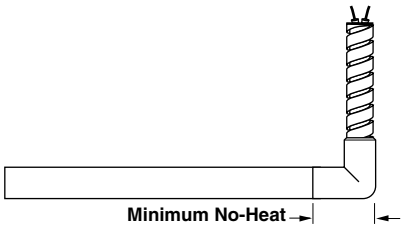
LA Right Angle Stainless Steel Braid

LA right angle stainless steel braid is provided for wiring convenience. Like the LA straight braid, it protects leads from abrasion against sharp edges. Unless specified, 305 mm (12 in.) braid is supplied. Leads are 51 mm (2 in.) longer than braid.

To order, specify **option code Y**.

Minimum No-Heat Required inches					
Dia.	¼	⅜	½	⅝	¾
Inches	N/A	1	1	1	1⅛

Note: Option is not available on 6 mm (0.25 in.) diameter.



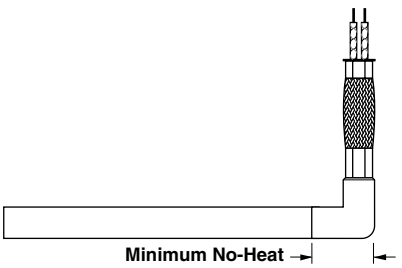
LA Right Angle Stainless Steel Hose with Teflon® Leads and Seal

LA right angle stainless steel hose with Teflon® leads and seal provides the ultimate combination of abrasion protection and a moisture resistant seal with wiring convenience. Unless specified, a 305 mm (12 in.) hose is supplied. Leads are 51 mm (2 in.) longer than hose.

Minimum lead end no-heat required is 38 mm (1.5 in.). Option adds 32 mm (1.25 in.) to overall length on stock units.

To order, specify **option code M**.

Note: Option is not available on 6 mm (0.25 in.) diameter.



LA Right Angle Stainless Steel Braid with Teflon® Leads and Seal

LA right angle stainless steel braid with Teflon® leads and seal provides Waltow's most flexible lead protection and moisture resistant Teflon® seal with wiring convenience. Unless specified, a 305 mm (12 in.) braid is supplied.

Leads are 51 mm (2 in.) longer than the braid.

Minimum lead end no-heat required is 38 mm (1.5 in.). Option adds 32 mm (1.25 in.) to overall length on stock units.

To order, specify **option code A**.

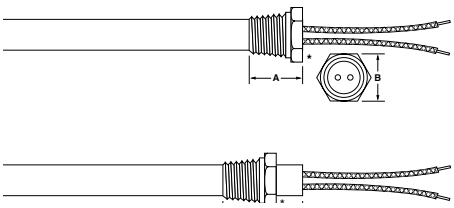
Note: Option is not available on 6 mm (0.25 in.) diameter.

Hot Runner Nozzle Heaters

FIREROD Cartridge

LA Stock

Mounting Options



Fitting overlaps the unheated section and is soldered to the sheath.

LA Stock Threaded Fittings

Threaded fittings allow for fast, water-tight installation of the heater into a threaded hole. These fittings can be ordered in either brass or 304 stainless steel. Other stainless steel alloys are available upon request. Double threaded fittings are also available.

To order, specify either **brass** or **stainless steel threaded fittings**.

On LA stock give location of fittings, if no-heat extension option is requested. Specify location from disc end to bottom of threads.

Lead Arrangement	STD Fitting ① Location Dimension A mm	(in.)
Crimped Leads	6	(¼)
Swaged in Leads	8	(5/16②④)
STR SS Hose	13	(¼③)
STR SS Braid	13	(¼)
Teflon® Seal & LDS	22	(⅞)
Silicone Seal & LDS	22	(⅞)

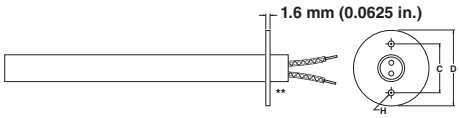
① The location of the threaded fitting from thread end of fitting to the lead end of heater.

All optional fitting locations are available only with LA Stock no-heat extensions. Consult the Watlow factory in St. Louis, Missouri, for details.

② On 6 mm (0.25 in.) diameter FIREROD only "A" dimension is 11 mm (0.4375 in.).

③ On 6 mm (0.25 in.) diameter FIREROD only "A" dimension is 16 mm (0.625 in.).

④ On 16 mm (0.625 in.) and 19 mm (0.75 in.) the fitting is located at 22 mm (0.875 in.) from lead end using a 16 mm (0.75 in.) no-heat extension. In order to locate at 8 mm (0.3125 in.) the fitting must be epoxied.



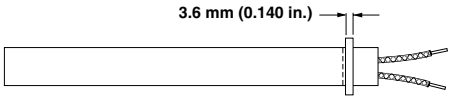
Flanges

Stainless steel flanges are a convenient mounting method as well as a way to position a heater within an application. The standard flange is staked on and located 6 mm (0.25 in.) from the LE. The flange can be located up to 57 mm (2.25 in.) from the LE as long as it is over a no-heat section. Use this option in combination with most LA configurations.

To order, specify **flange**, size and locations.

Flange Specifications

FIREROD Diameter inches	Flange Size	inches D	C	H
¼, ⅜, ½	FS	1	¾	0.144
¼, ⅜, ½ ⅝, ¾	FM	1 ½	1 ⅛	0.156
⅝, ¾, 1	FL	2	1 ½	0.201



Locating Ring

A stainless steel locating ring can be used as a retaining collar to position a FIREROD if mounting requirements are not critical.

On LA Stock, give location if the no-heat extension option is requested. On in-stock FIRERODs without an LA option, location will be on the last 6 mm (0.25 in.). To order, specify **locating ring**.

Locating Ring Specifications

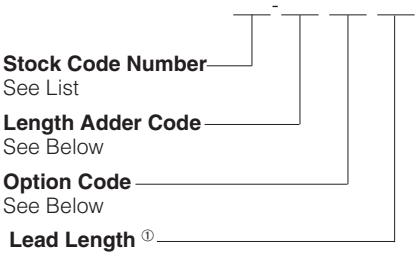
Minimum No-Heat Required inches				
Diameter	⅜	½	⅝	¾
Ring O.D.	⅝	¾	⅞	1

Hot Runner Nozzle Heaters

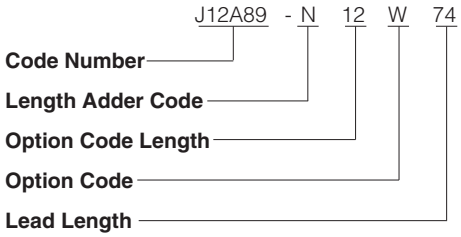
FIREROD Cartridge

LA Stock

LA Build-a-Code Number



Example:



① Lead length will be 51 mm (2 in.) longer than braid or hose unless otherwise specified on the order.

Option	Minimum Length Adders Per Diameter Per Option inches					Option Code
Heater Diameter	¼	⅜	½	⅝	¾	
Swaged-in Leads	E (¼)	E (¼)	E (¼)	E (¼)	E (¼)	None
Right Angle Leads	K (9⁄16)	G (½)	J (½)	J (½)	J (½)	R
Teflon® Seal and Leads	— —	N (¾)	N (¾)	N (¾)	N (¾)	T
Right Angle Teflon® Seal and Leads	— —	1E (1¼)	1E (1¼)	1E (1¼)	1E (1¼)	B
Silicone Seal and Leads	— —	N (¾)	N (¾)	N (¾)	N (¾)	P
Straight Hose	J (½)	J (½)	J (½)	J (½)	J (½)	H
Right Angle Hose	— —	N (¾)	N (¾)	N (¾)	R (⅞)	W
Straight Hose with Teflon® Seal and Leads	— —	N (¾)	N (¾)	N (¾)	N (¾)	G
Straight Braid	J (½)	J (½)	J (½)	J (½)	J (½)	C
Right Angle Braid	— —	N (¾)	N (¾)	N (¾)	R (⅞)	Y
Right Angle Braid with Teflon® Seal and Leads	— —	1E (1¼)	1E (1¼)	1E (1¼)	1E (1¼)	A

LA options are available on all stock FIRERODs, except 3 mm (0.125 in.) diameter. To order any of these options, please build the order number by specifying Watlow code number, length adder code, option code and lead length.

Ordering Example: The order number **J12A89-N72W74** indicates you have ordered a 305 mm (12 in.) FIREROD with 1830 mm (72 in.) right angle stainless steel hose and 1880 mm (74 in.) leads. The overall heater length equals 320 mm (12.75 in.).

Note: No-heat extensions are available for most LA options in diameters of 10 mm (0.375 in.), 13 mm (0.5 in.), 16 mm (0.625 in.), and 19 mm (0.75 in.). Consult factory for available LA options. No-heat length extensions are available in the following dimensions.

No-Heat Length Adder Codes

No-Heat Option mm	(in.)	Length Adder Code
10	(¾)	N
32	(1 ¼)	1E
44	(1 ¾)	1N
56	(2 ¼)	2E

To order any of these dimensions, please specify the applicable length adder code shown. No-heat extensions on all termination options are shipped within two to three days.

How to Order

To order Stock FIREROD cartridge heaters, specify:

- Watlow code number
- Quantity
- Options
- Lead length: If not specified, 305 mm (12 in.) crimped on leads will be shipped.

For **made-to-order** FIRERODs, please specify:

- Diameter
- Overall length
- Volts
- Watts
- Lead option and length or terminal configuration
- Lead end no-heat if different from standard
- Optional accessories, finishing, internal construction, sensors/ controls and mounting

Availability

Stock: Same day shipment on many FIREROD stock options

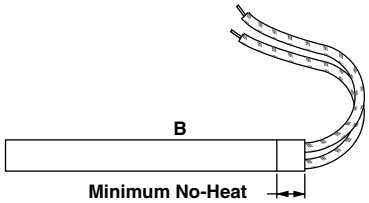
Made-to-Order: Consult factory

Hot Runner Nozzle Heaters

FIREROD Cartridge

Made-to-Order

Straight Options

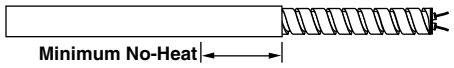


Swaged-in Flexible Leads

Swaged-in flexible leads are used in applications where a high degree of flexing exists or the leads must be bent sharply adjacent to the heater without exposing or breaking the conductor. The stranded wire leads are connected internally and exit through the lead end.

Minimum lead end no-heat required is 25 mm (1 in.). For heaters over 250 mm (10 in.) the minimum no-heat is 12 percent of overall length plus 6 mm (0.25 in.).

To order, please contact the factory.



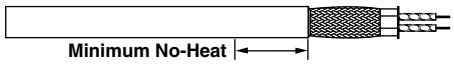
Made-to-Order Straight Stainless Steel Hose

Straight stainless steel hose provides the best protection against abrasion from sharp edges. It also offers ease of handling and wiring in abrasive environments.

Unless specified, a 305 mm (12 in.) hose is supplied. Leads are 51 mm (2 in.) longer than hose.

Minimum lead end no-heat required is 38 mm (1.5 in.). For heaters over 250 mm (10 in.) the minimum no-heat is 12 percent of overall length plus 6 mm (0.25 in.).

To order, specify **straight hose units 250 mm (10 in.) and under**.



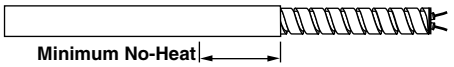
Made-to-Order Straight Stainless Steel Braid

Stainless steel braid is designed to protect leads from abrasion against sharp edges. It is the most flexible of Watlow's protective lead arrangements.

Unless specified, a 305 mm (12 in.) braid is supplied. Leads are 51 mm (2 in.) longer than braid.

Minimum lead end no-heat required is 38 mm (1.5 in.). For heaters over 250 mm (10 in.) the minimum no-heat is 12 percent of overall length plus 6 mm (0.25 in.).

To order, specify **straight stainless steel braid**.

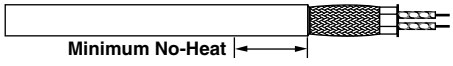


Made-to-Order Straight Stainless Steel Hose with Teflon® Leads and Seal

Straight stainless steel hose with Teflon® leads and seal for FIRERODs greater than 250 mm (10 in.) long with straight hose will have a

minimum lead end no-heat required is 35 mm (1.5 in.).

To order, specify **straight stainless steel hose**.



Made-to-Order Straight Stainless Steel Braid with Teflon® Leads and Seal

Straight stainless steel braid with Teflon® leads and seal for FIRERODs greater than 250 mm (10 in.) long with straight braid will have a

minimum lead end no-heat required is 35 mm (1.5 in.).

To order, specify **straight stainless steel braid with Teflon® leads and seal**.

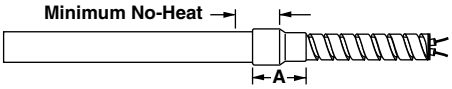
Hot Runner Nozzle Heaters

FIREROD Cartridge

Made-to-Order

Straight Options

Continued



Made-to-Order Straight Galvanized BX Conduit

Galvanized BX conduit equals stainless steel hose in its abrasion protection. The conduit is attached with a crimped-on straight copper coupling which overlaps the heater sheath.

The 6 mm (0.25 in.) diameter FIRERODs use stainless steel hose instead of conduit. On 25 mm (1 in.) diameter FIRERODs, 25 mm (1 in.) O.D. flexible galvanized hose is used.

To order, specify **straight galvanized BX conduit**.

Dia. inches	No-Heat	Dim. inches	BX O.D.
¼	½	⅞	—
⅜	⅝	1	½
½	⅝	1 3/16	9/16
⅝	¾	1¼	9/16
¾	⅞	1½	9/16
1	1	1⅞	—

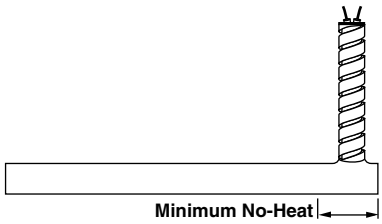
Right Angle Options

Made-to-Order Right Angle Leads

Made-to-order right angle leads are used when space is limited or a high degree of flexing occurs. However, these leads are externally connected (crimped) and insulated with fiberglass sleeving.

To order, specify **right angle leads** and **lead length**.

Dia. inches	Lead End Minimum No-Heat mm	(in.)
⅜	13	(½)
½	16	(⅝)
⅝	19	(¾)
¾	22	(⅞)

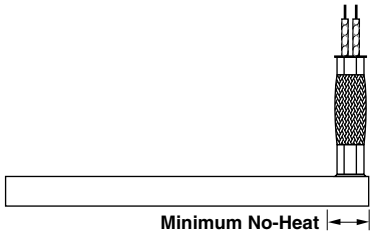


Made-to-Order Right Angle Stainless Steel Hose

Made-to-order right angle stainless steel hose, connected at a 90 degree angle, is provided for wiring convenience. Like the LA straight stainless steel hose, it protects leads from abrasion against sharp edges.

Unless specified, 305 mm (12 in.) hose is supplied. Leads are 51 mm (2 in.) longer than hose. Option is also available with Teflon® leads and seal. To order, specify **right angle stainless steel hose**.

Dia. inches	Lead End Minimum No-Heat mm	(in.)
⅜	16	(⅝)
½	21	(3/16)
⅝	22	(⅞)
¾	29	(1⅛)



Made-to-Order Right Angle Stainless Steel Braid

Made-to-order right angle stainless steel braid, connected at a 90 degree angle, is provided for wiring convenience. Like the LA straight stainless steel braid, it protects leads from abrasion against sharp edges.

Unless specified, 305 mm (12 in.) braid is supplied. Leads are 51 mm (2 in.) longer than braid. Option is also available with Teflon® leads and seal. To order, specify **right angle stainless steel braid**.

Dia. inches	Lead End Minimum No-Heat mm	(in.)
⅜	⅝	(16)
½	3/16	(17)
⅝	⅞	(22)
¾	1⅛	(29)

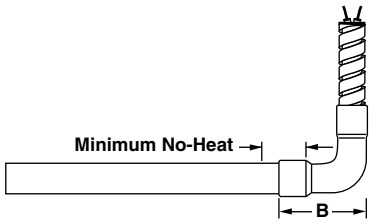
Hot Runner Nozzle Heaters

FIREROD Cartridge

Made-to-Order

Right Angle Options

Continued



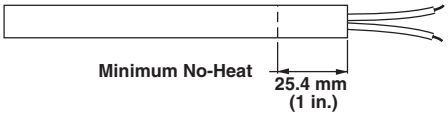
Made-to-Order Right Angle Galvanized BX Conduit

Galvanized BX conduit equals stainless steel hose in its abrasion protection. The conduit is attached with a crimped-on 90 degree elbow copper coupling which overlaps the heater sheath.

The 6 mm (0.25 in.) diameter FIRERODs use stainless steel hose instead of conduit. On 25 mm (1 in.) diameter FIRERODs, one inch O.D. flexible galvanized hose is used.

Dia. inches	No-Heat	Dim. inches	BX O.D.
¼	½	1 1/16	—
⅜	⅝	1⅜	½
½	⅝	1⅝	9/16
⅝	¾	2 1/16	9/16
¾	⅞	2⅛	9/16
1	1	2⅛	—

Moisture Resistant Seals

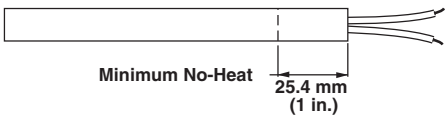


Teflon® Seal and Leads

Made-to-order Teflon® seal and leads protect the heater against moisture/ contamination from lubricating oil, cleaning solvents, plastic material or fumes and organic tapes. This seal is effective to 205°C (400°F) under continuous operation.

Teflon® seal and leads for made-to-order FIRERODs greater than 250 mm (10 in.) long will have a minimum unheated section of approximately 12 percent of the overall length. Longer no-heat sections are available if required.

Additional no-heat may be required to keep the seal below its maximum operating temperature.

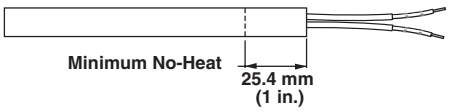


Silicone Rubber Seal and Leads

Made-to-order silicone rubber seal and leads protect the heater against moisture/ contamination from lubricating oil, cleaning solvents, plastic material or fumes and organic tapes. This seal is effective to 230°C (450°F) under continuous operation.

Silicone rubber seal and leads for made-to-order units greater than 250 mm (10 in.) long will have a minimum unheated section of approximately 12 percent of the overall length. Longer no-heat sections are available if required.

Termination Options

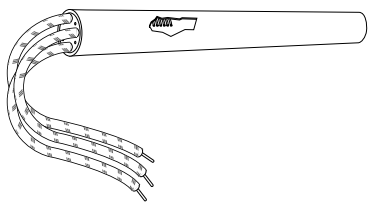


Epoxy Seal

Epoxy seals help protect the heater against moisture/contamination from lubricating oil, cleaning solvents, plastic material or fumes and organic tapes. These seals are effective to 260°C (500°F) under continuous operation.

Epoxy seals can be ordered only on units greater than 3 mm (0.125 in.) diameter with crimped on leads. Minimum unheated section at the lead end is 25 mm (1 in.). Longer unheated sections are available upon request.

To order, specify **epoxy seal**.



Ground Lead

Ground leads are a safety feature to protect both workers and equipment. This configuration is not available on all options. Consult the Watlow factory in St. Louis, Missouri, for additional information. To order, specify **ground lead**.

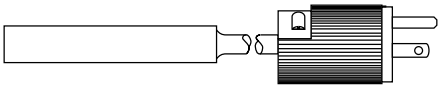
Hot Runner Nozzle Heaters

FIREROD Cartridge

Made-to-Order

Termination Options

Continued



UL® Listed Plugs

UL® listed plugs are a safe, convenient method of installation, especially when frequent connection or disconnection is required. These plugs have a nylon dead front, a molded-in cord grip and either straight or Twist-Lock® blades with or without ground.

Use UL® listed plugs with stainless steel hose, conduit, braid or lead wires with sleeving. To order, specify **UL® listed plugs**.

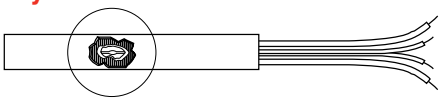
Options

Thermocouple Types

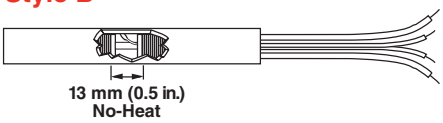
ASTM Code	Conductor Characteristics		Temperature Range °C (°F)
	Positive	Negative	
J	Iron (Magnetic) (White)	Constantan (Non-Magnetic) (Red)	-20 to 760 (0 to 1400)
K	Chromel® (Non-Magnetic) (Yellow)	Alumel® (Magnetic) (Red)	-20 to 1260 (0 to 2300)

For other ISA types, contact the Watlow factory in St. Louis, Missouri.

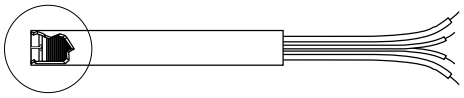
Style A



Style B



Style C



Internal Thermocouple

A Style A internal thermocouple can be used to evaluate heat transfer efficiency of an application … a measure that enables you to cut energy costs and increase heater life. This junction is located in the heater core to monitor the internal temperature of the heater.

The Style B internal thermocouple gives a good approximation of part temperature and can be located anywhere along the length of the heater. This style may be grounded or ungrounded.

This junction is located adjacent to the inside heater sheath in the center of the heated section unless other wise specified. A 13 mm (0.5 in.) unheated section is required.

A Style C internal thermocouple is useful in applications where material flows past the end of the heater, such as plastic molding. This junction is embedded in a special end disc. Unless requested, the disc end is not mechanically sealed.

To order, specify **internal thermocouple**, **Style A, B** or **C** and **thermocouple ASTM Type J** or **K**.

If not specified, 305 mm (12 in.) power and thermocouple leads are supplied.

Availability

All styles are available on all diameters with the exception of 3 mm (0.125 in.) diameter, which is available only with Style C.

Low Electrical Leakage

This construction technique minimizes current leakage of the heating element. It is especially useful in critical applications, like the medical field where low set point ground fault interrupts are used.

Low electrical leakage is available on 9, 13, 16 and 19 mm (0.375, 0.5, 0.625 and 0.75 in.) diameter FIRERODs. To order, specify **low electrical leakage**.

Twist-Lock® is a registered trademark of Hubbell Incorporated.

Alumel® and Chromel® are registered trademarks of Hoskins Manufacturing Co.

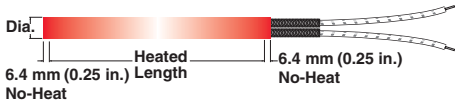
Hot Runner Nozzle Heaters

FIREROD Cartridge

Made-to-Order

Options

Internal Construction



Distributed Wattage

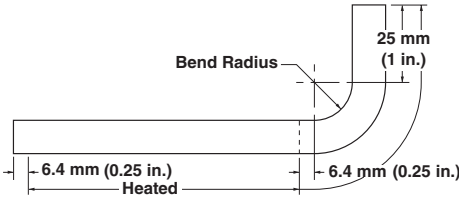
Distributed wattage varies the watt density along the length of the heater. This construction technique is used to compensate for heat losses along the edges of heated parts. This is ideal for seal bar applications.

To order, specify **distributed wattage** and give the length and wattage for each section.

Individually Controlled Heat Zones

Individually controlled heat zones give the flexibility of controlling temperature by zones, along the length of the FIREROD. This is an advantage for heating requirements of certain applications, like sealing bars. This internal construction can be ordered on 16, 19 and 25 mm (0.625, 0.75 and 1 in.) diameter FIRERODs. To order, specify **individually controlled heat zones** as well as wattage and length per zone.

Bent FIREROD



FIREROD Diameter in.	Minimum Required No-Heat Length mm	(in.)	Bend Radius mm	(in.)
¼	56	(2 ¼)	13	(½)
⅜	60	(2 ⅜)	13	(½)
½	72	(2 ⅞)	19	(¾)
⅝	83	(3 5⁄16)	25	(1)
¾	98	(3 13⁄16)	32	(1 ¼)

In applications where the leads must exit at an angle, a bend can be made in the unheated section only. Heated sections may be on either side of the bend. It is recommended that the heater be bent at the Watlow factory.

A 304 stainless steel sheath is used on bent FIRERODs. If the sheath temperature exceeds 540°C (1000°F), consult your Watlow sales engineer or authorized distributor.

See dimensions noted on the chart, or contact the Watlow factory in St. Louis, Missouri, if you need to exceed limitations shown.

Centerless Grinding

FIREROD Diameter inches	Actual Precision Diameter inches
¼	0.241 ± 0.0005
⅜	0.363 ± 0.0005
½	0.488 ± 0.0005
⅝	0.613 ± 0.0005
¾	0.738 ± 0.0005
1	0.984 ± 0.0005

Centerless grinding can be used to furnish precision diameters, thus permitting closer heater-to-part fit. Therefore, higher watt densities can be used.

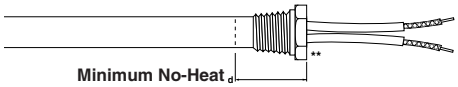
For centerless ground heaters, the heater must either have Teflon® leads and seal (maximum 305 mm (12 in.) lead length) or have crimped on leads. Longer lead lengths are available, but require external connection. The length of a FIREROD available for centerless grinding is dependent on the construction, please consult factory for assistance. To order, specify **centerless grinding**.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Made-to-Order

Mounting Options



Mounted at lead end, unless otherwise specified and welded or silver soldered, depending upon construction.

Threaded Fittings

Threaded fittings allow for fast, water-tight installation of the heater into a threaded hole. These fittings can be ordered in either brass or 304 stainless steel. Other stainless steel alloys are available upon request. Double threaded fittings are also available.

To order, specify either brass or stainless steel **threaded fittings**.

Made-to-order, specify location from disc end to bottom of threads.

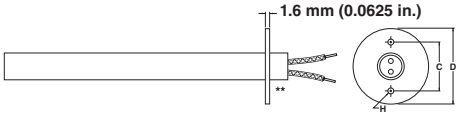
Made-to-Order Availability

FIREROD Diameter inches	Minimum No-Heat mm	(in.)
¼	19	(¾)
⅜	25	(1)
½	25	(1)
⅝	25	(1)
¾	32	(1 ¼)

Threaded Fittings Specifications

FIREROD Diameter inches	Pipe Thread Size NPTF	Fitting Length mm	(in.)
¼	⅛	13	(½)
⅜	¼	17	(11⁄16)
½	⅜	19	(¾)
⅝	½	22	(⅞)
¾	¾	23	(1)
1	1	25	(1)

Flanges



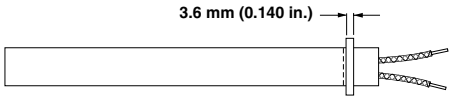
Stainless steel flanges are a convenient mounting method as well as a way to position a heater within an application. Standard location is 6 mm (0.25 in.) from lead end; however, a specific location may be requested any place on the unheated section. Flanges can be staked, soldered or welded.

To order, specify **flange**, size and location.

Flange Specifications

FIREROD Diameter inches	Flange Size	inches D	C	H
¼, ⅜, ½	FS	1	¾	0.144
¼, ⅜, ½ ⅝, ¾	FM	1 ½	1 ⅛	0.156
⅝, ¾, 1	FL	2	1 ½	0.201

Locating Ring



A stainless steel locating ring can be used as a retaining collar to position a FIREROD if mounting requirements are not critical.

To order, specify **locating ring** and location.

Diameter inches:	⅜	½	⅝	¾
Ring O.D. inches:	⅝	¾	⅞	1

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
3.18	(⅛)	31.8	(1 ¼)	120	25	13	(87)	0.009	(0.02)	Stock	**C1E14**
		31.8	(1 ¼)	120	50	18	(174)	0.009	(0.02)	Stock	**C1E13**
		31.8	(1 ¼)	240	35	27	(113)	0.009	(0.02)	Stock	**C1E42**
		38.1	(1 ½)	120	30	12	(78)	0.009	(0.02)	Stock	**C1J5**
		38.1	(1 ½)	120	60	24	(156)	0.009	(0.02)	Stock	**C1J6**
		50.8	(2)	120	50	13	(87)	0.009	(0.02)	Stock	**C2A4**
		50.8	(2)	120	100	27	(174)	0.009	(0.02)	Stock	**C2A5**
6.35	(¼)	25.4	(1)	120	80	32	(208)	0.009	(0.02)	Stock	**E1A51**
		25.4	(1)	120	100	40	(260)	0.009	(0.02)	Stock	**E1A52**
		25.4	(1)	120	150	60	(390)	0.009	(0.02)	Stock	**E1A53**
		25.4	(1)	240	100	39	(250)	0.009	(0.02)	Stock	**E1A66**
		31.8	(1 ¼)	120	75	20	(130)	0.009	(0.02)	Stock	**E1E41**
		31.8	(1 ¼)	120	100	27	(173)	0.009	(0.02)	Stock	**E1E42**
		31.8	(1 ¼)	120	150	40	(260)	0.009	(0.02)	Stock	**E1E43**
		31.8	(1 ¼)	240	225	60	(390)	0.009	(0.02)	Stock	**E1E61**
		38.1	(1 ½)	120	50	10	(65)	0.009	(0.02)	Stock	**E1J39**
		38.1	(1 ½)	120	100	20	(130)	0.009	(0.02)	Stock	**E1J40**
		38.1	(1 ½)	120	150	30	(195)	0.009	(0.02)	Stock	**E1J41**
		38.1	(1 ½)	240	175	35	(228)	0.009	(0.02)	Stock	**E1J49**
		38.1	(1 ½)	120	200	40	(260)	0.009	(0.02)	Stock	**E1J42**
		38.1	(1 ½)	240	200	40	(260)	0.009	(0.02)	Stock	**E1J52**
		38.1	(1 ½)	240	250	50	(325)	0.009	(0.02)	Stock	**E1J35**
		50.8	(2)	120	80	11	(68)	0.014	(0.03)	Stock	**E2A136**
		50.8	(2)	120	100	13	(87)	0.014	(0.03)	Stock	**E2A55**
		50.8	(2)	240	125	17	(108)	0.014	(0.03)	Stock	**E2A82**
		50.8	(2)	120	150	20	(130)	0.014	(0.03))	Stock	**E2A56**
		50.8	(2)	240	150	20	(130)	0.014	(0.03))	Stock	**E2A77**
		50.8	(2)	120	200	27	(173)	0.014	(0.03)	Stock	**E2A57**
		50.8	(2)	240	200	27	(173)	0.014	(0.03)	Stock	**E2A50**
		50.8	(2)	120	250	33	(217)	0.014	(0.03)	Stock	**E2A72**
		50.8	(2)	240	250	33	(215)	0.014	(0.03)	Stock	**E2A76**
		50.8	(2)	240	300	40	(260)	0.014	(0.03)	Stock	**E2A83**
		63.5	(2 ½)	120	250	25	(159)	0.014	(0.03)	Stock	**E2J80**
		63.5	(2 ½)	240	250	25	(159)	0.014	(0.03)	Stock	**E2J49**
		76.2	(3)	120	100	8	(52)	0.014	(0.03)	Stock	**E3A48**
		76.2	(3)	120	200	16	(104)	0.014	(0.03)	Stock	**E3A49**
		76.2	(3)	240	200	16	(104)	0.014	(0.03)	Stock	**E3A60**
		76.2	(3)	240	250	20	(128)	0.014	(0.03)	Stock	**E3A124**
		76.2	(3)	120	300	24	(156)	0.014	(0.03)	Stock	**E3A50**
		76.2	(3)	240	300	24	(156)	0.014	(0.03)	Stock	**E3A51**
		101.6	(4)	120	100	6	(37)	0.014	(0.03)	Stock	**E4A28**
		101.6	(4)	120	200	11	(74)	0.014	(0.03)	Stock	**E4A29**
		101.6	(4)	240	200	74	(11)	0.014	(0.03)	Stock	**E4A32**
		101.6	(4)	120	300	17	(111)	0.014	(0.03)	Stock	**E4A30**
		101.6	(4)	240	300	17	(111)	0.014	(0.03)	Stock	**E4A6**
		114.3	(4 ½)	120	200	10	(64)	0.023	(0.05)	Stock	**E4J30**
		127	(5)	240	350	16	(101)	0.023	(0.05)	Stock	**E5A45**
		127	(5)	120	400	18	(113)	0.023	(0.05)	Stock	**E5A57**
		127	(5)	240	400	18	(113)	0.023	(0.05)	Stock	**E5A34**
		152.4	(6)	240	400	14	(94)	0.027	(0.06)	Stock	**E6A46**
		203.2	(8)	240	800	21	(136)	0.036	(0.08)	Stock	**E8A76**

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Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
9.53	(⅜)	25.4	(1)	120	55	15	(95)	0.014	(0.03)	Stock	**G1A71**
		25.4	(1)	120	100	172	(26)	0.014	(0.03)	Stock	**G1A29** ①
		25.4	(1)	120	150	40	(259)	0.014	(0.03)	Stock	**G1A38** ①
		25.4	(1)	240	200	53	(344)	0.014	(0.03)	Stock	**G1A83**
		31.8	(1 ¼)	120	100	18	(115)	0.014	(0.03)	Stock	**G1E91**
		31.8	(1 ¼)	120	125	22	(144)	0.014	(0.03)	Stock	**G1E74**
		31.8	(1 ¼)	120	150	27	(172)	0.014	(0.03)	Stock	**G1E92** ①
		31.8	(1 ¼)	240	150	27	(172)	0.014	(0.03)	Stock	**G1E93**
		31.8	(1 ¼)	120	200	35	(230)	0.014	(0.03)	Stock	**G1E94**
		31.8	(1 ¼)	240	200	36	(230)	0.014	(0.03)	Stock	**G1E95**
		31.8	(1 ¼)	120	400	66	(426)	0.014	(0.03)	Stock	**G1E99**
		33.3	(1 5/16)	120	100	16	(104)	0.014	(0.03)	Stock	**G1F13**
		33.3	(1 5/16)	240	100	16	(104)	0.014	(0.03)	Stock	**G1F15**
		33.3	(1 5/16)	120	150	25	(160)	0.014	(0.03)	Stock	**G1F17**
		34.9	(1 ⅜)	240	160	23	(151)	0.014	(0.03)	Stock	**G1G23**
		36.5	(1 17/16)	120	100	15	(94)	0.014	(0.03)	Stock	**G1H6**
		38.1	(1 ½)	120	50	7	(43)	0.014	(0.03)	Stock	**G1J25**
		38.1	(1 ½)	120	75	10	(65)	0.014	(0.03)	Stock	**G1J70**
		38.1	(1 ½)	120	80	11	(68)	0.014	(0.03)	Stock	**G1J66**
		38.1	(1 ½)	120	100	13	(86)	0.014	(0.03)	Stock	**G1J59**
		38.1	(1 ½)	240	100	13	(86)	0.014	(0.03)	Stock	**G1J110**
		38.1	(1 ½)	240	125	16	(106)	0.014	(0.03)	Stock	**G1J182**
		38.1	(1 ½)	120	150	20	(129)	0.014	(0.03)	Stock	**G1J31**
		38.1	(1 ½)	240	150	20	(129)	0.014	(0.03)	Stock	**G1J39** ①
		38.1	(1 ½)	120	200	27	(173)	0.014	(0.03)	Stock	**G1J85**
		38.1	(1 ½)	240	200	27	(173)	0.014	(0.03)	Stock	**G1J73**
		38.1	(1 ½)	120	250	33	(216)	0.014	(0.03)	Stock	**G1J86**
		38.1	(1 ½)	240	250	33	(216)	0.014	(0.03)	Stock	**G1J54**
		44.5	(1 ¾)	120	125	13	(86)	0.023	(0.05)	Stock	**G1N45**
		44.5	(1 ¾)	120	175	19	(122)	0.023	(0.05)	Stock	**G1N46**
		44.5	(1 ¾)	120	250	27	(172)	0.023	(0.05)	Stock	**G1N43**
		44.5	(1 ¾)	240	250	27	(172)	0.023	(0.05)	Stock	**G1N32**
		46	(1 13/16)	240	150	15	(98)	0.023	(0.05)	Stock	**G1P14**
		46	(1 13/16)	120	200	20	(129)	0.023	(0.05)	Stock	**G1P15**
		46	(1 13/16)	240	250	25	(161)	0.023	(0.05)	Stock	**G1P11**
		47.6	(1 ⅞)	120	250	24	(152)	0.023	(0.05)	Stock	**G1R14**
		50.8	(2)	120	50	5	(29)	0.027	(0.06)	Stock	**G2A53**
		50.8	(2)	120	75	7	(42)	0.027	(0.06)	Stock	**G2A192**
		50.8	(2)	120	100	9	(57)	0.027	(0.06)	Stock	**G2A84**
		50.8	(2)	240	100	9	(57)	0.027	(0.06)	Stock	**G2A76**
		50.8	(2)	120	150	13	(86)	0.027	(0.06)	Stock	**G2A56** ①
		50.8	(2)	240	150	13	(86)	0.027	(0.06)	Stock	**G2A81** ①
		50.8	(2)	120	200	18	(115)	0.027	(0.06)	Stock	**G2A127** ①
		50.8	(2)	240	200	18	(115)	0.027	(0.06)	Stock	**G2A37** ①
		50.8	(2)	120	250	22	(144)	0.027	(0.06)	Stock	**G2A47**
		50.8	(2)	240	250	22	(144)	0.027	(0.06)	Stock	**G2A73**
		50.8	(2)	120	300	27	(172)	0.027	(0.06)	Stock	**G2A139**
		50.8	(2)	240	300	27	(172)	0.027	(0.06)	Stock	**G2A98** ①
		50.8	(2)	120	400	36	(230)	0.027	(0.06)	Stock	**G2A153**
		50.8	(2)	240	400	36	(230)	0.027	(0.06)	Stock	**G2A146**
		50.8	(2)	120	500	44	(282)	0.027	(0.06)	Stock	**G2A95**

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① MI leads available from stock. Add "Z" after Code No. to order. ex: GIJ39Z

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
9.53	(⅜)	50.8	(2)	240	500	44	(282)	0.027	(0.06)	Stock	**G2A97**
		54	(2 ⅛)	240	200	16	(106)	0.027	(0.06)	Stock	**G2C13**
		57.2	(2 ¼)	120	75	6	(37)	0.032	(0.07)	Stock	**G2E88**
		57.2	(2 ¼)	120	125	10	(62)	0.032	(0.07)	Stock	**G2E89**
		57.2	(2 ¼)	240	125	10	(62)	0.032	(0.07)	Stock	**G2E138**
		57.2	(2 ¼)	240	150	11	(73)	0.032	(0.07)	Stock	**G2E68**
		57.2	(2 ¼)	120	175	13	(86)	0.032	(0.07))	Stock	**G2E90**
		57.2	(2 ¼)	120	250	19	(123)	0.032	(0.07)	Stock	**G2E2**
		57.2	(2 ¼)	240	250	19	(123)	0.032	(0.07)	Stock	**G2E78**
		57.2	(2 ¼)	120	300	23	(148)	0.032	(0.07)	Stock	**G2E108**
		57.2	(2 ¼)	240	300	23	(148)	0.032	(0.07)	Stock	**G2E12**
		57.2	(2 ¼)	120	350	27	(173)	0.032	(0.07)	Stock	**G2E91**
		57.2	(2 ¼)	240	350	27	(173)	0.032	(0.07)	Stock	**G2E75**
		63.5	(2 ½)	120	200	13	(87)	0.032	(0.07)	Stock	**G2J110**
		63.5	(2 ½)	240	200	13	(87)	0.032	(0.07)	Stock	**G2J81**
		63.5	(2 ½)	120	250	17	(108)	0.032	(0.07)	Stock	**G2J46**
		63.5	(2 ½)	240	250	17	(108)	0.032	(0.07)	Stock	**G2J80**
		63.5	(2 ½)	120	300	20	(130)	0.032	(0.07)	Stock	**G2J118**
		63.5	(2 ½)	240	300	20	(130)	0.032	(0.07)	Stock	**G2J119**
		63.5	(2 ½)	120	400	27	(174)	0.032	(0.07)	Stock	**G2J26**
		63.5	(2 ½)	240	400	27	(174)	0.032	(0.07)	Stock	**G2J146**
		63.5	(2 ½)	120	500	33	(216)	0.032	(0.07)	Stock	**G2J109**
		63.5	(2 ½)	240	500	33	(216)	0.032	(0.07)	Stock	**G2J52**
		71.4	(2 13/16)	120	60	3	(22)	0.036	(0.08)	Stock	**G2P9**
		71.4	(2 13/16)	120	250	14	(92)	0.036	(0.08)	Stock	**G2P3**
		71.4	(2 13/16)	240	300	17	(110)	0.036	(0.08)	Stock	**G2P5**
		76.2	(3)	120	100	5	(34)	0.036	(0.08)	Stock	**G3A55**
		76.2	(3)	240	100	5	(34)	0.036	(0.08)	Stock	**G3A137**
		76.2	(3)	120	150	8	(52)	0.036	(0.08)	Stock	**G3A121**
		76.2	(3)	120	200	11	(69)	0.036	(0.08)	Stock	**G3A61**
		76.2	(3)	240	200	11	(69)	0.036	(0.08)	Stock	**G3A39** ①
		76.2	(3)	120	250	13	(86)	0.036	(0.08)	Stock	**G3A52**
		76.2	(3)	240	250	13	(86)	0.036	(0.08)	Stock	**G3A54**
		76.2	(3)	120	300	16	(104)	0.036	(0.08)	Stock	**G3A73** ①
		76.2	(3)	240	300	16	(104)	0.036	(0.08)	Stock	**G3A92**
		76.2	(3)	120	400	21	(138)	0.036	(0.08)	Stock	**G3A44**
		76.2	(3)	240	400	21	(138)	0.036	(0.08)	Stock	**G3A65**
		76.2	(3)	120	500	27	(173)	0.036	(0.08)	Stock	**G3A119** ①
		76.2	(3)	240	500	27	(173)	0.036	(0.08)	Stock	**G3A120**
		76.2	(3)	240	600	208	(32)	0.036	(0.08)	Stock	**G3A133**
		84.2	(3 5/16)	120	500	24	(152)	0.036	(0.08)	Stock	**G3F24**
		88.9	(3 ½)	120	250	11	(72)	0.041	(0.09)	Stock	**G3J77**
		88.9	(3 ½)	240	250	11	(72)	0.041	(0.09)	Stock	**G3J65**
		88.9	(3 ½)	120	300	13	(87)	0.041	(0.09)	Stock	**G3J87**
		88.9	(3 ½)	240	300	13	(87)	0.041	(0.09)	Stock	**G3J68**
		88.9	(3 ½)	120	500	22	(144)	0.041	(0.09)	Stock	**G3J22**
		88.9	(3 ½)	240	500	22	(144)	0.041	(0.09)	Stock	**G3J63**
		96.8	(3 13/16)	120	150	6	(38)	0.041	(0.09)	Stock	**G3P8**
		96.8	(3 13/16)	240	500	20	(128)	0.041	(0.09)	Stock	**G3P3**
		101.6	(4)	120	125	5	(31)	0.041	(0.09)	Stock	**G4A54**
		101.6	(4)	240	125	5	(31)	0.041	(0.09)	Stock	**G4A163**

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① MI leads available from stock. Add "Z" after Code No. to order.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
9.53	(⅜)	101.6	(4)	120	150	6	(37)	0.041	(0.09)	Stock	**G4A78**
		101.6	(4)	120	175	7	(43)	0.041	(0.09)	Stock	**G4A191**
		101.6	(4)	120	250	10	(62)	0.041	(0.09)	Stock	**G4A40**
		101.6	(4)	240	250	10	(62)	0.041	(0.09)	Stock	**G4A87**
		101.6	(4)	120	300	11	(74)	0.041	(0.09)	Stock	**G4A94**
		101.6	(4)	240	300	11	(74)	0.041	(0.09)	Stock	**G4A95**
		101.6	(4)	120	400	15	(99)	0.041	(0.09)	Stock	**G4A48**
		101.6	(4)	240	400	15	(99)	0.041	(0.09)	Stock	**G4A44**
		101.6	(4)	240	450	17	(109)	0.041	(0.09)	Stock	**G4A64**
		101.6	(4)	120	500	19	(123)	0.041	(0.09)	Stock	**G4A96**
		101.6	(4)	240	500	19	(123)	0.041	(0.09)	Stock	**G4A92** ①
		101.6	(4)	120	550	21	(134)	0.041	(0.09)	Stock	**G4A200**
		108	(4 ¼)	240	300	10	(67)	0.041	(0.09)	Stock	**G4E25**
		108	(4 ¼)	240	750	26	(167)	0.041	(0.09)	Stock	**G4E15**
		114.3	(4 ½)	120	300	10	(65)	0.045	(0.10)	Stock	**G4J54**
		114.3	(4 ½)	240	300	10	(65)	0.045	(0.10)	Stock	**G4J33**
		114.3	(4 ½)	120	500	17	(108)	0.045	(0.10)	Stock	**G4J55**
		114.3	(4 ½)	240	500	17	(108)	0.045	(0.10)	Stock	**G4J37**
		122.2	(4 13/16)	240	300	9	(59)	0.050	(0.11)	Stock	**G4P11**
		122.2	(4 13/16)	240	500	15	(98)	0.050	(0.11)	Stock	**G4P3**
		127	(5)	120	150	4	(29)	0.050	(0.11)	Stock	**G5A68**
		127	(5)	240	150	4	(29)	0.050	(0.11)	Stock	**G5A56**
		127	(5)	120	300	9	(58)	0.050	(0.11)	Stock	**G5A69**
		127	(5)	240	300	9	(58)	0.050	(0.11)	Stock	**G5A70** ①
		127	(5)	120	500	15	(96)	0.050	(0.11)	Stock	**G5A38**
		127	(5)	240	500	15	(96)	0.050	(0.11)	Stock	**G5A71** ①
		127	(5)	240	750	22	(144)	0.050	(0.11)	Stock	**G5A67**
		127	(5)	240	1000	301	(92)	0.050	(0.11)	Stock	**G5A115**
		133.4	(5 ¼)	240	200	7	(45)	0.054	(0.12)	Stock	**G5E16**
		139.7	(5 ½)	240	600	161	(04)	0.054	(0.12)	Stock	**G5J36**
		139.7	(5 ½)	240	1000	27	(173)	0.054	(0.12)	Stock	**G5J45**
		152.4	(6)	120	200	5	(31)	0.059	(0.13)	Stock	**G6A80**
		152.4	(6)	120	250	6	(39)	0.059	(0.13)	Stock	**G6A40** ①
		152.4	(6)	240	250	6	(39)	0.059	(0.13)	Stock	**G6A92**
		152.4	(6)	120	400	10	(63)	0.059	(0.13)	Stock	**G6A81**
		152.4	(6)	240	400	10	(63)	0.059	(0.13)	Stock	**G6A82**
		152.4	(6)	120	500	12	(79)	0.059	(0.13)	Stock	**G6A125**
		152.4	(6)	240	500	12	(79)	0.059	(0.13)	Stock	**G6A59**
		152.4	(6)	120	600	15	(94)	0.059	(0.13)	Stock	**G6A56**
		152.4	(6)	240	600	15	(94)	0.059	(0.13)	Stock	**G6A51**
		152.4	(6)	240	750	18	(117)	0.059	(0.13)	Stock	**G6A46**
		152.4	(6)	240	1000	24	(157)	0.059	(0.13)	Stock	**G6A83**
		165.1	(6 ½)	240	600	13	(86)	0.064	(0.14)	Stock	**G6J23**
		165.1	(6 ½)	240	1000	22	(144)	0.064	(0.14)	Stock	**G6J33**
		177.8	(7)	120	250	5	(33)	0.064	(0.14)	Stock	**G7A40**
		177.8	(7)	240	250	5	(33)	0.064	(0.14)	Stock	**G7A32**
		177.8	(7)	240	500	10	(65)	0.064	(0.14)	Stock	**G7A30**
		177.8	(7)	120	600	12	(80)	0.064	(0.14)	Stock	**G7A41**
		177.8	(7)	240	600	12	(80)	0.064	(0.14)	Stock	**G7A42** ①
		177.8	(7)	240	1000	21	(133)	0.064	(0.14)	Stock	**G7A43** ①
		190.5	(7 ½)	240	600	11	(74)	0.068	(0.15)	Stock	**G7J27** ①

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① MI leads available from stock. Add "Z" after Code No. to order.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
9.53	(⅜)	190.5	(7 ½)	240	1000	19	(124)	0.068	(0.15)	Stock	**G7J28**
		198.5	(7 13/16)	240	750	13	(87)	0.068	(0.15)	Stock	**G7P5**
		203.2	(8)	120	300	5	(34)	0.073	(0.16)	Stock	**G8A54**
		203.2	(8)	240	300	5	(34)	0.073	(0.16)	Stock	**G8A47**
		203.2	(8)	120	400	7	(45)	0.073	(0.16)	Stock	**G8A109**
		203.2	(8)	120	500	9	(58)	0.073	(0.16)	Stock	**G8A81**
		203.2	(8)	240	500	9	(58)	0.073	(0.16)	Stock	**G8A32**
		203.2	(8)	120	600	11	(69)	0.073	(0.16)	Stock	**G8A53**
		203.2	(8)	240	600	11	(69)	0.073	(0.16)	Stock	**G8A37**
		203.2	(8)	240	700	12	(79)	0.073	(0.16)	Stock	**G8A98**
		203.2	(8)	240	1000	18	(115)	0.073	(0.16)	Stock	**G8A45** ①
		219	(8 5/8)	240	500	8	(52)	0.077	(0.17)	Stock	**G8L3**
		228.6	(9)	240	1000	16	(100)	0.082	(0.18)	Stock	**G9A37**
		241.3	(9 ½)	240	600	9	(57)	0.086	(0.19)	Stock	**G9J20**
		241.3	(9 ½)	240	1000	15	(96)	0.086	(0.19)	Stock	**G9J12**
		254	(10)	120	400	6	(36)	0.086	(0.19)	Stock	**G10A48**
		254	(10)	120	600	8	(54)	0.086	(0.19)	Stock	**G10A35**
		254	(10)	240	600	8	(54)	0.086	(0.19)	Stock	**G10A31** ①
		254	(10)	240	1000	14	(91)	0.086	(0.19)	Stock	**G10A32**
		274.7	(10 13/16)	240	375	5	(31)	0.091	(0.20)	Stock	**G10P5**
		304.8	(12)	120	400	5	(30)	0.100	(0.22)	Stock	**G12A45**
		304.8	(12)	120	600	7	(45)	0.100	(0.22)	Stock	**G12A29**
		304.8	(12)	240	600	7	(45)	0.100	(0.22)	Stock	**G12A46**
		304.8	(12)	240	1000	12	(75)	0.100	(0.22)	Stock	**G12A47** ①
		325.5	(12 13/16)	240	1000	11	(69)	0.104	(0.23)	Stock	**G12P3**
12.70	(½)	25.4	(1)	120	50	10	(65)	0.027	(0.06)	Stock	**J1A30**
		25.4	(1)	120	150	30	(193)	0.027	(0.06)	Stock	**J1A31**
		31.8	(1 ¼)	120	50	7	(43)	0.032	(0.07)	Stock	**J1E50**
		31.8	(1 ¼)	120	125	17	(107)	0.032	(0.07)	Stock	**J1E51**
		31.8	(1 ¼)	240	125	17	(107)	0.032	(0.07)	Stock	**J1E58**
		31.8	(1 ¼)	240	200	27	(172)	0.032	(0.07)	Stock	**J1E52**
		31.8	(1 ¼)	240	250	33	(212)	0.032	(0.07)	Stock	**J1E88**
		38.1	(1 ½)	120	50	3	(32)	0.036	(0.08)	Stock	**J1J47**
		38.1	(1 ½)	120	150	15	(97)	0.036	(0.08)	Stock	**J1J48**
		38.1	(1 ½)	240	150	15	(97)	0.036	(0.08)	Stock	**J1J96**
		38.1	(1 ½)	120	200	20	(128)	0.036	(0.08)	Stock	**J1J59**
		38.1	(1 ½)	240	200	20	(128)	0.036	(0.08)	Stock	**J1J38**
		50.8	(2)	120	75	5	(32)	0.041	(0.09)	Stock	**J2A80**
		50.8	(2)	120	200	13	(86)	0.041	(0.09)	Stock	**J2A49**
		50.8	(2)	240	200	13	(86)	0.041	(0.09)	Stock	**J2A75**
		50.8	(2)	120	250	17	(108)	0.041	(0.09)	Stock	**J2A85**
		50.8	(2)	240	250	17	(108)	0.041	(0.09)	Stock	**J2A71** ①
		50.8	(2)	120	300	20	(128)	0.041	(0.09)	Stock	**J2A95**
		50.8	(2)	240	300	20	(128)	0.041	(0.09)	Stock	**J2A96**
		50.8	(2)	120	400	27	(171)	0.041	(0.09)	Stock	**J2A81**
		50.8	(2)	240	400	27	(171)	0.041	(0.09)	Stock	**J2A82**
		57.2	(2 ¼)	120	75	4	(28)	0.045	(0.10)	Stock	**J2E86**
		57.2	(2 ¼)	120	125	7	(46)	0.045	(0.10)	Stock	**J2E87**
		57.2	(2 ¼)	120	250	14	(92)	0.045	(0.10)	Stock	**J2E56**
		57.2	(2 ¼)	240	250	14	(92)	0.045	(0.10)	Stock	**J2E69**
		57.2	(2 ¼)	120	400	22	(147)	0.045	(0.10)	Stock	**J2E114**

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① MI leads available from stock. Add "Z" after Code No. to order.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
12.70	(½)	57.2	(2 ¼)	240	400	22	(147)	0.045	(0.10)	Stock	**J2E115**
		57.2	(2 ¼)	120	500	29	(184)	0.045	(0.10)	Stock	**J2E64**
		57.2	(2 ¼)	240	500	29	(184)	0.045	(0.10)	Stock	**J2E88**
		60.3	(2 ⅜)	120	100	5	(34)	0.045	(0.10)	Stock	**J2G35**
		60.3	(2 ⅜)	240	100	5	(34)	0.045	(0.10)	Stock	**J2G28**
		60.3	(2 ⅜)	120	250	13	(86)	0.045	(0.10)	Stock	**J2G34**
		60.3	(2 ⅜)	240	250	13	(86)	0.045	(0.10)	Stock	**J2G37**
		60.3	(2 ⅜)	120	500	27	(172)	0.045	(0.10)	Stock	**J2G36**
		60.3	(2 ⅜)	240	500	27	(172)	0.045	(0.10)	Stock	**J2G38**
		63.5	(2 ½)	120	100	5	(32)	0.050	(0.11)	Stock	**J2J67**
		63.5	(2 ½)	240	100	5	(32)	0.050	(0.11)	Stock	**J2J57**
		63.5	(2 ½)	120	250	13	(81)	0.050	(0.11)	Stock	**J2J68**
		63.5	(2 ½)	240	250	13	(81)	0.050	(0.11)	Stock	**J2J69**
		63.5	(2 ½)	120	300	15	(96)	0.050	(0.11)	Stock	**J2J109**
		63.5	(2 ½)	240	300	15	(96)	0.050	(0.11)	Stock	**J2J110**
		63.5	(2 ½)	120	400	20	(128)	0.050	(0.11)	Stock	**J2J81**
		63.5	(2 ½)	240	400	20	(128)	0.050	(0.11)	Stock	**J2J82**
		63.5	(2 ½)	120	500	24	(161)	0.050	(0.11)	Stock	**J2J66**
		63.5	(2 ½)	240	500	24	(161)	0.050	(0.11)	Stock	**J2J70**
		65.1	(2 9/16)	120	350	17	(108)	0.050	(0.11)	Stock	**J2K6**
		65.1	(2 9/16)	240	300	14	(93)	0.050	(0.11)	Stock	**J2K3**
		69.9	(2 ¾)	240	400	18	(115)	0.050	(0.11)	Stock	**J2N43**
		69.9	(2 ¾)	120	400	18	(115)	0.050	(0.11)	Stock	**J2N45**
		76.2	(3)	120	125	5	(32)	0.054	(0.12)	Stock	**J3A108**
		76.2	(3)	240	125	5	(32)	0.054	(0.12)	Stock	**J3A109**
		76.2	(3)	120	250	10	(64)	0.054	(0.12)	Stock	**J3A107**
		76.2	(3)	240	250	10	(64)	0.054	(0.12)	Stock	**J3A89**
		76.2	(3)	120	300	12	(78)	0.054	(0.12)	Stock	**J3A65**
		76.2	(3)	120	350	14	(89)	0.054	(0.12)	Stock	**J3A173**
		76.2	(3)	240	300	12	(78)	0.054	(0.12)	Stock	**J3A73**
		76.2	(3)	120	400	16	(104)	0.054	(0.12)	Stock	**J3A132**
		76.2	(3)	240	400	16	(104)	0.054	(0.12)	Stock	**J3A29**
		76.2	(3)	120	500	20	(129)	0.054	(0.12)	Stock	**J3A110**
		76.2	(3)	240	500	20	(129)	0.054	(0.12)	Stock	**J3A111**
		76.2	(3)	120	600	24	(154)	0.054	(0.12)	Stock	**J3A51**
		76.2	(3)	240	600	24	(154)	0.054	(0.12)	Stock	**J3A127**
		76.2	(3)	120	750	30	(193)	0.054	(0.12)	Stock	**J3A137**
		76.2	(3)	240	750	30	(193)	0.054	(0.12)	Stock	**J3A112**
		76.2	(3)	120	1000	39	(254)	0.054	(0.12)	Stock	**J3A79**
		88.9	(3 ½)	120	250	8	(54)	0.064	(0.14)	Stock	**J3J44**
		88.9	(3 ½)	240	250	8	(54)	0.064	(0.14)	Stock	**J3J64**
		88.9	(3 ½)	240	350	12	(75)	0.064	(0.14)	Stock	**J3J65**
		88.9	(3 ½)	120	500	17	(107)	0.064	(0.14)	Stock	**J3J45**
		88.9	(3 ½)	240	500	17	(107)	0.064	(0.14)	Stock	**J3J46**
		88.9	(3 ½)	240	750	25	(162)	0.064	(0.14)	Stock	**J3J63**
		96.8	(3 13/16)	120	500	15	(96)	0.068	(0.15)	Stock	**J3P9**
		96.8	(3 13/16)	240	250	7	(48)	0.068	(0.15)	Stock	**J3P2**
		101.6	(4)	120	150	4	(28)	0.068	(0.15)	Stock	**J4A117**
		101.6	(4)	240	150	4	(28)	0.068	(0.15)	Stock	**J4A122**
		101.6	(4)	120	250	7	(46)	0.068	(0.15)	Stock	**J4A118**
		101.6	(4)	240	250	7	(46)	0.068	(0.15)	Stock	**J4A90** ①

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① MI leads available from stock. Add "Z" after Code No. to order.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
12.70	(½)	101.6	(4)	120	300	9	(56)	0.068	(0.15)	Stock	**J4A63**
		101.6	(4)	240	300	9	(56)	0.068	(0.15)	Stock	**J4A26**
		101.6	(4)	120	350	10	(65)	0.068	(0.15)	Stock	**J4A1**
		101.6	(4)	240	350	10	(65)	0.068	(0.15)	Stock	**J4A103**
		101.6	(4)	120	400	11	(74)	0.068	(0.15)	Stock	**J4A139**
		101.6	(4)	240	400	11	(74)	0.068	(0.15)	Stock	**J4A68**
		101.6	(4)	120	500	14	(92)	0.068	(0.15)	Stock	**J4A16**
		101.6	(4)	120	550	16	(100)	0.068	(0.15)	Stock	**J4A242**
		101.6	(4)	240	500	14	(92)	0.068	(0.15)	Stock	**J4A92**
		101.6	(4)	120	750	21	(138)	0.068	(0.15)	Stock	**J4A198**
		101.6	(4)	240	750	21	(138)	0.068	(0.15)	Stock	**J4A119**
		101.6	(4)	240	1000	28	(184)	0.068	(0.15)	Stock	**J4A73**
		114.3	(4 ½)	120	500	12	(80)	0.077	(0.17)	Stock	**J4J69**
		114.3	(4 ½)	240	500	12	(80)	0.077	(0.17)	Stock	**J4J57**
		114.3	(4 ½)	120	750	19	(120)	0.077	(0.17)	Stock	**J4J70**
		114.3	(4 ½)	240	750	19	(120)	0.077	(0.17)	Stock	**J4J32**
		122.2	(4 13/16)	240	300	7	(44)	0.086	(0.19)	Stock	**J4P3**
		122.2	(4 13/16)	240	1000	23	(148)	0.086	(0.19)	Stock	**J4P6**
		127	(5)	120	200	4	(29)	0.086	(0.19)	Stock	**J5A85**
		127	(5)	240	200	4	(29)	0.086	(0.19)	Stock	**J5A74**
		127	(5)	120	350	8	(50)	0.086	(0.19)	Stock	**J5A86**
		127	(5)	240	350	8	(50)	0.086	(0.19)	Stock	**J5A63**
		127	(5)	120	400	9	(58)	0.086	(0.19)	Stock	**J5A98**
		127	(5)	240	400	9	(58)	0.086	(0.19)	Stock	**J5A46**
		127	(5)	120	500	11	(72)	0.086	(0.19)	Stock	**J5A52**
		127	(5)	240	500	11	(72)	0.086	(0.19)	Stock	**J5A45** ①
		127	(5)	120	750	17	(108)	0.086	(0.19)	Stock	**J5A121**
		127	(5)	240	750	17	(108)	0.086	(0.19)	Stock	**J5A72**
		127	(5)	240	1000	22	(143)	0.086	(0.19)	Stock	**J5A87**
		139.7	(5 ½)	240	200	4	(25)	0.091	(0.20)	Stock	**J5J3**
		139.7	(5 ½)	120	500	10	(64)	0.091	(0.20)	Stock	**J5J43**
		139.7	(5 ½)	240	500	10	(64)	0.091	(0.20)	Stock	**J5J33**
		139.7	(5 ½)	240	650	13	(83)	0.091	(0.20)	Stock	**J5J69**
		139.7	(5 ½)	120	750	15	(97)	0.091	(0.20)	Stock	**J5J44**
		139.7	(5 ½)	240	750	15	(97)	0.091	(0.20)	Stock	**J5J45**
		146	(5 ¾)	120	700	13	(86)	0.091	(0.20)	Stock	**J5N6**
		146	(5 ¾)	240	700	13	(86)	0.091	(0.20)	Stock	**J5N8**
		147.6	(5 13/16)	240	300	6	(36)	0.095	(0.21)	Stock	**J5P10**
		152.4	(6)	120	250	4	(29)	0.095	(0.21)	Stock	**J6A114**
		152.4	(6)	240	250	4	(29)	0.095	(0.21)	Stock	**J6A171**
		152.4	(6)	240	300	6	(35)	0.095	(0.21)	Stock	**J6A66**
		152.4	(6)	240	350	7	(41)	0.095	(0.21)	Stock	**J6A119**
		152.4	(6)	120	500	9	(59)	0.095	(0.21)	Stock	**J6A115**
		152.4	(6)	240	500	9	(59)	0.095	(0.21)	Stock	**J6A94** ①
		152.4	(6)	480	500	9	(59)	0.095	(0.21)	Stock	**J6A301**②
		152.4	(6)	120	750	14	(88)	0.095	(0.21)	Stock	**J6A99**
		152.4	(6)	240	750	14	(88)	0.095	(0.21)	Stock	**J6A90**
		152.4	(6)	120	1000	18	(117)	0.095	(0.21)	Stock	**J6A53**
		152.4	(6)	240	1000	18	(117)	0.095	(0.21)	Stock	**J6A36** ①
		165.1	(6 ½)	240	500	8	(54)	0.104	(0.23)	Stock	**J6J45**
		165.1	(6 ½)	240	1000	17	(108)	0.104	(0.23)	Stock	**J6J27** ①

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① MI leads available from stock. Add "Z" after Code No. to order.
② Units with 480 volts cannot be supplied with LA lead terminations.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
12.70	(½)	177.8	(7)	120	250	4	(25)	0.109	(0.24)	Stock	**J7A79**
		177.8	(7)	120	500	8	(50)	0.109	(0.24)	Stock	**J7A80**
		177.8	(7)	240	500	8	(50)	0.109	(0.24)	Stock	**J7A57**
		177.8	(7)	120	600	9	(60)	0.109	(0.24)	Stock	**J7A50**
		177.8	(7)	240	600	9	(60)	0.109	(0.24)	Stock	**J7A95**
		177.8	(7)	240	1000	15	(99)	0.109	(0.24)	Stock	**J7A81**
		190.5	(7 ½)	240	500	7	(46)	0.118	(0.26)	Stock	**J7J25**
		190.5	(7 ½)	240	1000	14	(92)	0.118	(0.26)	Stock	**J7J26**
		203.2	(8)	120	300	4	(26)	0.127	(0.28)	Stock	**J8A71**
		203.2	(8)	240	300	4	(26)	0.127	(0.28)	Stock	**J8A111**
		203.2	(8)	120	500	7	(43)	0.127	(0.28)	Stock	**J8A64**
		203.2	(8)	240	500	7	(43)	0.127	(0.28)	Stock	**J8A66**
		203.2	(8)	120	1000	13	(86)	0.127	(0.28)	Stock	**J8A84**
		203.2	(8)	240	1000	13	(86)	0.127	(0.28)	Stock	**J8A60**
		203.2	(8)	480	1000	13	(86)	0.127	(0.28)	Stock	**J8A35** ②
		203.2	(8)	240	1500	20	(129)	0.127	(0.28)	Stock	**J8A100**
		203.2	(8)	240	2000	27	(172)	0.127	(0.28)	Stock	**J8A101** ①
		215.9	(8 ½)	240	300	4	(24)	0.132	(0.29)	Stock	**J8J39**
		215.9	(8 ½)	240	500	6	(40)	0.132	(0.29)	Stock	**J8J30**
		215.9	(8 ½)	240	1000	12	(80)	0.132	(0.29)	Stock	**J8J28**
		228.6	(9)	240	500	6	(38)	0.136	(0.30)	Stock	**J9A35**
		228.6	(9)	240	1000	12	(76)	0.136	(0.30)	Stock	**J9A58**
		241.3	(9 ½)	240	500	6	(36)	0.145	(0.32)	Stock	**J9J14**
		241.3	(9 ½)	240	1000	11	(72)	0.145	(0.32)	Stock	**J9J12** ①
		254	(10)	120	500	5	(34)	0.150	(0.33)	Stock	**J10A61**
		254	(10)	240	500	5	(34)	0.150	(0.33)	Stock	**J10A62**
		254	(10)	120	1000	11	(68)	0.150	(0.33)	Stock	**J10A63**
		254	(10)	240	1000	11	(68)	0.150	(0.33)	Stock	**J10A42**
		254	(10)	240	1500	16	(102)	0.150	(0.33)	Stock	**J10A33**
		254	(10)	240	2000	21	(136)	0.150	(0.33)	Stock	**J10A64** ①
		279.4	(11)	240	1000	9	(61)	0.163	(0.36)	Stock	**J11A60**
		304.8	(12)	120	500	4	(28)	0.181	(0.40)	Stock	**J12A63**
		304.8	(12)	240	500	4	(28)	0.181	(0.40)	Stock	**J12A76**
		304.8	(12)	120	1000	9	(56)	0.181	(0.40)	Stock	**J12A40**
		304.8	(12)	240	1000	9	(56)	0.181	(0.40)	Stock	**J12A49**
		304.8	(12)	480	1200	10	(66)	0.181	(0.40)	Stock	**J12A215** ②
		304.8	(12)	240	1500	13	(84)	0.181	(0.40)	Stock	**J12A37**
		304.8	(12)	240	2000	17	(112)	0.181	(0.40)	Stock	**J12A89**
		355.6	(14)	240	1000	7	(48)	0.218	(0.48)	Stock	**J14A41**
		355.6	(14)	240	2300	17	(110)	0.218	(0.48)	Stock	**J14A39**
		381	(15)	240	1500	10	(66)	0.227	(0.50)	Stock	**J15A19**
		406.4	(16)	240	1000	7	(41)	0.236	(0.52)	Stock	**J16A12**
		457.2	(18)	240	1500	9	(55)	0.259	(0.57)	Stock	**J18A19**
		457.2	(18)	240	1700	9	(62)	0.259	(0.57)	Stock	**J18A23**
15.88	(⅝)	31.8	(1 ½)	120	50	5	(34)	0.045	(0.10)	Stock	**L1E26**
		31.8	(1 ½)	120	200	21	(137)	0.045	(0.10)	Stock	**L1E24**
		31.8	(1 ½)	120	250	27	(171)	0.045	(0.10)	Stock	**L1E27**
		38.1	(1 ½)	120	250	20	(128)	0.050	(0.11)	Stock	**L1J23**
		38.1	(1 ½)	240	250	20	(128)	0.050	(0.11)	Stock	**L1J24**
		50.8	(2)	120	100	5	(34)	0.059	(0.13)	Stock	**L2A48**

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① MI leads available from stock. Add "Z" after Code No. to order.
② Units with 480 volts cannot be supplied with LA lead terminations.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
15.88	(⅝)	50.8	(2)	120	200	11	(68)	0.059	(0.13)	Stock	**L2A49**
		50.8	(2)	240	500	26	(170)	0.059	(0.13)	Stock	**L2A54**
		57.2	(2 ¼)	120	100	4	(29)	0.064	(0.14)	Stock	**L2E49**
		57.2	(2 ¼)	120	250	11	(73)	0.064	(0.14)	Stock	**L2E50**
		57.2	(2 ¼)	240	250	11	(73)	0.064	(0.14)	Stock	**L2E12**
		57.2	(2 ¼)	120	350	16	(103)	0.064	(0.14)	Stock	**L2E40**
		57.2	(2 ¼)	240	350	16	(103)	0.064	(0.14)	Stock	**L2E51**
		60.3	(2 ⅜)	120	280	12	(77)	0.073	(0.16)	Stock	**L2G18**
		60.3	(2 ⅜)	240	280	12	(77)	0.073	(0.16)	Stock	**L2G19**
		76.2	(3)	120	150	5	(31)	0.091	(0.20)	Stock	**L3A81**
		76.2	(3)	120	250	8	(51)	0.091	(0.20)	Stock	**L3A82**
		76.2	(3)	240	250	8	(51)	0.091	(0.20)	Stock	**L3A9**
		76.2	(3)	120	400	13	(81)	0.091	(0.20)	Stock	**L3A94**
		76.2	(3)	120	500	16	(102)	0.091	(0.20)	Stock	**L3A113**
		76.2	(3)	240	500	16	(103)	0.091	(0.20)	Stock	**L3A33**
		76.2	(3)	240	750	24	(154)	0.091	(0.20)	Stock	**L3A71**
		95.3	(3 ¾)	120	525	13	(82)	0.109	(0.24)	Stock	**L3N12**
		95.3	(3 ¾)	240	525	13	(82)	0.109	(0.24)	Stock	**L3N1**
		101.6	(4)	120	250	6	(37)	0.118	(0.26)	Stock	**L4A99**
		101.6	(4)	240	250	6	(37)	0.118	(0.26)	Stock	**L4A104**
		101.6	(4)	240	400	9	(58)	0.118	(0.26)	Stock	**L4A47**
		101.6	(4)	240	500	11	(73)	0.118	(0.26)	Stock	**L4A53**
		101.6	(4)	240	600	14	(88)	0.118	(0.26)	Stock	**L4A44**
		101.6	(4)	240	750	17	(110)	0.118	(0.26)	Stock	**L4A100**
		101.6	(4)	240	1000	23	(146)	0.118	(0.26)	Stock	**L4A71**
		127	(5)	120	250	4	(28)	0.132	(0.29)	Stock	**L5A76**
		127	(5)	240	250	4	(28)	0.132	(0.29)	Stock	**L5A107**
		127	(5)	240	500	9	(57)	0.132	(0.29)	Stock	**L5A24**
		127	(5)	240	750	13	(86)	0.132	(0.29)	Stock	**L5A31**
		127	(5)	240	1000	18	(114)	0.132	(0.29)	Stock	**L5A77**
		85.7	(5 ⅜)	120	800	13	(84)	0.136	(0.30)	Stock	**L5G3**
		85.7	(5 ⅜)	240	800	13	(84)	0.136	(0.30)	Stock	**L5G1**
		152.4	(6)	120	300	4	(28)	0.154	(0.34)	Stock	**L6A28**
		152.4	(6)	240	300	4	(28)	0.154	(0.34)	Stock	**L6A64**
		152.4	(6)	240	500	7	(47)	0.154	(0.34)	Stock	**L6A73** ①
		152.4	(6)	240	750	11	(70)	0.154	(0.34)	Stock	**L6A70**
		152.4	(6)	240	1000	14	(93)	0.154	(0.34)	Stock	**L6A71** ①
		152.4	(6)	120	1500	22	(139)	0.154	(0.34)	Stock	**L6A163**
		152.4	(6)	240	1500	22	(140)	0.154	(0.34)	Stock	**L6A94** ①
		165.1	(6 ½)	120	500	7	(43)	0.172	(0.38)	Stock	**L6J43**
		165.1	(6 ½)	240	500	7	(43)	0.172	(0.38)	Stock	**L6J55**
		177.8	(7)	120	500	6	(39)	0.181	(0.40)	Stock	**L7A42**
		177.8	(7)	240	500	6	(39)	0.181	(0.40)	Stock	**L7A15** ①
		177.8	(7)	240	1000	12	(79)	0.181	(0.40)	Stock	**L7A37** ①
		177.8	(7)	240	1500	18	(118)	0.181	(0.40)	Stock	**L7A12** ①
		203.2	(8)	120	500	5	(34)	0.213	(0.47)	Stock	**L8A96** ①
		203.2	(8)	240	500	5	(34)	0.213	(0.47)	Stock	**L8A46** ①
		203.2	(8)	240	850	9	(58)	0.213	(0.47)	Stock	**L8A115** ①
		203.2	(8)	240	1000	10	(68)	0.213	(0.47)	Stock	**L8A10** ①
		203.2	(8)	240	1500	16	(102)	0.213	(0.47)	Stock	**L8A37** ①
		203.2	(8)	240	2000	21	(137)	0.213	(0.47)	Stock	**L8A80** ①

CONTINUED

① MI leads available from stock. Add "Z" after Code No. to order.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
15.88	(⅝)	254	(10)	120	500	4	(27)	0.240	(0.53)	Stock	**L10A51**
		254	(10)	240	500	4	(27)	0.240	(0.53)	Stock	**L10A40** ①
		254	(10)	240	750	6	(40)	0.240	(0.53)	Stock	**L10A69**
		254	(10)	240	1000	8	(54)	0.240	(0.53)	Stock	**L10A52** ①
		254	(10)	480	1000	8	(54)	0.240	(0.53)	Stock	**L10A193** ②
		254	(10)	240	1500	13	(81)	0.240	(0.53)	Stock	**L10A8** ①
		254	(10)	240	2000	17	(108)	0.240	(0.53)	Stock	**L10A50** ①
		304.8	(12)	120	500	3	(22)	0.300	(0.66)	Stock	**L12A81** ①
		304.8	(12)	240	500	3	(22)	0.300	(0.66)	Stock	**L12A80** ①
		304.8	(12)	240	900	6	(40)	0.300	(0.66)	Stock	**L12A102**
		304.8	(12)	120	1000	7	(45)	0.300	(0.66)	Stock	**L12A82** ①
		304.8	(12)	240	1000	7	(45)	0.300	(0.66)	Stock	**L12A34** ①
		304.8	(12)	120	1500	10	(66)	0.300	(0.66)	Stock	**L12A147**
		304.8	(12)	240	1500	10	(67)	0.300	(0.66)	Stock	**L12A39** ①
		304.8	(12)	240	2000	14	(89)	0.300	(0.66)	Stock	**L12A63** ①
		355.6	(14)	240	3700	22	(140)	0.358	(0.79)	Stock	**L14A21**
		381	(15)	240	750	4	(27)	0.381	(0.84)	Stock	**L15A35** ①
		381	(15)	240	2400	13	(84)	0.381	(0.84)	Stock	**L15A20**
		381	(15)	480	2500	14	(88)	0.381	(0.84)	Stock	**L15A88** ②
		381	(15)	240	4000	22	(141)	0.381	(0.84)	Stock	**L15A41**
		406.4	(16)	240	2500	13	(82)	0.412	(0.91)	Stock	**L16A33**
		406.4	(16)	240	4500	23	(148)	0.412	(0.91)	Stock	**L16A40**
		457.2	(18)	240	1500	7	(44)	0.467	(1.03)	Stock	**L18A32**
		457.2	(18)	240	3000	13	(87)	0.467	(1.03)	Stock	**L18A34**
		457.2	(18)	240	4700	21	(137)	0.467	(1.03)	Stock	**L18A36**
		508	(20)	240	1500	6	(40)	0.567	(1.25)	Stock	**L20A19** ①
		508	(20)	240	3500	14	(92)	0.567	(1.25)	Stock	**L20A13**
		508	(20)	480	3500	14	(92)	0.567	(1.25)	Stock	**L20A96** ②
		508	(20)	240	4700	19	(123)	0.567	(1.25)	Stock	**L20A14**
		609.6	(24)	240	2000	7	(44)	0.667	(1.47)	Stock	**L24A19** ①
		609.6	(24)	240	4700	15	(102)	0.667	(1.47)	Stock	**L24A14**
		914.4	(36)	240	3000	7	(43)	2.30	(1.04)	Stock	**L36A8**
19.05	(¾)	57.2	(2 ¼)	120	200	8	(49)	0.086	(0.19)	Stock	**N2E8**
		76.2	(3)	120	250	7	(43)	0.109	(0.24)	Stock	**N3A11**
		76.2	(3)	240	500	13	(85)	0.109	(0.24)	Stock	**N3A12** ①
		101.6	(4)	120	250	5	(31)	0.141	(0.31)	Stock	**N4A16** ①
		101.6	(4)	240	500	9	(61)	0.141	(0.31)	Stock	**N4A17** ①
		101.6	(4)	240	1000	19	(122)	0.141	(0.31)	Stock	**N4A15**
		127	(5)	120	300	4	(28)	0.172	(0.38)	Stock	**N5A19**
		127	(5)	240	500	7	(47)	0.172	(0.38)	Stock	**N5A12** ①
		127	(5)	240	1000	15	(95)	0.172	(0.38)	Stock	**N5A20** ①
		152.4	(6)	120	500	6	(39)	0.200	(0.44)	Stock	**N6A19**
		152.4	(6)	240	500	6	(39)	0.200	(0.44)	Stock	**N6A20** ①
		152.4	(6)	240	1000	12	(78)	0.200	(0.44)	Stock	**N6A21** ①
		152.4	(6)	480	1000	12	(78)	0.200	(0.44)	Stock	**N6A225** ②
		152.4	(6)	240	1500	18	(116)	0.200	(0.44)	Stock	**N6A82**
		152.4	(6)	240	2000	24	(155)	0.200	(0.44)	Stock	**N6A22** ①
		177.8	(7)	120	500	5	(33)	0.231	(0.51)	Stock	**N7A15**
		177.8	(7)	240	500	5	(33)	0.231	(0.51)	Stock	**N7A1** ①
		177.8	(7)	240	1000	10	(66)	0.231	(0.51)	Stock	**N7A16** ①
		203.2	(8)	120	500	4	(28)	0.263	(0.58)	Stock	**N8A19**

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① MI leads available from stock. Add "Z" after Code No. to order.
② Units with 480 volts cannot be supplied with LA lead terminations.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.
19.05	(¾)	203.2	(8)	240	500	4	(28)	0.263	(0.58)	Stock	**N8A20** ①
		203.2	(8)	240	1000	9	(57)	0.263	(0.58)	Stock	**N8A21** ①
		203.2	(8)	240	2000	17	(114)	0.263	(0.58)	Stock	**N8A22** ①
		254	(10)	240	1000	7	(45)	0.327	(0.72)	Stock	**N10A15** ①
		254	(10)	240	2000	14	(90)	0.327	(0.72)	Stock	**N10A14** ①
		304.8	(12)	240	1000	6	(37)	0.381	(0.84)	Stock	**N12A15** ①
		304.8	(12)	240	2000	11	(74)	0.381	(0.84)	Stock	**N12A24**
		304.8	(12)	480	2000	11	(74)	0.381	(0.84)	Stock	**N12A198** ②
		304.8	(12)	240	4000	23	(148)	0.381	(0.84)	Stock	**N12A25**
		304.8	(13)	240	1000	5	(34)	0.422	(0.93)	Stock	**N13A26** ①
		355.6	(14)	240	1250	6	(40)	0.467	(1.03)	Stock	**N14A22** ①
		355.6	(14)	240	2500	12	(79)	0.467	(1.03)	Stock	**N14A20**
		355.6	(14)	240	4500	22	(142)	0.467	(1.03)	Stock	**N14A21**
		381	(15)	240	1500	22	(44)	0.494	(1.09)	Stock	**N15A26** ①
		406.4	(16)	240	1800	8	(49)	0.517	(1.14)	Stock	**N16A26** ①
		406.4	(16)	240	4700	20	(129)	0.517	(1.14)	Stock	**N16A18**
		457.2	(18)	240	2000	8	(49)	0.567	(1.25)	Stock	**N18A13**
		457.2	(18)	240	5000	19	(122)	0.567	(1.25)	Stock	**N18A15**
		508	(20)	240	1150	4	(25)	0.635	(1.40)	Stock	**N20A21** ①
		508	(20)	240	2250	8	(49)	0.635	(1.40)	Stock	**N20A22** ①
		508	(20)	240	5250	18	(115)	0.635	(1.40)	Stock	**N20A10**
		609.6	(24)	240	1375	4	(25)	0.816	(1.80)	Stock	**N24A24**
		609.6	(24)	240	2750	8	(50)	0.816	(1.80)	Stock	**N24A23**
		609.6	(24)	480	2750	8	(50)	0.816	(1.80)	Stock	**N24A78** ②
		609.6	(24)	240	5500	16	(100)	0.816	(1.80)	Stock	**N24A13**
		914.4	(36)	240	2500	6	(30)	1.13	(2.50)	Stock	**N36A4**

① MI leads available from stock. Add “Z” after Code No. to order.
② Units with 480 volts cannot be supplied with LA lead terminations.

Hot Runner Nozzle Heaters

FIREROD Cartridge

Heaters for Hot Runner Systems

Diameter mm	Diameter (in.)	Sheath Length mm	Sheath Length (in.)	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Approx. Net Wt. kg	Approx. Net Wt. (lbs)	Availability	Code No.	Incoe® Part No.
9.53	(⅜)	44.5	(1 ¾)	240	200	22	(142)	0.041	(0.09)	Stock	**G1NX39E**	TJ38017
		50.8	(2)	240	250	24	(152)	0.041	(0.09)	Stock	**G2AX163B**	TJ38020
		63.5	(2 ½)	240	250	17	(112)	0.045	(0.10)	Stock	**G2JX131D**	TJ38025
		76.2	(3)	240	260	14	(92)	0.045	(0.10)	Stock	**G3AX238K**	TJ38030
		88.9	(3 ½)	240	320	14	(91)	0.054	(0.12)	Stock	**G3JX114K**	TJ38035
		101.6	(4)	240	370	14	(92)	0.054	(0.12)	Stock	**G4AX255D**	TJ38040
		114.3	(4 ½)	240	420	14	(90)	0.059	(0.13)	Stock	**G4JX84E**	TJ38045
		127	(5)	240	470	17	(108)	0.064	(0.14)	Stock	**G5AX183E**	TJ38050
		139.7	(5 ½)	240	525	14	(91)	0.068	(0.15)	Stock	**G5JX64C**	TJ38055
		152.4	(6)	240	575	14	(90)	0.068	(0.15)	Stock	**G6AX222D**	TJ38060
		165.1	(6 ½)	240	625	15	(93)	0.073	(0.16)	Stock	**G6JX34C**	TJ38065
		177.8	(7)	240	675	14	(92)	0.077	(0.17)	Stock	**G7AX105C**	TJ38070
		190.5	(7 ½)	240	725	16	(101)	0.082	(0.18)	Stock	**G7JX36D**	TJ38075
		203.2	(8)	240	775	14	(91)	0.086	(0.19)	Stock	**G8AX202C**	TJ38080
		88.9	(3 ½)	240	420	14	(92)	0.077	(0.17)	Stock	**J3JX103C**	TJ12035
		101.6	(4)	240	490	14	(90)	0.086	(0.19)	Stock	**J4AX372A**	TJ12040
		114.3	(4 ½)	240	550	12	(80)	0.091	(0.20)	Stock	**J4JX62C**	TJ12045
12.70	(½)	127	(5)	240	625	14	(89)	0.100	(0.22)	Stock	**J5AX178B**	TJ12050
		139.7	(5 ½)	240	700	14	(91)	0.104	(0.23)	Stock	**J5JX54B**	TJ12055
		152.4	(6)	240	775	16	(104)	0.113	(0.25)	Stock	**J6AX412A**	TJ12060
		165.1	(6 ½)	240	850	16	(104)	0.118	(0.26)	Stock	**J6JX45C**	TJ12065
		190.5	(7 ½)	240	975	16	(100)	0.132	(0.29)	Stock	**J7JX88A**	TJ12075

Note: All heaters have Type J thermocouple in location C and 914 mm (36 in.) swaged-in leads.

Hot Runner Nozzle Heaters

Metric FIREROD® Cartridge

The Watlow FIREROD® not only set the industry standard for cartridge heaters, it continues making improvements in construction and design. Among those improvements is the metric FIREROD, a variation of the FIREROD cartridge heater which was built to meet the exacting specifications of the global plastics market.

Like its counterpart, the metric FIREROD consistently outperforms other cartridge heaters because of design solutions like its exclusive resistance wire winding process. Plus, details like bringing the resistance wire closer to the sheath, and compacting the MgO insulation, maximize heat transfer. The end result is longer service life and better efficiency.

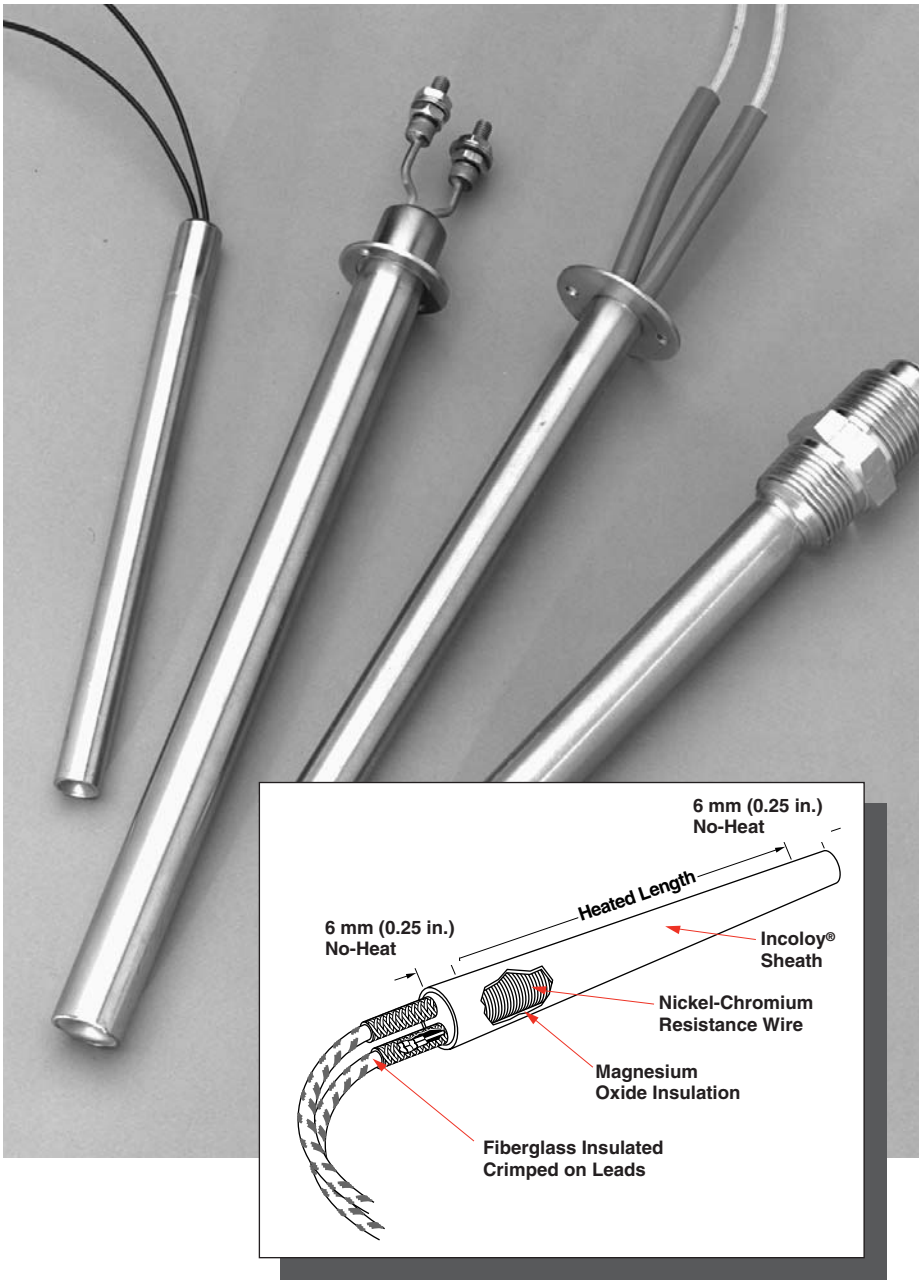
Performance Capabilities

- Part temperatures to 760°C (1400°F) on Incoloy® sheath
- Watt densities to 60 W/cm^2 (400 W/in^2)

Features and Benefits

- **Nickel-chromium resistance wire,** precisely wound and centered in the unit, assures even, efficient distribution of heat to the sheath.
- **Conductor pins** metallurgically bonded to the resistance wire ensure trouble-free electrical continuity.
- **Magnesium oxide insulation of specific grain and purity,** swaged to the proper density, results in high dielectric strength and contributes to faster heat-up.

*The metric FIREROD is currently manufactured and ordered in our Kronau, Germany facility.



- **Incoloy® sheath** resists oxidation and corrosion from chemicals, heat and atmospheres.
- **Minimal spacing between the element wire and sheath** results in lower internal temperature, giving you the ability to design with fewer or smaller heaters that operate at higher watt densities.

Applications

- Molds
- Hot runner nozzles

Hot Runner Nozzle Heaters

Metric FIREROD Cartridge

Applications and Technical Data

The Electrical Data table will assist you in selecting the correct metric FIREROD heater for your application, according to available voltage, amperage and wattage.

Electrical Data

Heater Diameter (mm)	6.5	8	10	12.5	16	20
Nominal Diameter (in.)	0.256	0.315	0.394	0.492	0.630	0.787
Maximum Voltage	250	250	250	400	480	480
Crimped-On Leads						
Maximum Amps	4.4	6.7	9.7	9.7	23	23
Maximum Wattage @ 230V	1010	1540	2230	2230	5290	5290
Maximum Wattage @ 400V				3880	9200	9200
Swaged-In Leads						
Maximum Amps	3.1/4.4 ①	4.4/7.2 ①	7.6/12.5	7.6/12.5 ①	7.6/12.5 ①	12.5/21
Maximum Wattage @ 230V	710/1010	1010/1560	1750/2875	1750/2875	1750/2875	2875/4830
Maximum Wattage @ 400V	—	—	—	3040/5000	3040/5000	5000/8400

① On certain lead constructions, maximum amperage is 3.1, 4.4, 7.6 or 12.5. In these instances, amperage is determined by internal construction and the current carrying capacity of internal parts to the lead wire. For more information about these amperage restrictions or higher current requirements, please contact your Watlow sales engineer or authorized distributor.

Tolerances

Diameter:

-0.02 mm, -0.08 mm (-0.0008 in., -0.0031 in.)

Length:

±2 percent with ±2.4 mm (±.0937 in.) minimum

Wattage:

+10 percent, -5 percent. Wattage decreases approximately five percent with temperature. Wattage tolerances are for heaters at operating temperature.

Resistance:

+5 percent, -10 percent. Resistance is measured at room temperature following first heater operation.

Camber:

0.25 mm (0.01 in.) maximum on any length to 300 mm (12 in.). For lengths over 300 mm:

$$\frac{[\text{Heater Length (mm)}]^2}{182{,}900}$$

Metric FIREROD Cartridge

Maximum Allowable Watt Density

The following four graphs detail maximum allowable watt densities for applications involving metal heating or steam, air and gas heating. Please review these respective graphs and applicable data to determine the correct watt density for your application.

Heating Metals

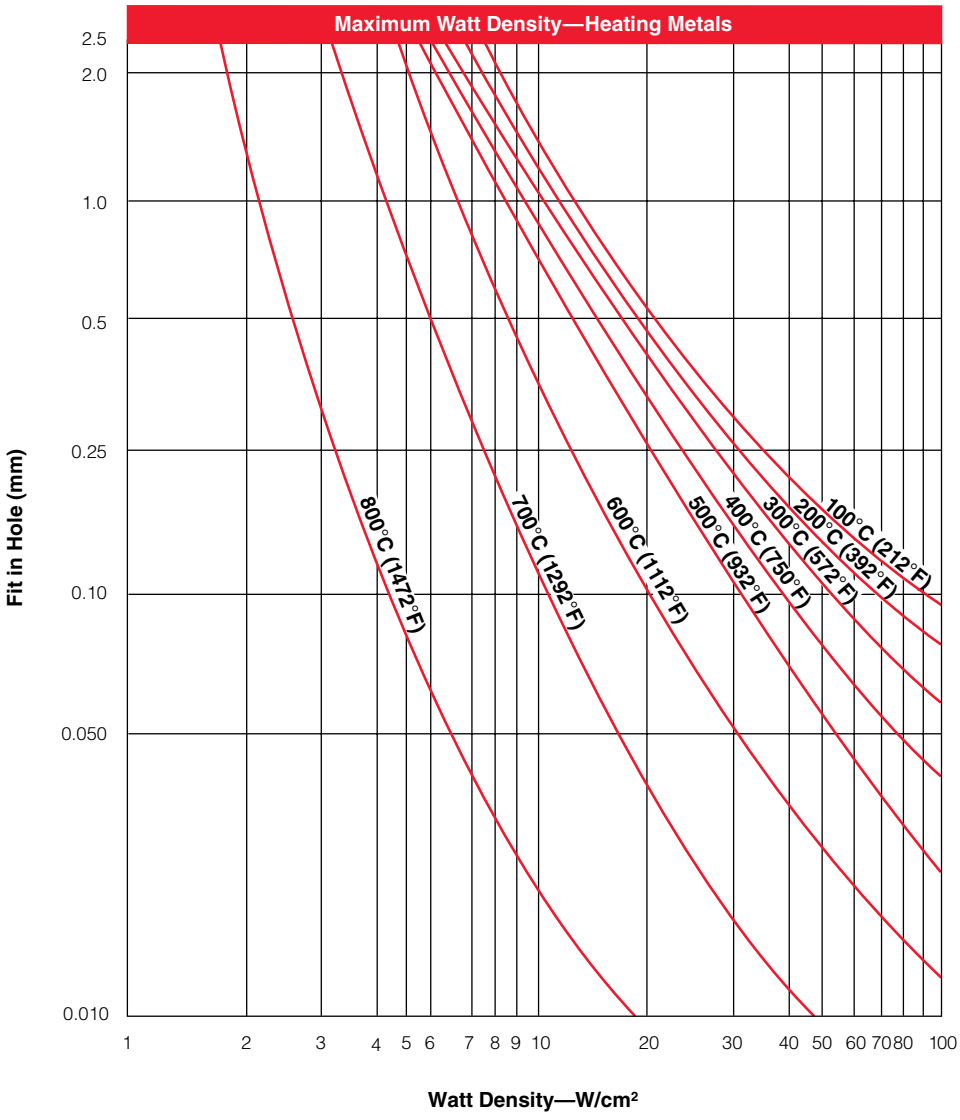
The Maximum Watt Density—Heating Metals graph will tell you either the maximum hole fit or recommended watt density of the heater. Enter the chart with either known variable, part fit in hole dimension or watt density. Then find the application temperature by reading up or over on the chart.

If the fit of the heater in the hole dimension is not known, it is easily determined. Subtract the minimum diameter of the metric FIREROD (nominal diameter minus tolerance) from the maximum hole diameter.

For example, take a hole diameter of 16.1 mm minus a heater diameter of 16 mm - 0.08 mm. The hole fit would be 0.18 mm. For metric FIREROD heaters in square holes or grooves, contact your Watlow sales engineer or authorized distributor for fit in hole dimension.

Correction Factors:

Also note, the Maximum Watt Density—Heating Metals graph depicts metric FIRERODs used in steel parts. Therefore, for either stainless steel or aluminum and brass, refer to applicable correction factors ① and ② .



① For stainless steel, enter the graph with a fit 0.04 mm (0.0015 in.) larger than actual.

② For aluminum and brass, enter the graph with a temperature 55°C (100°F) above actual temperature.

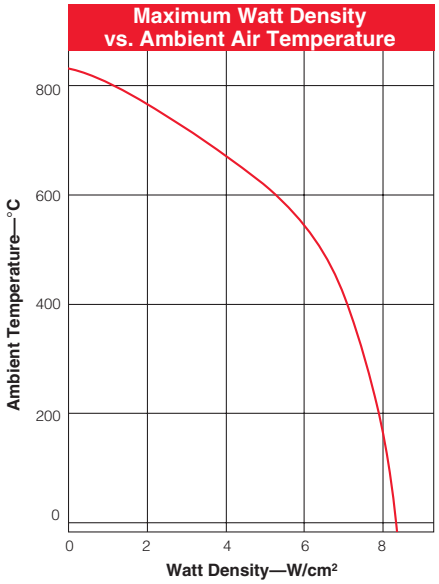
Hot Runner Nozzle Heaters

Metric FIREROD Cartridge

Maximum Allowable Watt Density

Continued

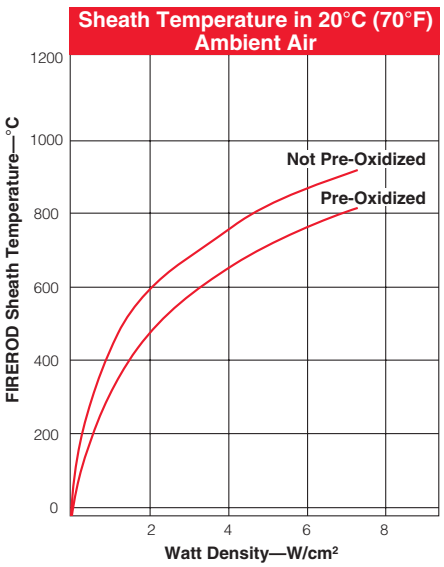
Heating Steam, Air and Gases



Watt Density vs. Ambient Air

The Watt Density vs. Ambient Air Temperature graph shows the maximum allowable watt density when one metric FIREROD heater is operated in air or similar gas.

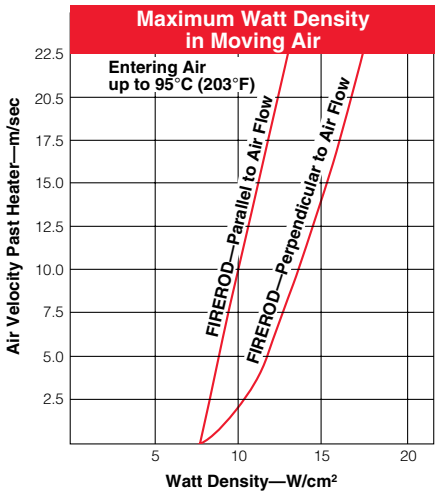
For metric FIRERODs grouped in a single row, with no less than one diameter between elements, multiply value from graph by 0.95. When a reflector is placed behind the heaters, multiply the maximum allowable watt density value from the graph by 0.85.



Sheath Temperature in Ambient Air

The Sheath Temperature in Ambient Air graph indicates the watt density required to bring a metric FIREROD heater to a given sheath temperature when operated in 20°C (70°F) ambient air.

At 7 W/cm² (44 W/in²), the sheath temperature would be 790°C (1450°F). At this temperature, one year life would be expected, provided that cycling is not too frequent. Higher temperatures would result in reduced heater life.



Watt Density in Moving Air

The Watt Density in Moving Air graph gives the maximum allowable watt density of a metric FIREROD heater in moving air.

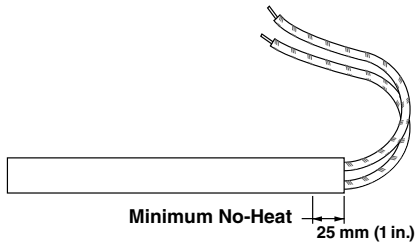
If the volumetric flow rate of air is known in m³/s (or CFM), divide this value by the net free area in m² (or ft²) around the heater to determine air flow velocity. The net free area is the total area of the enclosure minus the area occupied by the heater.

Hot Runner Nozzle Heaters

Metric FIREROD Cartridge

Termination Options

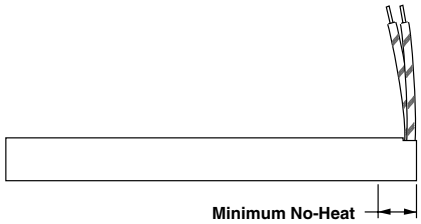
Swaged-in Flexible Leads



Swaged-in flexible leads, with a silicone-fiberglass insulation, are recommended for applications in which the leads must be bent at the exit point from the heater. Unless longer length is specified, 250 mm (10 in.) leads are supplied.

Heaters 150 mm (6 in.) or shorter generally have a 6 mm (0.25 in.) no-heat section. Heaters to 250 mm (10 in.) require a 25 mm (1 in.) no-heat section. Heaters greater than 250 mm (10 in.) may require more than a 25 mm (1 in.) no-heat section. To order, please specify **swaged-in flexible leads**.

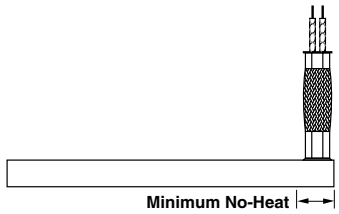
Right Angle Leads



Right angle leads are used in applications with a high degree of flexing and when space limitations are critical. Lead wires exit at a 90 degree angle through the side of the heater sheath. To order, specify **right angle leads** and lead length.

Metric FIREROD Diameter mm	Minimum No-Heat Length mm	(in.)
6.5	11	(7/16)
8	11	(7/16)
10	13	(1/2)
12.5	16	(5/8)
16	19	(3/4)
20	22	(7/8)

Stainless Steel Braid



Stainless steel braid is designed to protect leads from abrasion against sharp edges. It is the most flexible of Watlow's protective lead arrangements.

When the leads exit straight out, the braid is swaged into the no-heat section of the heater. When the leads exit at a right angle, a crimp connector is used to attach the braids.

Unless otherwise specified, leads are 350 mm (14 in.) and the braid is 300 mm (12 in.) long.
To order, specify either **straight or right angle stainless steel braid**, lead length and no-heat section.

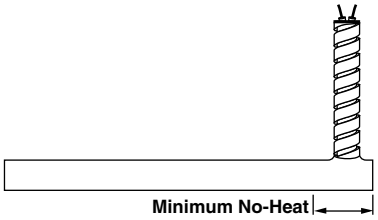
Metric FIREROD Dia. mm	Min. No-Heat Length Straight mm	(in.)	Right Angle mm	(in.)
6.5	29	(1 1/8)	14	(1/2)
8	29	(1 1/8)	14	1/2)
10	38	(1 1/2)	16	(5/8)
12.5	38	(1 1/2)	17	(2/3)
16	38	(1 1/2)	22	(7/8)
20	38	(1 1/2)	30	(1 3/16)

Hot Runner Nozzle Heaters

Metric FIREROD Cartridge

Termination Options

Continued

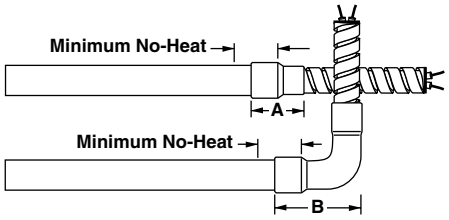


Stainless Steel Hose

Stainless steel hose provides the best protection against abrasion from sharp edges or abrasive equipment. It also offers ease of handling and wiring in abrasive environments.

When the leads exit at a right angle to the heater, the hose is silver-soldered to the sheath. Unless otherwise specified, leads are 350 mm (14 in.) long and the hose is 305 mm (12 in.) long. To order, specify **stainless steel hose**, lead length and no-heat section.

Metric FIREROD Diameter mm	Min. No-Heat Length				Stainless Steel Hose O.D.	
	Straight		Right Angle			
	mm	(in.)	mm	(in.)	mm	(in.)
6.5	29	(1⅛)	14	(½)	5.6	(⅜)
8	29	(1⅛)	14	(½)	6.5	(¼)
10	38	(1½)	16	(⅝)	7.2	(⅜)
12.5	38	(1½)	17	(⅔)	9.5	(⅜)
16	38	(1½)	22	(⅞)	12.7	(½)
20	38	(1½)	30	(1⅜)	15.9	(⅝)

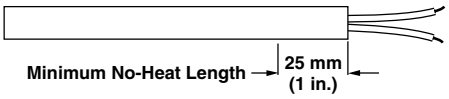


Galvanized Conduit

Galvanized conduit equals stainless steel hose in its abrasion protection. The conduit is attached with 90 degree elbow copper coupler which overlaps the heater sheath.

Unless specified, 250 mm (10 in.) leads are supplied. To order, specify **galvanized conduit**, lead length and no-heat section.

Metric FIREROD Diameter mm	Minimum No-Heat Length		Dimension A		Dimension B		Galvanized Conduit O.D.	
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)
6½	12	(7⁄16)	22	(⅞)	29	(1⅛)	10	(⅜)
8	12	(7⁄16)	22	(⅞)	29	(1⅛)	10	(⅜)
10	14	(½)	22	(⅞)	29	(1⅛)	10	(⅜)
12½	16	(⅝)	28	(1⅛)	30	(1 3⁄16)	14	(½)
16	19	(¾)	28	(1⅛)	34	(1 5⁄16)	14	(½)
20	22	(⅞)	29	(1⅛)	36	(1 7⁄16)	16	(⅝)



Teflon® Seal and Leads

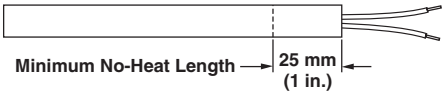
Teflon® seal and leads protect the heater against moisture/contamination from lubricating oil, cleaning solvents, plastic material or fumes and organic tapes. This seal is effective to 200°C (400°F) under continuous operation.

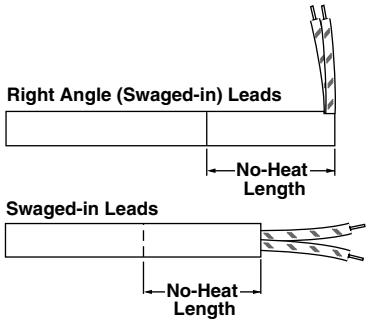
Please note, when ordering this option, that a 25 mm (1 in.) minimum no-heat section is required to allow for construction. Additional no-heat may be required to keep the seal below effective temperatures. To order, specify **Teflon® seal and leads** and lead length.

Metric FIREROD Cartridge

Termination Options

Continued





Silicone Rubber Seal and Leads

Silicone rubber seal and leads protect the heater against moisture/contamination from lubricating oil, cleaning solvents, plastic material or fumes and organic tapes. This seal is effective to 230°C (450°F) under continuous operation. Epoxy potting for up to 260°C (500°F) for continuous operation is available upon request.

Please note, when ordering this option, that a 25 mm (1 in.) minimum unheated section is required to allow for construction. Additional no-heat may be required to keep the seal below effective temperatures. To order, specify **silicone or epoxy seal and leads** and lead length.

No-Heat Section

No-heat sections are recommended in applications where leads may be exposed to excessive heat, thus requiring a cooler lead end. Also use when heat is not required along the entire length of the metric FIREROD. Unheated extensions are available on all diameters with both pin style and swaged-in leads. To order, specify **no-heat** section and length of no-heat.

Hot Runner Nozzle Heaters

Metric FIREROD Cartridge

Options

Accessories

Watlube

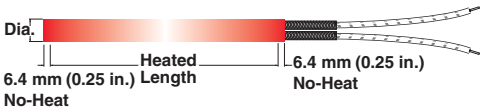
Watlube is an electrically non-conductive lubricant that acts as a barrier against high temperature oxidation, thus making heater removal easier. In addition, it aids in the transfer of heat from the metric FIREROD to the block. However, do not use it as a substitute for proper hole fit. Watlube is packaged in 118 ml (four ounce) bottles.

To order, specify **Watlube**.

External Finishing

Centerless Grinding

Centerless grinding can be used to finish precision diameters, thus permitting closer heater-to-part fit and higher watt densities. Centerless grinding of metric FIREROD heaters with swaged-in flexible leads is limited to 305 mm (12 in.) lead length. Longer lead lengths are available, but require external connection. To order, specify **centerless grinding**.



Distributed Wattage

Distributed wattage varies the watt density along the length of the heater. This construction technique is used to compensate for heat losses along the edges of heated parts. To order, specify **distributed wattage** and give the length and wattage for each section.

Individually Controlled Heat Zones

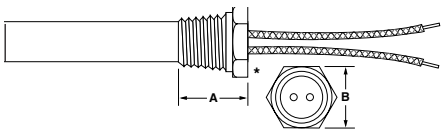
Individually controlled heat zones give the flexibility of controlling temperature by zones, along the length of the metric FIREROD. This is an advantage for heating requirements of certain applications, like sealing bars. This internal construction can be ordered on 12.5, 16 and 20 mm (0.5, 0.63 and 0.78 in.) diameter units. If not specified, 250 mm (10 in.) crimped on leads will be supplied. To order, specify **individually controlled heat zones** as well as length and wattage per zone and length of crimped on leads.

Hot Runner Nozzle Heaters

Metric FIREROD Cartridge

Options
Continued

Mounting Methods



Threaded Fittings

DIN Thread Size

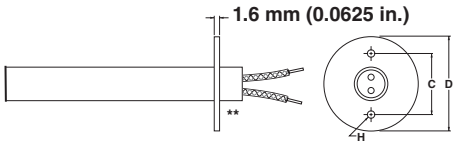
Metric FIREROD Diameter mm	Minimum No-Heat Length mm	(in.)	Thread Size DIN 13	A mm	(in.)	B mm	(in.)	Length of Threaded Section mm	(in.)
6.5	16	(5/8)	M10 X 1.0	10	(3/8)	12	(7/16)	6	(1/4)
8	16	(5/8)	M12 X 1.0	10	(3/8)	14	(1/2)	6.5	(1/4)
10	18	(11/16)	M14 X 1.5	11	(7/16)	17	(5/8)	6.5	(1/4)
12.5	19	(3/4)	M16 X 1.5	12	(7/16)	19	(3/4)	7.5	(5/16)
16	20	(3/4)	M20 X 1.5	14	(1/2)	24	(15/16)	9	(3/8)
20	22	(7/8)	M26 X 1.5	15	(9/16)	30	(1 3/16)	10	(3/8)

① Swaged in unit pictured.

NPT Thread Size

Metric FIREROD Diameter mm	Minimum No-Heat Length mm	(in.)	Thread Size NPT	A mm	(in.)	B mm	(in.)	Length of Threaded Section mm	(in.)
6.5	19	(3/4)	(1/8)	13	(1/2)	11	(7/16)	10	(3/8)
8	22	(7/8)	(1/4)	16	(5/8)	14	(1/2)	13	(1/2)
10	22	(7/8)	(1/4)	16	(5/8)	14	(1/2)	13	(1/2)
12.5	25	(1)	(3/8)	19	(3/4)	17.5	(11/16)	15	(9/16)
16	28	(1 1/8)	(1/2)	22	(7/8)	22	(7/8)	16	(5/8)
20	32	(1 1/4)	(3/4)	25	(1)	29	(1 1/8)	19	(3/4)

Threaded fittings allow for fast, water-tight installation of the heater into a threaded hole. These fittings can be ordered in either brass or stainless steel. Double threaded fittings are also available. See dimensions noted on the DIN Size and NPT Size Threaded Fittings charts or contact your Watlow sales engineer or authorized distributor if you need to exceed limitations shown. To order, specify either brass or stainless steel **threaded fittings**.



Flanges

Stainless steel flanges are a convenient mounting method as well as a way to position a heater within an application. These flanges can be located in any no-heat section of the heater sheath. To order, specify **flange**, flange size and location.

Metric FIREROD Diameter mm	Flange Size	D mm	(in.)	C mm	(in.)	H mm	(in.)
6.5, 8, 10,12.5, 16 ②	FS	25	(1)	19	(3/4)	4.3	(3/16)
6.5, 8, 10, 12.5, 16, 20	FM	38	(1 1/2)	28.5	(1 1/8)	4.3	(3/16)
16, 20	FL	51	(2)	38	(1 1/2)	5.3	(3/16)

① Swaged in unit pictured.
② The FS flange for 16 mm (0.625 in.) diameter units have no “H” holes.

Hot Runner Nozzle Heaters

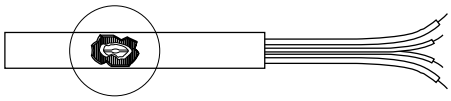
Metric FIREROD Cartridge

Options
Continued

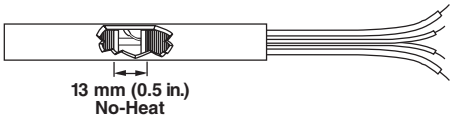
Sensors

Internal Thermocouple

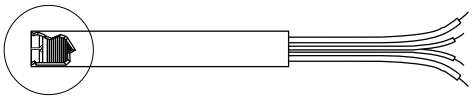
Style A



Style B



Style C



The **Style A** internal thermocouple can be used to evaluate heat transfer efficiency of an application, a measure that enables you to cut energy costs and increase heater life.

The **Style B** internal thermocouple gives a good approximation of part temperature, and is available in all diameters. The thermocouple junction can be in contact with the inside of the heater sheath, located in the 13 mm (0.5 in.) no-heat section anywhere along the heater length.

A **Style C** internal thermocouple is useful in applications where material flows past the end of the heater, as in plastic molding. This junction is embedded in a special end disc. Style C is not available on 20 mm (0.78 in.) diameter units.

To order, specify **internal thermocouple Style A, B** or **C** and thermocouple **Type J, T, K** or **E**. If not specified, 250 mm (10 in.) thermocouple leads are supplied.

Thermocouple Types

ISA Code	Conductor Characteristics Positive	Conductor Characteristics Negative	Temperature Range °C	Temperature Range (°F)
J	Iron (Magnetic)	Constantan (Non-magnetic)	-20 to 760	(0 to 1400)
K	Chromel® (Non-magnetic)	Alumel® (Magnetic)	-20 to 1260	(0 to 2300)

For other thermocouple types, contact your Watlow sales engineer or authorized distributor.

Made in Kronau, Germany

How to Order:

Metric FIREROD cartridge heaters are available as **made-to-order** units only. To order, please specify:

- Diameter
- Overall length
- Volts
- Watts
- Lead type and length or terminal configuration
- Options

Availability

Made-to-order: Shipment within three weeks.

Hot Runner Nozzle Heaters

Quick Ship • *Next day shipment on all stock units.*

Metric EB Cartridge

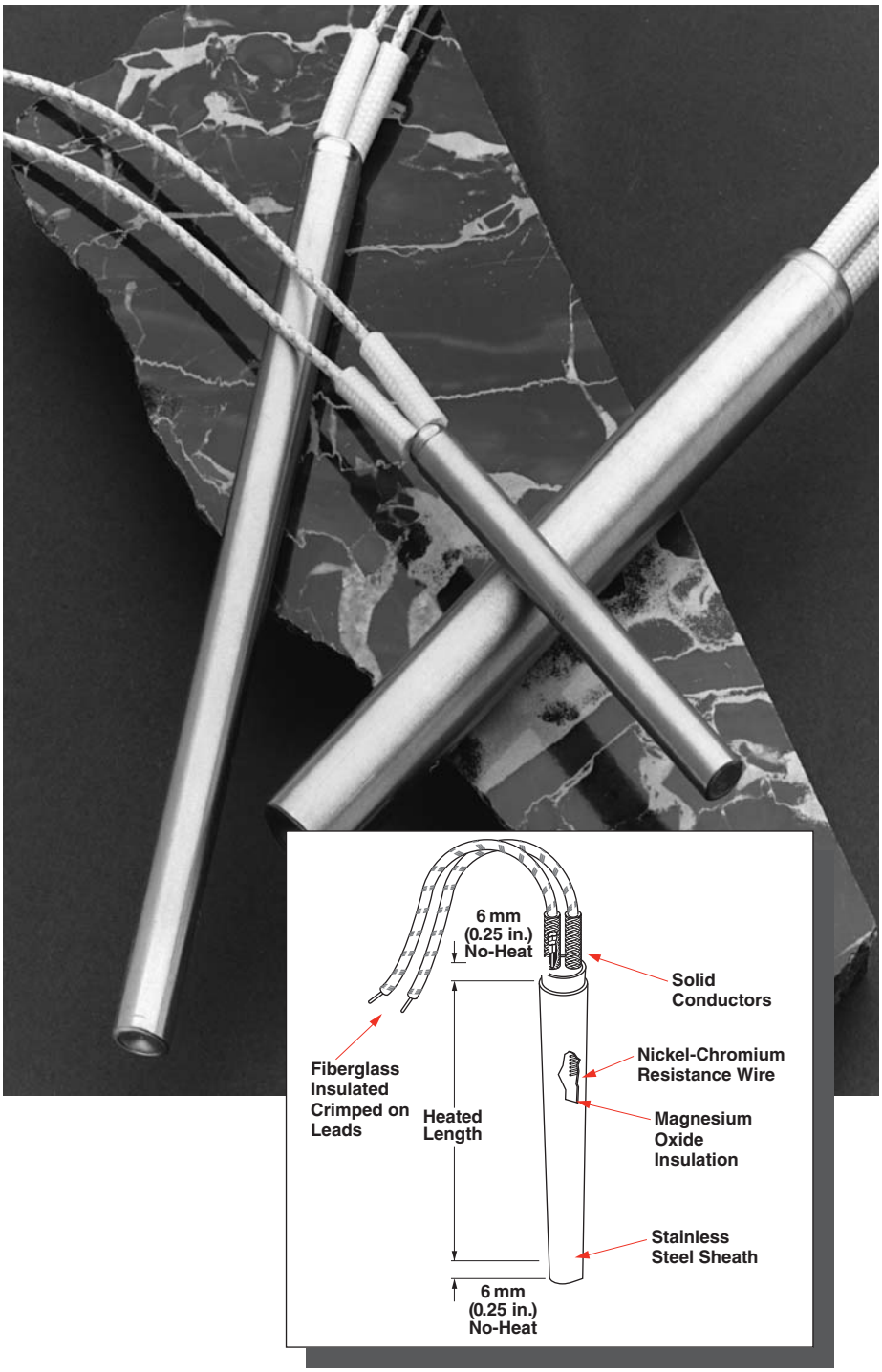
The Watlow EB cartridge heater is a proven performer like the metric FIREROD®. That's because the same quality materials go into its construction; MgO insulation, nickel-chromium resistance wire, silicone-fiberglass insulated lead wires. The only difference is that the EB cartridge is packaged in a more economical design. Instead of having the high watt density capabilities of a metric FIREROD, it's made for medium watt density applications.

Performance Capabilities

- Part temperatures to 600°C (1100°F)
- Maximum watt density to 30 W/cm² (190 W/in²)
- Maximum voltage to 480V~(ac)

Features and Benefits

- **Magnesium oxide insulation,** compacted to the proper density, results in high dielectric strength and contributes to faster heat-up.
- **Nickel-chromium resistance wire,** precisely wound through the heated length, assures even, efficient distribution of heat to the sheath.
- **Metallurgically-bonded conductor pins,** crimp-connected to the resistance wires, ensure trouble-free electrical continuity. This process provides lead flexibility just 8 mm (0.3125 in.) from the end of the heater.
- **Flexible stranded wires,** with silicone-fiberglass sleeve, insulate the wires to temperatures of 250°C (480°F).
- **Optional lead end with silicone rubber seal** protects the leads against moisture and other contaminants.



- **VDE component recognition** to 230V~(ac) according to VDE 0721 part 1/3.78 and part 2/3.78 Section E in connection with VDE 0720 part 1/11.74.

Applications

- Plastic injection molds, dies and sealing jaws
- Hot melt systems, labeling

Hot Runner Nozzle Heaters

Metric EB Cartridge

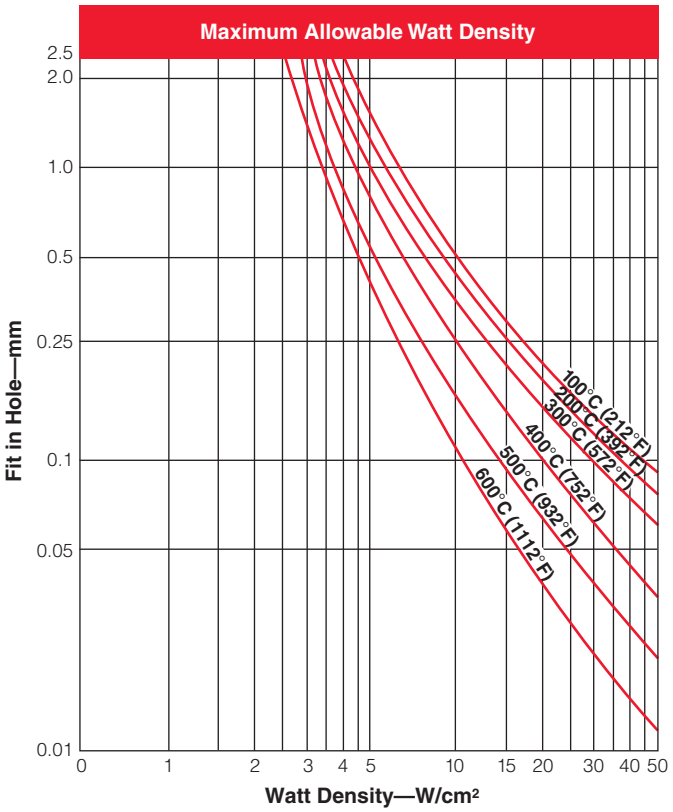
Applications and Technical Data

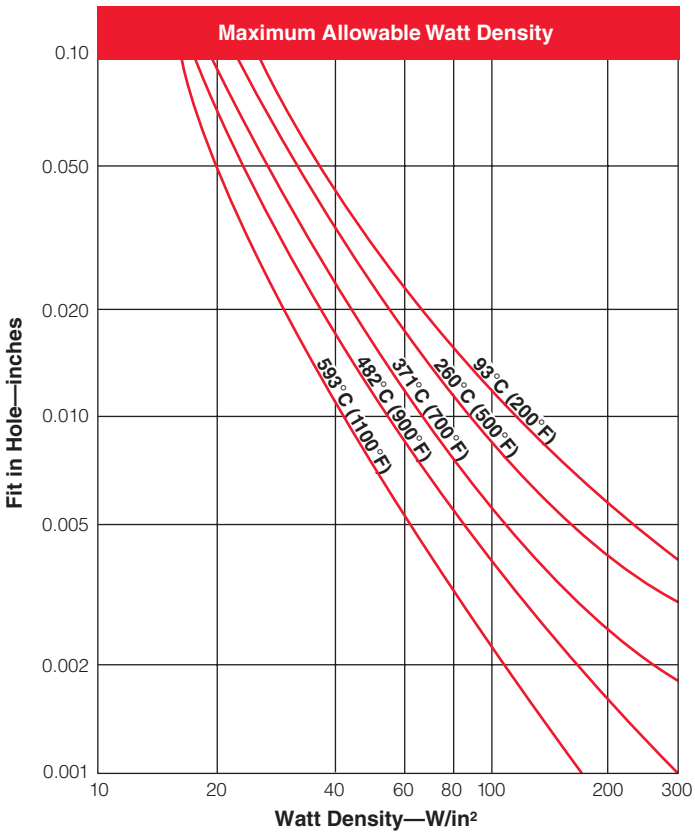
Continued

Maximum Allowable Watt Density

Both the Maximum Allowable Watt Density metric and inch-base charts will tell you either the hole fit or recommended watt density in relationship to part temperature. Enter the chart with either known variable, part fit in hole dimension or watt density. Then find the part temperature by reading up or over on the chart. The part temperature curves shown are measured 13 mm (0.5 in.) from the heater in a mild steel block. For stainless steel blocks, enter the graph with a fit of 0.04 mm (0.0015 in.) larger than actual. For aluminum and brass blocks, enter the graph with a temperature 55°C (100°F) above actual block temperature.

On-Off Cycling: On-off cycling shortens heater life. If the heater cycles more than once per hour, multiply the watt density, shown on the chart, by 0.8 to determine the maximum allowable watt density for the application. If the heater cycles more than once a minute, multiply by 0.7.





Tolerances

Diameter: -0.02 mm, -0.08 mm (-0.0008 in., -0.0031 in.)

Length: ±3 percent with ±2.4 mm (±0.0937 in.) minimum

Resistance: +5 percent, -10 percent. Resistance is measured at room temperature following first heater operation.

Wattage: +10 percent, -5 percent. Wattage decreases approximately 5 percent with temperature. Wattage tolerances are for heaters at operating temperature.

Hot Runner Nozzle Heaters

Metric EB Cartridge

Applications and Technical Data

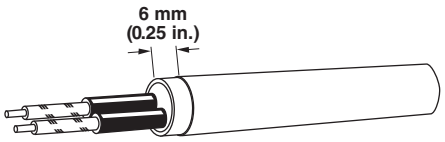
Continued

Dimensional & Electrical Data

Heater Diameter (mm)	6.5	8	10	12.5	16	20
Nominal Diameter (in.)	0.256	0.315	0.394	0.492	0.630	0.787
Maximum Voltage	250	250	250	400	480	480
Crimped-On Leads						
Maximum Amps	4.4	4.4	6.7	9.7	23	23
Maximum Wattage @ 230V	1010	1010	1540	2230	5290	5290
Maximum Wattage @ 400V				3880	9200	9200
Swaged-In Leads						
Maximum Amps	3.1/4.4 ①	3.1/4.4 ①	4.4	7.6/12.5 ②	7.6/12.5	12.5
Maximum Wattage @ 230V	710/1010	710/1010	1010	1750/2875	1750/2875	2875
Maximum Wattage @ 400V	—	—	—	3040/5000	3040/5000	5000

① On certain lead construction, maximum amperage is 3.1. Please consult Watlow.
② On certain lead construction, maximum amperage is 7.6. Please consult Watlow.

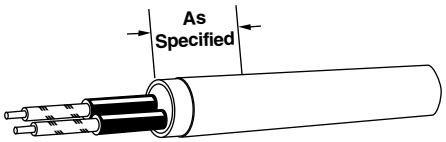
Termination Options



Crimped-on Lead

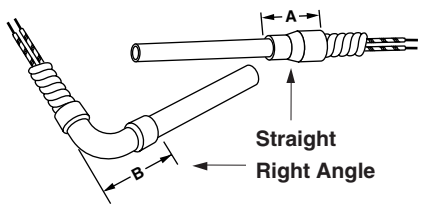
Crimped-on leads with a 6 mm (0.25 in.) unheated section are recommended for applications where the lead wire temperature does not exceed 250°C (480°F).

Unless a longer length is specified, 250 mm (10 in.) leads will be supplied. To order, request **crimped-on leads** and desired lead length.



No-Heat Zone

An unheated section can be used to extend the leads safely into a cool zone in a high temperature application. Leads should be kept below 250°C (480°F) for maximum service life. To order, specify **no-heat zone** and length of unheated section.



Galvanized Conduit

Flexible galvanized conduit can be installed over the leads for abrasion protection. It is attached with either a straight or 90 degree elbow copper coupler. The copper coupler overlaps the heater sheath by 6 mm (0.25 in.). A no-heat section is required. To order, specify **galvanized conduit, straight** or **right angle.**

Stainless Steel Hose

Stainless steel hose also protects leads against abrasion. It is attached with a straight or 90 degree elbow copper coupler. The copper coupler overlaps the heater sheath by 6 mm (0.25 in.). It can also be swaged-in straight or silver soldered to the heater sheath at a right angle. A no-heat section is required. To order, specify **stainless steel hose, straight** or **right angle with copper coupler, straight swaged-in** or **right angle silver soldered.**

Hot Runner Nozzle Heaters

Metric EB Cartridge

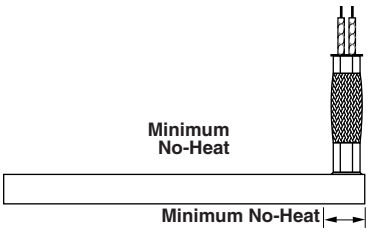
Termination Options

Continued

Galvanized Conduit and Stainless Steel Hose Dimensions

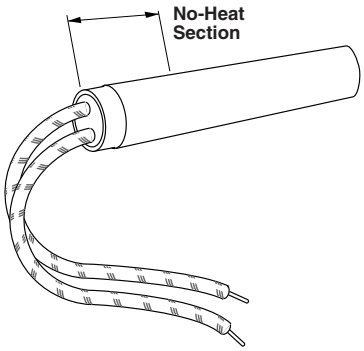
Heater Diameter mm	Minimum No-Heat Length mm	(in.)	Dimension A mm	(in.)	Dimension B mm	(in.)	Galvanized Conduit O.D. mm	(in.)	Stainless Steel Hose O.D. mm	(in.)
6.5	12	(7/16)	22	(7/8)	29	(1 1/8)	10	(3/8)	5.6	(3/16)
8	12	(7/16)	22	(7/8)	29	(1 1/8)	10	(3/8)	6.5	(1/4)
10	14	(1/2)	22	(7/8)	29	(1 1/8)	10	(3/8)	7.2	(5/16)
12.5	16	(5/8)	28	(1 1/8)	30	(1 3/16)	14	(9/16)	9.5	(3/8)
16	19	(3/4)	28	(1 1/8)	34	(1 3/8)	14	(9/16)	12.7	(1/2)
20	22	(7/8)	29	(1 1/8)	36	(1 7/16)	16	(5/8)	15.9	(5/8)

Dimensions are shown for designs with copper coupler only.



Stainless Steel Braid

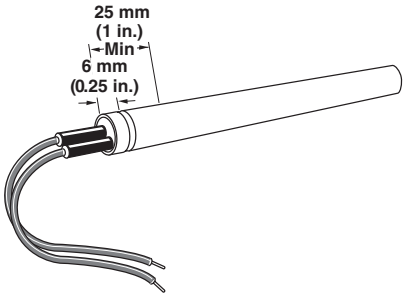
Like stainless steel hose, stainless steel braid also protects against abrasion. Stainless steel braid is swaged-in straight or crimped-on to the heater at a right angle. Metal braid is recommended when excellent flexibility with good physical protection is needed. A unheated section is required. To order, specify **stainless steel braid, straight** or **right angle.**



Swaged-in Flexible Lead

Swaged-in flexible leads, with a silicone-fiberglass insulation, are recommended for applications in which the leads must be bent at the exit point from the heater. Unless longer length is specified, 250 mm (10 in.) leads are supplied.

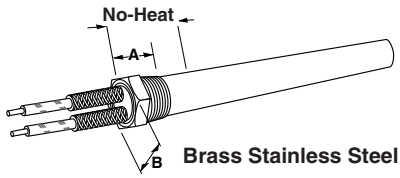
Heaters 140 mm (5.5 in.) or shorter generally have a six mm (0.25 in.) no-heat section. Heaters to 250 mm (10 in.) require a 25 mm (1 in.) no-heat section. Heaters greater than 250 mm (10 in.) may require more than a 25 mm (1 in.) no-heat section. To order, please specify **swaged-in flexible leads.**



Moisture Resistant Seal

Silicone rubber moisture resistant seals can be provided at the lead end to virtually seal the heater. This seal is rated to 230°C (450°F) continuous operation.

A 25 mm (1 in.) no-heat section is required at the lead end. Solid pin leads exit through the seal with crimped-on silicone rubber insulated lead wires and silicone rubber sleeves that extend into the seal. Swaged-in leads are also an option where flexibility at the lead exit is required. To order specify, **silicone rubber moisture resistant seal** and either **crimped-on** or **swaged-in leads**.



Threaded Fitting

Either brass or stainless steel threaded fittings for screw-in mounting can be added to units that have moisture resistant seals. Available dimensions are shown on the Threaded Fittings charts. To order, please request **brass** or **stainless steel threaded fittings** and location on the heater.

Note: For liquid immersion applications, please also specify heavy weld end disc.

Hot Runner Nozzle Heaters

Metric EB Cartridge

Termination Options

Continued

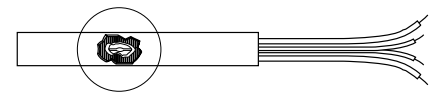
DIN Thread Size

Heater Diameter mm	Minimum No-Heat Length mm	(in.)	Thread Size DIN 13	Dimension A mm	(in.)	Dimension B mm	(in.)	Length of Threaded Section mm	(in.)
6.5	16	(⅝)	M 10 X 1	10	(⅜)	12	(7⁄16)	6	(¼)
8	16	(⅝)	M 12 X 1	10	(⅜)	14	(½)	6.5	(¼)
10	18	(11⁄16)	M 14 X 1.5	11	(7⁄16)	17	(⅝)	6.5	(¼)
12.5	19	(¾)	M 16 X 1.5	12	(7⁄16)	19	(¾)	7.5	(5⁄16)
16	20	(¾)	M 20 X 1.5	14	(9⁄16)	24	(15⁄16)	9	(⅜)
20	22	(⅞)	M 26 X 1.5	15	(9⁄16)	30	(1 3⁄16)	10	(⅜)

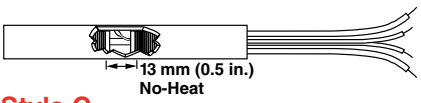
NPT Thread Size

Heater Diameter mm	Minimum No-Heat Length mm	(in.)	Thread Size NPT	Dimension A mm	(in.)	Dimension B mm	(in.)	Length of Threaded Section mm	(in.)
6.5	19	(¾)	⅛	13	(½)	11	(7⁄16)	10	(⅜)
8	22	(⅞)	¼	16	(⅝)	14	(½)	13	(½)
10	22	(⅞)	¼	16	(⅝)	14	(½)	13	(½)
12.5	25	(1)	⅜	19	(¾)	17.5	(11⁄16)	15	(9⁄16)
16	28	(1⅛)	½	22	(⅞)	22	(⅞)	16	(⅝)
20	32	(1¼)	¾	25	(1)	29	(1⅛)	19	(¾)

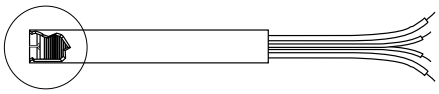
Style A



Style B



Style C



Thermocouple Types

ASTM Code	Conductor Characteristics		Temperature Range	
	Positive	Negative	°C	(°F)
J	Copper	Constantan (Silver Color)	-60 to 370	(-75 to 700)
K	Chromel® (Non-Magnetic)	Alumel® (Magnetic)	-20 to 1260	(0 to 2300)

For other ASTM types, contact Watlow.

Internal Thermocouple

Style A is used to evaluate heat transfer efficiency of an application. The junction is located in the heater core to monitor the internal temperature of the heater.

Style B approximates part temperature, and is available in all diameters. The thermocouple junction can be in contact with the inside of the heater sheath, located in the 13 mm (0.5 in.) no-heat section anywhere along the heater length.

Style C is useful in applications where material flows past the end of the heater. This junction is embedded in a special end disc. Type C is available only on 6.5, 8, 10, 12.5 and 16 mm diameter units.

To order, specify **internal thermocouple**, **Style A, B** or **C** and **thermocouple ASTM Type J, T, K** or **E**. If not specified, 250 mm (10 in.) thermocouple leads are supplied.

How to Order

To order stock AB cartridge heaters, please specify:

- Code number
- Termination options, and length of leads

For **made-to-order** units, please specify:

- Diameter
- Overall length
- Watts
- Termination options, and length of leads

Availability

Stock: Next day shipment

Made-to-Order: Shipment within three weeks

Hot Runner Nozzle Heaters

Made in Kronau, Germany

Metric EB Cartridge

Diameter mm	Sheath Length mm	(in.)	No-Heat Length mm	Watts	Watt Density W/cm²	(W/in²)	Availability	Code No.
6.5	40	(1 19/16)		50	9	(58)	Stock	KEBE0040C001A
	40	(1 19/16)		75	14	(90)	Stock	KEBE0040C002A
	40	(1 19/16)		100	19	(123)	Stock	KEBE0040C003A
	40	(1 19/16)		125	24	(155)	Stock	KEBE0040C004A
	40	(1 19/16)		150	28	(181)	Stock	KEBE0040C005A
	60	(2 3/8)		50	5	(32)	Stock	KEBE0060C001A
	60	(2 3/8)		100	11	(71)	Stock	KEBE0060C002A
	60	(2 3/8)		150	16	(103)	Stock	KEBE0060C003A
	60	(2 3/8)		200	21	(135)	Stock	KEBE0060C004A
	60	(2 3/8)		250	27	(174)	Stock	KEBE0060C005A
	80	(3 1/8)		100	7	(45)	Stock	KEBE0080C001A
	80	(3 1/8)		150	11	(71)	Stock	KEBE0080C002A
	80	(3 1/8)		200	15	(97)	Stock	KEBE0080C003A
	80	(3 1/8)		300	22	(142)	Stock	KEBE0080C004A
	80	(3 1/8)		450	33	(213)	Stock	KEBE0080C005A
	100	(3 15/16)		100	6	(39)	Stock	KEBE0100C001A
	100	(3 15/16)		200	11	(71)	Stock	KEBE0100C002A
	100	(3 15/16)		300	17	(110)	Stock	KEBE0100C003A
8.0	40	(1 19/16)		50	8	(52)	Stock	KEBF0040C001A
	40	(1 19/16)		75	11	(71)	Stock	KEBF0040C002A
	40	(1 19/16)		100	15	(97)	Stock	KEBF0040C003A
	40	(1 19/16)		150	23	(148)	Stock	KEBF0040C004A
	40	(1 19/16)		200	31	(200)	Stock	KEBF0040C005A
	60	(2 3/8)		75	6	(39)	Stock	KEBF0060C001A
	60	(2 3/8)		150	13	(84)	Stock	KEBF0060C002A
	60	(2 3/8)		200	17	(110)	Stock	KEBF0060C003A
	60	(2 3/8)		250	22	(142)	Stock	KEBF0060C004A
	60	(2 3/8)		300	26	(168)	Stock	KEBF0060C005A
	80	(3 1/8)		100	6	(39)	Stock	KEBF0080C001A
	80	(3 1/8)		200	12	(77)	Stock	KEBF0080C002A
	80	(3 1/8)		300	18	(116)	Stock	KEBF0080C003A
	80	(3 1/8)	25	400	33	(213)	Stock	KEBF0080D001A
	80	(3 1/8)	25	500	41	(265)	Stock	KEBF0080D002A
	100	(3 15/16)		100	5	(32)	Stock	KEBF0100C001A
	100	(3 15/16)		250	12	(77)	Stock	KEBF0100C002A
	100	(3 15/16)	25	400	23	(148)	Stock	KEBF0100D001A
	100	(3 15/16)	25	500	29	(187)	Stock	KEBF0100D002A
	100	(3 15/16)	25	600	35	(226)	Stock	KEBF0100D003A
	130	(5 3/8)	25	200	8	(52)	Stock	KEBF0130D001A
	130	(5 3/8)	25	350	14	(90)	Stock	KEBF0130D002A
	130	(5 3/8)	25	500	20	(129)	Stock	KEBF0130D003A
10.0	40	(1 19/16)		50	6	(39)	Stock	KEBG0040C001A
	40	(1 19/16)		100	12	(77)	Stock	KEBG0040C002A
	40	(1 19/16)		150	18	(116)	Stock	KEBG0040C003A
	40	(1 19/16)		200	24	(155)	Stock	KEBG0040C004A
	40	(1 19/16)		250	31	(200)	Stock	KEBG0040C005A
	60	(2 3/8)		100	7	(45)	Stock	KEBG0060C001A
	60	(2 3/8)		150	10	(65)	Stock	KEBG0060C002A
	60	(2 3/8)		200	14	(90)	Stock	KEBG0060C003A
	60	(2 3/8)		300	21	(135)	Stock	KEBG0060C004A
	60	(2 3/8)		400	28	(181)	Stock	KEBG0060C005A
	80	(3 1/8)		100	5	(32)	Stock	KEBG0080C001A
	80	(3 1/8)		200	10	(65)	Stock	KEBG0080C002A
	80	(3 1/8)		300	14	(90)	Stock	KEBG0080C003A
	80	(3 1/8)		400	19	(123)	Stock	KEBG0080C004A
	80	(3 1/8)		600	29	(187)	Stock	KEBG0080C005A
	100	(3 15/16)		200	7	(45)	Stock	KEBG0100C001A
	100	(3 15/16)		300	11	(71)	Stock	KEBG0100C002A
	100	(3 15/16)		400	15	(97)	Stock	KEBG0100C003A
	100	(3 15/16)		500	19	(123)	Stock	KEBG0100C004A
	100	(3 15/16)	25	700	33	(213)	Stock	KEBG0100D001A

CONTINUED

Note: All stock EB cartridge heaters 230V~(ac) and 1000 mm fiberglass insulated swaged-in leads.

Hot Runner Nozzle Heaters

Made in Kronau, Germany

Metric EB Cartridge

Diameter mm	Sheath Length mm	(in.)	No-Heat Length mm	Watts	Watt Density W/cm²	(W/in²)	Availability	Code No.
10.0	130	(5⅛)		200	5	(32)	Stock	**KEBG0130C001A**
	130	(5⅛)		400	11	(71)	Stock	**KEBG0130C002A**
	130	(5⅛)	25	600	19	(123)	Stock	**KEBG0130D001A**
	130	(5⅛)	25	800	26	(168)	Stock	**KEBG0130D002A**
	130	(5⅛)	25	1000	32	(206)	Stock	**KEBG0130D003A**
	160	(6⅜)	25	200	5	(32)	Stock	**KEBG0160D001A**
	160	(6⅜)	25	500	12	(77)	Stock	**KEBG0160D002A**
	160	(6⅜)	25	800	20	(129)	Stock	**KEBG0160D003A**
	160	(6⅜)	25	1000	25	(161)	Stock	**KEBG0160D004A**
	160	(6⅜)	25	1200	30	(194)	Stock	**KEBG0160D005A**
	200	(7⅞)	25	300	6	(39)	Stock	**KEBG0200D001A**
	200	(7⅞)	25	600	11	(71)	Stock	**KEBG0200D002A**
	200	(7⅞)	25	1000	19	(123)	Stock	**KEBG0200D003A**
	200	(7⅞)	25	1200	23	(148)	Stock	**KEBG0200D004A**
	200	(7⅞)	25	1400	27	(174)	Stock	**KEBG0200D005A**
	250	(9⅞)	25	400	6	(39)	Stock	**KEBG0250D001A**
	250	(9⅞)	25	700	10	(65)	Stock	**KEBG0250D002A**
	250	(9⅞)	25	1000	15	(97)	Stock	**KEBG0250D003A**
	250	(9⅞)	25	1400	20	(129)	Stock	**KEBG0250D004A**
	300	(11¹³⁄₁₆)	30	500	6	(39)	Stock	**KEBG0300D004A**
	300	(11¹³⁄₁₆)	30	1000	12	(77)	Stock	**KEBG0300D002A**
	300	(11¹³⁄₁₆)	30	1500	18	(116)	Stock	**KEBG0300D003A**
12.5	80	(3⅛)		150	6	(39)	Stock	**KEBJ0080C001A**
	80	(3⅛)		300	12	(77)	Stock	**KEBJ0080C003A**
	80	(3⅛)		400	15	(97)	Stock	**KEBJ0080C004A**
	80	(3⅛)		500	19	(123)	Stock	**KEBJ0080C002A**
	80	(3⅛)		700	27	(174)	Stock	**KEBJ0080C005A**
	100	(3¹⁵⁄₁₆)		200	6	(39)	Stock	**KEBJ0100C001A**
	100	(3¹⁵⁄₁₆)		400	12	(77)	Stock	**KEBJ0100C002A**
	100	(3¹⁵⁄₁₆)		600	18	(116)	Stock	**KEBJ0100D003A**
	100	(3¹⁵⁄₁₆)		800	24	(155)	Stock	**KEBJ0100D004A**
	100	(3¹⁵⁄₁₆)	25	1000	37	(239)	Stock	**KEBJ0100D001A**
	130	(5⅜)		250	5	(32)	Stock	**KEBJ0130C001A**
	130	(5⅜)		500	11	(71)	Stock	**KEBJ0130C002A**
	130	(5⅜)	25	800	21	(135)	Stock	**KEBJ0130D001A**
	130	(5⅜)	25	1000	26	(168)	Stock	**KEBJ0130D002A**
	130	(5⅜)	25	1400	36	(232)	Stock	**KEBJ0130D003A**
	160	(6⅜)	25	300	6	(39)	Stock	**KEBJ0160D001A**
	160	(6⅜)	25	600	12	(77)	Stock	**KEBJ0160D002A**
	160	(6⅜)	25	1000	20	(129)	Stock	**KEBJ0160D003A**
	160	(6⅜)	25	1400	28	(181)	Stock	**KEBJ0160D004A**
	160	(6⅜)	25	1700	34	(219)	Stock	**KEBJ0160D005A**
	200	(7⅞)	25	400	6	(39)	Stock	**KEBJ0200D002A**
	200	(7⅞)	25	700	11	(71)	Stock	**KEBJ0200D003A**
	200	(7⅞)	25	1000	15	(97)	Stock	**KEBJ0200D004A**
	200	(7⅞)	25	1500	23	(148)	Stock	**KEBJ0200D005A**
	200	(7⅞)	25	2000	30	(194)	Stock	**KEBJ0200D006A**
	250	(9⅞)	25	500	6	(39)	Stock	**KEBJ0250D001A**
	250	(9⅞)	25	1000	12	(77)	Stock	**KEBJ0250D002A**
	250	(9⅞)	25	1500	18	(116)	Stock	**KEBJ0250D003A**
	250	(9⅞)	25	2000	23	(148)	Stock	**KEBJ0250D004A**
	300	(11¹³⁄₁₆)	30	600	6	(39)	Stock	**KEBJ0300D001A**
	300	(11¹³⁄₁₆)	30	1500	15	(97)	Stock	**KEBJ0300D002A**
16.0	80	(3⅜)		200	6	(39)	Stock	**KEBL0080C001A**
	80	(3⅜)		400	12	(77)	Stock	**KEBL0080C002A**
	80	(3⅜)		600	18	(116)	Stock	**KEBL0080C003A**
	80	(3⅜)		800	24	(155)	Stock	**KEBL0080C004A**
	100	(3¹⁵⁄₁₆)		300	7	(45)	Stock	**KEBL0100C001A**
	100	(3¹⁵⁄₁₆)		500	12	(77)	Stock	**KEBL0100C002A**
	100	(3¹⁵⁄₁₆)		700	16	(103)	Stock	**KEBL0100C003A**
	100	(3¹⁵⁄₁₆)	25	1000	29	(187)	Stock	**KEBL0100D001A**

CONTINUED

Note: All stock EB cartridge heaters 230V~(ac) and 1000 mm fiberglass insulated swaged-in leads.

Hot Runner Nozzle Heaters

Made in Kronau, Germany

Metric EB Cartridge

Diameter mm	Sheath Length mm	(in.)	No-Heat Length mm	Watts	Watt Density W/cm²	(W/in²)	Availability	Code No.
16.0	130	(5⅛)	25	400	8	(52)	Stock	**KEBL0130D001A**
	130	(5⅛)	25	600	12	(77)	Stock	**KEBL0130D002A**
	130	(5⅛)	25	800	16	(103)	Stock	**KEBL0130D003A**
	130	(5⅛)	25	1200	24	(155)	Stock	**KEBL0130D004A**
	160	(6⅝)	25	500	8	(52)	Stock	**KEBL0160D001A**
	160	(6⅝)	25	700	11	(71)	Stock	**KEBL0160D002A**
	160	(6⅝)	25	1000	16	(103)	Stock	**KEBL0160D003A**
	160	(6⅝)	25	1500	23	(148)	Stock	**KEBL0160D004A**
	160	(6⅝)	25	2000	31	(200)	Stock	**KEBL0160D005A**
	200	(7⅞)	25	600	7	(45)	Stock	**KEBL0200D001A**
	200	(7⅞)	25	1000	12	(77)	Stock	**KEBL0200D002A**
	200	(7⅞)	25	1500	18	(116)	Stock	**KEBL0200D003A**
	200	(7⅞)	25	2000	24	(155)	Stock	**KEBL0200D004A**
	250	(9⅞)	25	700	6	(39)	Stock	**KEBL0250D001A**
	250	(9⅞)	25	1500	14	(90)	Stock	**KEBL0250D002A**
	250	(9⅞)	25	2000	18	(116)	Stock	**KEBL0250D003A**
	300	(11¾)	30	1000	8	(52)	Stock	**KEBL0300D001A**
	300	(11¾)	30	1500	11	(71)	Stock	**KEBL0300D002A**
	300	(11¾)	30	2000	15	(97)	Stock	**KEBL0300D003A**
20.0	200	(7⅞)	25	1000	9	(58)	Stock	**KEBN0200D001A**
	200	(7⅞)	25	1500	14	(90)	Stock	**KEBN0200D002A**
	200	(7⅞)	25	2000	19	(123)	Stock	**KEBN0200D003A**
	300	(11¾)	30	1000	6	(39)	Stock	**KEBN0300D001A**
	300	(11¾)	30	1500	9	(58)	Stock	**KEBN0300D002A**
	300	(11¾)	30	2500	15	(97)	Stock	**KEBN0300D003A**
	400	(15¾)	40	1000	5	(32)	Stock	**KEBN0400D001A**
	400	(15¾)	40	2500	11	(71)	Stock	**KEBN0400D002A**
	400	(15¾)	40	4000	18	(116)	Stock	**KEBN0400D003A**
	500	(19¹¹⁄₁₆)	50	1000	4	(26)	Stock	**KEBN0500D001A**
	500	(19¹¹⁄₁₆)	50	2500	9	(58)	Stock	**KEBN0500D002A**
	500	(19¹¹⁄₁₆)	50	4000	14	(90)	Stock	**KEBN0500D003A**

Note: All stock EB cartridge heaters 230V~(ac) and 1000 mm fiberglass insulated swaged-in leads.

Hot Runner Nozzle Heaters

Metric K-RING® and Mini K-RING

Watlow's K-RING® and mini K-RING heaters take nozzle heating technology a step ahead of the competition. Thanks to the innovative design, plastic molders no longer have to compromise with sloppy fit tolerances, uneven temperature profiles or short heater life.

Featuring a machined brass casting construction, these heaters can handle very high temperatures while providing maximum heat transfer.

Watlow's mini K-RING design is ideal for applications where space is limited such as hot runner molds with multiple cavities. The heating element fits easily into the small area and heats with precision and efficiency.

The K-RING and mini K-RING heaters feature highly flexible unheated ends which give the customer the ability to form leads to the wire channel. The unit also contains small lead adapters which take up less space in the machine.

With a precision machined inside diameter, the K-RING and mini K-RING heaters fit perfectly—and do not require clamping bands. Precision fit, along with the excellent thermal conductivity of brass, allow the K-RING and mini K-RING to give you an extremely even temperature profile.

Performance Capabilities

- Operating temperature to 650°C (1200°F)
- Maximum watt density on inside diameter to 50 W/cm^2 (320 W/in^2)
- Maximum voltage to 240V~(ac)

Features and Benefits

- **Brass casting construction** protects heater from damage, as well as maximizes transfer of heat to heated parts.
- **Precision machining** of length and inside diameter gives accurate fit tolerances.
- **Sealed construction** of the K-RING and mini K-RING eliminates contamination.
- **Stainless steel outer casing** protects the brass heater body, and acts as an insulator.
- **Distributed wattage** allows heat to be precisely placed for an even temperature profile.
- **Customized diameters** are available to meet specific application needs.

Applications

- Sprue bushings in plastic molding equipment
- Plastic injection nozzles
- Hot melt equipment

Hot Runner Nozzle Heaters

Metric K-RING and Mini K-RING

Technical Data

K-RING and Mini K-RING Comparison Chart

Characteristic	K-RING	Mini K-RING
Maximum voltage	240 volts	240 volts
Maximum amperage	4.5 amps	2.0 amps
Minimum outer diameter	18 mm (0.70 in.)	10 mm (0.39 in.)
Minimum wall thickness	4 mm (0.16 in.)	2.5 mm (0.10 in.)
Maximum element length	L (max) = I.D.* x 6.5 Max. length 250 mm (7.87 in.)	L (max) = I.D.* x 6.5 mm Max. length 250 mm (7.87 in.)
Thermocouple	Internal or external Type J or K	External possible
Lead - T/C insulation	Fiberglass Teflon®	Fiberglass Teflon®
Lead protection	Fiberbraid Stainless steel braid Stainless steel hose	None
Lead adapter	Standard swaged 6.5 mm (0.25 in.) dia.	Hermetic seal 4 mm (0.16 in.) diameter
Lead exit	Single ended	Dual ended
Lead exit length	Standard = 25 mm (1 in.) to adapter longer possible upon request	Standard = 150/200 mm (5/7 in.) staggered to adapter longer or shorter possible upon request
Reinforced lead exit	Yes - Diameter 7.7 mm (0.30 in.) minimum 30 mm (1.18 in.) long	No
Wattage tolerance	±10 percent	±10 percent

* Inner diameter equation applies to all heater sizes.

How to Order

To order your K-RING and mini K-RING heater, specify:

- I.D.
- Maximum possible O.D.
- Length
- Voltage
- Wattage
- No-heat at lead end
- Lead exit
- Lead length
- Wattage distribution

Quick Ship • *Same day shipment on all stock heaters with post terminals or Type B leads.*

Hot Runner Nozzle Heaters

MI Nozzle Band

The MI Band is a high performance nozzle heater constructed from Watlow's exclusive mineral insulation—a material that has much higher thermal conductivity than the mica and hard ceramic insulators used in conventional nozzle band heaters.

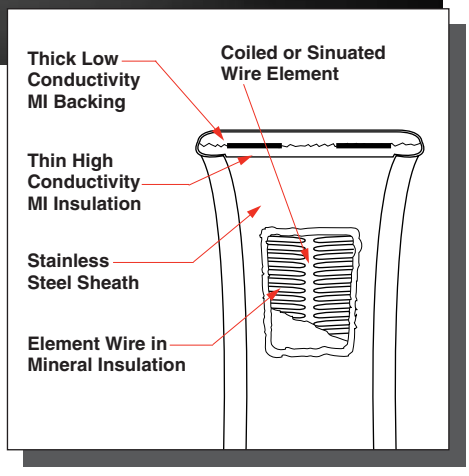
A thin layer of the "high" thermal conductive MI material is used to electrically insulate the element wire from the inside diameter of the heater sheath. A thicker, "low" thermal conductivity layer backs up the element wire, directing the heat inward towards the part that is being heated. The result is more efficient heat transfer ... a performance solution that lowers element wire temperatures and increases heater life.

Performance Capabilities

- Heater operating temperatures to 760°C (1400°F)
- Watt densities to 35.6 W/cm^2 (230 W/in^2) available on small diameter nozzle bands

Features and Benefits

- **Operating temperatures to 760°C (1400°F)** make it possible to safely melt even highly engineered resins, like Peek™, Teflon®, Ultem® and Zytel®.
- **Higher watt densities than any other band** contribute to faster heat-up and through-put to increase productivity.
- **High thermal conductivity of MI** and low mass construction give almost instant response to temperature control.



- **Stainless steel** design resists contamination of plastic blow back or other free-flowing materials. Side folds turn to the inside diameter rather than the outside diameter.

Applications

- Automotive molding
- Highly engineered resins

Teflon® and Zytel® are registered trademarks of E.I. du Pont de Nemours & Company.

Ultem® is a registered trademark of General Electric Corporation.

Peek™ is a trademark of Victrex plc.

Hot Runner Nozzle Heaters

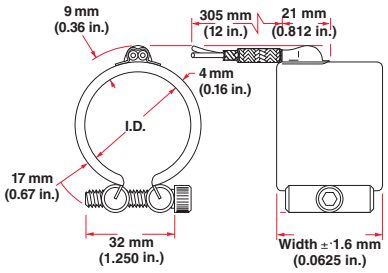
MI Nozzle Band

Termination Variations

Leads Type B, Type B—90 Degree Rotation,Type B—180 Degree Rotation or Type C: Two fiberglass-insulated lead wires exit in a single metal braid for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than braid. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **type** and **length.**

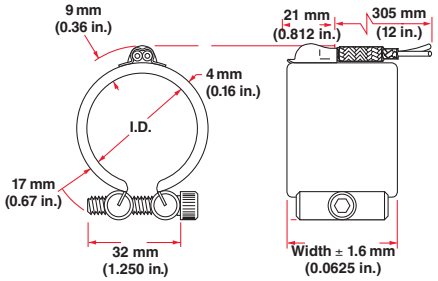
Type B

Stock



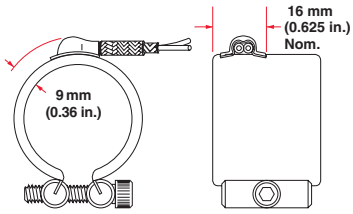
Type B—180 Degree Rotation

Stock



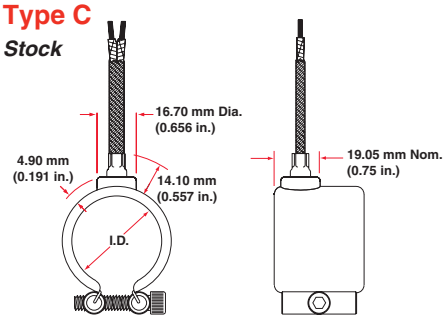
Type B—90 Degree Rotation

Non-Stock



Type C

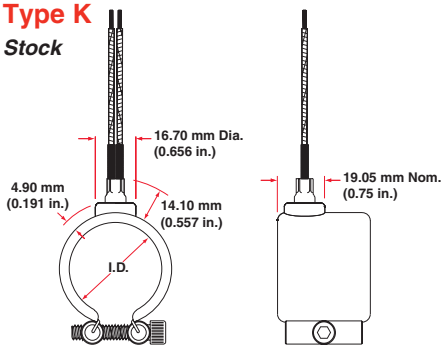
Stock



Post Terminals

Type K

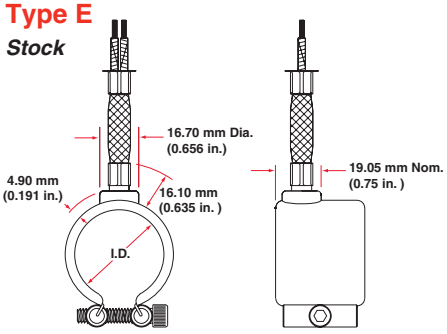
Stock



Type K: Flexible lead wires exit vertically from the heater. These leads can be bent adjacent to the heater for a quick and easy connection. To order, specify **Type K** and **length**.

Type E

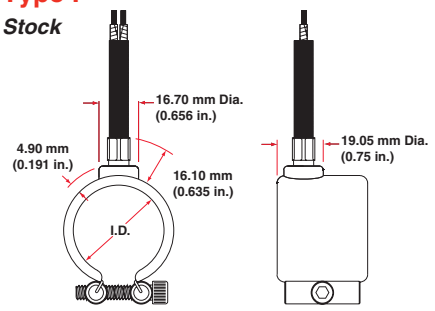
Stock



Type E: Loose metal braid encloses two fiberglass leads for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than braid. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **Type E** and **length.**

Type F

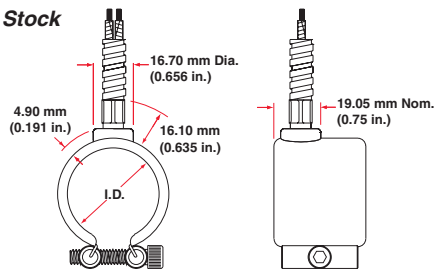
Stock



Type F: Loose fiberglass sleeving encloses two fiberglass leads for additional insulation protection where high temperature or minor abrasion is present. Leads are 51 mm (2 in.) longer than the sleeving. To order, specify **Type F** and **length**.

Type H

Stock



Type H: A flexible steel hose encloses the leads for maximum abrasion protection. Leads are 51 mm (2 in.) longer than hose. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **Type H** and **length.**

Hot Runner Nozzle Heaters

MI Nozzle Band

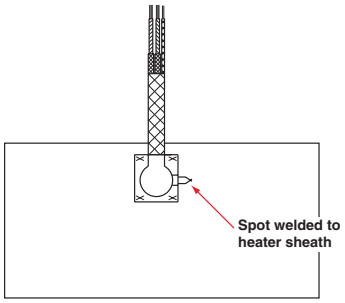
Variations

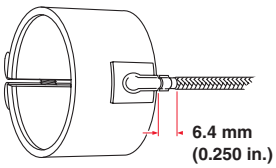
Lead Wire

Heaters rated at less than 250V~(ac) use UL® approved lead insulation for operations to 250°C (480°F) as standard. Lead insulation UL® rated for operation to 450°C (840°F) is available for high temperature applications where the leads are shrouded or enclosed with the heater. These leads are available in any of the Type B with loose braid as well as Types E, F and H lead configurations. All heaters rated at more than 250V~(ac) use this wire. When ordering, specify **450˚C (850°F) wire.**

Thermocouple

ASTM Type J or K internal thermocouples are available on lead Type B with loose braid. The thermocouple junction, which is welded inside the lead cap or spot-welded to heater sheath, provides a signal for measuring relative heater temperature.



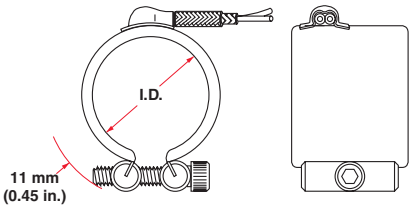


Heavy Duty Strain Relief

Heavy duty strain relief is recommended for applications where there is great stress or continued flexing of the leads. The strain relief is available on Type B, Type B—90 Degree and Type B—180 Degree leads only. To order, specify **heavy duty strain relief.**

Low Profile Tig Welded Nuts

Low profile nuts are available on all widths. Low profile nuts have a clearance of 10 mm (0.406 in.). To order, specify **low profile tig welded nuts**.



Low Profile Clamp Bars

Low profile clamp bars are available on both one 25 mm (1 in.) and 38 mm (1.5 in.) wide heaters, for wider widths consult factory. The bars are 6 mm (0.25 in.) diameter with an 8-32 screw. To order, specify **low profile clamp bars.**

Hot Runner Nozzle Heaters

MI Nozzle Band

MI Stock Product

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Construction	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Termination	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.
25.4	(1)	25.4	(1)	1pc	120	100	9.4	(61)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN2**
		25.4	(1)	1pc	120	150	14.2	(92)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN1**
		25.4	(1)	1pc	120	200	18.9	(122)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN3**
		25.4	(1)	1pc	240	200	18.9	(122)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN4**
		38.1	(1½)	1pc	120	200	10.8	(70)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN4**
		38.1	(1½)	1pc	240	200	10.8	(70)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN3**
		38.1	(1½)	1pc	120	300	16.4	(106)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN2**
		38.1	(1½)	1pc	240	300	16.4	(106)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN1**
		38.1	(1½)	1pc	240	400	21.8	(141)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN5**
31.8	(1¼)	25.4	(1)	1pc	120	250	16.1	(104)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN2**
		25.4	(1)	1pc	240	250	16.1	(104)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN1**
		25.4	(1)	1pc	240	300	19.2	(124)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN3**
		38.1	(1½)	1pc	120	350	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN2**
		38.1	(1½)	1pc	240	350	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN1**
		38.1	(1½)	1pc	240	450	17.3	(112)	Type B,C,E or H	0.09)	(0.2)	Stock	**MB1E1JN3**
31.8	(1¼)	25.4	(1)	1pc	120	200	9.6	(62)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN4**
		25.4	(1)	1pc	240	200	9.6	(62)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN3**
		25.4	(1)	1pc	120	300	14.4	(93)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN2**
		25.4	(1)	1pc	240	300	14.4	(93)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN1**
		25.4	(1)	1pc	240	400	19.3	(125)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN5**
		38.1	(½)	1pc	120	300	9.0	(58)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN1**
		38.1	(½)	1pc	240	300	9.0	(58)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN3**
		38.1	(½)	1pc	240	450	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN2**
		38.1	(½)	1pc	240	600	17.9	(116)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN4**
		50.8	(2)	1pc	240	300	6.5	(42)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN2**
		50.8	(2)	1pc	240	450	8.8	(57)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN1**
		50.8	(2)	1pc	240	900	19.3	(125)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN3**
		76.2	(3)	1pc	240	350	4.8	(31)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN2**
		76.2	(3)	1pc	240	500	7.0	(45)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN1**
		76.2	(3)	1pc	240	1000	16.1	(104)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN3**

CONTINUED

Hot Runner Nozzle Heaters

MI Nozzle Band

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Construction	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Termination	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.
44.5	(1¾)	38.1	(1½)	1pc	120	300	7.7	(50)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN2**
		38.1	(1½)	1pc	240	300	7.3	(47)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN1**
		38.1	(1½)	1pc	240	700	17.0	(110)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN3**
		50.8	(2)	1pc	240	750	13.3	(86)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1N2AN1**
50.8	(2)	25.4	(1½)	1pc	120	350	11.3	(73)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN2**
		25.4	(1½)	1pc	240	350	11.3	(73)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN1**
		25.4	(1½)	1pc	240	450	14.5	(94)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN3**
		38.1	(1½)	1pc	240	400	8.2	(53)	Type B,C,E or H	0.14	(0.3)	Stock	**MB2A1JN1**
		38.1	(1½)	1pc	240	1000	20.4	(132)	Type B,C,E or H	0.14	(0.3)	Stock	**MB2A1JN2**
		50.8	(2)	1pc	240	750	11.3	(73)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2A2AN1**
		50.8	(2)	1pc	240	1200	19.3	(125)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2A2AN2**
57.2	(2¼)	63.5	(2½)	1pc	240	1000	11.2	(72)	Type B,C,E or H	0.23	(0.5)	Stock	**MB2E2JN1**
63.5	(2½)	25.4	(1)	1pc	240	400	9.7	(63)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2J1AN1**
		38.1	(1½)	1pc	240	500	7.7	(50)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2J1JN1**

How to Order

To order your stock MI Nozzle heater, specify:

- Quantity
- Watlow code number
- Options
- Lead type and length, or terminal type configuration (If code number has an "N" as the last letter in the code, you must specify termination type and lead length. 305 mm (12 in.) leads will be supplied if not otherwise specified).

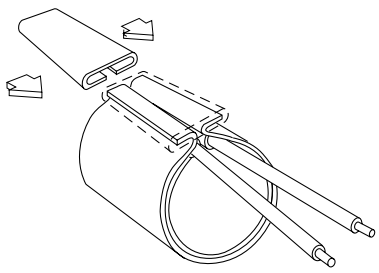
Availability

Stock: Same day shipment on MI Nozzle heaters with post terminals or 305 mm (12 in.) Type B leads. Longer lead lengths or other terminations will ship next day.

Made-to-Order: If stock units do not meet application needs, Watlow can manufacture MI Nozzle heaters to special requirements. Please consult a Watlow sales engineer or authorized distributor.

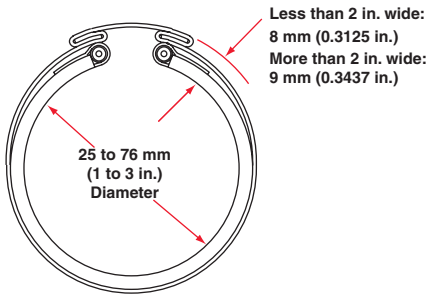
Special Mica Nozzle

Clamping Variations



HV Wedge-Lok

Designed to provide excellent clamping where mounting space is limited. Available with Type A and L leads only. Clearance from I.D. of the heater to the outside edge of the Wedge-Lok is 8 mm (0.3125 in.) nominal. Available on certain sizes from stock. To order, specify **HV Wedge-Lok.**



Hot Runner Nozzle Heaters

Thick Film Nozzle

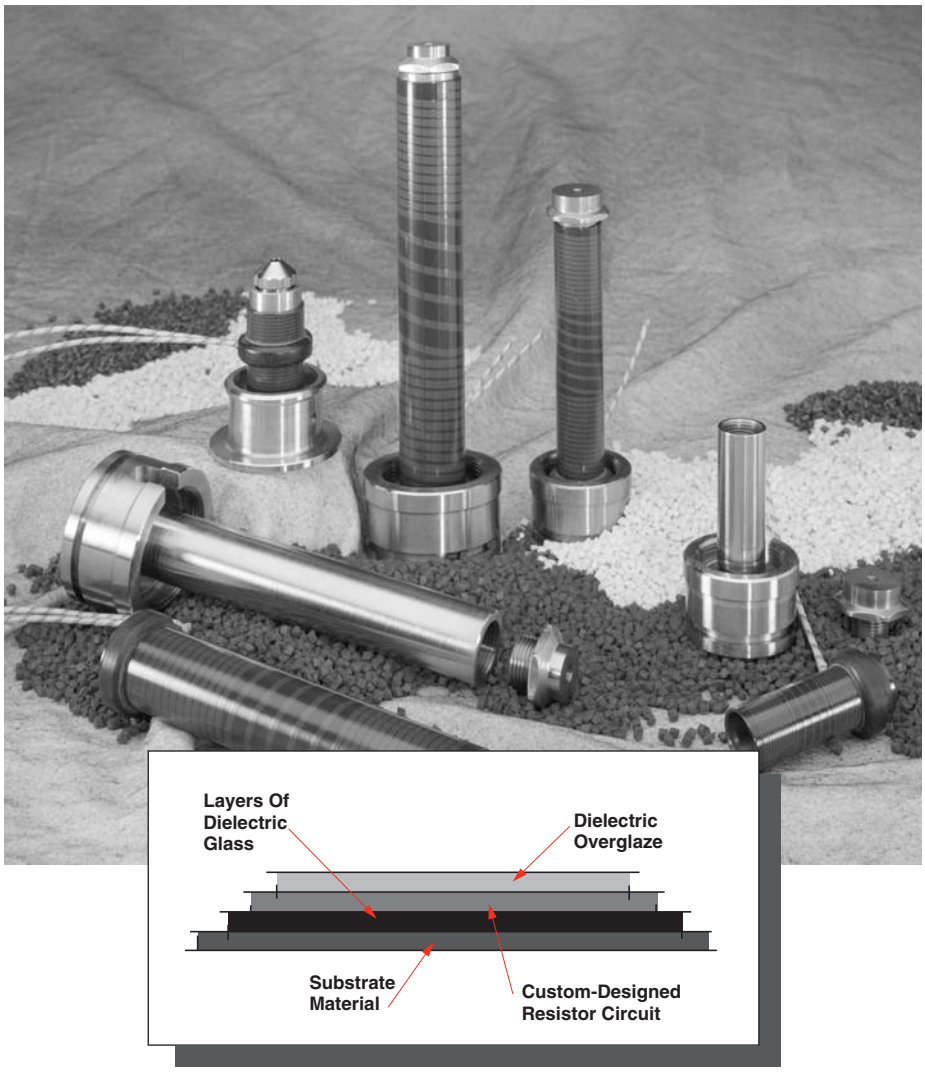
Because the hot runner nozzle is the final melt path between the manifold and the gate area, temperature uniformity is critical to avoid differences in melt viscosity. Whether it's hot spots causing thermal degradation of the plastic, or cold spots causing flow restrictions, both affect the final part quality and consistency from shot to shot.

Watlow's innovative thick film heating technology provides the injection molding industry with a patented (U.S. patent number 5,973,296) high-performance, low profile hot runner nozzle heater. The direct surface contact of the thick film material to the cylindrical stainless steel sleeve creates optimal heat transfer while the non-porous glass film prevents moisture absorption resulting in dielectric failure in other heaters.

Watlow has also developed a thick film nozzle heater configured with a low-profile, protective metallic oversleeve. This metal sleeve allows for internal lead terminations resulting in a heater thickness unmatched in the marketplace. It also provides additional protection of the dielectric glass material as well as further improving mechanical resistance and enhanced thermal efficiency by directing more heat transfer through the heater substrate directly into the nozzle itself. This added heat transfer (or reduced heat loss to the outside) results in a more efficient heater and overall less energy consumption.

Consult factory for more details on the metallic oversleeve option.

(U.S. patent number 6,410,894)



Features and Benefits

- **Uniform thermal profile and ability to pattern heater layout** results in uniform melt temperature for equal cavity filling and improved part quality; eliminates hot and cold spots.
- **Low thermal mass** allows quicker heat up and less thermal lag between the heater and the nozzle.
- **Extremely low radial profile** allows closer pitch – center-to-center distance – between nozzles for higher nozzle density and more parts per mold.
- **Moisture-resistant non-porous glass film construction** eliminates need for soft starting, minimizes current leakage and ultimately reduces cost by eliminating special need of GFCI protection.

Agency Approvals

- UL®, CSA and CE

Robust industrial heaters

- Designed to operate in 24 x 7 x 365 hour applications.

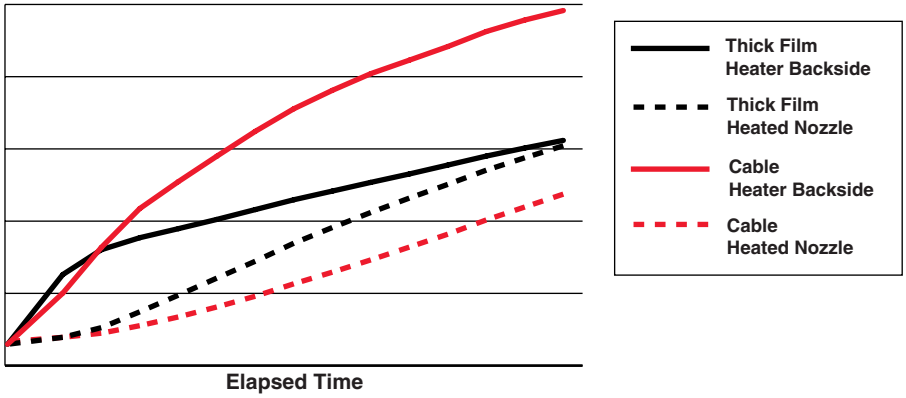
Operating temperature

- Able to run heaters up to 500˚C (932˚F).

Hot Runner Nozzle Heaters

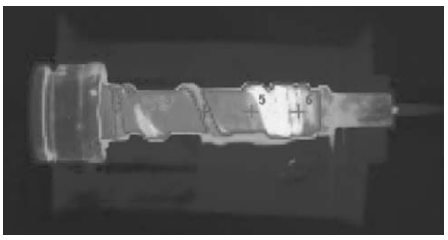
Thick Film Nozzle

Thick Film Nozzle Heater Response Test
Thick Film vs. Axial Clamped Coiled Cable

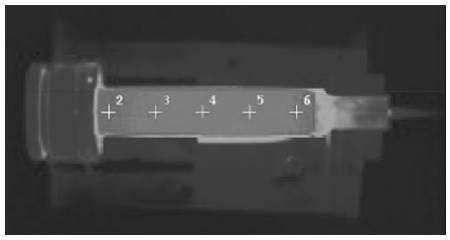


Precise Wattage Distribution

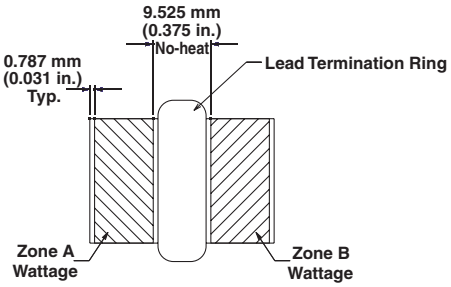
Thick film nozzle heaters rated to 500˚C (932˚F) provide superior temperature uniformity by putting the energy exactly where it is needed.

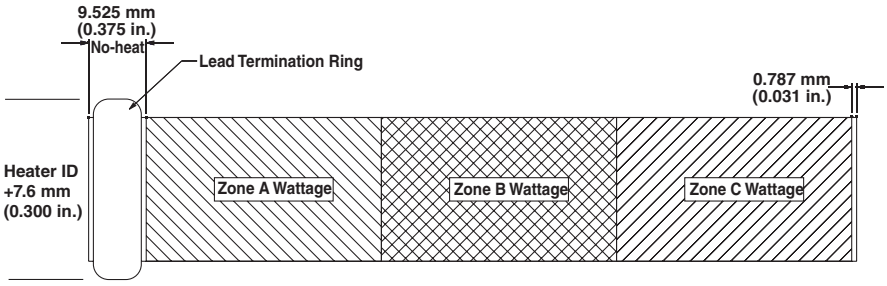


Temperature distribution using standard coiled cable heater.



Temperature distribution using thick film heating technology.





Watlow thick film technology heaters offer distinct competitive advantages over coiled cable heater technology:

1. Uniform temperature profile
2. No requirement for clamping of the heater
3. High dielectric barrier with agency approvals eliminates need for soft start
4. Lower heater operating temperatures
5. Precise and repeatable wattage distribution
6. Increased controllability of system
7. Increased productivity through decreased set-up time
8. Design allows thermocouple to be directly immersed into nozzle body. Replaceable option to accurately measure melt temperature – not the heater.
9. Low profile design allows for larger nozzle with higher feed into a smaller hole. Also, the water jacket can be closer to the nozzle producing better control and higher yield.

Installation

The thick film nozzle heaters are designed with the optimum diametric clearance of 0.038 mm (0.0015 in.) above the actual nozzle. This clearance allows for easy insertion and removal of the heater and excellent heat transfer without the need for clamping, anti-seize or heat sink compound with the thick film nozzle heater.

Nozzle surface preparation may be necessary if the nozzle has any surface contamination or other irregularities. Cleaning of the used nozzle body surface is easily accomplished with light sand blasting of the surface and then a light buffing of the surface with a piece of emery cloth. After the cleaning operation the nozzle heater should slip on and off very easily. Forcing a heater on to a nozzle may result in heater damage and possible failure after it has been in operation.

Do not use anti-seize or heat sink compound with thick film nozzle heaters.

Hot Runner Nozzle Heaters

Thick Film Nozzle

Substrate I.D.

Standard substrate I.D.s include:

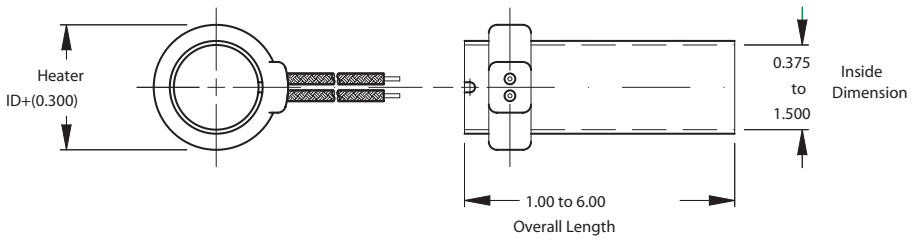
- 6.0 mm (0.238 in.)
- 10.0 mm (0.396 in.)
- 12.0 mm (0.474 in.)
- 12.7 mm (0.502 in.)
- 14.0 mm (0.553 in.)
- 15.9 mm (0.627 in.)
- 19.0 mm (0.752 in.)
- 22.2 mm (0.877 in.)
- 25.4 mm (1.02 in.)
- 28.0 mm (1.104 in.)

Substrate Length

- Lengths available starting from 12 mm (0.5 in.). Since development of new length capabilities are ongoing, please consult factory for maximum length.

Voltage

- Voltages ranging from 100 to 240V are available.



These dimensions are for general guidelines only. For specific nozzle heater requirements, please consult factory.

Nozzle Heaters

I.D. mm	I.D. (in.)	O.D. mm	O.D. (in.)	Length mm	Length (in.)	Voltage	Wattage	Termination Location	Termination Style	Heater Size Operating Temp	Maximum Watlow Code Number
Class II – Molded Termination Ring											
9.6	(0.377)	11.1	(0.437)	76.2	(3.0)	230	250	end	molded	500˚C (932˚F)	TNAA0377-0300AA
15.9	(0.627)	17.4	(0.687)	38.1	(1.5)	230	220	end	molded	500˚C (932˚F)	TNAA0627-0150AA
15.9	(0.627)	17.4	(0.687)	101.6	(4.0)	230	425	end	molded	500˚C (932˚F)	TNAA0627-0400AA
15.9	(0.627)	17.4	(0.687)	177.8	(7.0)	230	575	end	molded	500˚C (932˚F)	TNAA0627-0700AA
19.1	(0.752)	20.6	(0.812)	30.5	(1.2)	230	185	end	molded	500˚C (932˚F)	TNAA0752-0120AA
19.1	(0.752)	20.6	(0.812)	30.5	(1.2)	230	160	center	molded	500˚C (932˚F)	TNAA0752-0120AB
19.1	(0.752)	20.6	(0.812)	30.5	(1.2)	115	135	end	molded	500˚C (932˚F)	TNAA0752-0120AC
19.1	(0.752)	20.6	(0.812)	30.5	(1.2)	240	145	center	molded	500˚C (932˚F)	TNAA0752-0120AD
19.1	(0.752)	20.6	(0.812)	35.6	(1.4)	230	235	end	molded	500˚C (932˚F)	TNAA0752-0140AA
19.1	(0.752)	20.6	(0.812)	35.6	(1.4)	230	210	center	molded	500˚C (932˚F)	TNAA0752-0140AB
22.3	(0.877)	23.8	(0.937)	30.5	(1.2)	230	210	end	molded	500˚C (932˚F)	TNAA0877-0120AA
22.3	(0.877)	23.8	(0.937)	30.5	(1.2)	230	185	center	molded	500˚C (932˚F)	TNAA0877-0120AB
22.3	(0.877)	23.8	(0.937)	35.6	(1.4)	230	270	end	molded	500˚C (932˚F)	TNAA0877-0140AA
22.3	(0.877)	23.8	(0.937)	35.6	(1.4)	230	235	center	molded	500˚C (932˚F)	TNAA0877-0140AB
Class III – Metallic Oversleeve											
250	end	CL III		500˚C (932˚F)		TNDA0953-0762AA	9.5	(0.375)	13.5	(0.532)*	95.3 (3.0) 230

*Sleeve O.D.

Consult factory for additional sizes.

Hot Runner Nozzle Heaters

Quick Ship

- *Same day shipment on more than 1000 variations of THINBAND heaters.*

For application and technical data on THINBAND MICA heaters reference page 37.

THINBAND®, HV and Special Mica Nozzle Heaters

The THINBAND® heater is Watlow's patented redesign of the mica band. THINBAND heaters deliver fast and install easily, keeping costs down and machines up and running.

Watlow's HV and special mica nozzle heaters provide affordable, low profile solutions for injection molding applications. The

Performance Capabilities

- Sheath temperatures to 480°C (900°F)
- Watt densities to 8.5 W/cm^2 (55 W/in^2)

Features and Benefits

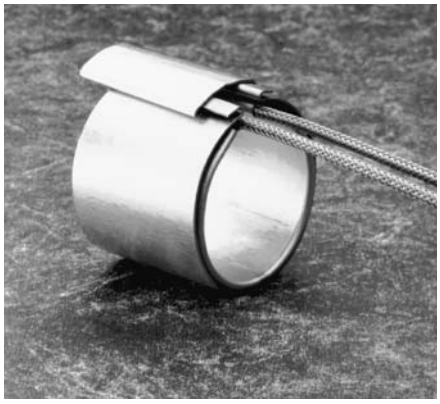
- **Same day shipment** on more than 1000 variations of THINBAND lead attachments is due to Watlow's exclusive Lead Adapter—or LA—manufacturing method. Customers can reduce inventories and costly downtime.
- **Permanently attached clamping bars.**
- **Contamination resistance.** No folds on outside of heater.

Applications

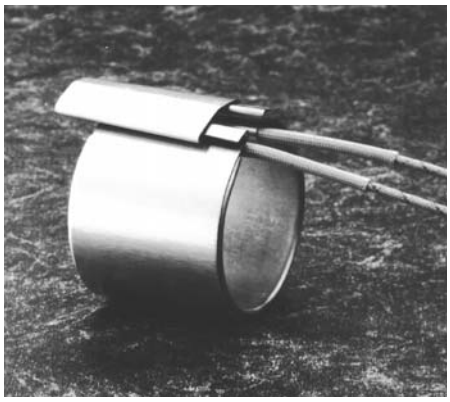
- Injection molding nozzles

THINBAND HV Nozzle with "A" Lead

HV Nozzle with "L" Lead



HV Nozzle with Wedge-Lok Clamp and "A" Lead



HV Nozzle with Wedge-Lok Clamp and "L" Lead

Hot Runner Nozzle Heaters

THINBAND Mica Nozzle

Features

- Economically priced
- Watlow quality in a low cost heater
- Low profile clamping

HV Nozzle with "L" Leads

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Volts	Watts	Watlow Code Number
25	(1)	25	(1)	120	100	**SHV1A1A1-L10**
25	(1)	25	(1)	240	100	**SHV1A1A2-L10**
25	(1)	25	(1)	120	125	**SHV1A1A4-L10**
25	(1)	25	(1)	240	125	**SHV1A1A3-L10**
25	(1)	38	(1.5)	120	150	**SHV1A1J1-L10**
25	(1)	38	(1.5)	240	150	**SHV1A1J5-L10**
25	(1)	38	(1.5)	240	200	**SHV1A1J4-L10**
25	(1)	51	(2)	240	200	**SHV1A2A2-L10**
25	(1)	76	(3)	240	300	**SHV1A3A1-L10**
38	(1.5)	25	(1)	240	200	**SHV1J1A1-L10**
38	(1.5)	38	(1.5)	120	275	**SHV1J1J1-L10**
38	(1.5)	38	(1.5)	240	275	**SHV1J1J2-L10**
38	(1.5)	38	(1.5)	240	300	**SHV1J1J4-L10**
38	(1.5)	38	(1.5)	240	250	**SHV1J1J5-L10**
38	(1.5)	51	(2)	120	300	**SHV1J2A2-L10**
38	(1.5)	51	(2)	240	300	**SHV1J2A3-L10**
38	(1.5)	64	(2.5)	240	400	**SHV1J2J2-L10**
38	(1.5)	76	(3)	120	400	**SHV1J3A1-L10**
38	(1.5)	76	(3)	240	400	**SHV1J3A2-L10**
38	(1.5)	76	(3)	120	450	**SHV1J3A3-L10**
38	(1.5)	76	(3)	240	450	**SHV1J3A8-L10**
38	(1.5)	102	(4)	120	600	**SHV1J4A1-L10**
38	(1.5)	102	(4)	120	550	**SHV1J4A3-L10**
38	(1.5)	102	(4)	240	550	**SHV1J4A4-L10**
44	(1.75)	102	(4)	240	300	**SHV1N1J1-L10**
51	(2)	38	(1.5)	240	300	**SHV2A1J1-L10**

Hot Runner Nozzle Heaters

THINBAND Mica Nozzle

Features

- Metal braided leads
- Economically priced
- Low profile clamping

HV Nozzle with "A" Leads

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Volts	Watts	Watlow Code Number
25	(1)	25	(1)	120	100	**SHV1A1A1-A10**
25	(1)	25	(1)	240	100	**SHV1A1A2-A10**
25	(1)	25	(1)	240	125	**SHV1A1A3-A10**
25	(1)	25	(1)	120	125	**SHV1A1A4-A10**
25	(1)	38	(1.5)	240	200	**SHV1A1J4-A10**
25	(1)	51	(2)	240	200	**SHV1A2A2-A10**
25	(1)	76	(3)	240	300	**SHV1A3A1-A10**
38	(1.5)	25	(1)	240	200	**SHV1J1A1-A10**
38	(1.5)	38	(1.5)	120	275	**SHV1J1J1-A10**
38	(1.5)	38	(1.5)	240	275	**SHV1J1J2-A10**
38	(1.5)	38	(1.5)	240	300	**SHV1J1J4-A10**
38	(1.5)	38	(1.5)	240	250	**SHV1J1J5-A10**
38	(1.5)	51	(2)	120	300	**SHV1J2A2-A10**
38	(1.5)	51	(2)	240	300	**SHV1J2A3-A10**
38	(1.5)	64	(2.5)	240	400	**SHV1J2J2-A10**
38	(1.5)	76	(3)	120	400	**SHV1J3A1-A10**
38	(1.5)	76	(3)	240	400	**SHV1J3A2-A10**
38	(1.5)	76	(3)	240	450	**SHV1J3A8-A10**
38	(1.5)	102	(4)	120	600	**SHV1J4A1-A10**
38	(1.5)	102	(4)	120	550	**SHV1J4A3-A10**
38	(1.5)	102	(4)	240	550	**SHV1J4A4-A10**
51	(2)	38	(1.5)	240	300	**SHV2A1J1-A10**

Hot Runner Nozzle Heaters

THINBAND Mica Nozzle

Features

- Low price
- Low profile: 38 mm (1.5 in.) I.D. band fits into a 55 mm (2.165 in.) diameter hole
- No bolts, nuts, flanges; permanently attached band
- Full width clamping band for even heat transfer

HV Nozzle with Wedge-Lok Clamp

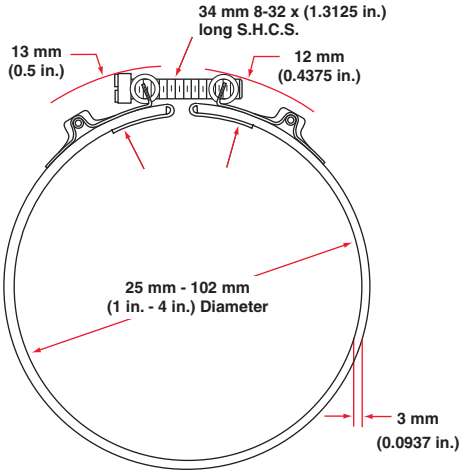
I.D. mm	I.D. (in.)	Width mm	Width (in.)	Volts	Watts	Watlow Code Number
25	(1)	25	(1)	120	100	**SHV1A1A1-L10W**
25	(1)	25	(1)	240	100	**SHV1A1A2-L10W**
25	(1)	25	(1)	120	125	**SHV1A1A4-L10W**
25	(1)	25	(1)	240	125	**SHV1A1A3-L10W**
25	(1)	38	(1.5)	120	150	**SHV1A1J1-L10W**
25	(1)	38	(1.5)	240	150	**SHV1A1J5-L10W**
25	(1)	38	(1.5)	240	200	**SHV1A1J4-L10W**
25	(1)	51	(2)	240	200	**SHV1A2A2-L10W**
38	(1.5)	25	(1)	240	200	**SHV1J1A1-L10W**
38	(1.5)	38	(1.5)	120	275	**SHV1J1J1-L10W**
38	(1.5)	38	(1.5)	240	275	**SHV1J1J2-L10W**
38	(1.5)	38	(1.5)	240	300	**SHV1J1J4-L10W**
38	(1.5)	51	(2)	120	300	**SHV1J2A2-L10W**
38	(1.5)	51	(2)	240	300	**SHV1J2A3-L10W**
38	(1.5)	64	(2.5)	240	400	**SHV1J2J2-L10W**
38	(1.5)	76	(3)	120	450	**SHV1J3A3-L10W**
38	(1.5)	76	(3)	240	450	**SHV1J3A8-L10W**
38	(1.5)	102	(4)	240	550	**SHV1J4A4-L10W**
44	(1.75)	38	(1.5)	240	300	**SHV1N1J1-L10W**
51	(2)	38	(1.5)	240	300	**SHV2A1J1-L10W**
25	(1)	25	(1)	120	100	**SHV1A1A1-A10W**
25	(1)	25	(1)	240	100	**SHV1A1A2-A10W**
25	(1)	25	(1)	240	125	**SHV1A1A3-A10W**
25	(1)	25	(1)	120	125	**SHV1A1A4-A10W**
25	(1)	38	(1.5)	240	200	**SHV1A1J4-A10W**
25	(1)	51	(2)	240	200	**SHV1A2A2-A10W**
38	(1.5)	25	(1)	240	200	**SHV1J1A1-A10W**
38	(1.5)	38	(1.5)	120	275	**SHV1J1J1-A10W**
38	(1.5)	38	(1.5)	240	275	**SHV1J1J2-A10W**
38	(1.5)	38	(1.5)	240	300	**SHV1J1J4-A10W**
38	(1.5)	51	(2)	120	300	**SHV1J2A2-A10W**
38	(1.5)	51	(2)	240	300	**SHV1J2A3-A10W**
38	(1.5)	64	(2.5)	240	400	**SHV1J2J2-A10W**
38	(1.5)	76	(3)	240	450	**SHV1J3A8-A10W**
38	(1.5)	102	(4)	120	550	**SHV1J4A3-A10W**
38	(1.5)	102	(4)	240	550	**SHV1J4A4-A10W**
51	(2)	38	(1.5)	240	300	**SHV2A1J1-A10W**

Hot Runner Nozzle Heaters

THINBAND Mica Nozzle

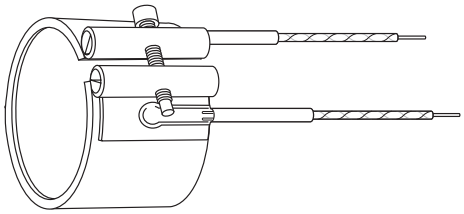
Heater Terminations

- One to four inch diameter
- One to six inches wide



Type L

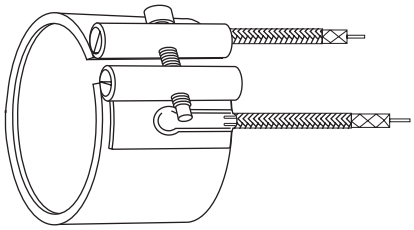
Stock Option



Flexible lead wires with fiberglass sleeves exit the nozzle heater on both sides of the gap. The heater sheath encloses the ends for protection against contamination. To order, specify **Type L.**

Type A

Stock Option



Especially designed for nozzle heaters. A galvanized metal braid over the fiberglass insulated leads provides strength and protection. The heater ends are enclosed to protect against melted plastic and contaminants. This arrangement permits 25 mm (1 in.) and wider nozzle heaters to be placed flush against a flange. Available on nozzle sizes only. To order, specify **Type A.**

Hot Runner Nozzle Heaters

THINBAND Mica Nozzle

Stock Product List

I.D. mm (in.)	Width mm (in.)	Volts	Watts	Watt Density W/cm² (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg (lbs)	Avail.	Code No.	Former Code No.
23.8 (15/16)	50.8 (2)	240	175	7.0 (45)	1	Mica Band–12 in. Type K	0.09 (0.2)	Stock	**BOS2AK1**	–
25.4 (1)	25.4 (1)	120	100	6.8 (44)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1A1**	**B1A1AN1**
	25.4 (1)	240	100	6.8 (44)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1A2**	**B1A1AN2**
	25.4 (1)	120	125	8.5 (55)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1A3**	**B1A1AN3**
	25.4 (1)	240	125	8.5 (55)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1A4**	**B1A1AN4**
	38.1 (1½)	120	150	6.8 (44)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1J1**	**B1A1JN1**
	38.1 (1½)	240	150	6.8 (44)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1J2**	**B1A1JN2**
	38.1 (1½)	120	200	9.1 (59)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1J3**	**B1A1JN3**
	38.1 (1½)	240	200	9.1 (59)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1A1J4**	**B1A1JN4**
31.8 (1¼)	15.9 (5/8)	120	100	8.4 (54)①	1	Mica Band–12 in. Type A	0.09 (0.2)	Stock	**B1EOLA1**	–
	38.1 (1¼)	120	125	5.1 (33)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1E1E1**	**B1E1EN1**
	38.1 (1¼)	240	125	5.1 (33)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1E1E2**	**B1E1EN2**
	38.1 (1¼)	240	75	3.1 (20)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1E1E4**	**B1E1EN3**
	38.1 (1¼)	240	250	10.4 (67)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1E1E3**	**B1E1EN4**
	76.2 (3)	240	150	2.5 (16)	1	THINBAND–Type A or L	0.22 (0.5)	Stock	**STB1E3A1**	**B1E3AN1**
	76.2 (3)	240	250	4.2 (27)	1	THINBAND–Type A or L	0.22 (0.5)	Stock	**STB1E3A2**	**B1E3AN2**
	76.2 (3)	240	300	5.1 (33)	1	THINBAND–Type A or L	0.22 (0.5)	Stock	**STB1E3A3**	**B1E3AN3**
34.9 (1⅜)	25.4 (1)	120	140	6.4 (41)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1G1A1**	**B1G1AN1**
	50.8 (2)	240	300	7.9 (51)①	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1G2A1**	**B1G2AK1**
	88.9 (3½)	240	200	2.6 (17)	1	THINBAND–Type A or L	0.27 (0.6)	Stock	**STB1G3J1**	**B1G3JA1**
	88.9 (3½)	240	250	3.3 (21)	1	THINBAND–Type A or L	0.27 (0.6)	Stock	**STB1G3J2**	**B1G3JA2**
38.1 (1½)	22.2 (7/8)	240	100	4.8 (31)	1	Mica Band–Type A or L	0.09 (0.2)	Stock	**B1JORN1**	–
	25.4 (1)	120	100	4.0 (26)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1J1A1**	**B1J1AN1**
	25.4 (1)	240	100	4.0 (26)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1J1A2**	**B1J1AN2**
	25.4 (1)	120	150	6.0 (39)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1J1A3**	**B1J1AN3**
	25.4 (1)	240	150	6.0 (39)	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1J1A4**	**B1J1AN4**
	25.4 (1)	120	200	8.0 (52)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1J1A5**	**B1J1AN5**
	25.4 (1)	240	200	8.0 (52)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1J1A6**	**B1J1AN6**
	31.8 (1¼)	240	250	8.0 (52)①	1	THINBAND–Type A or L	0.09 (0.2)	Stock	**STB1J1E1**	**B1J1EN1**
	38.1 (1½)	120	200	5.4 (35)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J1J1**	**B1J1JN1**
	38.1 (1½)	240	200	5.4 (35)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J1J2**	**B1J1JN2**
	38.1 (1½)	120	250	6.6 (43)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J1J3**	**B1J1JN3**
	38.1 (1½)	240	250	6.6 (43)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J1J4**	**B1J1JN4**
	38.1 (1½)	120	275	7.4 (48)①	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J1J5**	**B1J1JN5**
	38.1 (1½)	240	275	7.4 (48)①	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J1J6**	**B1J1JN6**
	38.1 (1½)	240	300	8.0 (52)①	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J1J7**	**B1J1JN7**
	38.1 (1½)	240	200	6.7 (43)	1	Mica Band–36 in. Black Glass 90° from Gap	0.14 (0.3)	Stock	**B1J1JX1**	–

CONTINUED

① Watt density is above Watlow recommendations at some common molding temperatures.

Hot Runner Nozzle Heaters

THINBAND Mica Nozzle

I.D. mm (in.)	Width mm (in.)	Volts	Watts	Watt Density W/cm² (W/in²)	1 pc. or 2 pc.	Terminals, Leads and Special Features	Approx. Net. Wt. kg (lbs)	Avail.	Code No.	Former Code No.
38.1 (1½)	50.8 (2)	240	300	6.0 (39)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1J2A1**	**B1J2AN1**
	63.5 (2½)	240	400	6.5 (42)	1	THINBAND–Type A or L	0.23 (0.5)	Stock	**STB1J2J1**	**–**
	76.2 (3)	240	350	4.6 (30)	1	THINBAND–Type A or L	0.27 (0.6)	Stock	**STB1J3A1**	**B1J3AN1**
	76.2 (3)	240	500	6.7 (43)	1	THINBAND–Type A or L	0.27 (0.6)	Stock	**STB1J3A2**	**B1J3AN2**
	76.2 (3)	240	800	10.7 (69)①	1	THINBAND–Type A or L	0.27 (0.6)	Stock	**STB1J3A3**	**B1J3AN3**
	101.6 (4)	240	600	6.0 (39)	1	THINBAND–Type A or L	0.27 (0.6)	Stock	**STB1J4A1**	**–**
44.5 (1¾)	38.1 (½)	240	150	3.4 (22)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1N1J1**	**B1N1JN1**
	38.1 (½)	120	200	4.5 (29)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1N1J2**	**B1N1JN2**
	38.1 (½)	240	200	4.5 (29)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1N1J3**	**B1N1JN3/4**
	38.1 (½)	240	225	5.0 (32)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1N1J5**	**B1N1JN5**
	38.1 (½)	240	250	5.6 (36)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1N1J6**	**B1N1JN6**
44.5 (1¾)	38.1 (½)	120	300	6.7 (43)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1N1J7**	**B1N1JN7**
	38.1 (½)	240	300	6.7 (43)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1N1J8**	**B1N1JN8**
	38.1 (½)	240	200	4.6 (30)	1	Mica Band–72 in. Type C	0.14 (0.3)	Stock	**B1N1JC3**	**–**
47.6 (1⅞)	25.4 (1)	240	140	4.3 (28)	1	THINBAND–Type A or L	0.14 (0.3)	Stock	**STB1R1A1**	**B1R1AL1**

① Watt density is above Watlow recommendations at some common molding temperatures.
② Mica Band-Post-thermocouple hole at gap, THINBAND replacement does not include thermocouple hole at gap.

Hot Runner Nozzle Heaters

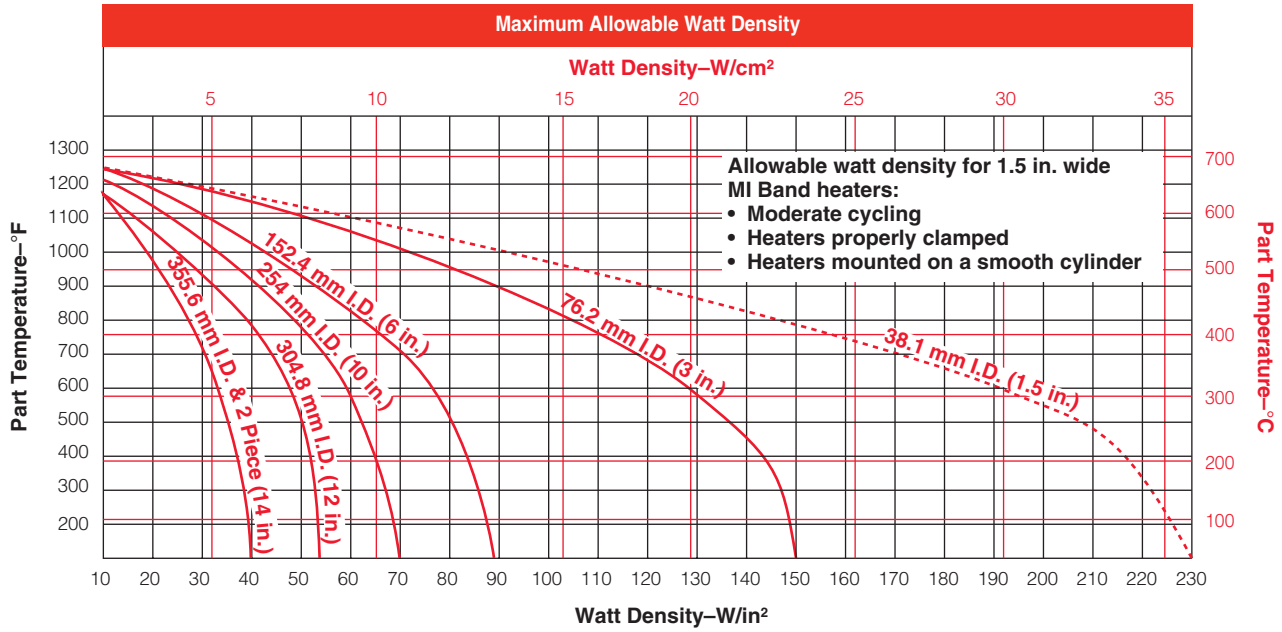
Technical Data

Maximum Allowable Watt Density

The following derating factors apply to the Maximum Allowable Watt Density chart, which are shown in both inch base and metric for your convenience. Please review these factors and the chart to determine the correct watt density curve for your application.

Derating Factors:

- For units over 51 mm (2 in.) in width, multiply watt density by 0.8.
- In applications where unusual operating conditions are present, such as irregular mounting surfaces, contact the Watlow factory in St. Louis, Missouri, for watt density limitations.
- For applications where insulating blankets are used, multiply W/in² (W/cm²) by 0.75.



Hot Runner Nozzle Heaters

Problem Solvers

Watlow Solution To Common Nozzle Heater Problems

Heater replacement intervals can be lengthened or heater problems eliminated by using the optimum heater technology. Check the list below to see if your plastics processing can be improved.

Problem	Heater Solution
Contamination shortening heater life	• MI, THINBAND nozzle heater with contamination resistant side folds on I.D. of heater • Sealed K-RING heater • Coiled cable heater • Thick film nozzle heater
High process temperature shortening heater life	• MI nozzle heater • Thick film nozzle heater 500˚C (932˚F)
Uneven temperature profile on nozzle	• Thick film nozzle heater - able to optimize heat pattern • MI, coiled cable or K-RING heater • Distributed wattage cable or K-RING heater
Process temperature not reaching set point	• Check for proper heater fit-to-nozzle • Increase heater wattage and/or switch to higher watt density MI, coiled cable heater • Thick film nozzle heater
Tight clearance/limited space	• Low profile thick film nozzle heater • Axial clamp cable heater • Low profile clamp bars on MI heater • Wedge-Lok mica heater • Low profile cable heater
No space/limited space for temperature sensor	• Cable or K-RING heater with internal thermocouple
Power leads overheating/insulation deteriorating	• Use MGT 454°C (850°F) rated wire • Fiberglass sleeve over leads • Use cable heater with unheated tail section
Power lead insulation abrading/require physical protection against sharp edges	• Metal braided leads • Stainless steel hose
Power lead failure cause by excess flexing	• Heavy duty strain relief on MI or K-RING heater
No stock heater listed for application	• **Made-to-order** emergency delivery service– premium one to three day shipment except on MI products

Hot Runner Nozzle Heaters

Case History

Hot Runner Nozzle Heaters

Problem:
An injection molding customer required a more efficient heating method for their hot runner system to increase start-up and throughput.

A segment where hot runner systems have been readily adopted is in the production of plastic preform parts (unblown bottles). This particular molder was utilizing multiple plastic resins with melt temperature ranges of 176°C to 301°C (350°F to 575°F). Thick film technology heaters have an operating range up to 500°C (932°F) and due to the overall efficiency and low profile; they were an ideal heating method for this hot runner system.

The heated nozzle section of this hot runner system utilized cable heaters to keep the melt at temperature. The customer found that the loose fitting wound heater design was not providing an even thermal profile on the nozzle resulting in lost efficiencies. Therefore, a different approach was required.

Solution:
Multi-zone distributed wattage thick film nozzle heaters from Watlow. The thick film heating technology offered the OEM multiple benefits to meet the needs of the application.

Watlow's thick film nozzle heaters provide OEMs and molders with the following advantages:

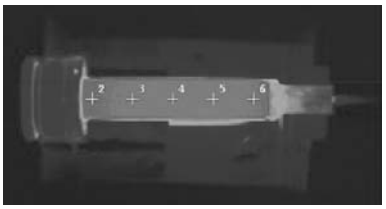
Low radial ink / substrate profile – 0.9 mm (0.035 in.)
- Allows for higher nozzle density in the tool.
- Allows for use of larger nozzles with larger feed into a smaller hole resulting in more plastic throughput.
- Permits water jackets to be closer to the nozzle; better control resulting in higher part yield.

Construction
- Provides uniform surface contact along the nozzle- even thermal profile
- Increased controllability of the system; thermocouples are separate from the heater and immersed into the body of the nozzle, resulting in a more consistent process temperature reading
- Flexible leads allow for greater manipulation in wiring channel, which provides greater manifold design flexibility
- Moisture and contamination resistant
- High-temperature molded termination

Precise wattage distribution and tight tolerance
- Reduces part scrap
- Provides more consistent results than traditional methods
- Able to maintain consistent temperatures as the system is running

Positive resistance coefficient
- Improves response time, controllability and heater life
- Faster ramp to operating temperature

Overall Results:
The customer experienced benefits of cost savings on steel, additional machining; purchasing one heater (manifold) versus multiple tubulars, decreased overall power consumption, faster system response and a higher part yield. This customer has plans to order additional thick film technology heaters to incorporate into additional systems.



Thick film nozzle heaters provide a superior temperature uniformity capability by putting the energy exactly where it is needed by the application.

Hot Runner Manifold Heaters

Watlow's Family of Hot Runner Manifold Heater Solutions

Watlow offers a broad line of manifold heaters for hot runner systems. While every heater has a unique set of qualities, each manifold heater is designed with the needs of injection molders in mind. Whether you require enhanced performance, high temperature capabilities, high watt density, or all of these, Watlow has the heater to best fit your application.

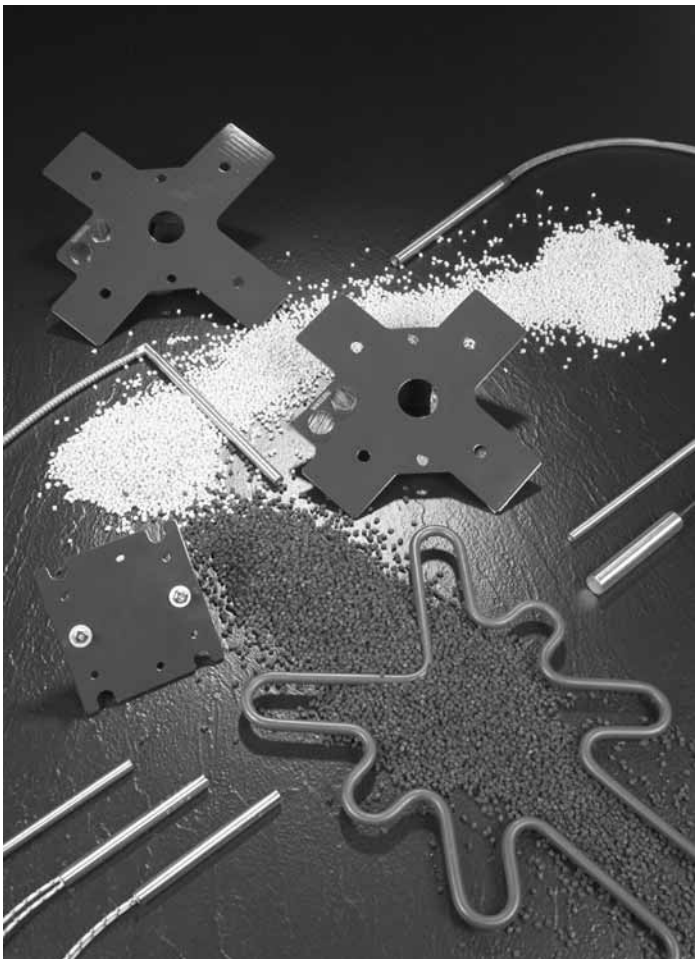
Watlow's hot runner manifold heaters include:

- FIREROD® cartridge heaters
- Metric FIREROD cartridge heaters
- Thick film heaters
- Tubular milled groove heaters

These manifold heaters are ideally suited to meet the demands of today's new resins and provide a wide range of benefits including:

- Moisture and corrosion resistant designs
- Flexible designs ensuring easy installation and removal

Watlow's hot runner manifold heaters also provide even heat distribution. Temperature uniformity is crucial in avoiding hot or cold spots in molds that can lead to thermal degradation or flow restrictions. Both conditions can affect final part quality as well as shot to shot consistency.



Watlow's hot runner heaters provide uniform melt temperatures for equal cavity filling. This even heating greatly diminishes heat irregularities and allows injection molders to reduce start-up and cycle times. The end result is consistent product quality from shot to shot and fit more parts per mold.

Applications

- Hot runner manifold heaters

For more information on Watlow's line of manifold heaters, contact your local Watlow representative.

Hot Runner Manifold Heaters

For complete information on FIREROD cartridge heaters reference pages 70 to 119.

FIREROD® Cartridge Family

Watlow's family of cartridge heaters provides superior heat transfer; uniform temperatures and resistance to oxidation and corrosion even at high temperatures.

Watlow's cartridge heaters are available in high, medium and low-watt density units. The wattage distribution can be configured to yield a uniform heat profile and the overall superior construction allows for rapid heat dissipation into the former heater.

Performance Capabilities—FIREROD Cartridge and Metric Version

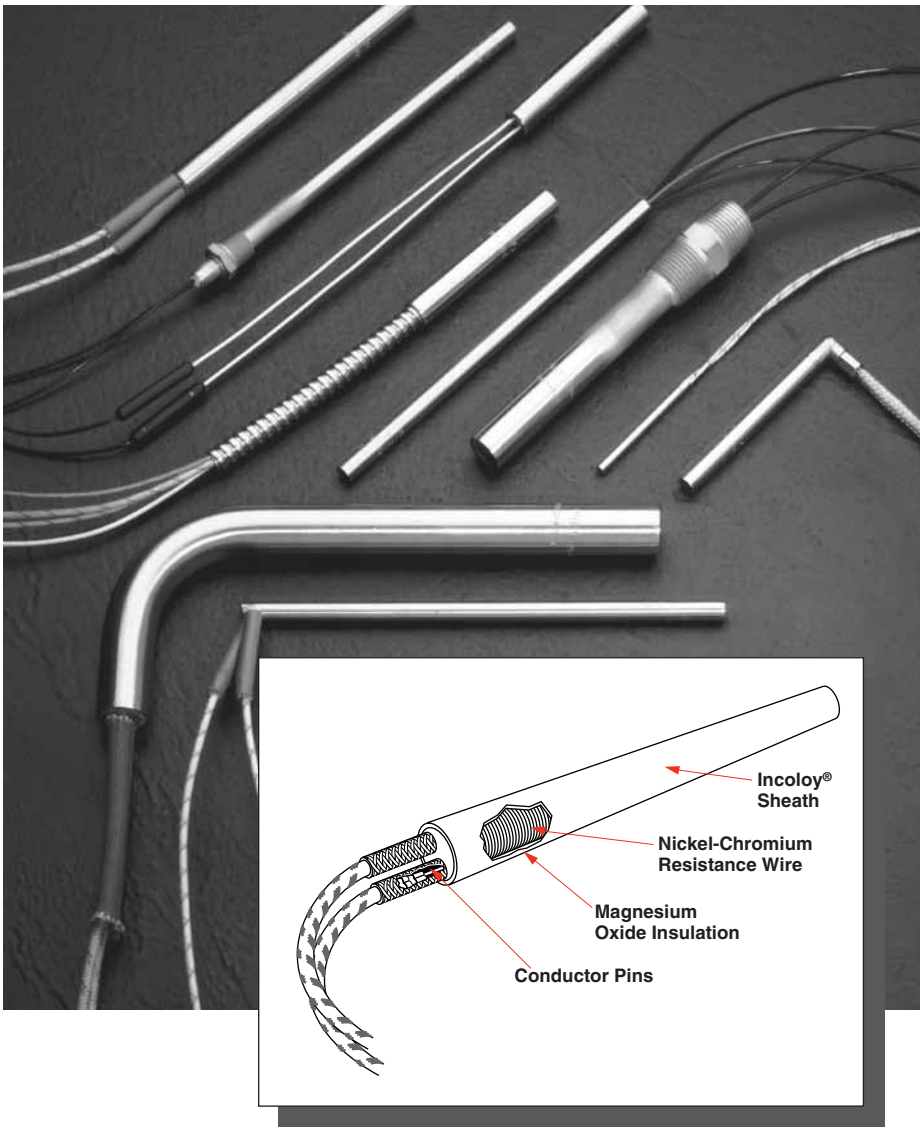
- Temperatures to 760°C (1400°F) on Incoloy® sheath
- Temperatures up to 540°C (1000°F) on optional stainless steel sheath
- Watt densities to 62 W/cm^2 (400 W/in^2)

Performance Capabilities—Metric EB Cartridge

- Part temperatures to 600°C (1100°F)
- Maximum watt density to 30 W/cm^2 (190 W/in^2)
- Maximum voltage to 480V~(ac)

Features and Benefits

- **Nickel-chromium resistance wire,** precisely wound and centered assures even, efficient heat distribution to the sheath.
- **Conductor pins** metallurgically bonded to the resistance wire ensure trouble-free electrical continuity. (The EB version features crimp-connected pins).
- **Magnesium oxide insulation of specific grain and purity,** swaged to the proper density, results in high dielectric strength and contributes to faster heat-up.



- **Incoloy® sheath** resists oxidation and corrosion from many chemicals, heat and atmospheres.
- **Minimal spacing between the element wire and sheath** results in lower internal temperature, giving you the ability to design with fewer or smaller heaters that operate at higher watt densities.
- **UL® and CSA approved flexible stranded wires,** with silicone-fiberglass oversleeve, insulate the wires to temperatures of 250°C (480°F).
- **VDE component recognition** to 230V~(ac) according to VDE 0721 part 1/3.78 and part 2/3.78 Section E in connection with VDE 0720 part 1/11.74.
- **Patented Lead Adapter (LA) method** allows same day shipment on more than 150,000 configurations of stock FIREROD heaters and lead combinations.

Applications

- Extrusion dies
- Formers

Incoloy® is a registered trademark of Special Metals Corporation.
UL® is a registered trademark of Underwriter's Laboratories, Inc.

Hot Runner Manifold Heaters

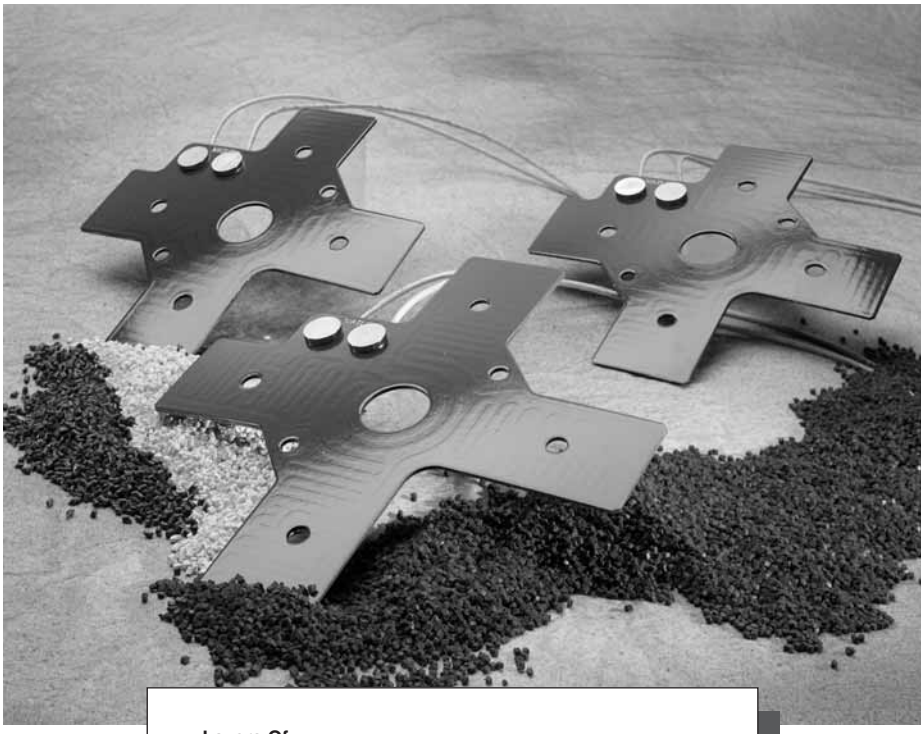
Thick Film Manifold

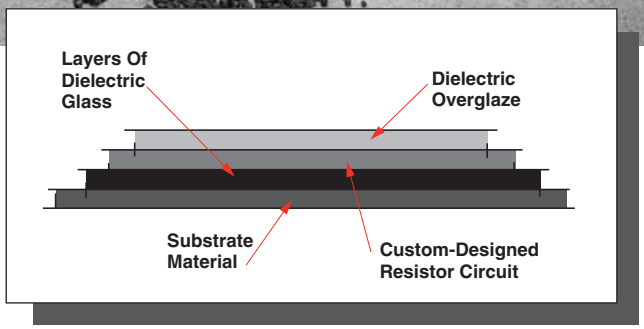
Watlow's innovative thick film manifold heaters allow hot runner operations to gain more control over temperature uniformity while reducing overall cycle times.

Thick film manifold heaters are designed to clamp directly to the outer surface of the hot runner manifold. This clamp-on design provides many advantages to hot runner molds including:

- Uniform heat distribution
- Smaller-mass hot runner manifolds, since the extra steel required for the tubular heaters is eliminated; smaller manifolds will heat up more quickly, reducing the overall start-up time of the injection molding machine
- Design flexibility
- Shape of the heater matches the shape of the manifold allowing the heater to adapt to any hot runner geometry
- Simpler manufacturing, as the grooves that were traditionally machined in the steel manifold to accept tubular or cable heaters are eliminated

Thick film manifold heaters are manufactured utilizing Watlow's thick film heating technology on stainless steel plates. The basis for the low profiles lies in its unique sandwich design. Watlow's thick film resistance heaters are made of several layered materials. A glassy dielectric film coats the substrate and is then covered with a custom-designed resistor circuit and a final dielectric overglaze. The thick film circuitry allows the heater to vary heat output across the entire surface of the heater helping to control and correct virtually any temperature uniformity issues caused by conventional heaters.





Features and Benefits

Low profile package

- Allows heater to be designed to fit around mounting holes, notches, sensors, etc.

Quick thermal response within manifold during start-up and operation

- Allows for a more efficient system

Heaters not affected by plastic resin leakage and are easily replaced

- Reduces machine downtime

Elimination of milled channel required for cartridge, cable or tubular heaters

- Reduces overall mold height and costs

Lower overall thermal mass in manifold

- Reduces power consumption
- Allows for faster thermal response

Superior thermal profile in the manifold

- Generates higher part quality and yield
- Allows for shorter recovery between cycles

Moisture-resistant non-porous glass film construction

- Eliminates need for soft starting, minimizes current leakage and ultimately reduces cost by eliminating special need of GFCI protection

Robust industrial heaters

- Designed to operate in 24 x 7 x 365 hour applications

Hot Runner Manifold Heaters

Thick Film Manifold

Applications

- Hot runner manifold systems

Specifications

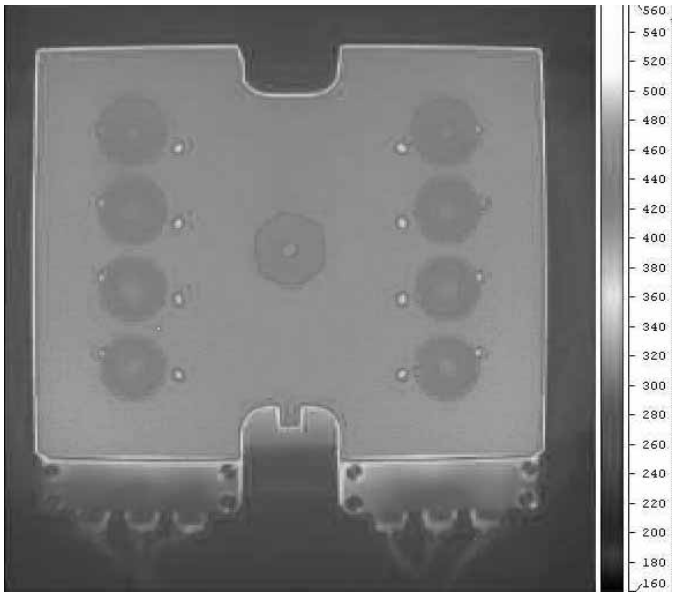
- Maximum substrate temperature of 550°C (1025°F)
- Watt densities are application dependent over entire substrate surface
- 5.43 W/cm² (35 W/in²) for radiant heating applications
- Up to 240 volts, three-phase
- Termination options include contact pad, soldered lead wire or welded stud/lead wire (standard)

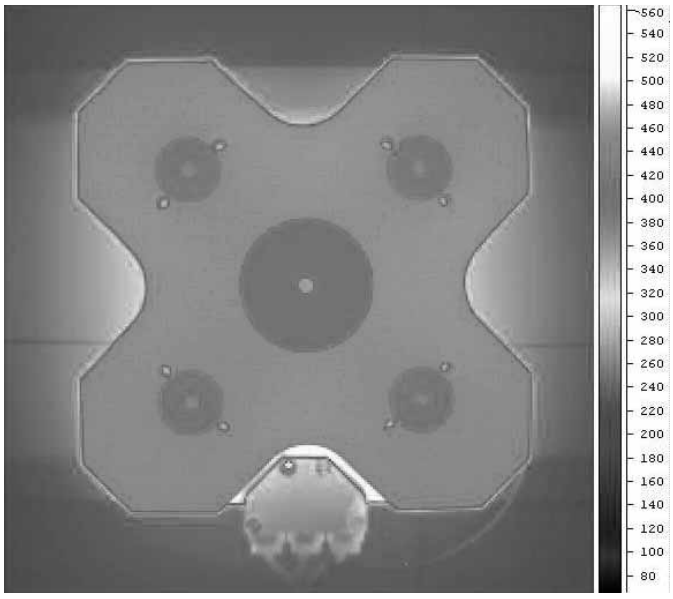
Watlow thick film technology heaters offer distinct competitive advantages over tubular heater technology:

1. Uniform thermal profile that eliminates hot and cold spots
2. Low thermal mass allows for quick heat up and reduces thermal lag
3. High dielectric barrier with agency approvals eliminates need for soft start
4. Lower heater operating temperatures
5. Precise and repeatable wattage distribution
6. Increased controllability of system
7. Increased productivity through decreased set-up time
8. More manifold design flexibility
9. Simpler manufacturing by eliminating the need for traditional machined grooves
10. Terminations can withstand temperatures of up to 550°C (1025°F) and can be located in nearly any location (moving them away from areas where damage can occur during normal maintenance

Precise Wattage Distribution

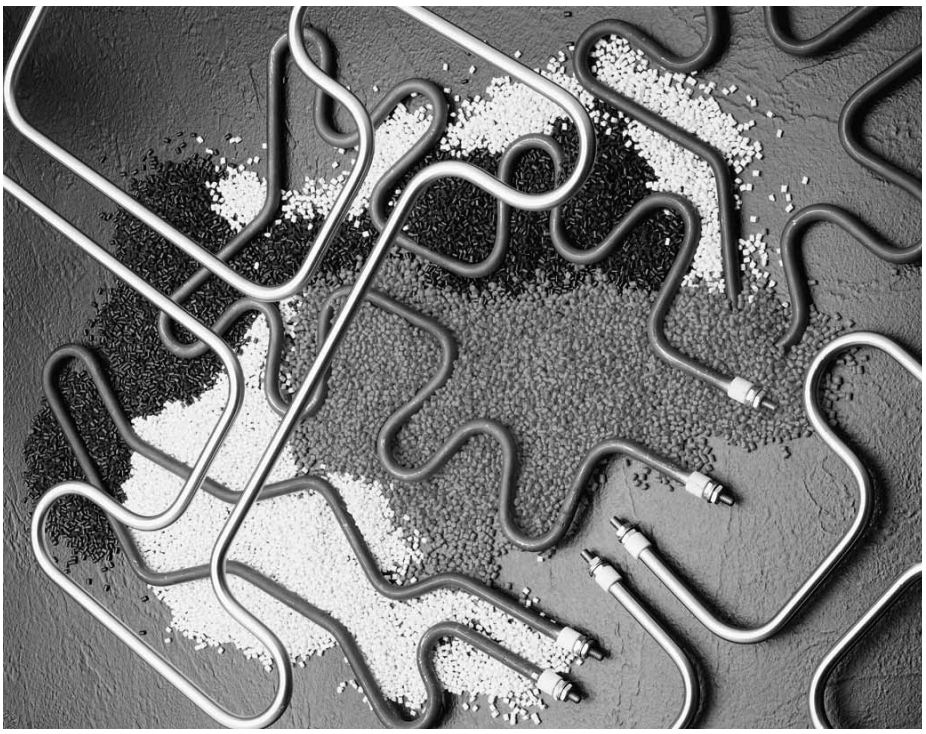
Thick film manifold heaters rated to 550˚C (1025˚F) provide superior temperature uniformity by putting the energy exactly where it is needed.





Hot Runner Manifold Heaters

Tubular Milled Groove



Hot runner molds require uniform heat. It has been machined so that only a complex tubular formation can fit. The heater must install quickly and easily. And you want it now.

No problem.

WATROD milled groove heaters are precision-formed and customized to your hot runner mold application. Even tight radius bends of 6.35 mm (0.250 in.) maintaining tolerances of ±0.062 to ±0.002 inch are possible. This versatility means the heater can be designed in a broad range of diameters, lengths, terminations and sheet materials. This capability not only allows you freedom to design for the optimum uniform heating pattern for your plastics process, but also guarantees quick and easy installation.

The heater must be precisely formed to seat properly into the milled slot in the mold. To insure this fit, templates are used as inspection tools during the forming process.

Simply supply the factory a drawing that provides full dimensioning of the groove, either in hard copy or electronically. Acceptable file formats include, but are not limited to: PDF, DWG, DXF, IGS (IGES), MicroStation DGN and SolidWorks SLDDRW.

A variety of sheath materials are available including Incoloy®, 304 stainless steel and 316 stainless steel; each offering unique advantages of long life in high temperature molds, rigidity to maintain shape during shipment and corrosion resistance.

Watlow not only delivers the heat fast to your process with efficient heat transfer, but guarantees the heater's fast delivery, too. While we guarantee our standard delivery within two to three weeks, tough delivery schedules are our specialty.

Features

- Precision formed heaters
- Formed to milled groove
- Precision wound, custom engineered resistance wire
- Incoloy® or stainless steel sheath
- UL® and CSA component recognition
- Metric diameters available

Benefits

- Quick and easy installation; heater efficiency
- Puts heat where required
- Evenly distributed heat, heater efficiency and reliability
- High temperature; retains shape
- Safety and agency approvals

Applications

- Hot runner molds

Performance Capabilities

- Watt densities to 15.5 W/cm^2 (100 W/in^2)
- Wattages to 100 kilowatt
- UL® and CSA component recognition to 480V~(ac) and 600V~(ac) respectively
- Incoloy® sheath temperatures to 870°C (1600°F)
- 304 stainless steel sheath temperatures to 650°C (1200°F)
- Steel sheath temperatures to 400°C (750°F)
- Copper sheath temperatures to 175°C (350°F)

Hot Runner Manifold Heaters

Tubular Milled Groove

Watt Density

The wattage dissipated per square inch of the element sheath surface (defined as Element Watt Density) is critical to the proper heating of the application and to the life expectancy of the heater. This is calculated with the following formula:

$$\text{Watt Density (W/in}^2\text{)} = \frac{\text{Element Wattage}}{\pi \times \text{Element Dia.} \times \text{Element Heated Length}}$$

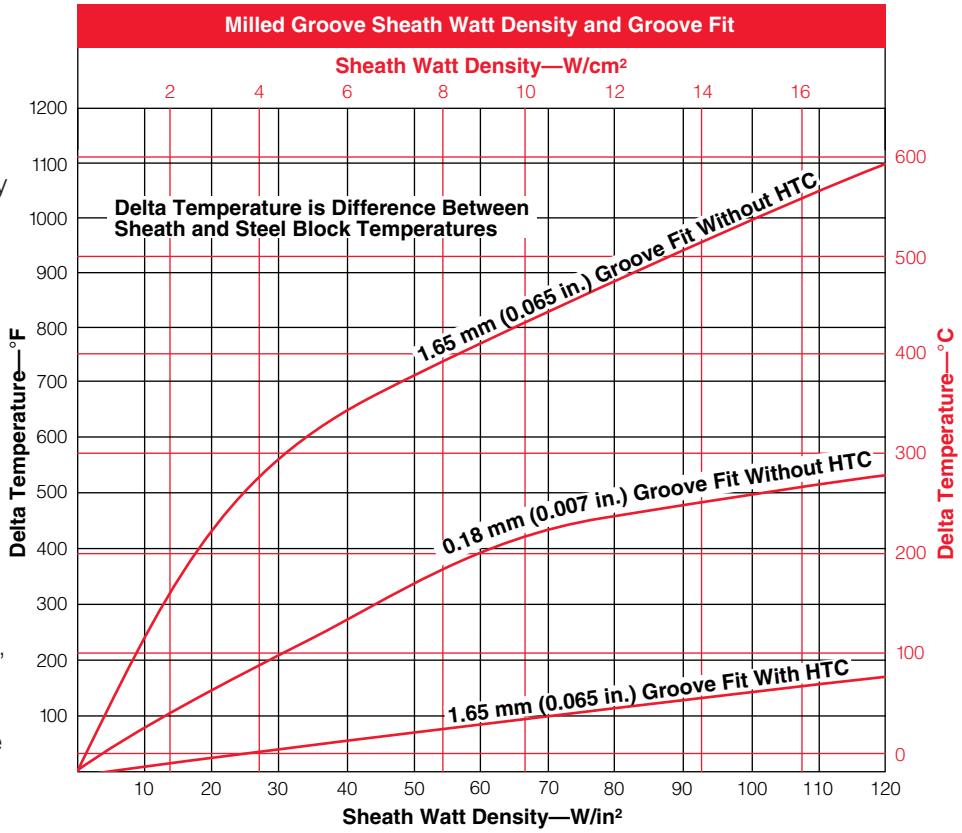
Construction

Tubular heaters are a versatile and widely used source of electric heat for hot runner manifold applications. They can be designed in a wide range of electrical ratings, diameters, lengths, terminations and sheath materials. Important and useful characteristics of tubular heaters are that they can be formed into virtually any manifold geometry.

Though we recommend the use of heat transfer cement for maximum heater performance and long life, proper groove fit even without HTC can still assure good heater performance as well as easier installation.

With or without heat transfer cement, use the graph above to select the sheath watt density or the tightest groove fit for your hot runner mold application.

Optimum groove fit without heat transfer cement is determined by plotting the intersect point between the required sheath watt density and the Delta temperature. If the Delta T is known, simply subtract the mold temperature from the maximum



HTC = Heat transfer cement

Recommended watt density: 40 to 70 W/in2

537°C (1000°F) sheath temperature. Any combination of watt density and groove fit which results in a Delta T below the recommended maximum will maximize heater life. Conversely, the greater the Delta T, the shorter the heater life.

Common Diameters

6.6 mm (0.260 in.)

8 mm (0.315 in.)

8.5 mm (0.335 in.)

9.5 mm (0.375 in.)

10.9 mm (0.430 in.)

Ordering Information

To order a replacement heater, specify the existing Watlow code number.

To order a heater for your application, specify:

- Type of application
- Operating temperature
- Volts
- Watts
- Termination
- Bend configuration and dimensions
- Groove cross section dimensions
- Diameter
- Sheath material
- Hot and cold junctions

Due to precision forming requirements, please provide a detailed drawing or electronic file.

Hot Runner Manifold Heaters

Problem Solvers

Watlow Solutions To Common Manifold Heater Problems

Tubular manifold hot runner mold heater replacement intervals can be lengthened or heater problems eliminated by using the optimum heater technology. Check the list below to see if your plastics processing can be improved.

Problem	Heater Solution
Poor heater fit in groove	• Use precision formed Watlow tubular heaters • Eliminate need for groove with clamp on thick film manifold
Hot spots and premature failure	• Use heat transfer cement to fill voids and promote heat transfer • Eliminate hot and cold spots with thick film manifolds
Poor quality parts caused by uneven/undesirable heat patterns	• The resistance coils of Watlow tubular heaters deliver extremely even heat; distributed wattage option can help produce desired heat patterns • Customized heat pattern with thick film manifold
Short heater life caused by contamination	• Specify seal options to meet application requirements (silicone, RTV or epoxy)
Overheated terminations	• Use a heater with a sufficient no-heat section within the manifold

Hot Runner Manifold Heaters

Case History

Hot Runner Manifold Heaters

Problem:
An injection molding customer required a more efficient heating method for their hot runner system to increase start-up and throughput.

A segment where hot runner systems have been readily adopted is in the production of plastic preform parts (unblown bottles). This particular molder was utilizing multiple plastic resins with melt temperature ranges of 176°C to 301°C (350°F to 575°F). Thick film technology heaters have an operating range up to 500°C (932°F) and due to the overall efficiency and low profile; they were an ideal heating method for this hot runner system.

Traditionally, the steel assembly required for the hot half of a mold includes a heated steel section known as the manifold. This consists of a thick steel plate with multiple tubular heaters press-fit into machined channels within the steel. Manifolds comprise a considerable amount of mass to accommodate the milled grooves for tubulars as well as having several challenges to insure overall thermal uniformity for the system.

Due to the mass of the manifold, the traditional tubular heaters in this particular instance were not able to heat the mold quickly enough or provide the precise level of thermal uniformity preferred by the customer. An additional drawback to this method of heating was that the tubular heaters were difficult to remove and created a significant mess at installation and removal.

Solution:
Multi-zone distributed wattage thick film manifold and nozzle heaters from Watlow.
The thick film heating technology offered the molder multiple benefits to meet the needs of the application. Not only did thick film provide increased overall system controllability, but also allowed for cost savings in a reduction of steel mass on the hot half as well as heater inventories.

Watlow's thick film manifold heaters provide OEMs and molders with the following advantages:

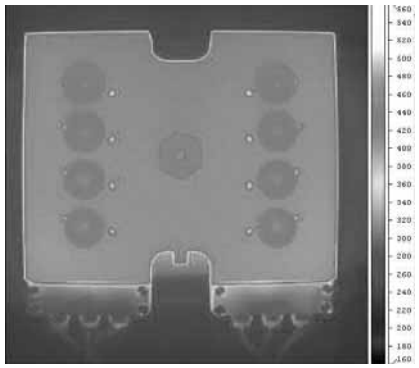
Low profile design
- External clamp-on design allows for a reduction in overall manifold mass- no machining required for tubular channel.
- Reduction in overall tool costs as machined channels to accommodate tubular, cartridge or cable heaters are eliminated.
- Low thermal mass of heater also results in faster thermal response within the manifold and reduced power consumption during startup and operation.

Construction
- Custom CAD designs to fit exacting requirements of manifold; able to put the heat precisely where it is needed.
- Provides uniform surface contact with manifold.
- Terminations can withstand temperatures of up to 550°C (1022°F) and can be located in nearly any location thus avoiding areas where damage could occur during normal maintenance procedures.
- Thick film manifold heaters do not absorb moisture, avoiding potential GFCI problems found with other heater technologies.
- Contamination resistant- plastic drool can be easily removed.
- Easy replacement due to clamp-on design.

Uniform thermal profile
- Superior thermal profile in the manifold; generating better molding results and shorter recovery between cycles.

Reduction in heater inventory
- Thick film technology allows molders to utilize one heater to bring steel to temperature rather than multiple tubular or cartridge units.

Overall Results:
The molder experienced benefits of cost savings on steel, additional machining; purchasing one heater (manifold) versus multiple tubulars, experienced decreased overall power consumption, faster system response and a higher part yield. This customer has plans to order additional thick film technology heaters to incorporate into additional systems.



Custom Designs- CAD-generated designs allow for customization to allow for holes, fittings or nozzle areas within the manifold.

Thick film technology allows hot runner system OEMs and molders to optimize the placement of the heater circuit.

Hot Runner Manifold Heaters

Case History

Bolt Heaters Help Attach Platens to Injection Molding Machine

Problem:

An original equipment manufacturer needed to heat the bolts used to hold platens in their injection molding machines. To effect proper tension, the 182 cm by 7.6 cm (6 feet by 3 in.) bolt and nuts needed to be quite tight.

Solution:

The manufacturer packaged Watlow FIREROD® bolt heaters with each injection molding machine. Correct torque was achieved by sliding the heaters through the middle of the bolts and heating them to 95°C (200°F). This elongated the bolts by as much as 12.5 mm (0.5 in.). When the nuts were turned tight and the heaters were removed, the bolts cooled and shrank, tightening even further.

Customers now benefit during initial set up as well as reassembly when the molds are changed out at the completion of production runs. The OEM credits the Watlow FIREROD bolt heaters with the increase in equipment sales.

Tubular/Immersion

Immersion Heaters for the Plastics Industry

The temperature of mold surfaces, with which molten plastic comes into contact, changes as the room temperature changes. In many locations this temperature can vary as much as 30 degrees; summer to winter months experiencing even greater differences. Mold control units provide consistent mold temperatures, regardless of the season. Processors can increase set point as ambient temperatures change, resulting in improved part quality and cycle times. Watlow has an extensive offering of heaters for mold control systems.

Watlow presents an easy-to-use, cross-reference for process heaters in the plastics industry. This is a complete listing of immersion heater products from many OEMs serving this market. Watlow's extensive experience in this industry has allowed the compilation of this index and to manufacture over 60 of the most popular designs available from stock. The cross-reference chart includes over 250 designs with flange sizes ranging from 89 mm (3.5 in.) square up to 203 mm (8 in.) with a 150 pound ANSI rating.

Performance Capabilities

- Watt densities to 15.5 W/cm^2 (100 W/in^2)
- Wattages to 100 kilowatt
- UL® and CSA component recognition to 480V~(ac) and 600V~(ac) respectively
- Incoloy® sheath temperatures to 870°C (1600°F)
- 304 stainless steel sheath temperatures to 650°C (1200°F)
- Steel sheath temperatures to 400°C (750°F)
- Copper sheath temperatures to 175°C (350°F)

Features and Benefits

Quick delivery: Same day for stock units; next day for assembly stock units

- Minimal down time

Wide variety of OEM and competitor part numbers in one location for quick reference

- Single source supplier for many OEM applications
- Save time and money with original part manufacturer

Full product descriptions available upon request

- Accurate information from original heater manufacturer
- Proper heater replacement for the OEM equipment

Applications

- Mold temperature control units

Incoloy® is a registered trademark of the Special Metals Corporation.

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

OEM Cross Reference

Immersion Heater Cross Reference for Plastic Processing Applications

Watlow presents this easy-to-use, cross reference for plastic process heaters. This is a listing of immersion heater products from many OEMs serving the market. Watlow's extensive experience in the plastics industry has allowed the compilation of this index and to manufacture over 60 of the most popular designs available from stock. The cross-reference chart includes over 250 designs with flange sizes ranging from 3.5 in^2 up to 203.2 mm (8 in.) with a 150 pound ANSI rating.

Sterlco Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
A0503481		TPN01168	**6-29-167-3**	6 in. sq.	208/230	9/12	3	15 ¼ in.	Same day
A0503482		TPN01169	**6-29-167-2**	6 in. sq.	230	9.00	3	15 ¼ in.	Same day
A0503483		TPN01170	**6-29-167-1**	6 in. sq.	460	9.00	3	15 ¼ in.	Same day
A0503484		TPN01424	**6-29-167-7**	6 in. sq.	575	9.00	3	15 ¼ in.	10 days
A0503485		TPN01171	**6-29-167-5**	6 in. sq.	208	12.00	3	15 ¼ in.	10 days
A0503486		TPN01172	**6-29-167-4**	6 in. sq.	460	12.00	3	15 ¼ in.	Same day
A0503487		TPN01430	**6-29-167-6**	6 in. sq.	575	12.00	3	15 ¼ in.	10 days
A0549041			**6-29-167-8**	6 in. sq.	240	9.00	3	15 ¼ in.	10 days
722-00043-01	K2S-3-0058		**6-21-12-2**	6 in. dia.	240	6.00	3	29 in.	10 days
722-00043-02	K2S-3-0042		**6-21-12-1**	6 in. dia.	480	6.00	3	29 in.	Same day
722-00043-03	K2C-3-0032		**6-22-6-1**	2 in.-150 lb	480	9.00	3	29 in.	10 days
722-00043-05			**6-21-12-3**	2 in.-150 lb	600	6.00	3	29 in.	10 days
722-00043-07			**6-21-12-5**	6 in. dia.	208	6.00	3	29 in.	10 days
722-00044-01	K2C-3-0009		**6-22-12-1**	2 in.-150 lb	240	9.00	3	29 in.	Same day
722-00044-02	K2C-3-0010		**6-22-12-2**	2 in.-150 lb	480	9.00	3	29 in.	Same day
722-00044-04	K2C-3-0052		**6-22-12-14**	2 in.-150 lb	480	12.00	3	29 in.	10 days
722-00044-06			**6-22-12-3**	2 in.-150 lb	600	9.00	3	29 in.	Same day
722-00044-07	K2C-3-0054		**6-22-12-4**	2 in.-150 lb	240	4.50	3	16 in.	10 days
722-00044-08	K2C-3-0055		**6-22-12-5**	2 in.-150 lb	480	4.50	3	16 in.	Same day
722-00044-10			**6-22-12-12**	2 in.-150 lb	208	9.00	3	29 in.	10 days
722-00044-12			**6-22-12-19**	2 in.-150 lb	208	4.50	3	16 in.	10 days
722-00044-14			**6-22-12-9**	2 in.-150 lb	600	12.00	3	29 in.	10 days
722-00044-16			**6-22-12-22**	2 in.-150 lb	480	9.00	3	21 ⅜ in.	10 days
722-00044-18			**6-22-12-18**	2 in.-150 lb	480	4.50	3	12 ⅛ in.	10 days
722-00044-23			**6-22-25-2**	2 in.-150 lb	480	9.00	3	29 in.	10 days
722-00044-30			**6-22-1-14**	2 in.-150 lb	480	9.00	1	29 in.	10 days
722-00048-01			**6-22-16-1**	6 in. dia.	480	4.50	3	12 ⅛ in.	10 days
722-00051-02	KR-3-0079-M1		**6-39-10-8**	2.5 in. NPT	480	12.00	3	22 $^{11}/_{16}$ in.	10 days
722-00051-08	KR-3-0061-M1		**6-39-10-3**	2.5 in. NPT	240	9.00	3	22 ⅜ in.	Same day
722-00051-09	KR-3-0063-M1		**6-39-10-1**	2.5 in. NPT	480	9.00	3	22 ⅜ in.	Same day
722-00051-10	KR-3-0082-M1		**6-39-10-2**	2.5 in. NPT	240	4.50	3	11 $^{3}/_{16}$ in.	10 days
722-00051-11	KR-3-0086-M1		**6-39-10-4**	2.5 in. NPT	480	4.50	3	11 $^{3}/_{16}$ in.	10 days
722-00051-12			**6-39-10-9**	2.5 in. NPT	550	9.00	3	23 $^{3}/_{16}$ in.	10 days
722-00051-16			**6-39-10-16**	2.5 in. NPT	208	9.00	3	22 ⅜ in.	10 days

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Tubular/Immersion

OEM Cross Reference

Sterlco Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
722-00058-03			**6-21-1-6**	8 in.-150 lb	600	50.00	3	53 ¾ in.	10 days
722-00058-22			**6-21-1-14**	8 in.-150 lb	240	50.00	3	56 in.	10 days
722-00086-07			**7-21-5-10**	6 in.-150 lb	600	18.00	3	34 in.	10 days
722-00086-08			**6-21-2-14**	6 in.-150 lb	208	24.00	3	32 15/16 in.	10 days
722-00086-11	K6S-12-0129		**7-21-5-15**	6 in.-150 lb	240/480	18.00	3	34 in.	10 days
722-00086-12			**7-21-5-13**	6 in.-150 lb	240/480	24.00	3	34 in.	10 days
722-00086-16			**7-22-7-2**	6 in.-150 lb	240	50.00	3	33 ¾ in.	10 days
722-00086-17			**7-21-5-7**	6 in.-150 lb	240	18.00	3	34 in.	10 days
722-00086-18	K6S-12-0132		**7-21-5-17**	6 in.-150 lb	240	24.00	3	34 in.	Same day
722-00086-19			**6-22-10-1**	6 in.-150 lb	240	36.00	3	33 15/16 in.	10 days
722-00086-22			**7-21-5-9**	6 in.-150 lb	600	24.00	3	33 15/16 in.	10 days
722-00086-29			**6-21-2-18**	6 in.-150 lb	480	24.00	3	32 15/16 in.	10 days
722-00091-06	K5S-6-0228		**7-21-7-17**	5 in.-150 lb	240/480	9.00	3	28 9/16 in.	10 days
722-00091-07			**7-21-7-2**	5 in.-150 lb	240/480	6.00	3	22 in.	10 days
722-00091-08	K5S-6-0229		**7-21-7-3**	5 in.-150 lb	240	12.00	3	34 in.	Same day
722-00091-09			**7-21-7-7**	5 in.-150 lb	600	12.00	3	34 in.	10 days
722-00091-12			**6-21-3-5**	5 in.-150 lb	600	6.00	3	22 in.	10 days
722-00093-05	K6S-15-0133		**7-21-5-2**	6 in.-150 lb	480	36.00	3	34 in.	Same day
722-00093-06	K6S-15-0134		**7-21-5-4**	6 in.-150 lb	480	24.00	3	33 in.	10 days
722-00093-08	K6S-15-0219		**7-21-5-25**	6 in.-150 lb	480	50.00	3	56 in.	10 days
722-00093-11			**7-21-5-37**	6 in.-150 lb	208	36.00	3	34 in.	10 days
722-00093-14			**7-21-5-33**	6 in.-150 lb	600	36.00	3	34 in.	10 days
722-00093-16			**7-21-5-38**	6 in.-150 lb	600	36.00	3	34 in.	10 days
722-00093-19			**7-21-5-41**	6 in.-150 lb	480	36.00	3	56 in.	10 days
722-00093-23			**7-21-5-26**	6 in.-150 lb	480	48.00	3	34 in.	10 days
722-00093-26			**7-21-5-34**	6 in.-150 lb	240	50.00	3	56 in.	10 days
722-00093-27			**7-21-5-36**	6 in.-150 lb	480	40.00	3	56 in.	10 days
722-00093-28			**7-21-5-44**	6 in.-150 lb	480	100.00	3	35 in.	10 days
722-00093-31			**7-22-7-5**	6 in.-150 lb	480	75.00	3	34 in.	10 days
722-00093-33			**7-22-7-7**	6 in.-150 lb	480	60.00	3	34 in.	10 days
722-00093-37			**7-22-7-9**	6 in.-150 lb	480	48.00	3	34 in.	10 days
722-00093-38			**7-22-7-10**	6 in.-150 lb	480	80.00	3	34 in.	10 days
722-00093-39			**7-21-5-43**	6 in.-150 lb	600	50.00	3	56 in.	10 days
722-00093-41			**7-21-5-46**	6 in.-150 lb	600	48.00	3	34 in.	10 days
722-00094-03	K5C-6-0225		**6-22-4-5**	5 in.-150 lb	240/480	24.00	3	33 in.	10 days
722-00102-02			**7-21-7-13**	5 in.-150 lb	480	24.00	3	56 in.	10 days
722-00102-05			**7-21-7-11**	5 in.-150 lb	240	12.00	3	33 ½ in.	10 days
722-00102-06			**7-21-7-5**	5 in.-150 lb	480	12.00	3	33 ½ in.	10 days

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Tubular/Immersion

OEM Cross Reference

Sterlco Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
722-00102-07			**7-21-7-22**	5 in.-150 lb	600	18.00	3	33 in.	10 days
722-00102-08			**7-21-7-4**	5 in.-150 lb	480	18.00	3	33 in.	10 days
722-00104-02			**6-18-230-2**	8 in.-150 lb	480	75.00	3	56 in.	10 days
722-00104-07			**8-21-17-2**	8 in.-150 lb	600	100.00	3	56 in.	10 days
722-00104-09			**7-21-40-1**	8 in.-150 lb	480	90.00	3	56 in.	Three weeks
722-00108-01	K3C-6-0263	TPN01479	**6-22-218-1**	7.5 in. dia.	480	9.00	3	16 in.	Same day
722-00108-02	K3C-6-0262	TPN01478	**6-22-218-2**	7.5 in. dia.	240	9.00	3	16 in.	Same day
722-00108-03	K3C-6-0273	TPN01483	**6-22-218-3**	7.5 in. dia.	240	12.00	3	16 in.	10 days
722-00108-04	K3C-6-0274	TPN01299	**6-22-218-4**	7.5 in. dia.	480	12.00	3	16 in.	10 days
722-00108-06			**6-22-218-6**	7.5 in. dia.	480	24.00	3	29 in.	10 days
722-00108-07		TPN01477	**6-22-218-7**	7.5 in. dia.	208	9.00	3	16 in.	10 days
722-00108-08			**6-22-218-8**	7.5 in. dia.	600	9.00	3	16 in.	10 days
722-00108-10			**6-22-218-10**	7.5 in. dia.	480	18.00	3	29 in.	10 days
722-00108-20			**6-22-218-19**	7.5 in. dia.	480	4.50	3	16 in.	10 days
722-00108-22			**6-22-218-20**	7.5 in. dia.	600	12.00	3	16 in.	10 days
722-00108-27			**6-22-218-37**	7.5 in. dia.	240	6.00	3	16 in.	10 days
722-00110-04			**6-22-220-4**	7.5 in. dia.	480	12.00	3	16 in.	10 days
722-00110-06			**6-22-220-6**	7.5 in. dia.	480	24.00	3	29 in.	10 days
722-00110-10			**6-22-220-10**	7.5 in. dia.	480	18.00	3	29 in.	10 days
722-00126-01	KP-6-0439	TPN01170	**6-29-123-1**	6 in. sq.	480	9.00	3	16 in.	Same day
722-00126-02	KP-6-0501	TPN01169	**6-29-123-2**	6 in. sq.	240	9.00	3	16 in.	Same day
722-00126-03		TPN01429	**6-29-123-3**	6 in. sq.	240	12.00	3	16 in.	10 days
722-00126-04		TPN01172	**6-29-123-4**	6 in. sq.	480	12.00	3	16 in.	Same day
722-00126-05			**6-29-123-5**	6 in. sq.	240	24.00	3	29 in.	10 days
722-00126-06			**6-29-123-6**	6 in. sq.	480	24.00	3	29 in.	Same day
722-00126-07		TPN01168	**6-29-123-7**	6 in. sq.	208	9.00	3	16 in.	Same day
722-00126-08		TPN01424	**6-29-123-8**	6 in. sq.	600	9.00	3	16 in.	Same day
722-00126-09			**6-29-123-9**	6 in. sq.	208	4.50	3	16 in.	10 days
722-00126-10			**6-29-123-10**	6 in. sq.	480	18.00	3	29 in.	Same day
722-00126-11			**6-29-123-11**	6 in. sq.	240	18.00	3	29 in.	10 days
722-00126-12			**6-29-123-12**	6 in. sq.	415	9.00	3	16 in.	10 days
722-00126-13			**6-29-123-13**	6 in. sq.	240	4.50	3	16 in.	10 days
722-00126-14			**6-29-123-14**	6 in. sq.	380	12.00	3	16 in.	10 days
722-00126-15			**6-29-123-15**	6 in. sq.	208	18.00	3	29 in.	10 days
722-00126-17			**6-29-123-16**	6 in. sq.	600	18.00	3	29 in.	10 days
722-00126-18		TPN01171	**6-29-123-17**	6 in. sq.	208	12.00	3	16 in.	10 days
722-00126-19			**6-29-123-18**	6 in. sq.	600	24.00	3	29 in.	10 days
722-00126-20			**6-29-123-19**	6 in. sq.	480	4.50	3	16 in.	Same day

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Tubular/Immersion

OEM Cross Reference

Sterlco Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
722-00126-21			**6-29-123-22**	6 in. sq.	600	4.50	3	16 in.	10 days
722-00126-22		TPN01430	**6-29-123-20**	6 in. sq.	600	12.00	3	16 in.	10 days
722-00126-23			**6-29-123-21**	6 in. sq.	380	9.00	3	16 in.	10 days
722-00126-25			**6-29-123-41**	6 in. sq.	480	7.50	3	16 in.	10 days
722-00126-27			**6-29-123-37**	6 in. sq.	240	6.00	3	16 in.	10 days
722-00126-30			**6-29-123-27**	6 in. sq.	415	24.00	3	29 in.	10 days
722-00126-32			**6-29-123-38**	6 in. sq.	480	6.00	3	16 in.	10 days
722-00126-33			**6-29-123-40**	6 in. sq.	208	6.00	3	16 in.	10 days
722-00126-38			**6-29-123-32**	6 in. sq.	380	24.00	3	29 in.	10 days
722-00126-39			**6-29-123-35**	6 in. sq.	208	24.00	3	29 in.	10 days
722-00126-41			**6-29-123-34**	6 in. sq.	415	18.00	3	29 in.	10 days
722-00126-49			**6-29-177-1**	6 in. sq.	240	12.00	3	35 in.	10 days
722-00126-50			**6-29-177-2**	6 in. sq.	480	12.00	3	35 in.	Same day
722-00126-51			**6-29-177-3**	6 in. sq.	600	12.00	3	35 in.	10 days
722-00126-52			**6-29-177-4**	6 in. sq.	208	12.00	3	35 in.	10 days
722-00128-01			**3-39-70-145**	1 in. NPT	230	2.00	1	13 in.	10 days
722-00128-02			**3-39-70-146**	1 in. NPT	230	4.00	1	13 in.	Same day
722-00128-03			**3-39-70-148**	1 in. NPT	460	2.00	1	13 in.	10 days
722-00128-04			**3-39-70-147**	1 in. NPT	460	4.00	1	13 in.	Same day
722-82124-01			**6-21-285-5**	9 in. sq.	208	12.00	3	40 in.	10 days
722-82124-02			**6-21-284-12**	9 in. sq.	208	18.00	3	40 in.	10 days
722-82124-03			**6-21-284-11**	9 in. sq.	208	24.00	3	40 in.	10 days
722-82124-04			**6-21-285-2**	9 in. sq.	240	12.00	3	40 in.	10 days
722-82124-05			**6-21-284-10**	9 in. sq.	240	18.00	3	40 in.	Same day
722-82124-06			**6-21-284-9**	9 in. sq.	240	24.00	3	40 in.	10 days
722-82124-07			**6-21-285-3**	9 in. sq.	380	12.00	3	40 in.	10 days
722-82124-08			**6-21-284-8**	9 in. sq.	380	18.00	3	40 in.	10 days
722-82124-09			**6-21-284-7**	9 in. sq.	380	24.00	3	40 in.	10 days
722-82124-10			**6-21-285-4**	9 in. sq.	415	12.00	3	40 in.	10 days
722-82124-11			**6-21-284-6**	9 in. sq.	415	18.00	3	40 in.	10 days
722-82124-12			**6-21-284-5**	9 in. sq.	415	24.00	3	40 in.	10 days
722-82124-13			**6-21-285-1**	9 in. sq.	480	12.00	3	40 in.	Same day
722-82124-14			**6-21-284-2**	9 in. sq.	480	18.00	3	40 in.	10 days
722-82124-15			**6-21-284-1**	9 in. sq.	480	24.00	3	40 in.	10 days
722-82124-16			**6-21-285-6**	9 in. sq.	575	12.00	3	40 in.	10 days
722-82124-17			**6-21-284-4**	9 in. sq.	575	18.00	3	40 in.	10 days
722-82124-18			**6-21-284-3**	9 in. sq.	575	24.00	3	40 in.	10 days
722-82124-19			**6-21-284-13**	9 in. sq.	200	24.00	3	40 in.	10 days

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Tubular/Immersion

OEM Cross Reference

Sterlco Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
722-83385-02			**6-21-288-1**	9 in. sq.	208	18.00	3	40 in.	10 days
722-83385-04			**6-21-296-1**	9 in. sq.	240	12.00	3	40 in.	10 days
722-83385-13			**6-21-296-2**	9 in. sq.	480	12.00	3	40 in.	10 days
722-83385-14			**6-21-288-2**	9 in. sq.	480	18.00	3	40 in.	10 days
722-83385-15			**6-21-288-3**	9 in. sq.	480	24.00	3	40 in.	10 days
722-83386-01			**6-21-300-1**	9 in. sq.	208	12.00	3	40 in.	10 days
722-83386-09			**6-21-291-9**	9 in. sq.	380	24.00	3	40 in.	10 days
722-83386-13			**6-21-300-5**	9 in. sq.	480	12.00	3	40 in.	10 days
722-83386-14			**6-21-291-8**	9 in. sq.	480	18.00	3	40 in.	10 days
722-83386-15			**6-21-291-15**	9 in. sq.	480	24.00	3	40 in.	10 days

OEM Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
3743540			**BGN79N7**	2 in. NPT	240/480	2.00	1	9 ¾ in.	Next day
3743560			**BGC78C7**	2 in. NPT	240	2.00	1	8 ⅛ in.	Next day
3743565			**BHN79N3**	2 in. NPT	240	3.00	3	9 ¾ in.	Next day
3743566			**6-29-120-9**	4 in. O.D.	240	3.00	3	7 ⅜ in.	10 days
3743567			**3-29-139-1**	4 in. O.D.	480	3.00	3	7 ⅜ in.	10 days
3743568			**BHC78C3**	2 in. NPT	240	3.00	3	8 ⅛ in.	Next day
3743569			**BHC78C13**	2 in. NPT	480	3.00	3	8 ⅛ in.	Next day
3743600			**BGC715C7**	2 in. NPT	240/480	4.00	1	15 ⅛ in.	Next day
3747500			**6-21-257-2**	7 in. O.D.	240/480	4.50	3	12 ½ in.	Same day
3747510			**6-21-258-4**	7 in. O.D.	575	4.50	3	12 ½ in.	10 days
3747511			**BLNF18C20**	2 ½ in. NPT	240	4.90	3	18 ⅛ in.	Next day
3775000		TPN01339	**6-29-120-4**	4 in. O.D.	240	4.50	3	10 in.	10 days
3775100		TPN01465	**6-29-120-5**	4 in. O.D.	480	4.50	3	10 in.	10 days
3775200			**6-29-120-7**	4 in. O.D.	575	4.50	3	10 in.	10 days
3775500			**6-21-299-3**	5 in. sq.	240/480	6.00	3	5 in.	Same day
3775510			**6-21-299-1**	5 in. sq.	240/480	10.00	3	7 11⁄16 in.	Same day
3775515			**6-21-299-4**	5 in. sq.	575	10.00	3	7 11⁄16 in.	Same day
3775520			**6-21-299-2**	5 in. sq.	240/480	16.00	3	12 11⁄16 in.	Same day
3775521			**6-21-299-6**	5 in. sq.	575	16.00	3	12 11⁄16 in.	10 days
3775523			**6-21-299-5**	5 in. sq.	240/480	24.00	3	16 ½ in.	10 days
3775524			**6-21-299-8**	5 in. sq.	380	24.00	3	16 ½ in.	10 days
3775526			**6-21-299-7**	5 in. sq.	240/480	34.00	3	24 ⅜ in.	10 days
3775995			**6-29-120-11**	4 in. O.D.	208	9.00	3	14 in.	10 days
3776000			**6-29-120-1**	4 in. O.D.	230	9.00	3	14 in.	Same day

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Tubular/Immersion

OEM Cross Reference

OEM Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
3776100			**6-29-120-2**	4 in. O.D.	460	9.00	3	14 in.	Same day
3776101			**6-29-120-3**	4 in. O.D.	575	9.00	3	14 in.	10 days
3776107			**6-29-120-10**	4 in. O.D.	460	12.00	3	18 in.	10 days
3776125			**6-29-130-1**	5 in. O.D.	230/460	24.00	3	18 in.	10 days
3776145			**6-29-120-12**	4 in. O.D.	415	4.50	3	10 in.	10 days
3776150			**6-29-120-6**	4 in. O.D.	415	9.00	3	14 in.	10 days
3776155			**6-29-120-8**	4 in. O.D.	380	9.00	3	14 in.	10 days
3776200			**6-29-130-3**	5 in. O.D.	240/480	30.00	3	22 in.	10 days
3776500			**6-29-130-2**	5 in. O.D.	240/480	18.00	3	14 in.	10 days
3776510			**6-29-130-5**	5 in. O.D.	380	18.00	3	14 in.	10 days
3776600			**6-29-130-4**	5 in. O.D.	575	18.00	3	14 in.	10 days
3777000			**6-21-258-34**	7 in. O.D.	380	9.00	3	17 ¾ in.	10 days
3780000		TPN01198	**6-21-258-5**	7 in. O.D.	575	9.00	3	17 ¾ in.	10 days
3785000	K2.5A-3-0003-M0	TPN01223	**6-21-257-1**	7 in. O.D.	230/460	9.00	3	17 ¾ in.	Same day
3785100		TPN01304	**6-21-258-7**	7 in. O.D.	240	12.00	3	17 ¾ in.	10 days
3785200		TPN01467	**6-21-258-1**	7 in. O.D.	480	12.00	3	17 ¾ in.	Same day
3785201			**6-29-120-13**	4 in. O.D.	380	12.00	3	18 in.	10 days
3785300			**6-21-258-11**	7 in. O.D.	575	12.00	3	17 ¾ in.	10 days
3785326			**FPNA17R5**	6 in.-150 lb	480	12.00	3	17 ⅞ in.	Next day
3785327			**FPNA17R3**	6 in.-150 lb	240	12.00	3	17 ⅞ in.	Next day
3785470			**7-21-50-10SMB**	5 in.-150 lb	240	12.00	3	33 in.	Next day
3785471			**7-21-50-12SME**	5 in.-150 lb	480	12.00	3	33 in.	Next day
3785472			**7-21-50-10DMC**	5 in.-150 lb	240	12.00	3	33 in.	Next day
3786000			**6-21-258-2**	7 in. O.D.	240	18.00	3	30 in.	10 days
3787000			**6-21-258-12**	7 in. O.D.	380	18.00	3	30 in.	10 days
3788000			**6-21-258-3**	7 in. O.D.	480	18.00	3	30 in.	Same day
3788017			**6-29-159-3**	5 in.-150 lb	575	6.00	3	20 in.	10 days
3788018			**6-29-159-2**	5 in.-150 lb	240	6.00	3	20 in.	10 days
3788019			**6-29-159-1**	5 in.-150 lb	480	6.00	3	20 in.	10 days
3788020			**6-29-149-1**	5 in.-150 lb	240	9.00	3	20 in.	10 days
3788021			**6-29-149-2**	5 in.-150 lb	480	9.00	3	20 in.	10 days
3788023			**6-29-149-5**	5 in.-150 lb	575	9.00	3	20 in.	10 days
3788075			**FPS740G13**	6 in.-150 lb	480	10.00	3	40 ⅜ in.	Next day
3788100			**7-21-50-18SM**	5 in.-150 lb	240	18.00	3	48 in.	Next day
3788101			**7-21-50-20SMH**	5 in.-150 lb	480	18.00	3	48 in.	Next day
3788700			**7-21-60-66SMF**	6 in.-150 lb	480	24.00	3	32 ⅞ in.	Next day
3788800			**7-21-60-74SMF**	6 in.-150 lb	480	36.00	3	47 ⅞ in.	Next day
3789000			**6-21-258-6**	7 in. O.D.	575	18.00	3	30 in.	10 days

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Tubular/Immersion

OEM Cross Reference

OEM Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
3789025			**6-21-258-13**	7 in. O.D.	480	24.00	3	44 in.	10 days
3789030			**6-21-258-33**	7 in. O.D.	480	27.00	3	50 in.	10 days
3789100			**FPS725G5**	6 in.-150 lb	480	18.00	3	25 ⅜ in.	Next day
3789553			**7-21-67-1**	5 in.-150 lb	480	12.00	3	35 in.	10 days
3789554			**7-21-67-2**	5 in.-150 lb	240	12.00	3	35 in.	10 days
3789555			**7-21-53-1**	6 in.-150 lb	480	18.00	3	37 in.	10 days
3789556			**7-21-53-2**	6 in.-150 lb	240	18.00	3	37 in.	10 days
3789558			**7-21-68-1**	6 in.-150 lb	480	27.00	3	43 ¼ in.	10 days
3789559			**7-21-68-3**	6 in.-150 lb	575	27.00	3	43 ¼ in.	10 days
3789576			**FNN733A5**	5 in.-150 lb	480	24.00	3	33 in.	Next day
3789581			**7-21-50-116MC**	5 in.-150 lb	480	54.00	3	48 in.	Next day
3789585			**FPN732R5**	6 in.-150 lb	480	48.00	3	32 ⅞ in.	Next day
3789588			**7-18-268-3**	8 in.-150 lb	480	48.00	3	46 in.	10 days
3789589			**7-18-268-9**	8 in.-150 lb	240	48.00	3	46 in.	10 days
3789590			**7-18-268-12**	8 in.-150 lb	480	50.00	3	47 ⅜ in.	10 days
3789601			**7-18-268-2**	8 in.-150 lb	240	36.00	3	37 in.	10 days
3789604			**7-18-268-10**	8 in.-150 lb	380	36.00	3	37 in.	10 days
3789750			**FPS732R5**	6 in.-150 lb	480	24.00	3	32 ⅞ in.	Next day
3789900			**7-21-68-2**	6 in.-150 lb	240	27.00	3	43 ¼ in.	10 days
3795300			**FPN740G5**	6 in.-150 lb	480	60.00	3	40 ⅜ in.	Next day
3804000			**3-38-83-1**	1 in. NPT	240/480	1.50	3	22 ¾ in.	10 days
3804030			**6-29-202-2**	6 in. sq.	240	12.00	3	23 ½ in.	10 days
3804033			**6-29-202-3**	6 in. sq.	575	12.00	3	23 ½ in.	10 days
3804035			**6-29-202-1**	6 in. sq.	480	12.00	3	23 ½ in.	10 days
3804040			**7-21-53-5**	6 in. sq.	240	18.00	3	25 in.	10 days
3804055			**7-21-68-4**	6 in. sq.	480	27.00	3	31 ¼ in.	10 days
3804056			**7-21-68-5**	6 in. sq.	575	27.00	3	31 ¼ in.	10 days
3804064			**7-18-268-14**	8 in. sq.	575	36.00	3	25 in.	10 days
3804065			**7-18-268-11**	8 in. sq.	480	36.00	3	25 in.	10 days
3804075			**7-18-268-13**	8 in. sq.	480	48.00	3	34 in.	10 days
322-00029-01			**3-29-119-1**	2 ½ in. sq.	230	4.50	3	13 ⅜ in.	10 days
322-00029-02			**3-29-119-2**	2 ½ in. sq.	460	4.50	3	13 ⅜ in.	10 days
322-00033-01			**6-21-12-2**	6 in. O.D.	240	6.00	3	29 in.	10 days
322-00033-02			**6-21-12-1**	6 in. O.D.	480	6.00	3	29 in.	Same day
322-00033-04			**6-21-12-10**	6 in. O.D.	208	9.00	3	29 in.	10 days
322-00030-01			**6-21-218-37**	3 in.-150 lb	240/480	12.00	3	33 in.	10 days
322-00030-03			**6-21-218-38**	3 in.-150 lb	575	12.00	3	33 in.	10 days
322-00030-06			**6-21-218-39**	3 in.-150 lb	208	12.00	3	33 in.	10 days

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Tubular/Immersion

OEM Cross Reference

OEM Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
322-00027-01			**6-22-12-4**	6 in. O.D.	240	4.50	3	16 in.	10 days
322-00027-02			**6-22-12-5**	6 in. O.D.	480	4.50	3	16 in.	Same day
322-00027-03			**6-22-12-1**	6 in. O.D.	240	9.00	3	29 in.	Same day
322-00027-04			**6-22-12-2**	6 in. O.D.	480	9.00	3	29 in.	Same day
322-00025-02			**6-22-218-74**	7 ½ in. O.D.	240	9.00	3	12 11⁄16 in.	10 days
322-00025-04			**6-22-218-8**	7 ½ in. O.D.	600	9.00	3	16 in.	10 days
322-00025-06			**6-22-218-75**	7 ½ in. O.D.	240	12.00	3	16 in.	10 days
322-00025-09			**6-22-218-76**	7 ½ in. O.D.	240	18.00	3	22 in.	10 days
322-00025-12		TPN01449	**6-22-218-1**	7 ½ in. O.D.	480	9.00	3	16 in.	Same day
322-00025-17		TPN01483	**6-22-218-3**	7 ½ in. O.D.	240	12.00	3	16 in.	10 days

OEM Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
W00015304		TPN01174	**6-18-36-5**	3 ½ in. sq.	460	2.50	3	12 ½ in.	10 days
W00015855		TPN01201	**6-18-36-4**	3 ½ in. sq.	460	3.50	3	18 in.	10 days

OEM Part Number	Ogden Part Number	Tempco Part Number	Watlow Code Number	Flange Size	Volts	kW	Phase	Immersed Length	Standard Delivery
NA		TPN01198	**6-19-184-1**	7 in. O.D.	240	9.00	3	17 ¾ in.	10 days
NA		TPN01223	**6-19-184-7**	7 in. O.D.	480	9.00	3	17 ¾ in.	10 days

Tubular/Immersion

Problem Solvers

Watlow Solutions To Common Immersion/Mold Control Heater Problems

Mold control immersion heater replacement intervals can be lengthened or heater problems eliminated by using the optimum heater technology. Check the list below to see if your plastics processing can be improved.

Problem	Heater Solution
Failure from dry-fire conditions or some sheath materials melting	• Use heaters with high temperature alloy sheath such as Incoloy®
Failure from scale build-up	• Lower the heater's watt density, remove scale in a preventative maintenance program or drain and refill heat transfer fluid per manufacturer's recommendations
Burnt or melted power wiring	• Use proper gauge wire with appropriate temperature rated insulation per NEC; periodically disconnect power and tighten all electrical connections
Failure from low-liquid condition	• Check low liquid protection device; make sure the heater's no-heat section is at or below the outlet nozzle's centerline

Temperature Sensors

Thermocouples

Manufactured to recognized agency standards, Watlow thermocouple temperature sensors deliver reliable, accurate temperature measurement.

Stock Type J thermocouple sensor assemblies meet the most popular demands of the plastics processing industry.

Made-to-order and non-stock ANSI Type E, K and T also available.

Availability

All stock thermocouple sensors listed in the following pages are available for same day shipment.

Made-to-Order

If stock units do not meet your application needs, Watlow Richmond can custom manufacture to your special requirements. Consult your authorized Watlow Plastics Distributor for price and shipment details.

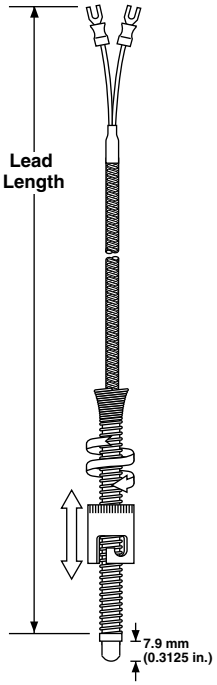
Temperature Sensors

Thermocouples

Spring Adjustable Style

Adjustable spring thermocouple fits a large range of hole depths. Bends to any angle for easy installation.

- **Sheath:** 304 stainless steel
- **Spring:** 305 mm (12 in.) long
  6.35 mm (0.25 in.) O.D.
- **Junction:** grounded
- **Leads:** 20 gauge stranded fiberglass insulation with stainless steel braid

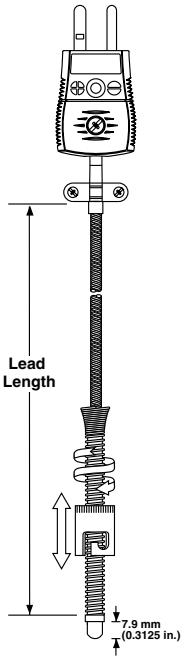


Termination Style: 64 mm (2.5 in.) split leads with spade lugs

Type	Lead Length mm	(in.)	Watlow Code No.
J	609.6	(24)	**80DJBGB024B**
J	914.4	(36)	**80DJBGB036B**
J	1219.2	(48)	**80DJBGB048B**
J	1524.0	(60)	**80DJBGB060B**
J	1828.8	(72)	**80DJBGB072B**
J	2438.4	(96)	**80DJBGB096B**
J	3048.0	(120)	**80DJBGB120B**
J	3657.6	(144)	**80DJBGB144B**

Termination Style: Plug

Type	Lead Length mm	(in.)	Watlow Code No.
J	609.6	(24)	**80DJBGB024D**
J	914.4	(36)	**80DJBGB036D**
J	1219.2	(48)	**80DJBGB048D**
J	1524.0	(60)	**80DJBGB060D**
J	1828.8	(72)	**80DJBGB072D**
J	2438.4	(96)	**80DJBGB096D**
J	3048.0	(120)	**80DJBGB120D**
J	3657.6	(144)	**80DJBGB144D**



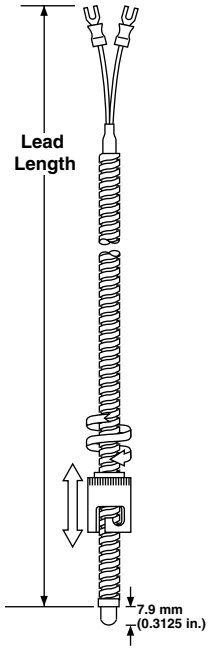
Temperature Sensors

Thermocouples

Adjustable Armor Style

Adjustable thermocouple fits a large range of hole depths. Bends to any angle. Stainless steel hose offers additional lead protection in demanding applications.

- **Sheath:** 304 stainless steel
- **Armor:** 6.7 mm (0.265 in.) O.D.
- **Junction:** grounded
- **Leads:** 20 gauge stranded fiberglass insulation with stainless steel hose

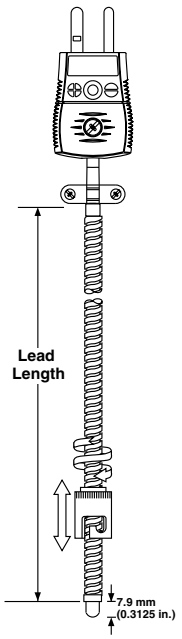


Termination Style: 64 mm (2.5 in.) split leads with spade lugs

Type	Lead Length mm	(in.)	Watlow Code No.
J	609.6	(24)	**81DJCGB024B**
J	914.4	(36)	**81DJCGB036B**
J	1219.2	(48)	**81DJCGB048B**
J	1524.0	(60)	**81DJCGB060B**
J	1828.8	(72)	**81DJCGB072B**
J	2438.4	(96)	**81DJCGB096B**
J	3048.0	(120)	**81DJCGB120B**
J	3657.6	(144)	**81DJCGB144B**

Termination Style: Plug

Type	Lead Length mm	(in.)	Watlow Code No.
J	609.6	(24)	**81DJCGB024D**
J	914.4	(36)	**81DJCGB036D**
J	1219.2	(48)	**81DJCGB048D**
J	1524.0	(60)	**81DJCGB060D**
J	1828.8	(72)	**81DJCGB072D**
J	2438.4	(96)	**81DJCGB096D**
J	3048.0	(120)	**81DJCGB120D**
J	3657.6	(144)	**81DJCGB144D**



Temperature Sensors

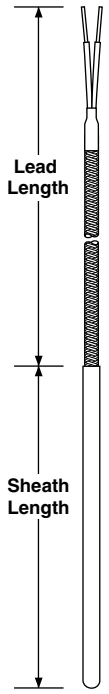
Thermocouples

Rigid Sheath Style

Rigid sheath provides protection and accurate placement through bulkheads or platens. Use with a compression fitting for liquid tight immersion applications.

- **Sheath:** 304 stainless steel
  4.76 mm (0.1875 in.) diameter
  25.4 or 76.2 mm (1 or 3 in.) long
- **Junction:** grounded
- **Terminations:** standard, 64 mm (2.5 in.) split leads
- **Leads:** 20 gauge stranded fiberglass insulation with stainless steel braid

Type	Sheath Length mm	(in.)	Lead Length mm	(in.)	Watlow Code No.
J	25.4	(1)	1219.2	(48)	**82DJBGB048A**
J	25.4	(1)	1828.8	(72)	**82DJBGB072A**
J	76.2	(3)	1219.2	(48)	**82DJBGF048A**
J	76.2	(3)	1828.8	(72)	**82DJBGF072A**

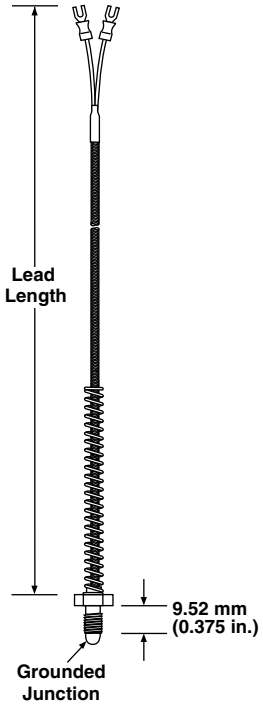


Nozzle Style

The nozzle thermocouple's short installation depth and low profile makes it well suited to measure the temperature of thin platens.

- **Bolt:** 304 stainless steel
  6.35 mm (0.25 in.) X 28 UNF
  9.52 mm (0.375 in.) thread depth
- **Junction:** grounded
- **Termination:** 64 mm (2.5 in.) split leads with spade lugs
- **Leads:** 20 gauge stranded fiberglass insulation with stainless steel overbraid

Type	Lead Length mm	(in.)	Watlow Code No.
J	1219.2	(48)	**87XJBGA048B**
J	1828.8	(72)	**87XJBGA072B**
J	3657.6	(144)	**87XJBGA144B**



Temperature Sensors

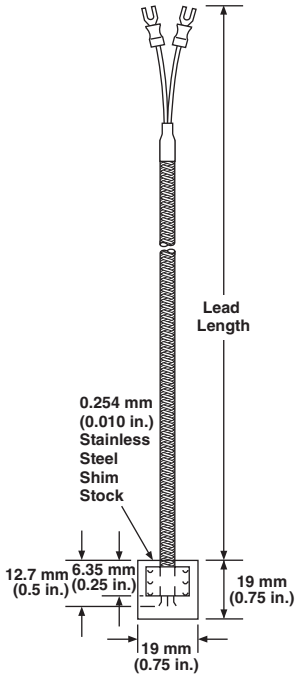
Thermocouples

Stainless Steel Shim Style

The shim stock's low profile permits placement between components for measuring surface temperature. Available in other shim sizes, contact your authorized Watlow Distributor.

- **Shim Size:** 19.05 X 19.05 X 254 mm (0.75 X .75 X 0.010 in.), 304 SS
- **Junction:** grounded
- **Termination:** 64 mm (2.5 in.) split leads with spade lugs
- **Leads:** 24 gauge stranded fiberglass insulation with stainless steel overbraid

Type	Lead Length mm	(in.)	Watlow Code No.
J	1219.2	(48)	**89XJSGA048B**
J	1828.8	(72)	**89XJSGA072B**

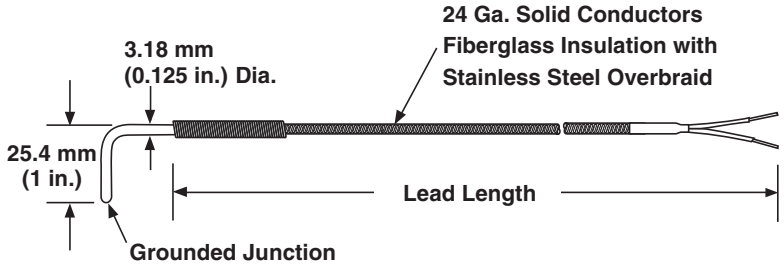


Newbury Nozzle Style

A direct replacement for OEM Type J nozzle thermocouples held in place with a set screw. The sheath is 3.18 mm (0.125 in.) diameter with 90 degree bend and strain relief.

- **Type J**
- **Junction:** grounded
- **Termination:** standard, 64 mm (2.5 in.) split leads
- **Leads:** 24 gauge solid fiberglass insulation with stainless steel overbraid

Lead Length mm	(in.)	Watlow Code No.
1219.2	(48)	**91J2A23D**
1524.0	(60)	**91J2A23E**



Temperature Sensors

Thermocouples

Mineral Insulated Hot Runner Style

Fast responding small diameter mineral insulated provides accurate measurement of hot runner nozzles. The durable high temperature plastic transition provides moisture seal and ruggedness to the flexible lead connection.

Type	Sheath Length mm	(in.)	Lead Length mm	(in.)	Watlow Code No.
J	50.8	(2)	1219.2	(48)	**AHDP0TF020GJ040**
J	101.6	(4)	1219.2	(48)	**AHDP0TF040GJ040**
J	152.4	(6)	1219.2	(48)	**AHDP0TF040GJ040**
J	203.2	(8)	1219.2	(48)	**AHDP0TF080GJ040**

Non-Contact Infrared

- Emissivity fixed @ 0.95
- Type J thermocouple 007PJ7
- Response time 350 (mSec 95 percent)
- 87 mm L x 19 mm D (3.4 in. L x 0.75 in. D)
- Temperature sensing range: 0 to 350°C (32 to 662°F)
- Accuracy: ±2% or ±3°C (±65°F), whichever is greater, between 0 to 115°C (32 to 240°F);

  ±5% or ±6°C (±10°F), whichever is greater, between 115 to 225°C (440 to 662°F);

  >±5% between 225 to 350°C (440 to 662°F)
- Repeatability: ±1% of measured value or ±1°C (2°F), whichever is greater
- 0 to 71°C (32 to 160°F) operating environment
- 4:1 optics
- Power requirements: 12-24 V⎓(dc) (≤2.5% ripple) @ 20 mA
- Optional power supply, air purge water cooling available

Sensors

Watlow Part No.	Cable (length/feet)	Output
RAYCI1A	3	TYPE J
RAYCI1A10L	10	TYPE J

Optional Items

Watlow Code No.	Input	Output	Part No.
Power Pack 110	220 VAC	24 VDC	XX CIDCPS
Fixed Mounting Bracket			XXX CIACFB

Temperature Sensors

Problem Solvers

Watlow Solutions To Common Temperature Sensing Problems

Temperature sensing is a vital part of process using a thermal loop. Sensing product temperatures can eliminate problems, reduce costly down time and waste. Check the list below to see if your temperature sensing can be improved.

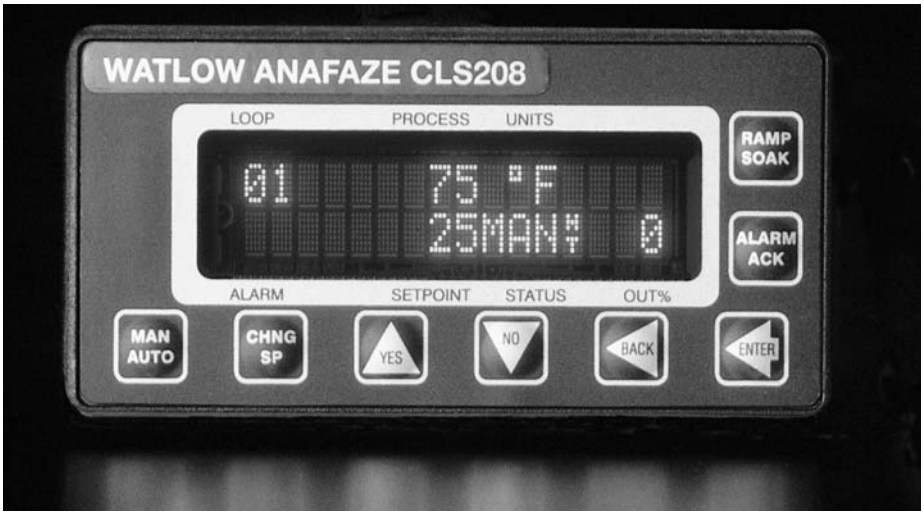
Problem	Solution
High process temperature causing premature sensor failure	• Use a mineral insulated thermocouple assembly
Sensor response too slow for changing temperatures	• Use a lower mass, 3.2 mm (0.125 in.) O.D. thermocouple assembly
Unable to reuse sensor removed from a compression fitting	• Use a thermocouple assembly with an adjustable compression fitting
Fiberglass insulation absorbing moisture or susceptible to contamination	• Use Teflon® insulated lead wire where temperature conditions permit
Sensor lead wires subject to high temperatures or contamination	• Use mineral insulated, metal-sheath cable
Application requires a custom sensor	• Made-to-order sensors, including; ASTM Types B, C*, E, J, K, N, R, S and T; DIN or JIS calibrated RTDs; positive or negative temperature coefficient thermistors

*Not an ANSI symbol.

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

Barrel Temperature Controllers

4-, 8-, 16-Loop CLS200



The Watlow CLS200 is a powerful line of controllers, combining performance and flexibility with compact design. The four, eight and 16-loop versions provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs is available, including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system and includes built-in serial communications for computer interface and data acquisition. An enhanced features option offers cascade control, ratio control, differential control, process variable retransmit and remote analog set point.

The CLS200 controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

Features and Benefits

PID control of up to 16 heat and cool loops

- Minimal panel space per loop
- Reduced installation time
- More reliable: fewer parts means fewer failures

Auto-tune

- Less time tuning
- Achieve excellent control with less expertise

Menu-guided operation with full text display

- Quick controller setup
- Easy to operate

Eight jobs stored and recalled

- Quickly change from one process to another

Multiple and mixed inputs

- Simply change sensor types at the last minute
- Less to learn, less inventory

Sensor failure detection

- Reduces time troubleshooting reversed, shorted and open sensors

High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms and process variable retransmit

EIA/TIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

Firmware Options

Choose firmware with the features needed for the application:

- Standard—includes closed-loop PID control, auto-tune, alarms, job memory and failed sensor detection
- Extruder— includes the standard firmware features, with PID control specifically adapted for plastic extruders
- Enhanced Features— includes the standard firmware features with the addition of process variable retransmit, remote analog set point, cascade control, ratio control and differential control algorithms. Each channel can be configured for standard PID control or one of the other control algorithms. Each channel of cascade control or remote analog set point requires two controller channels. Unused control outputs on any channel can be configured for retransmit.

Because the CLS200 has no onboard analog outputs, applications that use process variable retransmit typically require one SDAC module per retransmitted signal.

Watlow's WATVIEW and WATCONNECT software are ideal to use with the CLS200. See pages 180 and 182 for more information and ordering details.

UL® and C-UL® are registered trademarks of Underwriter's Laboratories, Inc.

Barrel Temperature Controllers

4-, 8-, 16-Loop CLS200

Specifications

Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller configuration can be loaded through the standard serial port

Analog Inputs

- CLS204 4 Differential
- CLS208 8 Differential
- CLS216 16 Single-ended

Noise Rejection

- 120db at 60Hz

Temperature Coefficient

- 40 ppm/˚C

Sensors/Inputs

- Thermocouples: User-selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: (CLS204 and CLS208 only) 2- or 3-wire, platinum, 100Ω @ 0˚C, DIN 0.003850Ω/˚C curve. Two user-selectable ranges offer different resolutions. Requires scaling resistors. See Special/ Linear Inputs in Ordering Information
- Linear: current and voltage signals from linear transmitters
- Pulse input

Input Range and Accuracy

Type B	66 - 1760°C	±4.0°C
	(150 - 3200°F)	(±7.2°F)
Type E	-200 - 787°C	±1.0°C
	(-328 - 1448°F)	(±1.8°F)
Type J	-212 - 760°C	±1.2°C
	(-350 - 1400°F)	(±2.2°F)
Type K	-268 - 1371°C	±1.3°C
	(-450 - 2500°F)	(±2.3°F)
Type R	-18 - 1766°C	±2.8°C
	(0 - 3210°F)	(±5.0°F)
Type S	-18 - 1760°C	±2.8°C
	(0 - 3200°F)	(±5.0°F)
Type T	-268 - 399°C	±1.6°C
	(-450 - 750°F)	(±2.9°F)

RTD's available on CLS204 and CLS208 only

	Range	Accuracy
(RTD1)	-100 - 275°C	1.1°C
	(-148 - 527°F)	(2.0°F)
(RTD2)	-120 - 840°C	1.6°C
	(-184 -1544°F)	(2.9°F)

Note: Accuracy @ 25˚C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 430°C to 1760°C (800˚F to 3200˚F.) RTD is for 100 percent of span

Linear Voltage and Current Inputs

Requires scaling resistors.
See Special Inputs in Ordering Information

0-10mA⎓(dc)
0-20mA⎓(dc)/4-20mA⎓(dc)
0-100mV⎓(dc)
0-500mV⎓(dc)
0-1V⎓(dc)
0-5V⎓(dc)
0-10V⎓(dc)
0-12V⎓(dc)

Other ranges available. Consult factory.

Pulse Input

- One TTL-level square wave input up to 2kHz

Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- CLS204: 6 samples per second, (update time: 0.167 sec.)
- CLS208: 3 samples per second, (update time: 0.333 sec.)
- CLS216: 1.5 samples per second, (update time: 0.667 sec.)

Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

Calibration

- Automatic zero and full scale

Digital Inputs

- TTL-level used for selecting recipes or jobs or R/S triggers
- Eight inputs and one pulse input with 50-pin terminal board option
- Two inputs and pulse input or three inputs with 18-pin terminal block option

Digital Outputs

- 34 digital outputs are available with 50-pin terminal board option
- 10 control outputs with 18-pin terminal block option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V⎓(dc)
- 350mA at 5V⎓(dc) available from on-board supply

Analog Outputs

- Use DAC and SDAC accessory modules. For process variable retransmit, use SDAC only.
See page 179.

Barrel Temperature Controllers

4-, 8-, 16-Loop CLS200

Alarm Outputs

- Independent process and deviation alarms for each channel.
- Alarms can operate any output not used for control.
- User-programmable deadband, delay and startup suppression.
- Global alarm output activates when any alarm occurs.
- Watchdog output indicates controller is functioning correctly.

Serial Interface

- EIA/TIA-232 or EIA/TIA-485

Baud Rate

- 2400, 9600 or 19200, user-selectable

Communication Protocol

- Modbus™ RTU

Line Voltage/Power

- 15 to 24V⎓(dc) ± 3V⎓(dc) @ 1A (maximum), 300mA (no load)

Agency Approvals

- UL®, C-UL® listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

Dimensions

Overall

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth	203 mm	(8.0 in.)

Bezel

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth	25 mm	(1.0 in.)

Chassis

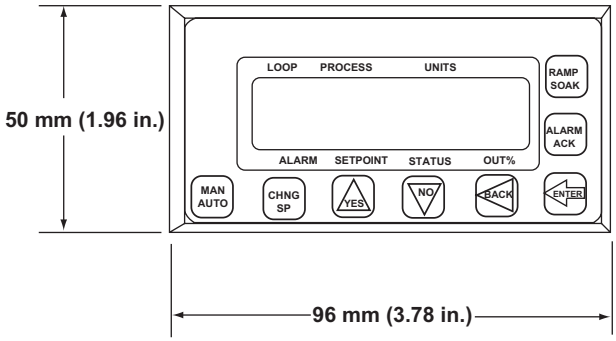
Height:	45 mm	(1.76 in.)
Width:	90 mm	(3.55 in.)
Depth	178 mm	(7.0 in.)

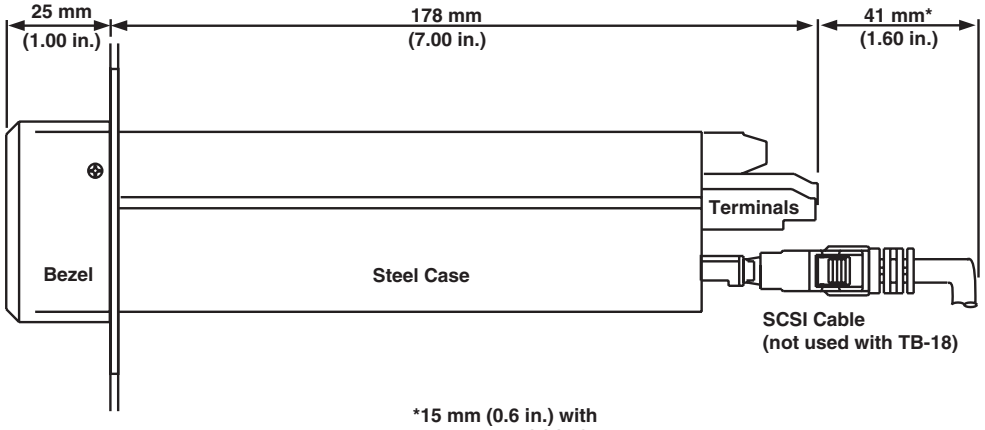
Controller Weight

0.9 kg (1.98 lbs)

Shipping Weight

1.8 kg (4.0 lbs)





*15 mm (0.6 in.) with
Right Angle SCSI Connector

Modbus™ is a trademark of Schneider Automation Incorporated.

Barrel Temperature Controllers

4-, 8-, 16-Loop CLS200

Note: Controller is configured for thermocouples and -10 to 60mV⎓(dc) linear inputs. For other sensors order special inputs, see below. For analog outputs order DAC or SDAC modules, see page 179. For easy setup order WATVIEW software, see page 180.

Availability

Up to four weeks, depending on complexity and order release quantity. Consult factory for details.

Ordering Information

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

2 __ - __ __ __ __ __ __

Number of Channels

04 = 4 channel
08 = 8 channel
16 = 16 channel

Controller Type

1 = Standard EPROM
2 = Extruder
3 = Ramp and soak
4 = Enhanced features

Terminal Block

0 = No terminal block accessory
1 = 18-pin terminal block (CLS204 and CLS208 only)
2 = 50-pin terminal block installed (includes 3 foot SCSI cable)

Power Supply

0 = No power supply
2 = 120/240V~(ac), 50/60Hz power supply adapter (5V⎓[dc], @ 4A, 15V⎓[dc] @ 1.2A) (CE approved)

SCSI Cables

0 = No SCSI cable (3 foot cable included with 50-pin terminal block)
1 = 6 foot SCSI cable
2 = 3 foot right angle SCSI cable
3 = 6 foot right angle SCSI cable

Serial Communication Cables

0 = No serial communications cable
1 = 10 foot serial communications cable (DB-9 female/bare wire)
2 = 25 foot serial communications cable (DB-9 female/bare wire)
3 = 50 foot serial communications cable (DB-9 female/bare wire)

Serial Communication Jumper Settings

0 = EIA/TIA-232
1 = EIA/TIA-485
2 = EIA/TIA-485 terminated

Special Inputs

(Standard unit is configured for thermocouples and -10 to 60 mV linear inputs. For other sensors, order special inputs. See below for ordering instructions. For CLS216 specify two digits, for CLS204 and CLS208 specify one digit.)

0 or 00 = Thermocouples and -10 to 60 mV inputs only
X or XX = Number of current, voltage or RTD inputs

CLSSI __ - __ - __

Special/Linear Input Type

(Not required for thermocouple sensor inputs.)

20 = RTD 1: 0.1°, -100.0 to 275.0°C (-148.0 to 527.0°F) Not available on CLS216
21 = RTD 2: 1°, -120 to 840°C (-184 to 1544°F) Not available on CLS216
43 = 0-10mA⎓(dc)
44 = 0-20mA⎓(dc)/4-20mA⎓(dc)
50 = 0-100mV⎓(dc)
52 = 0-500mV⎓(dc)
53 = 0-1V⎓(dc)
55 = 0-5V⎓(dc)
56 = 0-10V⎓(dc)
57 = 0-12V⎓(dc)

Start Channel

XX = Channel number XX

End Channel

XX = Channel number XX

Barrel Temperature Controllers

For complete information on the PPC-2000 reference pages 257 to 264.

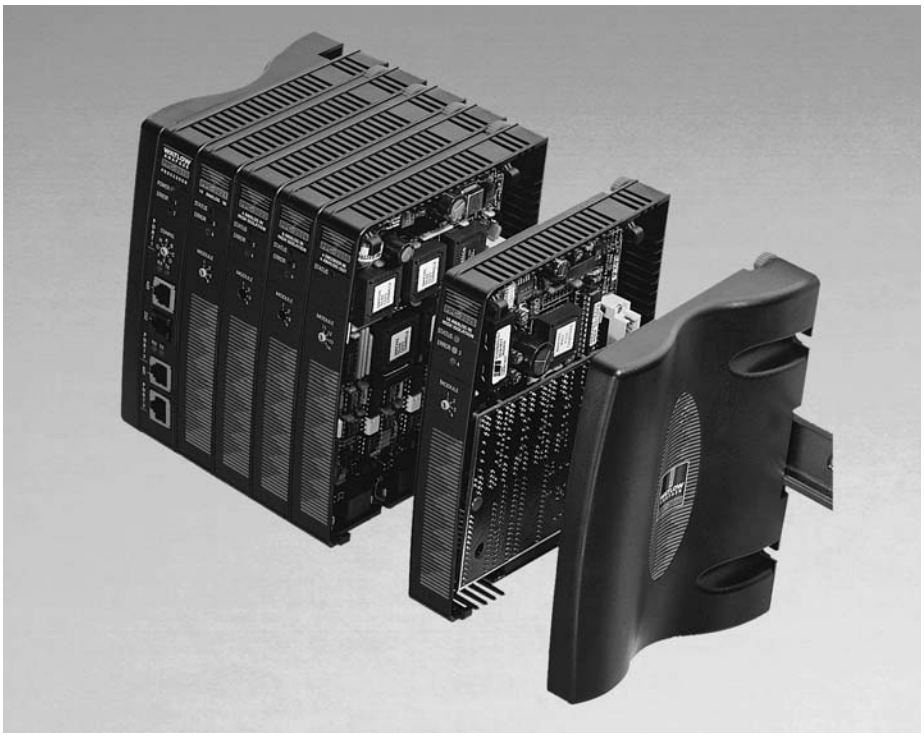
PPC-2000

The Watlow PPC-2000 is a powerful, multi-loop programmable process control system. It combines easy-to-set up multi-loop process control and programmable logic control in one integrated package. Its modular design enables users to select a set of hardware and develop a logic control program based on their specific control loop and logic application, making it ideal for OEMs.

The PPC-2000 controls up to 48 PID loops and supports additional analog inputs for logic programming or monitoring. It accepts multiple sensor inputs including thermocouples, RTDs, linear dc voltage or current inputs and counters. The base system has 46 digital I/O for temperature control or programmable logic. Plug-in I/O modules expand the capacity of the base system. Options include modules for pulse inputs, current and voltage analog outputs, digital inputs for ac and dc signals and relay outputs. The PPC-2000 is also available with an adaptive tuning option. Consult the factory for additional information.

Two serial communication ports support read/write access by a host computer and/or operator interface panel using Modbus™ RTU protocol. ANAWIN®3, the PPC-2000's Human Machine Interface (HMI) software makes it easy to configure, monitor and customize applications.

LOGICPRO graphical logic programming software package allows integration of programmable logic functionality into this new breed of multi-loop controller. Develop with easy-to-use drag and drop tools, then simulate and debug your program before downloading to the PPC-2000.



Features and Benefits

Up to 48 PID control loops

- Precisely control a large number of temperature zones and process loops with a single controller

Advanced auto-tune on all loops

- Quickly optimize PID parameters

Integrated programmable logic control

- Eliminates hard-wired relay logic or stand alone PLC
- Shares data between process control and logic functions

Fill-in-the-blank setup

- Easily setup and monitor closed-loop control

High density mixed analog input modules

- Connect any combination of T/C, RTDs, linear dc current or voltage on the same input module

Flexible and expandable I/O platform

- Saves cost and space by customizing a system to the exact I/O requirement

ANAWIN3 and LOGICPRO graphical software tools

- Easily configure, monitor and maintain processes
- Add custom functionality to support application requirements

Applications

- Injection molding barrel
- Electronic packaging equipment
- Extrusion and thermoforming equipment

Watlow's ANAWIN3 and LOGICPRO software applications are necessary to use with the PPC-2000. See pages 274 and 275 for more information and ordering details.

Barrel Temperature Controllers

SERIES SD

The features and performance offered by Watlow's family of SERIES SD PID controllers make them ideally suited for a broad range of applications in temperature and process control.

Watlow's SERIES SD single channel controllers include a universal sensor input with up to three outputs that can be programmed for heat or cool temperature control, or to operate as process or deviation alarms. Programming Inverse Scaling is also simplified with the user-friendly set-up menu, providing additional value without additional cost.

Advanced features of SERIES SD controllers include EIA-485 Modbus™ Serial Communications, Watlow's INFOSENSE™ sensor technology, Infrared Remote Communications operation, Watlow's patented User Definable Menu System and a "Save and Restore" feature that allows the restoration of either factory or user-defined settings. Two non-linear PID curves have also been added to improve performance in plastics extruder applications.

Available in 1/32, 1/16, 1/8 and 1/4 DIN panel mount sizes, Watlow's SERIES SD family is backed by an industry leading three-year warranty from Watlow. The SERIES SD controllers are UL® and C-UL® listed, CSA, CE and NSF-2 certified and include the IP65/NEMA 4X seal.

SERIES SD6_D

The SERIES SD6_D has been successfully tested for use with ODVA for DeviceNet™ on CAN networks. The controller includes a universal sensor input with two outputs that can be configured as heat, cool or alarm. The DeviceNet™ communications interface is supplied with a five-position removable screw terminal connector. For more information on the SERIES SD6_D controller, see page 175.

SERIES SD31

The SERIES SD31 offers improved accuracy of 0.1 percent of span as well as a faster sampling rate of 6.5Hz in a 1/32 DIN package. Users can also select between 11 different thermocouples, a 100 Ohm RTD, a 0 to 20mA or 0 to 10V process input- all from the front panel- that eliminates the need for dip-switches. For more information on the SERIES SD31 controller, see page 177.

Features and Benefits

Watlow's INFOSENSE™ sensor technology

- Thermal sensing technology improves sensor accuracy by a minimum of 50 percent

Watlow's patented User Defined Menu System

- Allows the user to assign up to 20 parameters in the operations menu
- Improves operational efficiency

"Save and Restore" feature for user settings

- Allows the user to save individual or factory settings
- Eliminates the need to contact the OEM or factory to restore settings

WATVIEW HMI (Human Machine Interface)

- Permits operation, configuration and data logging via a standard Windows® PC

Infrared communications

- Allows easier controller setup, operation and monitoring

Up to three outputs (two for 1/32 DIN)

- Results in application versatility

Dual display on all models

- Provides better recognition of process changes

Ramp to set point

- Controls temperature rise

Variable burst fire

- Prolongs heater life

Watlow's WATVIEW and WATCONNECT software are ideal to use with the SERIES SD. See pages 180 and 182 for more information and ordering details.

DeviceNet™ is a registered trademark of the Open DeviceNet Vendors Association.
Windows® is a registered trademark of Microsoft Corporation.

Barrel Temperature Controllers

SERIES SD6_D

Watlow's SERIES SD6_D delivers excellent control, quality and application versatility in a 1/16 DIN panel mount package.

The SERIES SD6_D has been successfully tested for use with ODVA on CAN networks.

The SERIES SD6_D controller includes a universal sensor input with two outputs that can be configured as heat, cool or alarm. The DeviceNet™ communications interface is supplied with a five position removable screw terminal connector for other market applications.

Additional features of the SERIES SD6_D family of controllers include Watlow's INFOSENSE™ sensor technology, a User Definable Menu System and a Save and Restore feature that allows users to restore factory as well as individually defined parameter values.

The SERIES SD6_D is available as a static set point and limit controller. Ramp soak profile versions will be available in the future. The controllers offer a three-year warranty, are UL® and C-UL® listed, CSA approved, CE certified and include the NEMA 4X (IP65) and NSF ratings. Limit versions of the controller have FM (factory mutual) approval.

Features and Benefits

DeviceNet™ communications capabilities

- Integrates with other DeviceNet™ nodes and software
- Users can select the DeviceNet™ implementation to meet their application needs
- Network and module status LEDs simplify commissioning and troubleshooting a network

INFOSENSE™ sensor technology

- Thermo-sensing technology improves sensor accuracy by a minimum of 50 percent

"Save and Restore" feature for user settings

- Allows the user or OEM to save and restore individual parameter settings
- Reduces downtime and trouble shooting costs due to programming errors

User Defined Menu System

- Allows the operator to view necessary information only
- Improves operational efficiency

Ramp to set point

- Controls temperature rise

Variable burst fire

- Prolongs heater life

Specifications

Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V≂(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

Environment

- -18 to 65°C (0 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

Barrel Temperature Controllers

SERIES SD6_D

Specifications Cont.

Agency Approvals

- UL® 3121, C-UL®, CSA, CE, IP65/NEMA 4X and NSF-2
- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: Input = 6.5Hz, Display = 10Hz and Outputs = 6.5Hz

Operator Interface

- Dual 4 digit, 7 segment LED displays
- Advance, infinity and up down keys
- DeviceNet™ on CAN or SEMI-SIG-ODVA protocols

Allowable Operating Range

Type J:	0	to	815°C
	(32	to	1500°F)
Type K:	-200	to	1370°C
	(-328	to	2500°F)
Type T:	-200	to	400°C
	(-328	to	750°F)
Type N:	0	to	1300°C
	(32	to	2372°F)
Type E:	-200	to	800°C
	(-328	to	1470°F)
Type C:	0	to	2315°C
	(32	to	4200°F)
Type D:	0	to	2315°C
	(32	to	4200°F)
Type PTII:	0	to	1395°C
	(32	to	2543°F)
Type R:	0	to	1760°C
	(32	to	3200°F)
Type S:	0	to	1760°C
	(32	to	3200°F)
Type B:	0	to	1816°C
	(32	to	3300°F)
RTD (DIN):	-200	to	800°C
	(-328	to	1472°F)
Process:	-1999	to	9999 units

Control Outputs

Outputs 1 and 2

- User selectable for heat/cool as on-off, P, PI, PD, PID or Alarm action.
- Electromechanical relay. Form A, rated 2A @ 120V~(ac), 2A @ 240V~(ac) or 2A @ 30V⎓(dc)
- Switched dc non-isolated minimum turn on voltage of 6V⎓(dc) into a minimum 500Ω load with a maximum on voltage of not greater than 12V⎓(dc) into an infinite load. Maximum switched dc power supply current available for up to two outputs is 60mA
- Solid state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression
- Process output (Non Isolated) User-selectable 0-10V⎓(dc), 0-5V⎓(dc), 1-5V⎓(dc) @ 1KΩ minimum, 0-20mA, 4-20mA @ 800Ω maximum
- Electromechanical relay. Form C, rated 5A @ 120V~(ac), 5A @ 240V~(ac) or 5A @ 30V⎓(dc)
- Open collector 42V⎓(dc) @ 250mA maximum

Dimensions

SD6C_D or SD6R_D or SD6L_D

- 1/16 DIN Size
- 97.8 mm (3.85 in.) behind panel maximum
- Width 52.1 mm (2.05 in.)
- Height 52.1 mm (2.05 in.)

Ordering Information

To order, complete the model number on the right with the information below.

S D 6 C - _ _ A - D _ _

SERIES SD6C_D = 1/16 DIN panel mount PID controller with DeviceNet™

Control Type
C = PID controller

Power Supply
H = 100 to 240V≂(ac/dc)
L = 24 to 28V≂(ac/dc)

Output 1
C = Switched dc
K = SSR, Form A, 0.5A
F = Universal process
J = Mechanical relay, Form A, 2A

Output 2
A = None
C = Switched dc
K = SSR, Form A, 0.5A
J = Mechanical relay, Form A, 2A
U = EIA-485 Modbus™ communications

DeviceNet™ Communications
N = DeviceNet™ on CAN (packaging or general industrial markets)
S = SEMI-SG-ODVA compliant (semi-conductor markets)

Display Colors and Custom Options
RG = Red Green (with Watlow name and SD logo)
RR = Red Red (with Watlow name and SD logo)
AA = Red Green (SD logo only)
AB = Red Red (SD logo only)

Barrel Temperature Controllers

SERIES SD31

The SERIES SD family of PID temperature controllers utilizes today's advanced micro-electronics technology to provide the value, benefits and accuracy you've come to expect from Watlow. The SERIES SD31 offers improved accuracy of 0.1 percent of span as well as a faster sampling rate of 6.5Hz in a ⅛ DIN package.

The SERIES SD31 controller delivers many flexible, user-friendly options. Easily choose factory or user defaults and display either process or set point values. Process inputs are scalable and invertible from the front panel. Other features include Variable Burst Fire and flexible Outputs, that users can select as On-Off, Heat/Cool or as Process or Deviation Alarms. Users can also select between 11 different Thermocouples, a 100 Ohm RTD, a 0 to 20mA or 0 to 10V process input - all from the front panel - which eliminates the need for dip-switches.

With optional EIA-485 communications, you can configure, monitor and data log with such optional software products like WATVIEW.

Features and Benefits

Simplified navigation

- Allows users to navigate forwards or backwards from any menu

INFOSENSE™ sensor technology

- Thermal sensing technology improves accuracy by a minimum of 50 percent

Watlow's patented User Defined Menu System

- Allows users to define, save, and access their most important Menu settings

Agency approvals

- UL®, C-UL®, CE IP65/NEMA 4X, plus CSA and NSF

Variable burst fire

- Prolongs heater life
- Reduces replacement costs

"Save and Restore" feature

- Allows the user to save individual or factory settings

Specifications

Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V≂(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

Environment

- -18 to 65°C (0 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

Agency Approvals

- UL® 3121, C-UL®, CSA, CE, IP65/NEMA 4X
- NSF for Type J, K, T and E thermocouples

Controller

- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: Input = 6.5Hz, Display = 10Hz and Outputs = 6.5Hz

Operator Interface

- Single 4 digit, 7 segment LED display
- "Set" infinity and up down keys
- Isolated EIA-485 Modbus™ serial communications, 9600, 19.2K or 38.4K baud rates

Barrel Temperature Controllers

SERIES SD31

Specifications Cont.

Wiring Termination-Touch Safe Terminals

- Input power and control outputs 12 to 22 AWG
- Sensor inputs and process outputs 20 to 28 AWG

Universal Input

- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum, 100Ω @ 0°C calibration to DIN-curve (0.00385 Ω/Ω/°C)
- Process, 0-20mA @ 100Ω, or 0-10V⎓(dc) @ 20kΩ input impedance; Scalable
- Inverse scaling
- >20MΩ input impedance
- Maximum of 20Ω source resistance

Allowable Operating Range

Type J:	0	to	815°C
	(32	to	1500°F)
Type K:	-200	to	1370°C
	(-328	to	2500°F)
Type T:	-200	to	400°C
	(-328	to	750°F)
Type N:	0	to	1300°C
	(32	to	2372°F)
Type E:	-200	to	800°C
	(-328	to	1470°F)
Type C:	0	to	2315°C
	(32	to	4200°F)
Type D:	0	to	2315°C
	(32	to	4200°F)
Type PTII:	0	to	1395°C
	(32	to	2543°F)
Type R:	0	to	1760°C
	(32	to	3200°F)
Type S:	0	to	1760°C
	(32	to	3200°F)
Type B:	0	to	1816°C
	(32	to	3300°F)
RTD (DIN):	-200	to	800°C
	(-328	to	1472°F)
Process:	-1999	to	9999 units

Control Outputs

Outputs 1 or 2

- User selectable for heat/cool as on-off, P, PI, PD, PID or Alarm action
- Electromechanical relay. Form A, rated 2A @ 120V~(ac), 2A @ 240V~(ac) or 2A @ 30V⎓(dc)
- Switched dc non-isolated minimum turn on voltage of 6V⎓(dc) into a minimum 500Ω load with a maximum on voltage of not greater than 12V⎓(dc) into an infinite load. Maximum switched dc power supply current available for up to two outputs is 60mA
- Solid state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression
- Process output (Non Isolated) User-selectable 0-10V⎓(dc), 0-5V⎓(dc), 1-5V⎓(dc) @ 1KΩ minimum, 0-20mA, 4-20mA @ 800Ω maximum
- Open collector 42V⎓(dc) @ 250mA maximum
- EIA-485 serial communications with Modbus™ protocol (output 2 only)
- 9600, 19.2K or 38.4 baud rates

Communications

- Modbus™ EIA-485
- WATVIEW

Dimensions

- 1/32 DIN size
- 97.8 mm (3.85 in.) behind panel maximum
- Width 52.6 mm (2.07 in.)
- Height 29.7 mm (1.17 in.)

Ordering Information

To order, complete the model number on the right with the information below.

SD31 - A-A A

DIN Size
3 = 1/32 DIN

Control Type
1 = 1/32 DIN single display PID control

Power Supply
H = 100 to 240V≂(ac/dc)
L = 24 to 28V≂(ac/dc)

Output 1
C = Switched dc
K = SSR, Form A, 0.5A
F = Universal process
J = Mechanical relay, Form A, 2A

Output 2
A = None
C = Switched dc
K = SSR, Form A, 0.5A
J = Mechanical relay, Form A, 2A
U = EIA-485 Modbus™ communications

Display Colors and Custom Options
0R = Red (Single display units)
0G = Green (Single display units)
XX = Custom options, special overlays, etc.

Barrel Temperature Controllers

Accessories

DAC and SDAC Modules

The optional DAC and SDAC modules are used to convert open collector outputs to analog voltage or current signals. SDAC modules may only be used with Watlow CLS200, CPC400, D8, MLS300 and PPC-2000 controllers.

DAC

The DAC (digital to analog converter) converts a controller's variable time base (also known as distributed zero crossing or DZC) output to an analog process control signal. Each DAC supports two independent analog outputs. Output signals are available in 4-20mA V⎓(dc), 0-5 V⎓(dc) and 0-10V ⎓(dc).

DAC Specifications

Storage Temperature

- -20 to 60°C (-4 to 140°F)

Operating Temperature

- 0 to 50°C (32 to 122°F)

Humidity

- 10 to 95 percent, non-condensing

Dimensions

- Length 112 mm (4.4 in.), Width 91 mm (3.6 in.), Height 44 mm (1.75 in.)

Power Requirements

- 12 to 24 V⎓(dc), 100 mA @ 15 V⎓(dc)

Accuracy

- ±6 percent of full scale

SDAC

The SDAC (serial digital to analog converter) allows CLS200, CPC400, D8, MLS300 and PPC-2000 controllers to output precise analog voltage or current signals. The unit is typically used for PV retransmit, open-loop control, motor or belt speed control or phase-angle fired SCR power controller. The SERIAL DAC is jumper-selectable for a 0 to 10 V⎓(dc) or 4 to 20 mA outputs. Multiple SERIAL DAC modules can be used with the same controller.

SDAC Specifications

Storage Temperature

- -20 to 60°C (-4 to 140°F)

Operating Temperature

- 0 to 50°C (32 to 122°F)

Humidity

- 10 to 95 percent, non-condensing

Dimensions

- Length 137 mm (5.4 in.), Width 91 mm (3.6 in.), Height 44 mm (1.75 in.)

Power Requirements

- 4.75 to 5.25 V⎓(dc), 100 mA

Resolution

- 15 bits

Accuracy

- 0.05 percent (voltage full scale); 0.5 percent (current full scale)

Agency Approvals

- UL® and C-UL® (UL® 916); CE (EMC directive 89/336/EEC)

Software Options
WATVIEW HMI

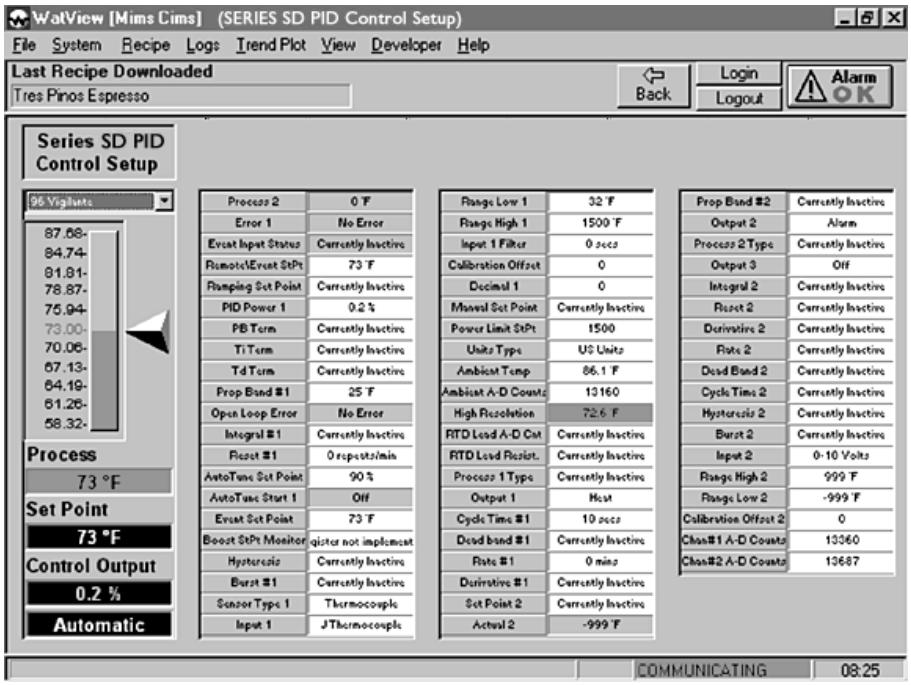
Searching for a quick, efficient way to set up your controllers? Need rapid data-logging and graphing capabilities? We have the answer: WATVIEW.

WATVIEW is Watlow's HMI (Human/Machine Interface) software designed to set up and monitor up to 32 Watlow controllers. With easy controller setup, a recipe and alarm manager, data-logging and trend plot graphing capabilities, animated custom overview screens and a superior online help system, you can be assured that WATVIEW is the ideal software for your application.

WATVIEW Editions:

WATVIEW is available in three editions making your software decision quick and effortless.

- **WATVIEW-R: The Run-Time Edition**
  Provides trend plot graphing, setup screens, data-logging, recipe manager with calendar-start, spreadsheet data editor, system activity log and alarm manager. The Run-Time Edition will "play back" custom screens created with the Developer Edition.
- **WATVIEW-D: The Developer Edition**
  Includes all functions of the Run-Time Edition plus a custom screen designer and user-defined variables.
- **WATVIEW-C: The Configurator Edition**
  Includes only spreadsheet data editor, recipe manager without calendar-start and system activity log.



Features and Benefits

Easy controller setup

- WATVIEW automatically detects which controllers are connected to the computer, then WATVIEW loads the appropriate setup screens for those controllers. Use built-in setup screens to adjust the controller parameters, or the simple "spreadsheet view" for a quick, intuitive interface. The spreadsheet categorizes all controller parameters according to their parameter groupings.

Recipe manager

- All editions of WATVIEW include the ability to create recipes (arrays of controller settings). Recipes can be created, edited, stored and downloaded to the controllers. Use recipes to store commonly used controller settings, to speed up repetitive controller setups and to create a "snapshot" of your setups. The Run-Time and Developer Editions also include a calendar-start function, allowing users to automatically download recipes on a one-time or repeating schedule.

Alarm manager

- WATVIEW Run-Time and Developer Editions receive alarms from controllers, maintain a log of alarms and allow users to clear and acknowledge alarms.

Data-logging and trend plot graphs

- WATVIEW Run-Time and Developer Editions include continuous data-logging of the parameters you choose. You can export the collected data to an Excel®-compatible spreadsheet file, or view up to 20 data items on a WATVIEW trend plot graph. An unlimited number of graphs may be named and stored for simple future retrieval.

Excel® is a registered trademark of Microsoft Corporation.

Barrel Temperature Controllers

Software Options
WATVIEW HMI

Features and Benefits, con't.

Colorful, animated custom overview screens

- Use WATVIEW Developer edition to create custom screens. WATVIEW's Custom Overviews (COVs) incorporate your graphic images (such as digital camera photos) with real-time data from the controllers to make a custom interface. You can also use WATVIEW's AnaMator program to create animated sequences, which can show your actual process in action. Custom Overviews created with the Developer edition can be used with any WATVIEW edition.

Superior online help system

- Use the online help to navigate through setup procedures, obtain specific help for various Watlow controllers, locate context-sensitive help or search and browse the entire contents. This online help system is a superior feature for HMI software and is included with each edition of WATVIEW.

Pentium® is a registered trademark of Intel Corporation.
Windows®95, 98 and NT are registered trademarks of Microsoft Corporation.

Specifications

System Requirements:

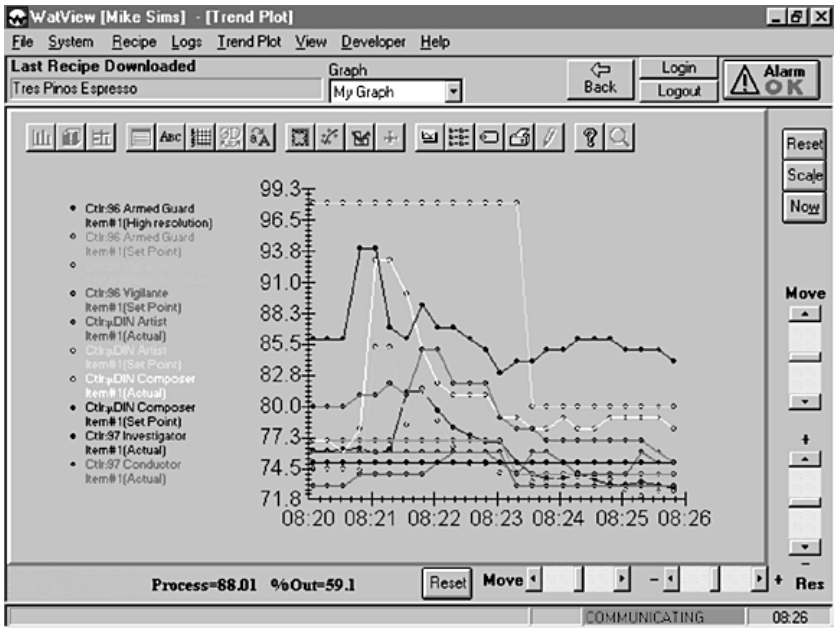
1. Pentium® 200MHz processor (depending on operating system)
2. 32 MB RAM
3. 800 x 600 screen resolution
4. 16-bit or higher color palette ("High Color")
5. Communications port capable of 19.2 kbaud (16550 UART)
6. Microsoft®-compatible pointing device (mouse or trackball)
7. High-density floppy drive
8. 200 MB hard drive space
9. CD-ROM drive
10. Windows®95, 98, NT 4.0, ME, 2000 or XP

Note: For Windows®NT 4.0 you must have 64 MB of RAM. For Windows® 2000 and XP you must have 128 MB of RAM

Controllers Supported:

WATVIEW supports the following controllers when equipped with the listed firmware revision or later:

- CLS200 standard, enhanced and extruder (Rev. 3.30), ramp and soak (Rev. 3.40)
- SERIES SD Dual Display (Rev. 1.00)
- SERIES SD Dual Display Limit (Rev. 1.00)
- MLS300



Barrel Temperature Controllers

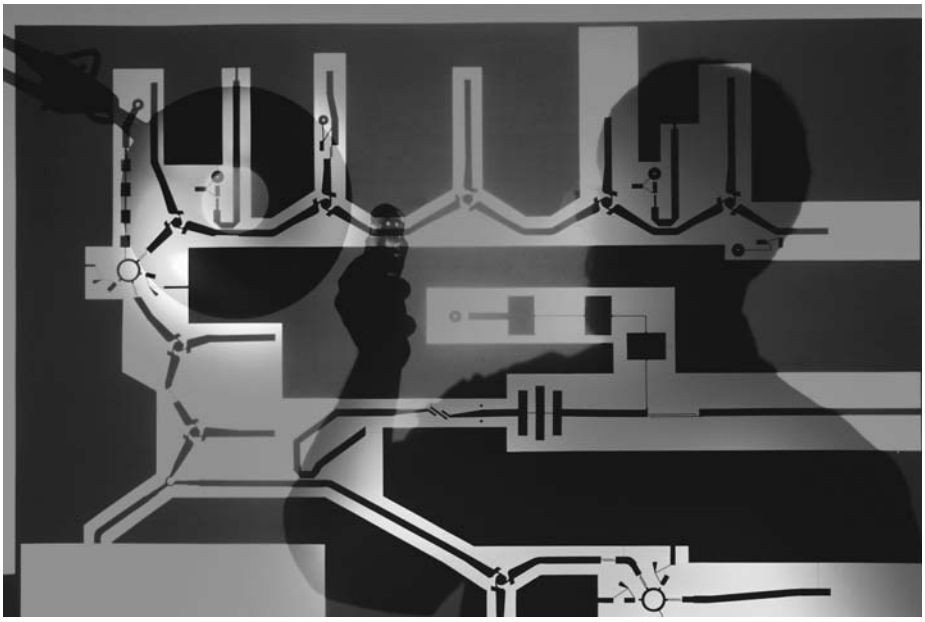
Software Options

WATCONNECT Communications Library

WATCONNECT is Watlow's new Windows®-based software library for Modbus™-RTU communications. This software tool kit makes it easy for programmers working in Visual Basic, C, C++ and Visual C++ to develop Windows® applications that communicate with Watlow controllers using the Modbus™ RTU protocol. The simplicity of the interface insures a short learning curve and shortened development times for Human Machine Interface or other applications that communicate with controllers.

The main benefit of the tool kit is that the programmer does not need to learn the details of the Modbus™ protocol or the operation of a Windows® serial port to successfully develop programs that read and set parameter values in controllers. The library provides four, easy-to-use functions: open port, close port, read data and write data. To use these functions, the programmer just needs to know the communications port settings and address of the desired data.

For more information, please contact your local Watlow representative.



Features and Benefits

Allows communication with one to 247 controllers

- Scalable

Safe for multi-threaded applications

- Several parts of a program can use the same communications port

Single source solution

- Eliminates multiple vendors
- Assures compatibility
- Saves time and money

License agreement allows user written applications to be distributed royalty free

- Adds no recurring cost to applications

Sample code provided for Visual C++ and Visual Basic environments

- Easy to follow examples shorten the learning curve

Reads and writes all standard Modbus™ data table locations: coils, inputs and registers

- Allows access to all controller parameters

Can handle custom-named ports such as serial port expanders

- Assures flexibility

Controllers Supported:

WATCONNECT supports the following controllers when equipped with the listed firmware revision or later:

- CLS200 standard, enhanced and extruder (Rev. 3.30), ramp and soak (Rev. 3.40)
- SERIES SD Dual Display (Rev. 1.00)
- SERIES SD Dual Display Limit (Rev. 1.00)

Windows® is a registered trademark of Microsoft Corporation.

Modbus™ is trademark of Schneider Automation Corporation.

Power Controllers

DIN-A-MITE® Family

COMPLIES WITH EUROPEAN EMC DIRECTIVE
EN 61326 (1997-98) and EN 50178
Available on Request...
Consult Your Watlow Representative

Made in the United States of America, Watlow's DIN-A-MITE® family of solid state power controllers provides SCR control, heatsink, wiring and touch-safe exterior in one package. By designing the DIN-A-MITE as a total power controller unit, the need to prep wires for terminals, find the right heatsink and determine adequate terminations is eliminated. It's a complete package you can install with Control Confidence®.

Performance Capabilities

Four DIN-A-MITE styles meet most power controller needs with ratings from 18 to 100 amps with voltages from 120 to 600V~(ac).

Features and Benefits

DIN-rail or sub-panel mounting

- Simple, fast installation

No mercury

- Environmentally safe product

Compact size

- Reduced panel space; less cost

Touch-safe exterior

- Increased safety for installer/user

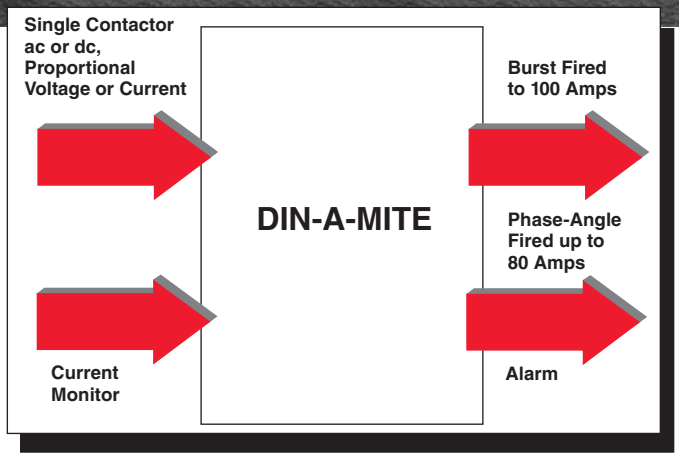
Easy Installation

Installation is simple and fast; saving time and money. All you have to do is strip wires and make connections.

- Sub-panel or DIN-rail mounting
- No drilling and tapping necessary
- Same footprint as comparably rated MDRs

Agency Approvals

- UL® 508 listed and C-UL® approved
- UL® 50, UL® 1604, and CE



Achieve Optimum Temperature Control With Variable Time Base Control

Variable time base control meets the rapid switching demands of PID temperature control to deliver more accurate process control. It also increases heater life by reducing temperature over- and undershoot.

Low Electrical Noise

Burst firing switches ac current at zero cross (zero potential) to produce minimal RFI and EMI electric noise (radio frequency interference/electromagnetic interference). This low electrical noise quality helps prevent interference with sensor circuits and particularly sensitive equipment in your system.

Rugged, Back-to-Back SCR Design Insures Long Term Reliability

With solid state components, there's no limit on the number of switching cycles the DIN-A-MITE can perform. The four DIN-A-MITE styles meet most application requirements by tolerating harsh industrial environments, electrical spikes and dissipating less power. When properly applied, the DIN-A-MITE will outlast all other types of non-electronic power controllers.

UL® and C-UL® are registered trademarks of the Underwriter's Laboratories, Inc.

Power Controllers

DIN-A-MITE Family

Reduce Wear On Thermal System

With optional variable time base switching, the DIN-A-MITE automatically adjusts output cycle time to meet system demands. The benefits of this option are:

- Heater output equal to load demand
- Minimized temperature over- and undershoot

Terminal System Helps Prevent Wiring Failures

A proven high-current copper terminal design ensures optimum electrical connection to reduce heat build-up. This helps avoid connection failures and ensures overall wiring reliability. To further reduce "hot spots," we've eliminated all unnecessary wires and fasteners which could possibly loosen, heat up and break down.

Compact Solid State Power Controller Delivers Big Performance in a Small Package

Watlow's DIN-A-MITE Style A, B, C and D power controllers provide a low-cost, highly compact and versatile solid state power control. What's more, no need to worry about mercury; all DIN-A-MITEs are mercury free and fit the same footprint as a comparably rated MDR. Each feature sub-panel mounting, while Styles A, B and C also have DIN-rail mounting capability.

Style A Capabilities

Style A capabilities include single-phase burst fire switching up to 25 amps at 600V~(ac) (see rating curve).

Variable time base, 4-20mA⎓(dc) process control or V~(ac)/ V⎓(dc) input contactor versions are available. All configurations are code number dependent and factory selectable, 50/60Hz independent.

Style B Capabilities

Style B capabilities include 1-phase and 3-phase burst fire up to 40 and 33 amps, respectively, at 600V~(ac) (see rating curve).

Variable time base, 4-20mA⎓(dc) process control or V~(ac)/V⎓(dc) input contactor versions are available. All configurations are code number dependent and factory selectable, 50/60Hz independent.

Style C Capabilities

Style C capabilities include 1-phase and 3-phase, 2-leg, and 3-phase, 3-leg burst fire, as well as 1-phase, phase-angle fire. Burst fire operation from 120 to 600V~(ac), phase-angle operation from 120 to 600V~(ac). Current switching capabilities range from 30 to 80 amps depending on the model ordered (see output rating curve).

Input options include variable time base, 4-20mA⎓(dc) process control, linear voltage control, manual control or V~(ac)/V⎓(dc) contactor input. All configurations are code number dependent and factory selectable. All models are 50/60Hz independent.

Style D Capabilities

Style D capabilities include 1-phase switching up to 100 amps at 600V~(ac) and 30°C (86°F) (see rating curve). Limited 3-phase operation is possible by ganging two and/or three Style D DIN-A-MITE contactor inputs together.

Style D features on-board semiconductor fuses (accessible from the front). Application is further enhanced with optional current transformer option for external load current monitoring and "shorted SCR detector" on some models.

Variable time base, 4-20mA⎓(dc) process control or V~(ac)/ V⎓(dc) input contactor options are available. All configurations are code number dependent and factory selectable, 50/60Hz independent.

The standard sub-panel mounting footprint is equal to that of an industry standard mercury displacement relay.

DIN-A-MITE Style A, B, C and D Features

- **Faster switching** with solid state components. Better control saves energy and extends heater life.
- **Back-to-back SCR design** for increased durability.
- **Three-year warranty** assures Control Confidence®.

Style B and C Features

- **1- and 3-phase power** permits use in a variety of applications.
- **Shorted output detector** (optional) notifies a shorted SCR condition.

Style C Features

- **Open heater detector** (optional) notifies when a partial or totally open heater occurs.

Style D Features

- **On-board semiconductor fusing** provides quick access with no extra mounting necessary.
- **Optional load current monitor** detects changes in load current.

Agency Approvals

- UL® 508 Listed, File #E73741
- C-UL® approved
- CE approved with proper line filter
- DIN-A-MITE Style C thru-wall mount is also UL® 50 and UL® 1604 approved.
- CE and EN 61326 Industrial Immunity Class A emissions with filter. EN 50178 safety directive

Power Controllers

DIN-A-MITE Family

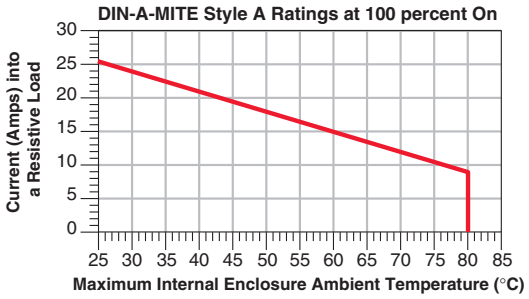
	DIN-A-MITE Style A	DIN-A-MITE Style B	DIN-A-MITE Style C	DIN-A-MITE Style D
1-Phase①	Up to 25 amps @ 600V~(ac)	Up to 40 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Up to 100 amps @ 600V~(ac)
3-Phase, 2-leg①	No	Up to 33 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Gang 2 units
3-Phase, 3-leg①	No	Up to 22 amps @ 600V~(ac)	Up to 70 amps @ 600V~(ac)	Gang 3 units
V~(ac) & V⎓(dc) - Burst Fire Contactor Input	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)
Multizone V~(ac) & V⎓(dc) Input	No	Yes	Yes	No
4-20mA⎓(dc) Input - Variable Time Base Output	Yes	Yes	Yes	Yes
Phase-Angle Fire Output②	No	No	Yes 1-phase only	No
Manual Control Via Potentiometer Input, or 0-5, 1-5 or 0-10V⎓(dc) Linear Voltage Input	No	No	Yes	No
Shorted SCR Alarm	No	Yes	Yes	Yes
Open Heater Alarm	No	No	Yes With "S" input only	Yes
Load Current Monitor CT	No	No	No	Yes
On Board Semiconductor Fusing	No	No	No	Yes
DIN-rail Mount	Yes	Yes	Yes	No
Sub-Panel Mount	Yes	Yes	Yes	Yes
Cabinet Thru-Wall Heatsink Mount UL® 50 and UL® 1604	No	No	Yes	No
Electrically Touch-Safe Package	Yes	Yes	Yes	Yes
Back-to-Back SCR Design	Yes	Yes	Yes	Yes
UL® 508 Listed/C-UL®/CE w/filter	Yes	Yes	Yes②	Yes
Dimensions	95 X 45 X 98 mm (3.7 H X 1.8 W X 3.9 in. D)	95 X 80 X 124 mm (3.7 H X 3.1 W X 4.9 in. D)	150 X 80 X 146 mm (6.0 H X 3.1 W③ X 5.7 in. D)	185 X 65 X 240 mm (7.25 H X 2.5 W X 9.4 in. D)
Controller Weight: kg (lbs)	0.32 (0.71)	0.68 (1.5)	1.18 (2.6)	2.95 (6.5)
Controller Weight w/fan: kg (lbs)	N/A	N/A	1.45 (3.2)	N/A

① Refer to curves on page 186 for your specific application ratings.
② Phase-angle fire is not CE approved.
③ Will fit within the width dimension of most comparable MDRs.

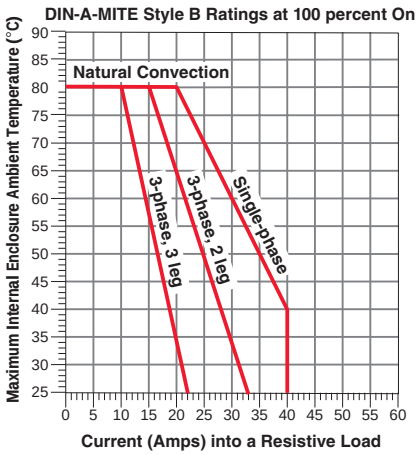
DIN-A-MITE Family

Output Current Rating Curves

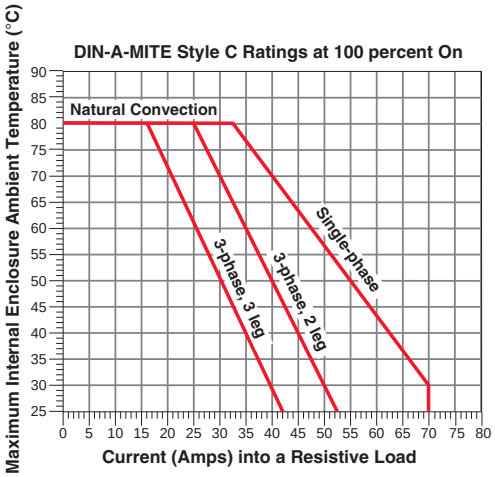
Style A



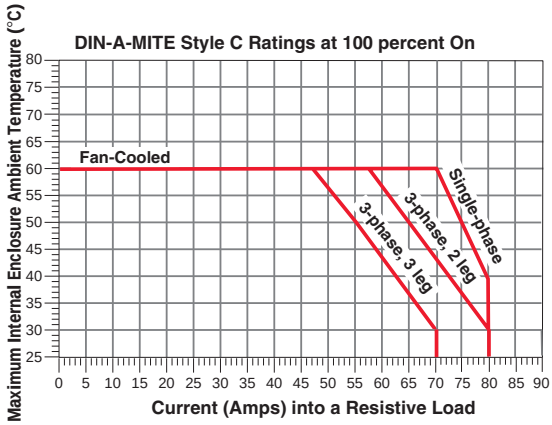
Style B



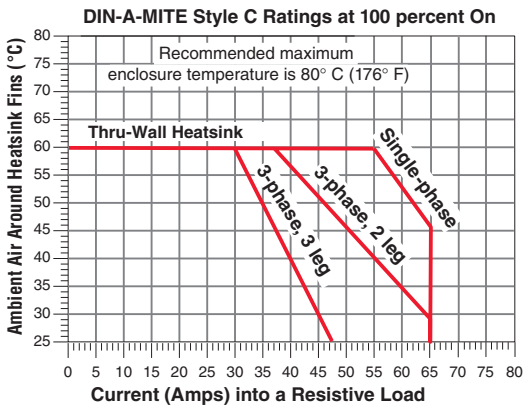
Style C



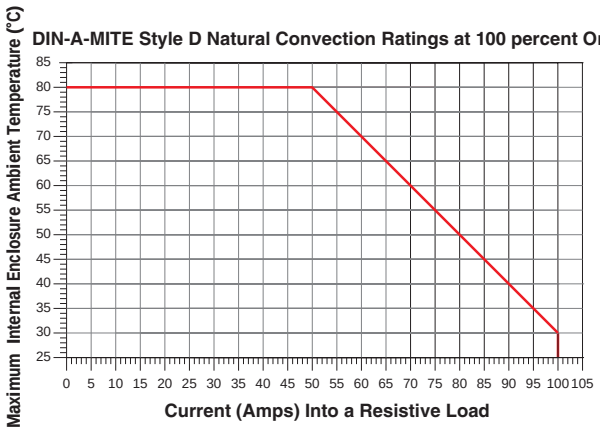
Style C - Fan Cooled



Style C—Thru-Wall



Style D



Power Controllers

DIN-A-MITE Family

Specifications Common To Styles A, B, C and D

Control Mode-Burst Fire

- V~(ac) input contactor
- V⎓(dc) input contactor
- 4-20mA⎓(dc) variable time base control

Operator Interface

- Command signal input
- Input signal indication LED

Input

- V~(ac): 24, 120, 240 nominal - 25mA maximum per controlled leg
- V⎓(dc): 4.5 to 32V⎓(dc): maximum current @ 4.5V is 6mA per leg. Add 2mA per LED used to the total current.
- 4-20mA⎓(dc) loop powered: 375Ω input impedance

Output Voltage

- 120-240V~(ac) units: 48V~(ac) minimum to 265V~(ac) maximum
- 277-600V~(ac) units: 85V~(ac) minimum to 660V~(ac) maximum
- Off state leakage 1mA⎓(dc) at 25°C (77°F) maximum

Operating Environment

- Up to 80°C (176°F),[3] see output rating curve for specific application

Storage Temperature

- -40 to 85°C (-40 to 185°F)

Mounting

Options include DIN-rail[1] or standard sub-panel mounting

- The DIN-rail specification is: DIN EN 50022, 35 mm x 7.5 mm (1.37 in. x 0.3 in.)

Multizone Input— Styles B & C

- V~(ac) input contactor
- V⎓(dc) input contactor
- Available 2 and 3 leg only

Amperage—Style A

- 1-phase, 24 amp output maximum at 30°C (86°F) into a resistive load[3]
- Maximum surge current for 16.6mSec. 380 amps peak
- Maximum I^2t for fusing 4,000 A^2 Sec.

Amperage—Style B

- 1-phase and 3-phase models. See output rating curves on page 186
- Maximum surge current for 16.6mSec. 380 amps peak
- Maximum I^2t for fusing 4,000 A^2 Sec.

Amperage—Style C

- Natural convection and fan cooled, in 1-phase and 3-phase models. See output rating curves on page 186
- Maximum surge current for 16.6mSec. 1350 amps peak
- Maximum I^2t for fusing 9100 A^2 Sec.

Style C—Phase-Angle Firing[2]

- 1-phase operation
- Line voltage compensation
- Soft start (4 seconds) on power up
- Missing half cycle detection (engages ESD and restarts soft)
- Optional current limit feature
- Linear voltage/current or manual control input. 5kΩ input impedance for voltage and 250 ohms for 4-20mA
- 120, 208, 240, 277, 400, 480 and 600V~(ac) operation. Model number dependent

Style C—Single Cycle Variable Time Base

- 1-phase and 3-phase operation
- Linearized input to output
- Linear voltage/current or manual control input. 5kΩ input impedance for voltage and 250 ohms for 4-20mA
- 120, 208, 240, 277, 400, 480 and 600V~(ac) operation. Model number dependent

Amperage—Style D

- 1-phase, 100 amp output maximum at 30°C (86°F)[3]
- Maximum surge current for 16.6mSec. 1800 amps peak
- Maximum I^2t for fusing 20,000 A^2 Sec.

Shorted Output Alarm Option—Styles B, C & D

- Triac output
- 24 to 240V~(ac), 300mA @ 25°C, 125mA @ 80°C (176°F)
- Energizes on alarm
- Holding current 200µA minimum
- Latching current 5mA typical

Terminals—Styles A & B

- Compression - will accept #8-18 AWG wire

Terminals—Style C

- Compression - will accept #4-14 AWG wire

Terminals—Style D

- Compression - will accept #2-6 AWG wire

Mounting—Style D

- Standard sub-panel mounting; fits the same mounting pattern as a 100 amp, 1-phase MDR
- Mounting holes offer clearance for #10 screw
- On-board semiconductor fusing, Bussmann part number 170N3437

Current Sensing—Style D

- On-board current transformer, 0.2V~(ac) output signal per amp load current into 1000Ω load

[1] Not available on Style D
[2] Style C phase-angle fire is not CE approved
[3] See output current rating curves, page 186.

Power Controllers

Style A

Availability

All combinations available in three working days or less.

CE approved product. Must use CE filter listed on page 287 for conducted emission.

Ordering Information

To order, complete the code number on the right with the information below.

DIN-A-MITE — **D A 1 0 - _ _ - 0**

Style A = Solid state power controller

Phase

1 = 1-phase, 1 controlled leg

Cooling and Current Rating

0 = Natural convection current rating 18A @ 50˚C (122˚F)
(See derating curve for current rating at other temperatures)

Line and Load Voltage

02 = 24 to 48V~(ac)
24 = 100 to 240V~(ac)
60 = 277 to 600V~(ac)

Input Type

C0 = 4.5 to 32V⎓(dc) contactor
F0 = 4 to 20mA⎓(dc) proportional
K1 = 22 to 26V~(ac) contactor
K2 = 100 to 120V~(ac) contactor
K3 = 200 to 240V~(ac) contactor

Manual Language

0 = English
1 = German
2 = Spanish
3 = French

Custom parts Designation

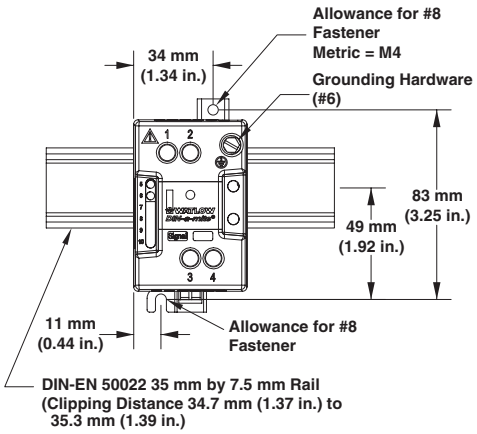
00 = Standard parts

Recommended Semiconductor Fuses and Fuse Kits

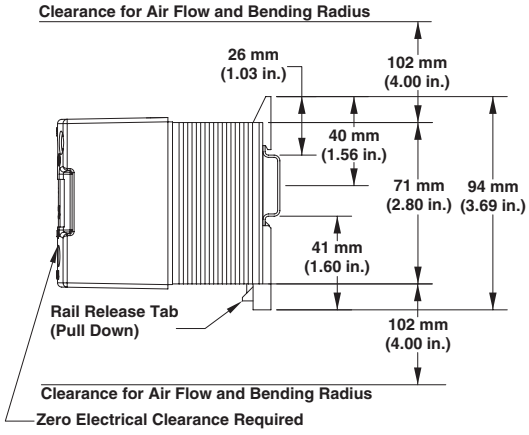
See page 288 for listings and part numbers.

Style A Dimensions

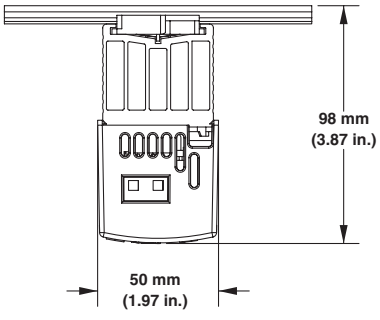
Front



Side



Top



Power Controllers

Style B

Ordering Information

To order, complete the code number on the right with the information below.

DIN-A-MITE **D B - - -**

Style B = Solid state power controller

Phase

1 = 1-phase, 1 controlled leg
2 = 3-phase, 2 controlled legs
3 = 3-phase, 3 controlled legs
8 = 2 independent zones (Input Type C or K)
9 = 3 independent zones (Input Type C or K)

Cooling and Current Rating Per Pole

0 = Natural convection standard DIN-rail or panel mount heatsink

Line and Load Voltage

02 = 24 to 48V~(ac)
24 = 120 to 240V~(ac)
60 = 277 to 600V~(ac)

Input Control Signal

C0 = 4.5 to 32V⎓(dc) contactor
F0 = 4 to 20mA⎓(dc) proportional
K1 = 22 to 26V~(ac) contactor
K2 = 100 to 120V~(ac) contactor
K3 = 200 to 240V~(ac) contactor

Alarm

0 = No alarm
S = Shorted SCR alarm

User Manual

0 = English
1 = German
2 = Spanish
3 = French

Custom Part Numbers

00 = Standard part
XX = Any letter or number, custom options, labeling, etc.

Availability

All combinations available in three working days or less.

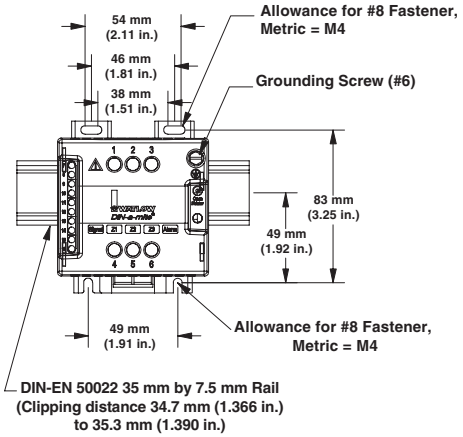
CE approved product. Must use CE filter listed on page 287 for conducted emission.

Recommended Semiconductor Fuses and Fuse Kits

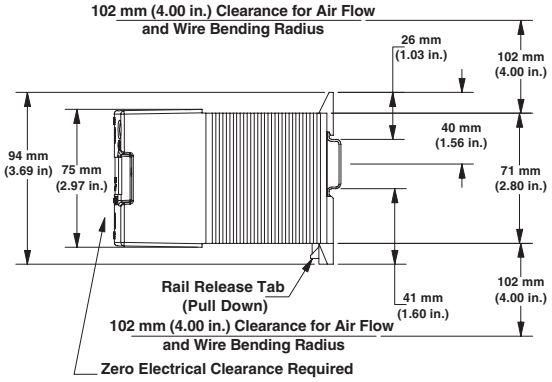
See page 288 for listings and part numbers.

Style B Dimensions

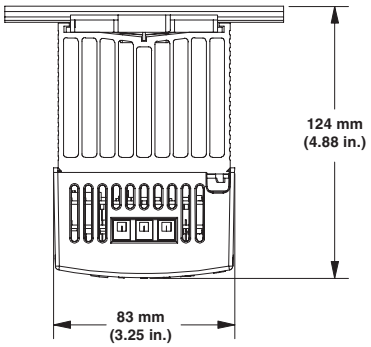
Front



Side



Top



Power Controllers

Style C

Current Rating Table

Phase	Cooling	Current at 50˚C (122˚F)
1	0	55A
1	T	60A
1	(1,2,3)	75A
2, 8	0	40A
2, 8	T	45A
2, 8	(1,2,3)	65A
3, 9	0	30A
3, 9	T	35A
3, 9	(1,2,3)	55A

Availability

All combinations available in three working days or less.

CE approved product. Must use CE filter listed on page 287 for conducted emission.

Ordering Information

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

DIN-A-MITE **D C - - - - -**

Style C = Zero cross solid state power controller in natural and forced air cooled versions

Phase

1 = 1-phase, 1 controlled leg
2 = 3-phase, 2 controlled legs
3 = 3-phase, 3 controlled legs (use with four wire wye)
8 = 2 independent zones (Input Type C, K)
9 = 3 independent zones (Input Type C, K)

Cooling and Current rating Per Leg (see table on left)

0 = Natural convection standard DIN-rail or panel heatsink
1 = Fan cooled 120V~(ac) standard DIN-rail or panel heatsink
2 = Fan cooled 240V~(ac) standard DIN-rail or panel heatsink
3 = Fan cooled 24V⎓(dc) standard DIN-rail or panel heatsink
T = Natural convection through wall or cabinet heatsink (NEMA 4X)

Line and Load Voltage

02 = 24 to 48V~(ac) (Control C, F, K)
24 = 100 to 240V~(ac) (Control C, F, K)
60 = 277 to 600V~(ac) (Control C, F, K)

Input Control Signal

C0 = 4.5 to 32V⎓(dc) contactor
F0 = 4 to 20mA⎓(dc) proportional
K1 = 22 to 26V~(ac) contactor
K2 = 100 to 120V~(ac) contactor
K3 = 200 to 240V~(ac) contactor

Alarm

0 = No alarm
S = Shorted SCR alarm

Language

0 = English
1 = German
2 = Spanish
3 = French

Custom Part Numbers

00 = Standard part
XX = Any letter or number, custom options, labeling, etc.

Recommended Semiconductor Fuses and Fuse Kits

See page 288 for listings and part numbers.

Note: Allow one fuse and one holder per leg fused. Example, a 3-phase, 2-leg DIN-A-MITE requires two fuses and two holders.

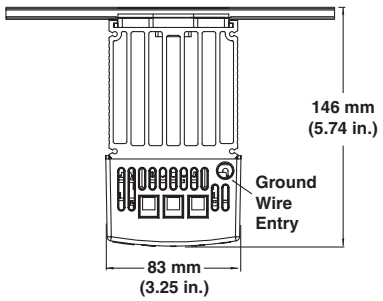
Power Controllers

Style C

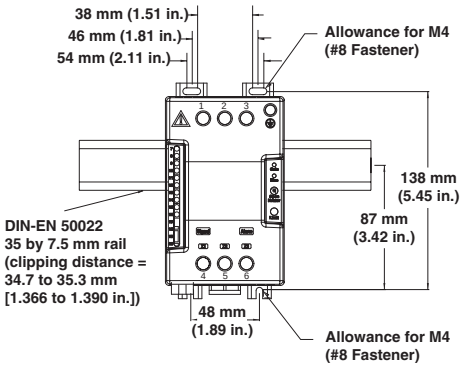
Style C Dimensions

Without Cooling Fan

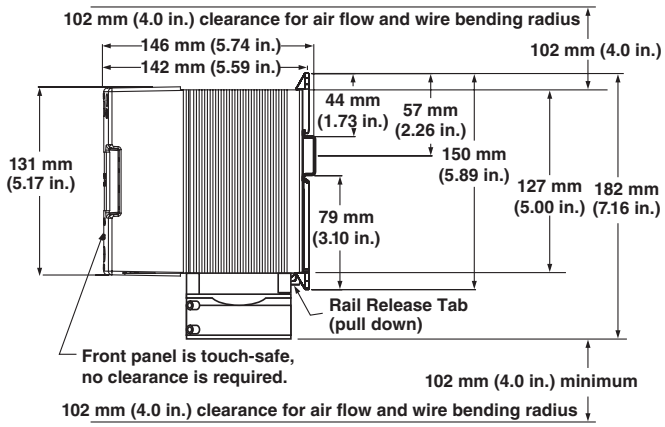
Top



Front



With Cooling Fan



Power Controllers

Style D

Availability

All combinations available in three working days or less.

CE approved product. Must use CE filter listed on page 287 for conducted emission.

Ordering Information

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

D D 1 0 - - -

Style D = Solid state power controller

Phase

1 = 1-phase, 1 controlled leg

Cooling and Current Rating

0 = Natural convection current rating 80A @ 50˚C (122˚F)

Line and Load Voltage

02 = 24 to 48V~(ac)
24 = 100 to 240V~(ac)
48 = 277 to 480V~(ac)
60 = 277 to 600V~(ac)

Input Control Signal

C0 = 4.5 to 32V⎓(dc) contactor
F0 = 4 to 20mA⎓(dc) proportional
K1 = 22 to 26V~(ac) contactor
K2 = 100 to 120V~(ac) contactor
K3 = 200 to 240V~(ac) contactor

Current Sensing or Alarm

0 = No alarm
1 = Load current transformer
S = Shorted SCR alarm

User Manual Language

0 = English
1 = German
2 = Spanish
3 = French

Custom Options

00 = Standard parts

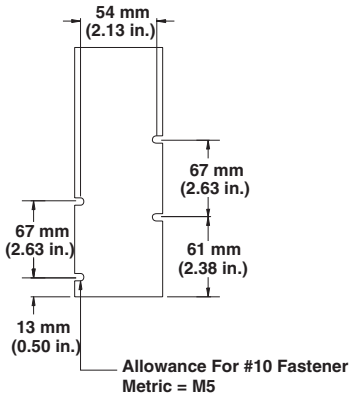
Recommended Semiconductor Fuses

Bussmann part number 170N3437 65 amp® 660V~(ac), Watlow part number 0808-0096-0000 requires two fuses per Style “D” DIN-A-MITE. These should be replaced in pairs.

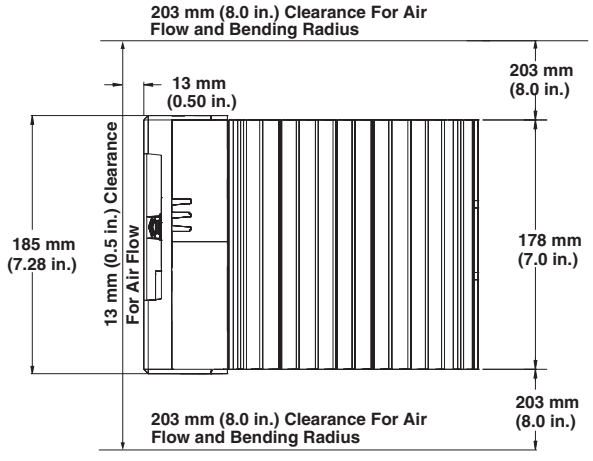
Style D Dimensions

Footprint

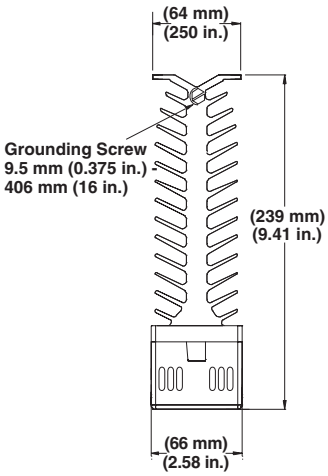
Same mounting footprint as industry standard mercury displacement relays.



Side



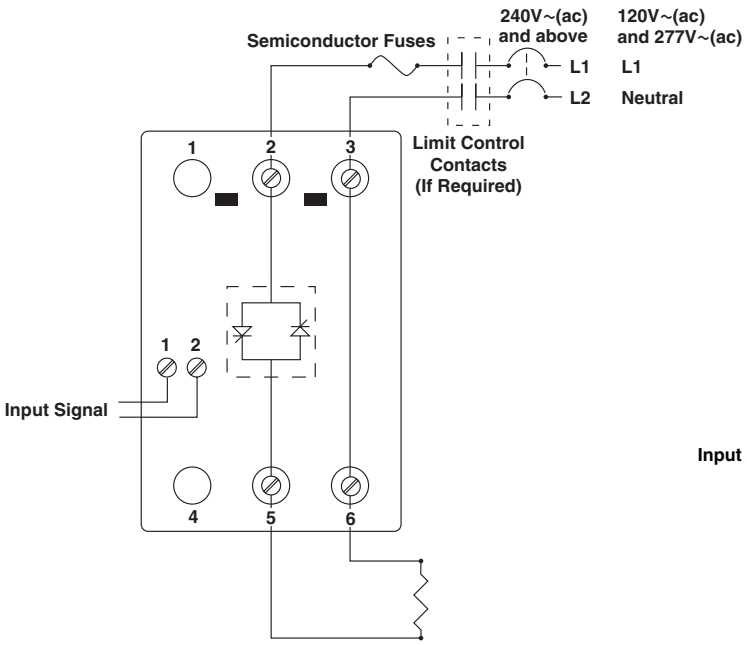
Top



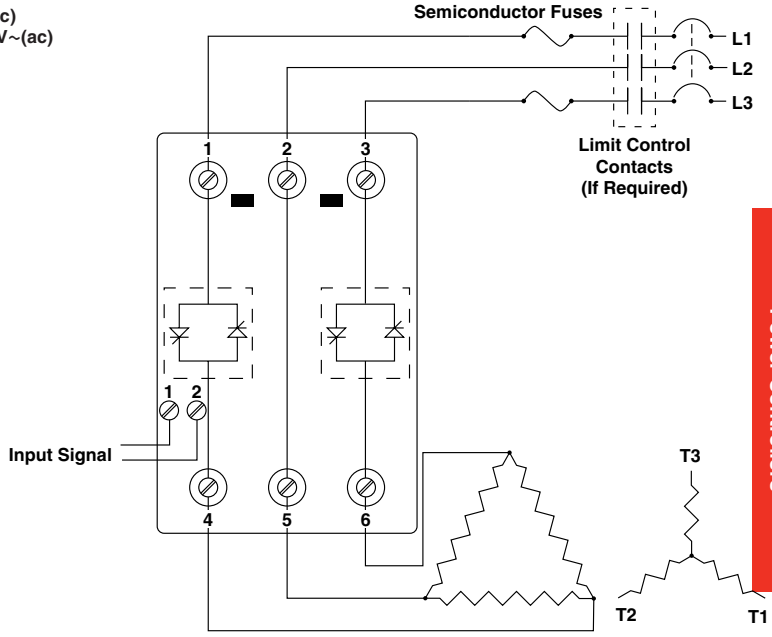
Power Controllers

System Diagram Examples

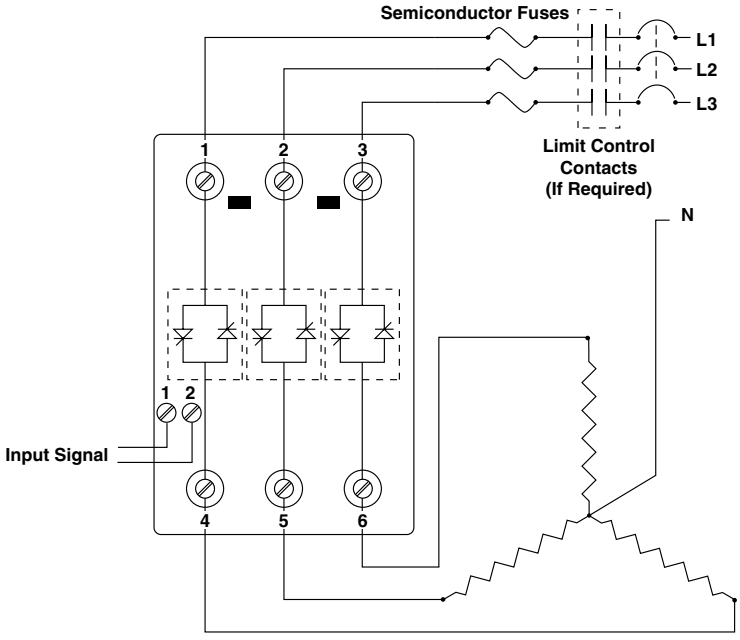
1-Phase Output, Styles A, B and C



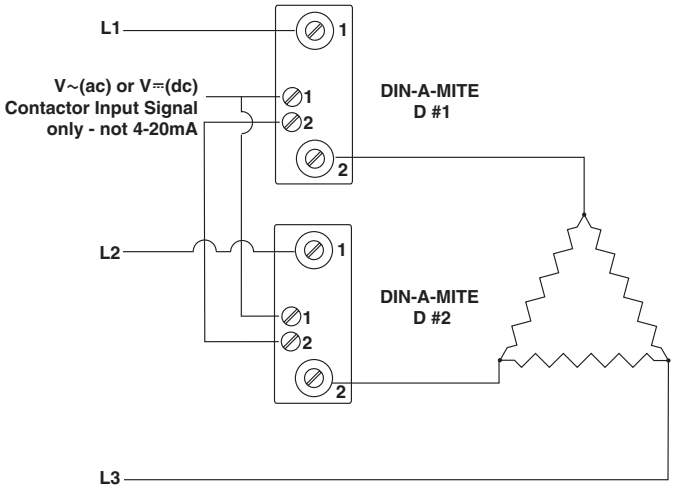
3-Phase, 2-Leg Output, Styles B and C



3-Phase, 3-Leg, 4-Wire Output, Styles B and C



3-Phase, 2-Leg Output, with Two Style D's



Power Controllers

E-SAFE® RELAY

The E-SAFE® mercury-free relay from Watlow provides reliable and accurate power switching for processing applications.

This relay can exceed the performance of typical mercury relays while fitting within the same footprint. The E-SAFE RELAY bridges the gap between mercury displacement relays (MDRs) and solid state relays (SSRs) by providing superior power switching in a non-mercury solution at a lower cost. This mercury-free relay also provides longer contact life and higher performance than typical mechanical relays used in equipment.

The E-SAFE RELAY eliminates mercury, reduces arcing and electrical noise and provides processors with an excellent solution for equipment power switching. The absence of mercury in the E-SAFE RELAY reduces toxic metal hazards in processing environments.

Performance Capabilities

- Up to 40 amps
- 240 V~(ac)

Features and Benefits

High current transient suppression

- High reliability
- Extended contact life
- Low electrical noise
- Out performs mechanical contactors

Compact size

- Fits footprint of definite purpose relays and most 30 to 50 amp mercury relays
- Easily retrofittable

Environmentally safer than mercury contactors

- Eliminates toxic waste (mercury) from the application environment and disposal from failed mercury contactors

Agency approvals

- UL® 508 listed and C-UL® approved

Specifications

- Output rating: from 20A to 40A maximum resistive load at -30 to 55°C (-22 to 130°F)
- Maximum power switching voltage: 208/240V~(ac), three pole
- Coil voltage: 24V~(ac), 120V~(ac) and 220V~(ac)
- Maximum operating ambient temperature: 55°C (130°F)
- Maximum cycle rate: 30 cycles per minute

Control Mode

- Zero cross switching output
- Form A outputs, without arcing
- Cycle rate: 30 cycles per minute, maximum

Input Command Signal

- 24V~(ac) (+10 / -15 percent), 120V~(ac) (+10 / -10 percent) 220V~(ac) (+10 / -15 percent)
- 50/60Hz, less than 9VA

Note: Do not place an R/C snubber (filter) on the E-SAFE RELAY input command signal.

Output Rating

- 20A to 40A max. per pole into a resistive load
- 208/240V~(ac), 50/60Hz, each pole
- Three pole

Operating Life

- 1,000,000 switching cycles at max. rating

Weight/Dimensions

- Weight: 0.560 kg (1.25 lbs.)
- 96.0 mm (3.78 in.) high x 82.3 mm (3.24 in.) wide x 90.2 mm (3.55 in.) deep

Terminals

- Controller input: Compression, accept #22 to 10 (0.2 to 6 mm^2) AWG wire. Torque to 7 in.-lbs (0.8 Nm) max.
- Output: Compression, accept #14 to 6 (2.5 to 16 mm^2) AWG wire. Torque to 35 in.-lbs max. (3.95 Nm)

Power Controllers

E-SAFE RELAY

Specifications Cont.

Operating Environment

- Operating temperature up to -30 to 55°C (-22 to 130°F)
- 5 to 85 percent RH, non-condensing
- Shipping and storage temperature -40 to 85°C (-40 to 185°F)

Mounting

- Definite purpose relay and MDR mounting footprint

Agency Approvals

- UL® 508 listed, C-UL® approved, File #E213822

Ordering Information

To order, complete the code number on the right with the information below.

E S - - -

E-SAFE RELAY = Hybrid zero cross contactor

Amperage

20 = 20 amp
40 = 30 amp

Number of Poles

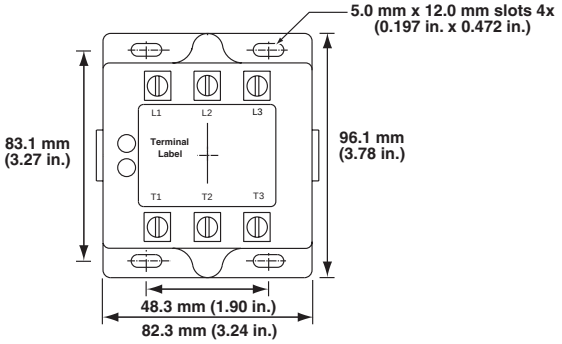
3 = Three pole

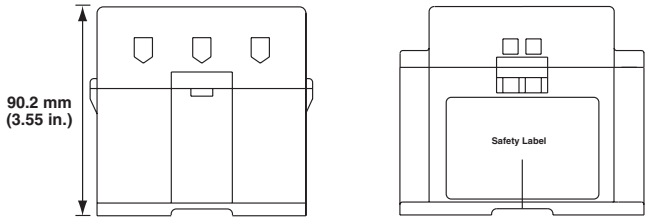
Control Voltage

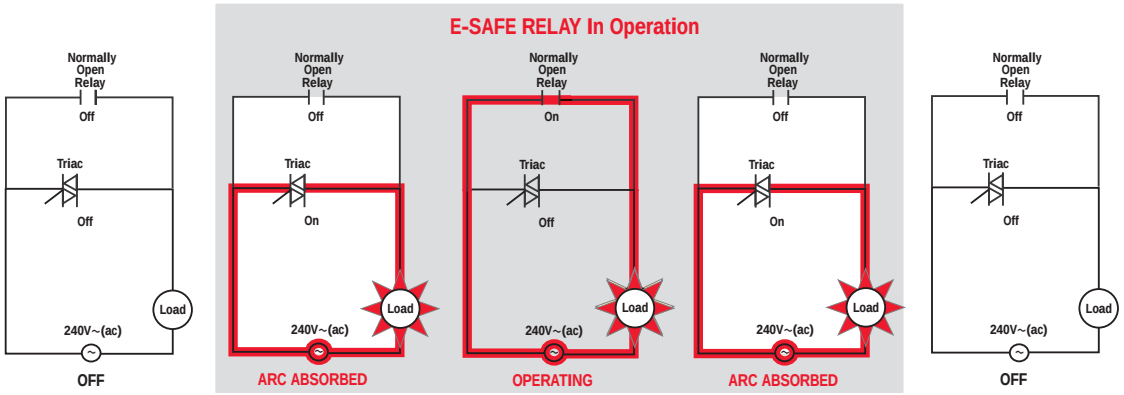
024-AC = 24V~(ac)
120-AC = 120V~(ac)
220-AC = 220V~(ac)

Label Options

00 = Standard product







Power Controllers

SERIES CZR

The SERIES CZR solid state contactor provides a low-cost, highly compact and versatile solid state option for controlling electric heat. With DIN-rail and back panel mounting standard on every controller, the CZR allows for simple and quick installation.

The extensive capabilities of the SERIES CZR include single-phase, 18 to 50 amp zero-cross and random switching up to 600V~(ac) (see output rating curve). The unique integrated design removes the guesswork associated with selecting a proper heatsink and precise terminations for the application.

SERIES CZR contactors are available in V≂(ac/dc) input contactor versions. All configurations are model number dependent and factory selectable.

The SERIES CZR is reliably backed by a two-year warranty from Watlow.

Performance Capabilities

- Output 18 to 50 amps
- Output voltage up to 660V~(ac)

Features and Benefits

DIN-rail or standard panel mount

- Versatile, quick and low-cost installation

Compact size

- Reduces panel space; less cost

Touch-safe terminals

- Increase safety for installer and operator

Mercury-free

- Environmentally safe

Faster switching with solid state

- Saves energy and extends heater life

Agency approvals

- UL® recognized, CSA certified, VDE and CE

Back-to-back SCR design

- Rugged design

Specifications

Control Mode

- Zero-cross or random fired contactor output

Operator Interface

- Command signal input
- Input signal indication LED

Input Command Signal

- Input Type DC1
  - Turn on voltage 4V⎓(dc) max., turn off voltage 1V⎓(dc) min.
  - Input current: dc typically 10mA @ 4V⎓(dc),13mA @ 32V⎓(dc)
- Input Type AC1
  - 90 to 140Vrms, must turn on at 90V~(ac), must turn off at 10V~(ac)
  - Input current: 15mA typical @120V~(ac)
- Input Type AC2
  - 18 to 36V~(ac) input, must turn on at 18V~(ac), must turn off at 10V~(ac)
  - Input current: 10mA typical @ 24V~(ac)

Output Voltage

- 24 volt; 24V~(ac) min. to 280V~(ac) max.
- 480 volt; 48V~(ac) min. to 530V~(ac) max.
- 600 volt; 48V~(ac) min. to 660V~(ac) max. (not available on 18 amp version)
- Off state leakage 1mA at 25°C (77°F) max. for 600V~(ac) models; 10mA at 25°C (77°F) max. for 24 through 480V~(ac) models
- Holding current: 250mA max.

Output Amperage

- See output rating curve. Ratings are into a resistive heater load.

Output Amperage Rating

- License number 130515 for 24 to 50 amp models

Output Terminals

Model	18	24	34
Maximum Surge Current 16.6 mSec	625	250	625
Maximum I^2t for fusing	1,620	260	1,620

Model	42	50
Maximum Surge Current 16.6 mSec	1,000	1,000
Maximum I^2t for fusing	4,150	6,000

Power Controllers

SERIES CZR

Specifications Cont.

Agency Approvals

- Class II construction
- UL® 508 recognition, File #E73741 and CSA File LR 700195
- 73/23/EEC CE Low Voltage Directive
- VDE 0805, registration number 126921
  - License number 136037 for 18 amp models
  - License number 130515 for 24 to 50 amp models

Output Terminals

- Compression type
- For 18 amp models:
  - Maximum wire size 3.0 mm (10 AWG), torque to 0.6 Nm (5.3 in. lbs)
- For 24 to 50 amp models:
  - Maximum wire size 16.0 mm (6 AWG stranded) torque to 1.5-1.7 Nm (13-15 in. lbs)

Operating Environment

- Up to 80°C (176°F). See output rating curves for your application.
- 0 to 90 percent RH, non-condensing
- Insulation only tested to 3,000 meters
- Units are suitable for “Pollution degree 2”
- Cycle time should be less than three seconds

Mounting

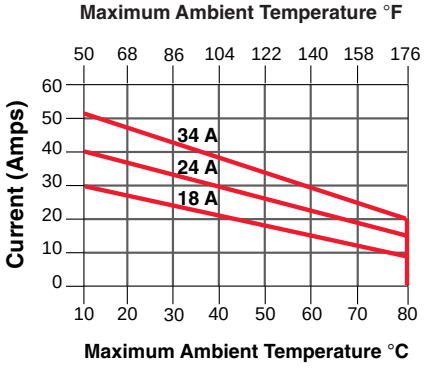
Options include DIN-rail or standard back panel mounting.

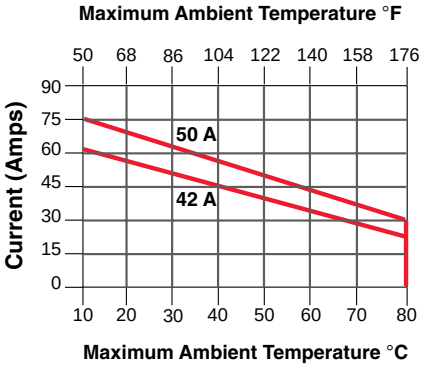
- The DIN-rail specification: DIN EN 50022, 35 mm x 7.5 mm
- Minimum clipping distance: 34.8 mm (1.37 in.)
- Maximum clipping distance: 35.3 mm (1.39 in.)
- Mount cooling fins vertical

Weight/Dimensions

- 260 g (9.2 oz)
- 24 to 50 amp models: 100 mm (3.95 in.) high x 45 mm (1.75 in.) wide x 109 mm (4.3 in.) deep
- 18 amp models: 100 mm (3.95 in.) high x 22.6 mm (0.89 in.) wide x 99 mm (3.9 in.) deep

Output Rating Curves





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

C ___ - A ___ V - ___ 0

Control Mode

R = Random
Z = Zero-cross

Output Amperage

18 = 18 amp (not available with 600V output)
24 = 24 amp
34 = 34 amp
42 = 42 amp
50 = 50 amp

Output Voltage

24 = 24 to 280V~(ac)
48 = 48 to 530V~(ac)
60 = 60 to 660V~(ac) (not available with 18A model)

Input Type (Contactor)

DC1 = 4 to 32V⎓(dc)
AC1 = 90 to 140V~(ac)
AC2 = 18 to 36V~(ac)

Note: Do not use the AC1 and AC2 input type models with temperature control outputs that include an AC snubber filter. This could cause the CZR to stay full on.

Solid State Relays (SSRs)

Lower cost and longer heater life is the main advantage provided by Watlow solid state relays (SSRs). A unique loop-powered firing card permits a very fast time proportional cycle rate of less than one-tenth of a second that allows using higher watt density heating elements and/or increasing heater life. In addition, temperature control accuracy is optimized with this fast cycle card.

Watlow SSRs can be ordered with all the components necessary for hassle-free mounting, including heatsinks, thermal foil and bevel washers along with semiconductor fuses.

Performance Capabilities

- Burst firing, 10 to 75 amps
- Operating environment -25 to 50°C (-13 to 122°F) with proper heatsink
- Can switch up to 575V~(ac)

Features and Benefits

Fast cycle card

- Heater life is increased, temperature control is optimized and higher watt density heaters can be used

Zero cross firing①

- Minimal electrical noise

Back-to-back SCR design

- Will withstand harsh or hostile environments

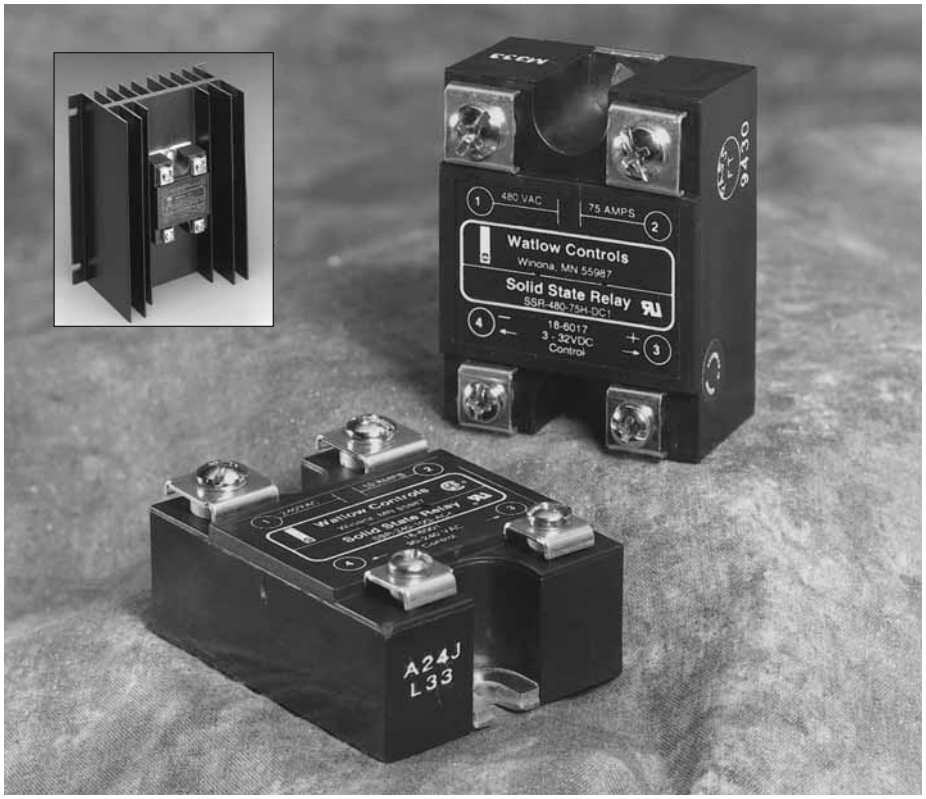
UL® recognized, CSA certified, VDE licensed

- For applications requiring agency approval

Applications

- Injection molding
- Thermoforming
- Extrusion
- Blow molding
- Packaging

① Not available on random fired models.



Specifications

Standard to all SSRs:

Agency Approvals

- UL® 873, File #E151484, E73741
- CSA #LR700195
- VDE 0805 EN60950, File #90995ÜG
- CE 60950

Dielectric Strength

- 4000 Volts RMS

DC Control Input

Voltage range

- 3-32V⎓(dc), model no. dependent
- 4-32V⎓(dc), model no. dependent

Input current

- 4mA @ 5V⎓(dc)

Turn on voltage

- 3V⎓(dc) minimum

Turn off voltage

- 1V⎓(dc) maximum

AC Control Input

Voltage range

- 90-280V~(ac)

Input current

- 2mA max. @ 120V~(ac)

Turn on voltage

- 90V~(ac) minimum

Turn off voltage

- 10V~(ac) maximum

Output (Maximum)

Forward voltage drop

- 1.5V~(ac) typically

Minimum holding current

- 50mA~(ac)

Turn on-off time

- 8.3ms

Storage Temperature

- -40 to 85°C (-40 to 185°F)

SSR Weight

- 0.090 kg (0.21 lb)

Shipping Weight

- 0.045 kg (1.0 lb)

Power Controllers

Solid State Relays (SSRs)

Ordering Information — Order by selecting the code number from the specifications table below.

Code Number	Output Current (Amps)	Output Voltage	Input Control Voltage	Off State Leakage	One Cycle Surge Current Amps	A^2 Sec. I^2t For Fuse	Thermal Resistance	Frequency Range	Output Voltage Range	PIV Rating
SSR-240-10A-DC1	10	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-DC1	25	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-DC1	40	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-DC1	50	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-DC1	75	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-10A-AC1	10	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-AC1	25	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-AC1	40	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-AC1	50	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-AC1	75	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-25A-DC1	25	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-DC1	50	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-DC1	75	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-25A-AC1	25	480V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-AC1	50	480V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-AC1	75	480V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-DC1	25	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-DC1	50	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-DC1	75	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-AC1	25	600V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-AC1	50	600V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-AC1	75	600V~(ac)	90-280V~(ac) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-240-10A-RND	10	240V~(ac)	4-32V⎓(dc) Random	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-50A-RND	50	480V~(ac)	4-32V⎓(dc) Random	10mA	625	1620	0.63°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-480-75A-RND	75	480V~(ac)	4-32V⎓(dc) Random	10mA	1000	4150	0.31°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-100-20A-DC1	20	100V⎓(dc)	3-32V⎓(dc)	0.3mA	NA	NA	1.06°C/W	N/A	0-100V⎓(dc)	N/A

Availability

Stock: Same day shipment

Power Controllers

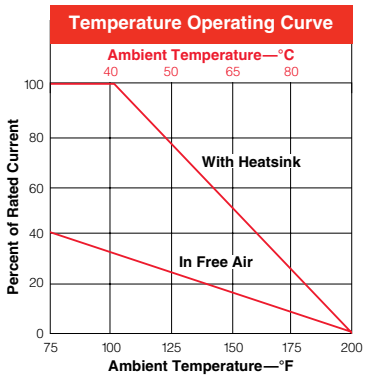
Solid State Relays (SSRs)

Application Hints

Thermal Transfer

A thermal foil is provided with each solid state relay for mounting on the base of the relay to improve heat transfer. In addition, two bevel washers are supplied to provide the proper pressure for the transfer of heat. Use two #8-32 screws, 15.8 mm (0.625 in.) long to secure the relay to the heatsink. See the derating curve, Temperature Operating Curve, for operation without heatsinks.

Note: This rating curve applies only to 10 and 25 amp SSRs. 40 through 75 amp SSRs should not exceed a seven amp load without using a heatsink.



Replacing Contactors or MDRs

Improvements in heater life and control accuracy can be anticipated with solid state relays operated with rapid cycle times as compared to slower operating electromechanical relays or even mercury displacement relays in some applications. When replacing these types of relays with the SSR, it is important to consider two aspects:

1. Heat

Solid state devices require a small voltage to turn on, which is consumed as heat (1.5 watts/amp). This heat must be removed from the device, and is usually accomplished by mounting the relay on heatsinks.

2. Failure Mode

Solid state devices should last for many years when properly protected with voltage and RC suppressors mounted on appropriate heatsinks, and when fused against the high currents caused by electrical shorts.

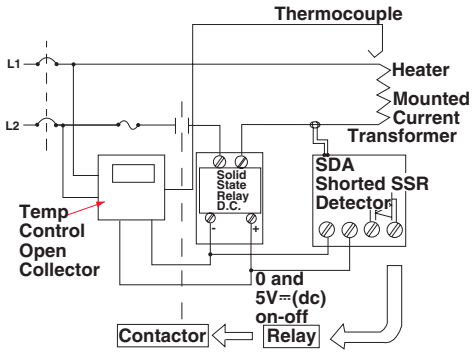
However, if the unit fails, the most probable condition will be a short. Both mechanical relays mentioned above also have a good probability of failing short. In all cases where uncontrolled full power can cause damage, it is recommended that a high limit temperature controller and contactor be used for protection.

System Diagrams

Shorted SSR Alarm—SDA

The most prevalent concern when using solid state relays is the possibility of a relay failing in a shorted condition. With this in mind, Watlow has designed a cost effective “Shorted SSR Alarm” SDA. The device monitors the output (current through the heater) and activates a triac (alarm) if there is no command signal from the temperature controller. The triac can be wired to a bell, or to a normally closed latching relay to remove power to the heater.

Single-Phase—SDA



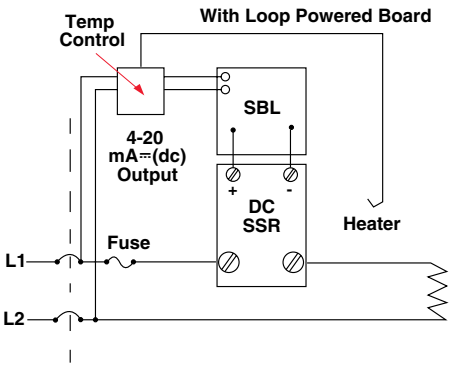
Single-Phase—SBL

4-20mA loop powered firing card for direct mounting on a dc solid state relay. Can be used in three-phase mode with two dc input solid state relays.

Single-Phase—AT and BT

Requires external power switching transformer. Consult factory for part number and voltage required.

SSR Card	Description	Code No.
SBL	Burst firing 4-20mA only loop powered card for dc input relays only	08-5399
SDA	Shorted SSR alarm for dc input relays only	08-5386
AT	Single-phase, phase-angle firing	08-5422
BT	Single-phase variable time base, single cycle, burst firing transformer power. 4-20mA input	08-5406

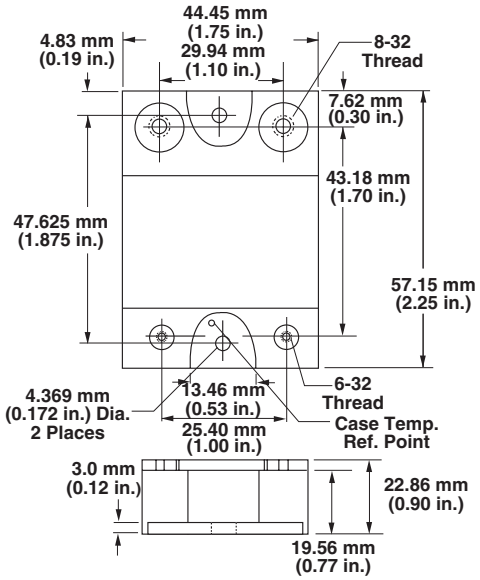


Power Controllers

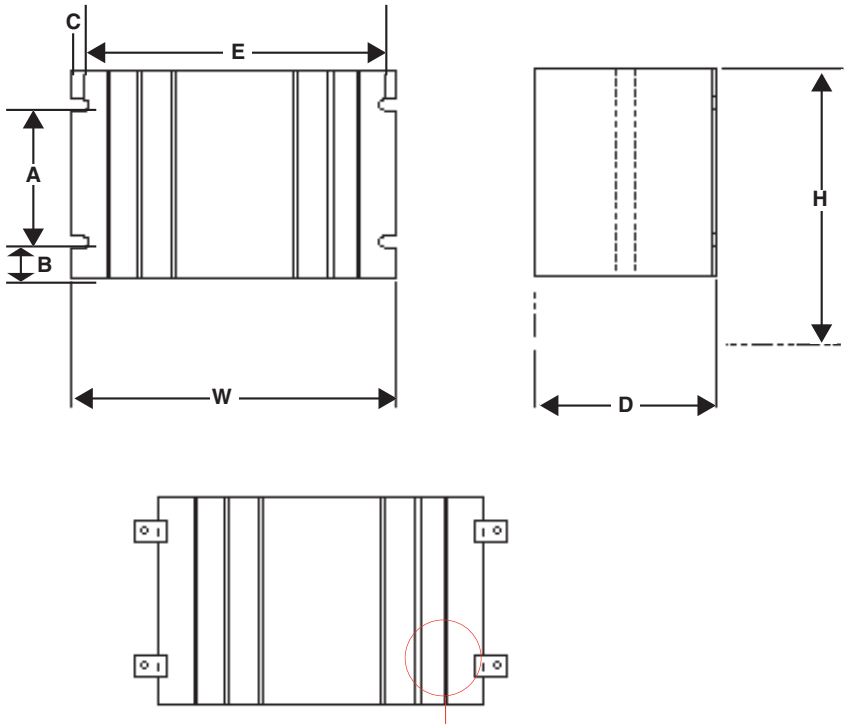
Solid State Relays (SSRs)

Dimensions

Solid State Relay



Heatsinks



Note: The 50 amp, 1-phase width mounting dimension has four mounting clips instead of the ½ round cutouts.

Heatsinks – 1-Phase

Amps	Maximum Overall Dimensions						Mounting Dimensions								Fan Cooled	Code Number
	Height (H)		Width (W)		Depth (D)		A		B		C		E			
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)		
10	100	(4.00)	115	(4.50)	25	(1.03)	75	(3.00)	12	(0.50)	4	(0.15)	105	(4.20)	No	**HS-10**
25	75	(3.00)	120	(4.75)	65	(2.60)	115	(2.00)	12	(0.50)	4	(0.15)	115	(4.45)	No	**HS-25**
40	140	(5.50)	120	(4.75)	65	(2.60)	115	(4.50)	12	(0.50)	4	(0.15)	115	(4.45)	No	**HS-40**
50	230	(9.00)	125	(5.00)	90	(3.50)	115	(7.00)	N/A	N/A	N/A	N/A	115	(5.90)	No	**HS-50**
75	190	(7.50)	125	(5.00)	140	(5.50)	175	(7.00)	25	(1.00)	4	(0.15)	120	(4.70)	Yes[2]	**HS-75-1**
75	190	(7.50)	125	(5.00)	140	(5.50)	175	(7.00)	25	(1.00)	4	(0.15)	120	(4.70)	Yes[3]	**HS-75-2**

[2] Heatsink includes fan; requires customer to supply and wire 120V~(ac) to the fan.
[3] Heatsink includes fan; requires customer to supply and wire 240V~(ac) to the fan.

Power Controllers

Problem Solvers

Watlow Solutions To Common Power Controller Problems

Power controller replacement intervals can be lengthened or problems eliminated by using the optimum power controller for the application. Check the list below to see if Watlow power controllers can improve your process.

Problem	Power Control Solution
Premature heater failure	• Stabilize heater element temperature and reduce thermal stress by using a solid state power control along with a PID temperature controller to reduce the temperature control cycle time
Excessive contactor failure	• Replace electromechanical contactors with solid state relays. Use E-SAFE® RELAY for long cycle times, solid state relays for short cycle times and PID control
Wasted power	• Reduce temperature overshoot and power consumption by smoothing out temperature/heating cycles with solid state power control and PID temperature control
Unsafe panel wiring	• The DIN-A-MITE® power controllers, when properly wired are totally safe from finger and palm electrical shock
Environmental concerns about MDRs	• Replace with solid state power controller or E-SAFE RELAY. The DIN-A-MITE has the same footprint as many MDRs
Excessive EMI causing problems in control circuits	• Correct wire routing for minimum EMI pick-up; change from electromechanical and mercury relays, and/or phase-angle fired solid state devices to zero cross (burst firing) solid state power control

Case History

E-SAFE® RELAY Delivers Lower Costs and Increased Productivity

Problem:

A plastics molder utilized mechanical relays (contactors) in the power control circuits of their 100-ton injection molding machine. The relays had to be replaced every 250,000 cycles and each change required a two hour shutdown of the production line. The manufacturer also had to dispose of the environmentally hazardous mercury from the failed contactors.

Solution:

To avoid these frequent shutdowns, Watlow E-SAFE RELAYs were installed. E-SAFE RELAYs were priced lower than the contactors, while also offering longer life. The E-SAFE RELAY provided high performance in a non-mercury offering and eliminated the toxic waste from failed mercury contactors.

After millions of cycles of operation, the customer informed Watlow that the E-SAFE RELAYs were still performing like new and had saved them thousands of dollars in replacement costs. In addition, had they continued to use the contactors, they would have experienced 24 production shutdowns and 48 hours of lost production time.

Barrel Heaters

Cast-In Heat/Cool

Fast production cycles and consistent operating temperatures are essential for plastics processing. Extruding specially engineered resins requires not only efficient thermal heating of the barrel upon startup, but also cooling to remove shear heat generated from screw rotation - all without degrading the material being processed.

Heat/cool band heaters from Watlow are made of cast aluminum, providing high thermal conductivity and extremely uniform surface temperatures for extrusion barrels. For high-volume quantities, Watlow utilizes permanent molds to ensure exacting precision batch-to-batch. These molds are constructed of steel or cast iron and provide a superior exterior finish. Pressure formed sand molds are used for small quantity runs and utilize wood patterns. This process provides a more economical approach due to lower mold costs as well as providing shorter initial lead times.

The heat/cool band heater consists of tubular heaters cast in with cooling tubes. These tubes are placed in proximity to the heating elements to produce an efficient heat/cool design.

Heat/cool bands from Watlow are contamination and corrosion resistant and can withstand high temperature and pressures in harsh environments with years of trouble-free service.

Features and Benefits

- **Optimized cooling tubes** allow instant cooling, which improves efficiency of extruder barrel plastics processing.
- **Delivery** is available on many replacement OEM designs in four weeks and non-standard designs are available in five weeks.
- **Watlow's complete foundry capabilities** assure precise and uniform placement of the element in the casting.
- **UL® component recognition** on cast-in heaters is available exclusively from Watlow.

Application

- Extruder barrels for plastics processing

Other Options

- Holes, cutouts, slots
- Thermowells
- Thermocouple fittings
- Cooling tube fittings
- Three-phase heater configuration
- Incoloy® cooling tube
- Self-draining cooling tube construction

Performance Capabilities

- Operating temperatures up to 370°C (700°F) with 319 or 356 aluminum
- Maximum watt densities to 9 W/cm² (60 W/in²) on the tubular sheath

Incoloy® is a registered trademark of the Special Metals Corporation.

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

Barrel Heaters

Cast-In Heat/Cool Barrel Heaters

Design Parameters

Cooling Tube Sizes

Stainless steel: 9.5 mm (0.375 in.) O.D. x 0.89 mm (0.035 in.) wall (standard)

Stainless steel: 12.7 mm (0.5 in.) O.D. x 1.24 mm (0.049 in.) wall (standard)

Dimensions

Minimum inside diameter: 76 mm (3 in.)

Maximum inside diameter: 457 mm (18 in.)

Minimum width: 76 mm (3 in.)
Maximum width: 457 mm (18 in.)

Finish and Fit

Bore finish: 125 RMS (standard)

Standard gap between heaters: 6.35 mm (0.25 in.)

Clamping

Straps are typically supplied to hold heaters against the barrel. 20 gauge Type 430 stainless steel straps are provided standard with 6.35 mm to 508 mm (0.25 in. to 20 in.) bolts and barrel nuts. Standard widths are 22.23 mm (8.75 in.) and 15.87 mm (0.625 in.). Clamping utilizing bolts can be provided based on customer specifications.

Cast-in Heater Thickness (inches)

Casting Thickness	Heat/Cool Heater Dia./ Cooling Tube Dia.	Heat Only (Heater Dia.)	Cool Only (Tube Dia.)
1	0.260 / 0.375	0.315	0.375
1.25	0.315 / .0375	0.315	0.375
1.5	0.315 / 0.5	0.315 or 0.430	0.5
1.75	0.430 / 0.5	0.315 or 0.430	0.5

Quick Ship

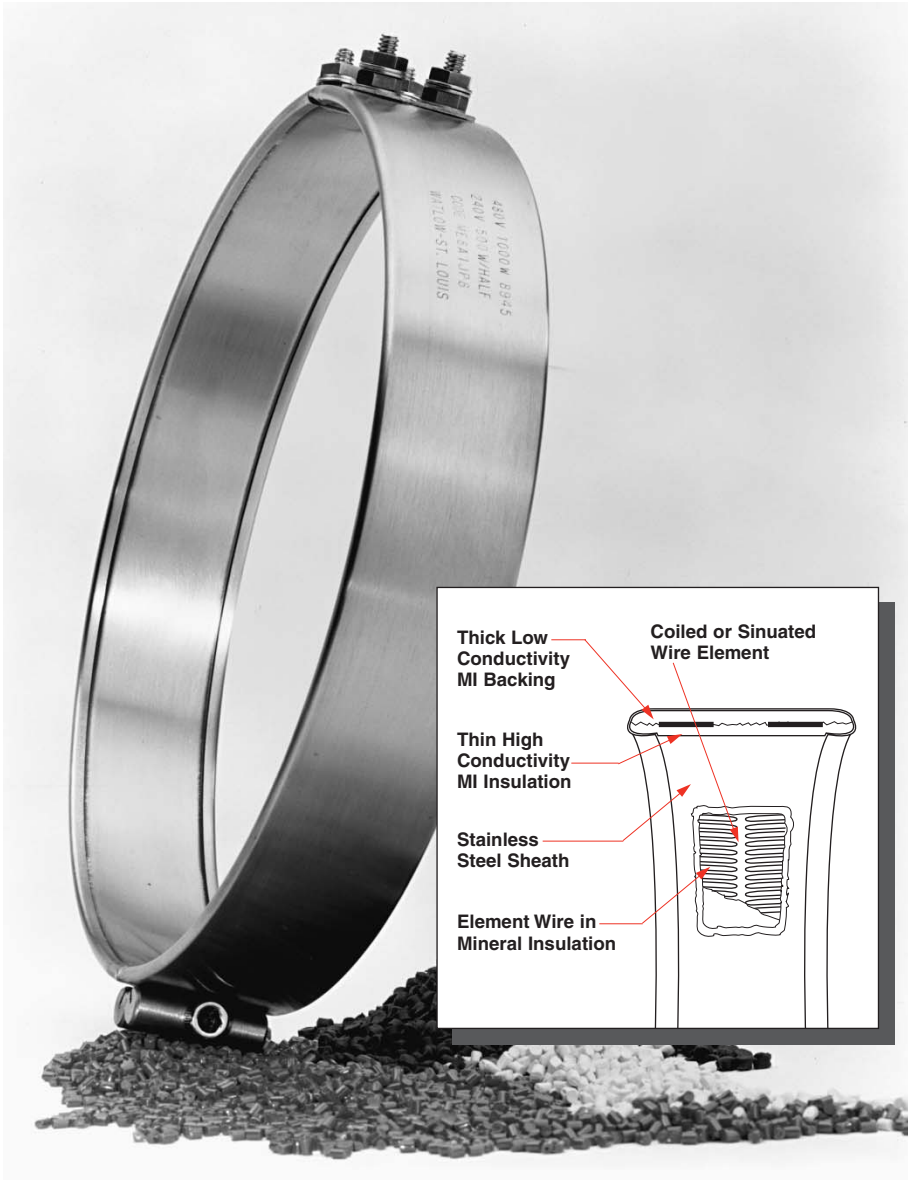
- *Same day shipment on all stock heaters with post terminals or Type B leads.*

Barrel Heaters

MI Band

The MI Band is a high performance heater. Its performance and name are derived from Watlow's exclusive mineral insulation—a material that has much higher thermal conductivity than the mica and hard ceramic insulators used in conventional heaters.

A thin layer of the "high" thermal conductive MI material is used to electrically insulate the element wire from the inside diameter of the heater sheath. A thicker, "low" thermal conductivity layer backs up the element wire, directing the heat inward towards the part that is being heated. The result is more efficient heat transfer...a performance solution that lowers element wire temperatures and increases heater life.



Performance Capabilities

- Heater operating temperatures to 760°C (1400°F)
- Watt densities to 35.6 W/cm² (230 W/in²) available on smaller diameter bands
- Watt densities to 15.5 W/cm² (100 W/in²) available on large diameter barrel bands

Features and Benefits

- **Operating temperatures to 760°C (1400°F)** make it possible to safely melt even the newest resins, like Peek™, Teflon®, Ultem® and Zytel®.
- **Higher watt densities than any other barrel heater** contribute to faster heat-up and through-put to increase productivity.
- **High thermal conductivity of MI and low mass construction** give almost instant response to temperature control. This performance solution eliminates thermal lag and temperature overshoot associated with ceramic knuckle heaters.
- **Stainless steel cover as well as side fold design** resist contamination by overflow of plastic or other free-flowing materials. Side folds turn to the inside diameter rather than the outside diameter.
- **Permanently attached clamp bars** eliminate cumbersome clamping straps, which makes installation easier.

Applications

- Extrusion barrels

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Ultem® is a registered trademark of General Electric.

Peek™ is a trademark of Victrex plc.

Barrel Heaters

MI Band

Applications and Technical Data

The Physical Limitations of Variations table below shows the availability of widths, inside diameters and terminations for Watlow's MI Band heaters. To make sure the available terminations will meet your application needs, refer to the illustrations of termination types on page 209.

If you need to exceed the limitations shown, contact your Watlow sales engineer or authorized distributor.

Physical Limitations of Variations

Widths		I.D. Available—mm (inches)										Available Terminations
		1 pc. Construction				Expandable				2 pc. Construction		
		Minimum		Maximum		Minimum		Maximum		Minimum		Maximum		
mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	
25.4	(1)	25.4	(1)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	255.6	(14)	All
34.9	(1⅜)	25.4	(1)	76.2	(3)	76.2	(3)	(152.4)	(6)	76.2	(3)	152.4	(6)	All
38.1	(1½)	25.4	(1)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All
50.8	(2)	31.8	(1¼)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All
63.5	(2½)	31.8	(1¼)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All
76.2	(3)	31.8	(1¼)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All
88.9	(3½)	44.5	(1¾)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All - Except 90° "B" Leads
101.6	(4)	50.8	(2)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All
114.3	(4½)	57.2	(2¼)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All
127.0	(5)	63.5	(2½)	355.6	(14)	76.2	(3)	(355.6)	(14)	76.2	(3)	711.2	(28)	All - Except 90° "B" Leads
139.7	(5½)	69.85	(2¾)	355.6	(14)	76.2	(3)	(355.6)	(14)	101.6	(4)	711.2	(28)	Post Terminals, SLE
152.4	(6)	76.2	(3)	355.6	(14)	76.2	(3)	(355.6)	(14)	101.6	(4)	711.2	(28)	All
177.8	(7)	N/A		N/A		101.6	(4)	(355.6)	(14)	N/A		N/A		Post Terminals

General Limitations:

- Maximum width of 25 mm (1 in.) diameter heater is 38 mm (1.5 in.) wide
- Maximum heater width = 3x heater diameter
- Minimum I.D. for Type B, C, E and H leads = 25 mm (1 in.)
- Minimum I.D. for Type B—90 degree leads = 28 mm (1.125 in.)
- Maximum lead amps: 8.5A per pair
- Maximum amps (post terminals): 30A per pair

Standard Gaps:

- ≤ 76.2 mm (3 in.) = 3 mm (0.125 in.) nominal
- 76.2 mm (3 in.) ≤ 152.4 mm (6 in.) = 3 mm (0.25 in.) nominal ± 3 mm (0.125 in.)
- 152.4 mm (6 in.) ≤ 355.6 mm (14 in.) = 9.52 mm (0.375 in.) nominal ± 3 mm (0.125 in.)
- > 355.6 mm (14 in.) = 12.7 mm (0.5 in.) nominal ± 6.3 mm (0.25 in.)

Barrel Heaters

MI Band

Applications and Technical Data

Calculating Watt Density

Watt density is the amount of wattage per square inch of heated area. To determine watt density, divide the total wattage by the heated area.

$$\text{Watt Density} = \frac{\text{Total Watts}}{\text{Heated Area}}$$

To apply this equation we must define the term "heated area."

Heated area is the total contact surface of the heater less areas of no heat that are found around terminals, mounting holes, etc.

Heated Area =
Total Contact Area - No-Heat Area

To calculate the heated area:

1. Locate the **no-heat factor** from the chart below that corresponds to the type of heater being considered.
2. To use the formula below, insert the no heat factors, diameter and width (in inches).

Heated Area =
(3.14 x Diameter - No-Heat Factor) x Width

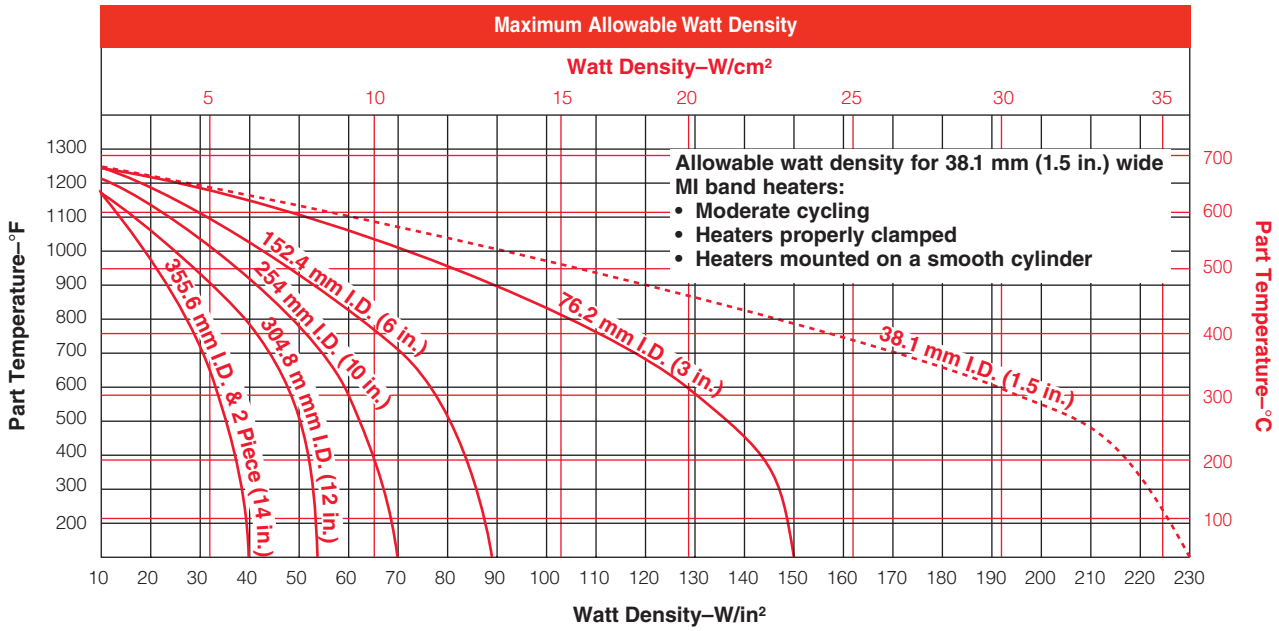
Type	Factor in.
1 pc. lead unit Type B, C, H, E or 90°B	1.37
1 pc. post terminal	1.60
2 pc. expandable post term	3.18
2 pc. expandable lead unit	3.00

Maximum Allowable Watt Density

The following derating factors apply to the Maximum Allowable Watt Density chart, which are shown in both metric and inch base for convenience. Please review these factors and the chart to determine the correct watt density curve for your application.

Derating Factors:

- For units over 51 mm (2 in.) in width, multiply watt density by 0.8.
- In applications where unusual operating conditions are present, such as irregular mounting surfaces, contact the Watlow factory in St. Louis, Missouri, for watt density limitations.
- For two-piece units used in vertical applications, refer to Clamping Matrix Application Guide, page 208.
- For applications where insulating blankets are used, multiply W/cm² (W/in²)by 0.75.



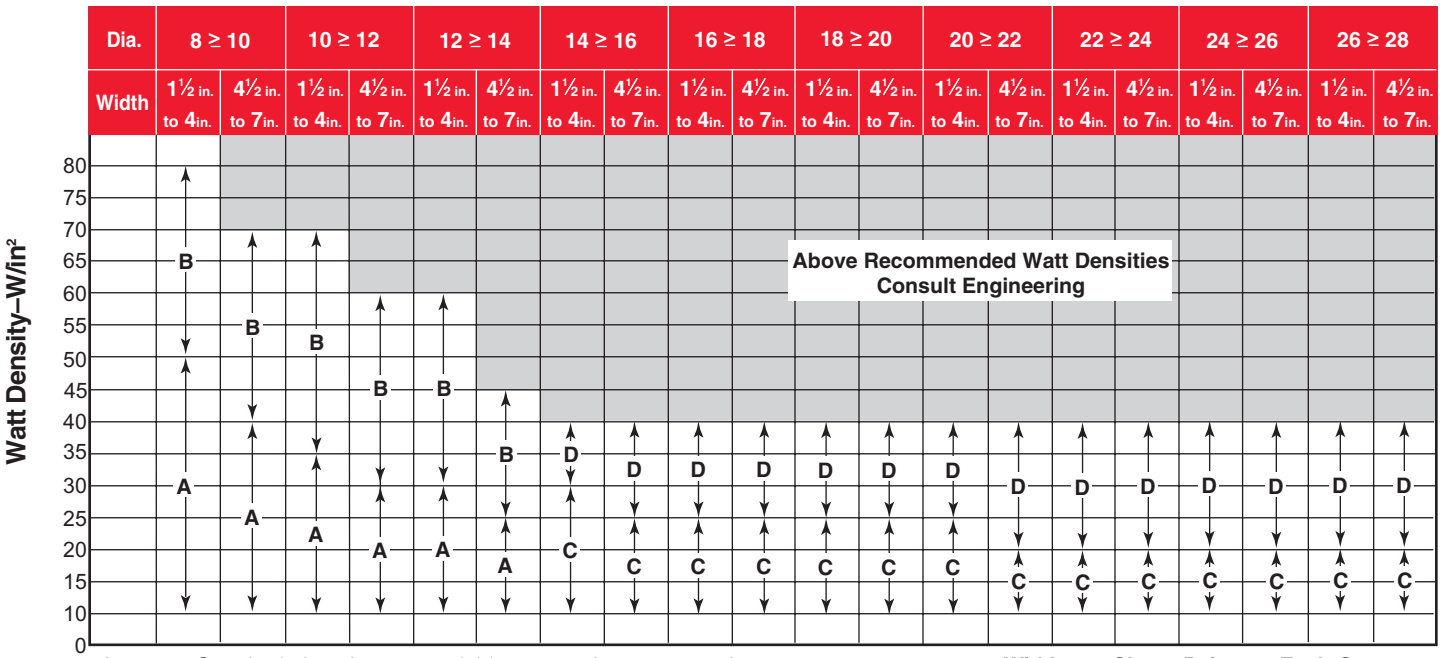
Barrel Heaters

MI Band

Applications and Technical Data

- Review the Watt Density chart on page 207 to ensure that the application does not exceed the maximum watt density at operating temperature after applying derating factors.
- Locate clamping guideline for unit diameter, width and watt density.
- Description of guideline letters are at lower left of page.
- **Note:** Upward arrows are up to and not including specified watt density. Downward arrows are greater than or equal to specified watt density.

MI Barrel Clamping Matrix Application Guide



A = Standard clamping, expandable or one piece construction
B = Spring clamps, expandable or one piece construction
C = Spring clamps, at one gap, welded barrel nuts at other gap
D = Spring clamps, spring clamps at both gaps

Width	Clamp Points at Each Gap
≥ 127 mm (5 in.)	3
≥ 76.2 mm (3 in.)	2
< 76.2 mm (3 in.)	1

MI Installation Procedures - For Standard Product

1. Install heaters over a clean surface.
2. After installing the unit, begin to tighten the clamp screw. The standard clamping screw is 6.35 mm-508 x 31.75 mm (0.25 in.-20 x 1.25 in.), nickel plated allen head cap screw. Begin tightening the clamp bars. If the clamp bars appear not to have seated, tap the clamp bars with a small hammer to insure the bars are well seated in the angle formed by the 60 degree bent tab and the heater.
3. If the bar has multiple screws, alternately tighten the screws at 10 lb in. as you would the lug nuts on a car wheel to insure even loading.
4. Torque all screws to approximately 80 lb in. (9-N-M).
5. When installing terminal lugs, torque the top nuts to 15-20 lb in. or 2.26 N meters.

Barrel Heaters

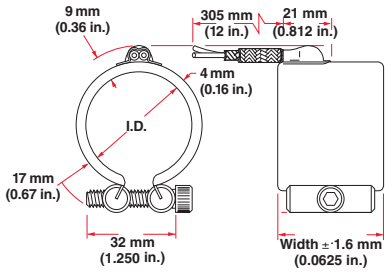
MI Band

Termination Variations

Leads Type B, Type B—90 degree Rotation,Type B—180 degree Rotation or Type C: Two fiberglass-insulated lead wires exit in a single metal braid for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than braid. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **type** and **length.**

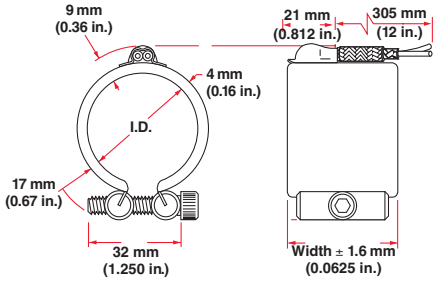
Type B

Stock



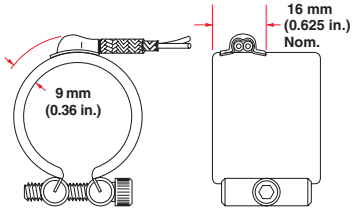
Type B—180 Degree Rotation

Stock



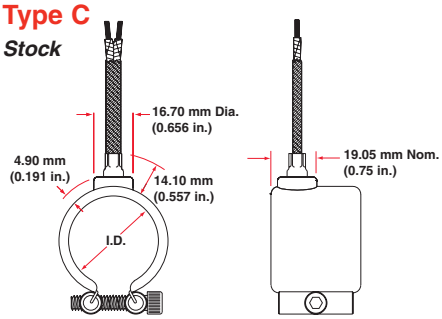
Type B—90 Degree Rotation

Non-Stock



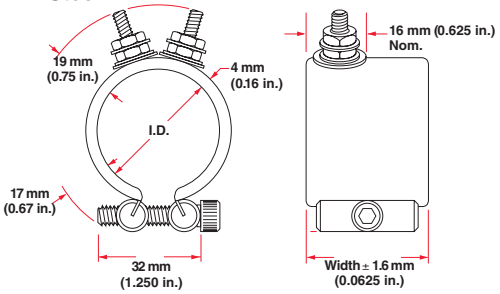
Type C

Stock



Post Terminals

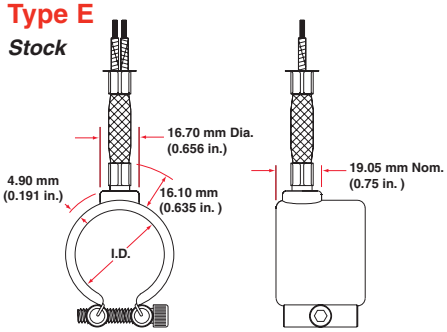
Stock



Post terminals provide optimum connections. Screw thread is 10-24. To order, specify **post terminals**.

Type E

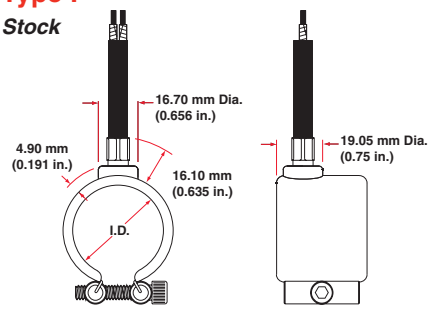
Stock



Type E: Loose metal braid encloses two fiberglass leads for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than braid. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **Type E** and **length.**

Type F

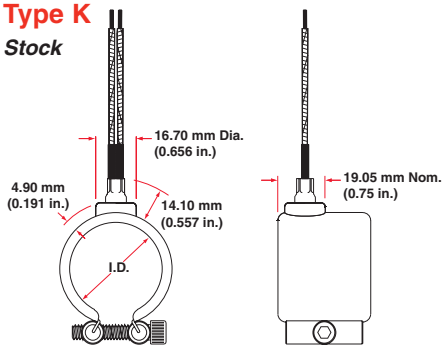
Stock



Type F: Loose fiberglass sleeving encloses two fiberglass leads for additional insulation protection where high temperature or minor abrasion is present. Leads are 51 mm (2 in.) longer than the sleeving. To order, specify **Type F** and **length**.

Type K

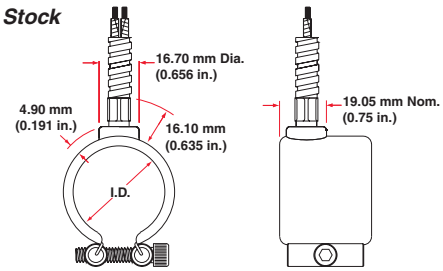
Stock



Type K: Flexible lead wires exit vertically from the heater. These leads can be bent adjacent to the heater for a quick and easy connection. To order, specify **Type K** and **length**.

Type H

Stock

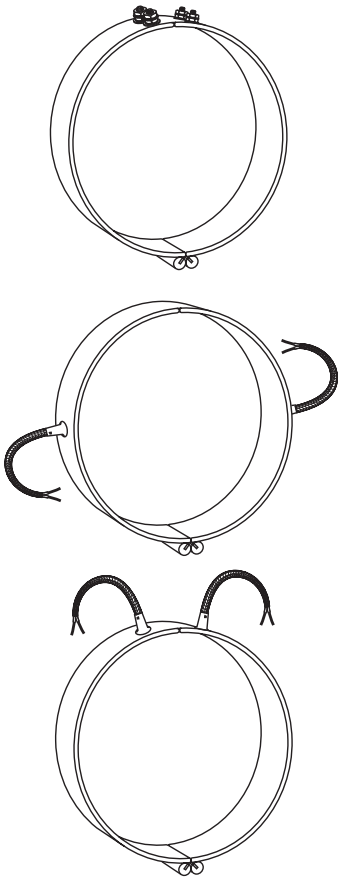


Type H: A flexible steel hose encloses the leads for maximum abrasion protection. Leads are 51 mm (2 in.) longer than hose. Shipped with 305 mm (12 in.) leads, unless longer length is specified. To order, specify **Type H** and **length.**

Barrel Heaters

MI Band

Variations



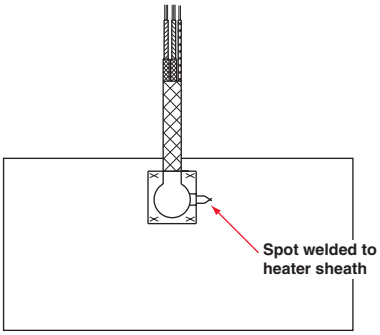
38 mm (1.5 in.) wide and greater

Lead Wire

Heaters rated at less than 250V~(ac) use UL® approved lead insulation for operations to 250°C (480°F) as standard. Lead insulation UL® rated for operation to 450°C (840°F) is available for high temperature applications where the leads are shrouded or enclosed with the heater. These leads are available in any of the Type B with loose braid as well as Types E, F and H lead configurations. All heaters rated at more than 250V~(ac) use this wire. When ordering, specify **450˚C (850°F) wire.**

Thermocouple

ASTM Type J or K internal thermocouples are available on lead Type B with loose braid. The thermocouple junction, which is welded inside the lead cap or spot-welded to heater sheath, provides a signal for measuring relative heater temperature.

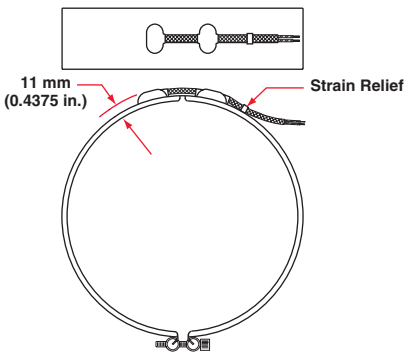


Expandable Heaters With and Without Leads

Expandable heaters are two-piece units with a common top metal that allows the heater to expand open to the full diameter of the barrel. On expandable bands, each half will be one half of the total wattage. Plus, on both expandable and two-piece bands, each half will be rated at full operating voltage, unless otherwise specified.

MI Barrel heaters 38 mm (1.5 in.) wide or greater will have post terminals located next to the expansion joint. Leads may be located anywhere along the circumference except near the gap and at the expansion joint. Two sets of leads are required.

On 25 mm (1 in.) wide MI Barrel heaters, post terminals will be located 90 degrees from the expansion joint. Leads may be located anywhere along the circumference except near the gap and at the expansion joint. Two sets of leads are required. To order, specify **expandable.**



Type SLE

Two fiberglass lead wires exit a single tightly woven metal braid at right angle on the expandable construction verses two sets of leads. Minimum diameter capabilities is 100 mm (4 in.). Minimum width capabilities is 38 mm (1.5 in.). To order, specify **Type SLE** and **length.**

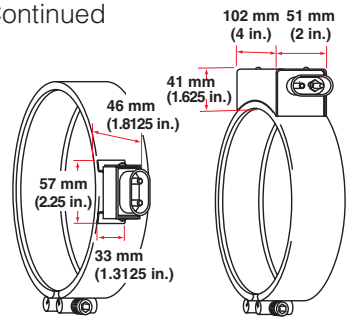
UL® is a registered trademark of Underwriter's Laboratories, Inc.

Barrel Heaters

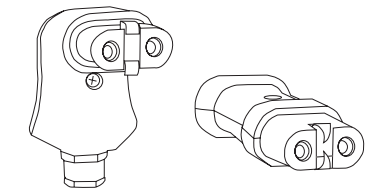
MI Band

Variations

Continued



Vertical **Horizontal**



Right Angle **Straight**

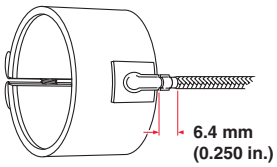
Code# N6027AF049 **Code# N6027ZZ028**

High Temperature "Quick Disconnect" European Style Plugs

These plugs provide the simplest and safest way to apply power to barrel heaters. The combination of high temperature male and female quick disconnect plug assemblies eliminates all live exposed terminals and electrical wiring that can be a potential hazard to employees or machine. Maximum 15 amps at 240V~(ac), maximum volts 240. To order, specify **vertical** or **horizontal** European Plug.

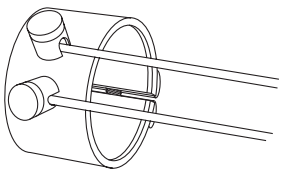
High Temperature "Quick Disconnect" European Style Female Adapters

Available as an accessory item that must be used in conjunction with high temperature "quick disconnect" European Style Plugs. To order, specify code number **N2027AF049** or **N6027ZZ028** and quantity.



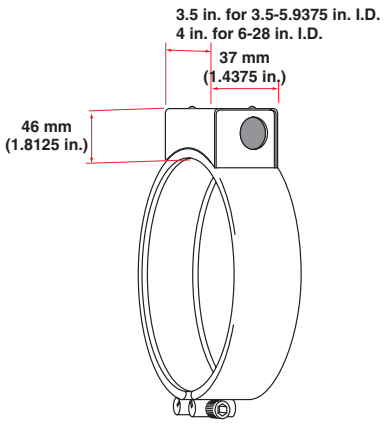
Heavy Duty Strain Relief

Heavy duty strain relief is recommended for applications where there is great stress or continued flexing of the leads. The strain relief is available on Type B, Type B—90 degree and Type B—180 degree leads only. To order, specify **heavy duty strain relief.**



Ceramic Terminal Cover

Ceramic covers, with openings for leads, are screwed on to post terminals, providing a convenient, economical insulator. To order, specify code number **Z-4918** and **quantity.**



Metallic Terminal Box

Metallic terminal boxes are available from stock on 89 mm x 38 mm (3.5 in. inside diameter x 1.5 in. wide) or larger heaters. Terminal boxes, which attach directly to the heater, act as a safety feature by covering the terminals. Conduit may be attached to the box through 22 mm (0.875 in.) diameter holes in the ends of the box. Two piece heaters require two boxes. To order, specify **terminal box.**

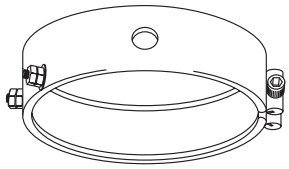
Oversized terminal boxes are available on heaters 51 mm (2 in.) and wider. Consult a Watlow representative.

Barrel Heaters

MI Band

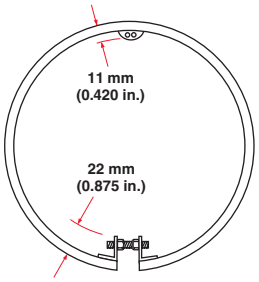
Variations

Continued



MI Barrel Heater With Holes

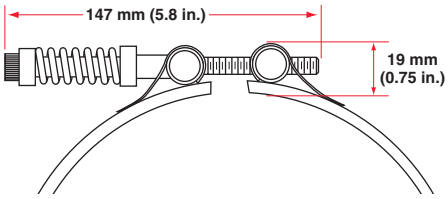
MI Barrel heaters with holes are available on all widths except 25.4 mm (1 in.) wide. Consult the Watlow factory in St. Louis, Missouri for hole sizes and location restraints. To order, specify **hole size** and **location.** 76.2 mm (3 in.) inside diameter minimum.



Outside Diameter Heater

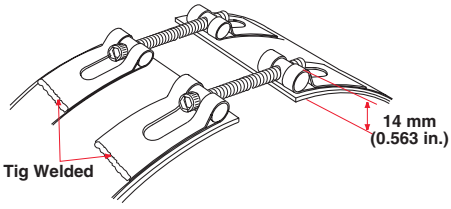
Two fiberglass insulated lead wires rated to 450°C (840°F) exit a metal braid 180 degrees opposite from gap, Type B outside diameter designed and constructed to mate with inside diameter of cylinders. To order, specify **outside diameter** heater. Note that 76.2 mm (3 in.) is the minimum cylinder I.D.

Clamping Variations



Tig Welded Barrel Nuts With Spring Loaded Clamping

Welded barrel nuts with spring loaded clamping are used during start-up to maintain a tight heater fit on large barrels. This clamping variation is standard for all MI Barrel heaters that are greater than 355 mm (14 in.) in diameter and 38 mm (1.5 in.) or greater in width. For smaller diameter heaters, this is an option and must be ordered separately. To order, specify **spring loaded clamping.**

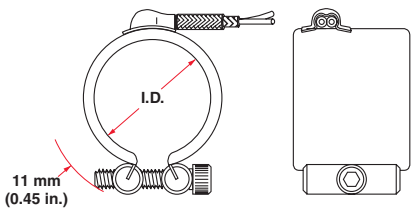


Tig Welded Barrel Nuts

An ideal way to provide access for instrumentation is to specify an oversized gap between the heater ends. If the clamp bar screw interferes with the positioning of the instrumentation device, welded barrel nuts are recommended. To order, specify **tig welded barrel nuts** and **gap dimension** when ordering.

Low Profile Tig Welded Barrel Nuts

Low profile barrel nuts are available on all widths. Low profile barrel nuts have a clearance of 10 mm (0.406 in.). To order, specify **low profile tig welded barrel nuts.**



Low Profile Clamp Bars

Low profile clamp bars are available on both one 25 mm (1 in.) and 38 mm (1.5 in.) wide heaters, for wider widths consult factory. The bars are 6 mm (0.25 in.) diameter with an 8-32 screw. To order, specify **low profile clamp bars.**

Barrel Heaters

MI Band

MI Stock Product

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Construction	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Termination	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.
25.4	(1)	25.4	(1)	1pc	120	100	9.4	(61)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN2**
		25.4	(1)	1pc	120	150	14.2	(92)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN1**
		25.4	(1)	1pc	120	200	18.9	(122)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN3**
		25.4	(1)	1pc	240	200	18.9	(122)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1AN4**
		38.1	(1½)	1pc	120	200	10.8	(70)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN4**
		38.1	(1½)	1pc	240	200	10.8	(70)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN3**
		38.1	(1½)	1pc	120	300	16.4	(106)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN2**
		38.1	(1½)	1pc	240	300	16.4	(106)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN1**
		38.1	(1½)	1pc	240	400	21.8	(141)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1A1JN5**
31.8	(1¼)	25.4	(1)	1pc	120	250	16.1	(104)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN2**
		25.4	(1)	1pc	240	250	16.1	(104)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN1**
		25.4	(1)	1pc	240	300	19.2	(124)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1E1AN3**
		38.1	(1½)	1pc	120	350	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN2**
		38.1	(1½)	1pc	240	350	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN1**
		38.1	(1½)	1pc	240	450	17.3	(112)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1E1JN3**
31.8	(1¼)	25.4	(1)	1pc	120	200	9.6	(62)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN4**
		25.4	(1)	1pc	240	200	9.6	(62)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN3**
		25.4	(1)	1pc	120	300	14.4	(93)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN2**
		25.4	(1)	1pc	240	300	14.4	(93)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN1**
		25.4	(1)	1pc	240	400	19.3	(125)	Type B,C,E or H	0.05	(0.1)	Stock	**MB1J1AN5**
		38.1	(1½)	1pc	120	300	9.0	(58)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN1**
		38.1	(1½)	1pc	240	300	9.0	(58)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN3**
		38.1	(1½)	1pc	240	300	10.0	(64)	Post	0.09	(0.2)	Stock	**MB1J1JP4**
		38.1	(1½)	1pc	240	450	13.5	(87)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN2**
		38.1	(1½)	1pc	240	450	14.8	(96)	Post	0.09	(0.2)	Stock	**MB1J1JP6**
		38.1	(1½)	1pc	240	600	17.9	(116)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1J1JN4**
		50.8	(2)	1pc	240	300	6.5	(42)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN2**
		50.8	(2)	1pc	240	450	8.8	(57)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN1**
		50.8	(2)	1pc	240	900	19.3	(125)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1J2AN3**
		76.2	(3)	1pc	240	350	4.8	(31)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN2**
		76.2	(3)	1pc	240	500	7.0	(45)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN1**
		76.2	(3)	1pc	240	1000	16.1	(104)	Type B,C,E or H	0.18	(0.4)	Stock	**MB1J3AN3**

CONTINUED

Barrel Heaters

MI Band

I.D. mm	I.D. (in.)	Width mm	Width (in.)	Construction	Volts	Watts	Watt Density W/cm²	Watt Density (W/in²)	Termination	Approx. Net. Wt. kg	Approx. Net. Wt. (lbs)	Avail.	Code No.
44.5	(1¾)	38.1	(1½)	1pc	120	300	7.7	(50)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN2**
		38.1	(1½)	1pc	240	300	7.3	(47)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN1**
		38.1	(1½)	1pc	240	700	17.0	(110)	Type B,C,E or H	0.09	(0.2)	Stock	**MB1N1JN3**
		50.8	(2)	1pc	240	750	13.3	(86)	Type B,C,E or H	0.14	(0.3)	Stock	**MB1N2AN1**
50.8	(2)	25.4	(1½)	1pc	120	350	11.3	(73)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN2**
		25.4	(1½)	1pc	240	350	11.3	(73)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN1**
		25.4	(1½)	1pc	240	450	14.5	(94)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2A1AN3**
		38.1	(1½)	1pc	240	400	8.2	(53)	Type B,C,E or H	0.14	(0.3)	Stock	**MB2A1JN1**
		38.1	(1½)	1pc	240	1000	20.4	(132)	Type B,C,E or H	0.14	(0.3)	Stock	**MB2A1JN2**
		50.8	(2)	1pc	240	750	11.3	(73)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2A2AN1**
		50.8	(2)	1pc	240	1200	19.3	(125)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2A2AN2**
57.2	(2¼)	63.5	(2½)	1pc	240	1000	11.2	(72)	Type B,C,E or H	0.23	(0.5)	Stock	**MB2E2JN1**
63.5	(2½)	25.4	(1)	1pc	240	400	9.7	(63)	Type B,C,E or H	0.09	(0.2)	Stock	**MB2J1AN1**
		38.1	(1½)	1pc	240	500	7.7	(50)	Type B,C,E or H	0.18	(0.4)	Stock	**MB2J1JN1**
76.2	(3)	25.4	(1)	1pc	240	400	8.4	(54)	Post	0.14	(0.3)	Stock	**MB3A1AP1**
		38.1	(1½)	1pc	240	500	6.2	(40)	Post	0.18	(0.4)	Stock	**MB3A1JP1**
		38.1	(½)	2pc exp	230/460	525	8.2	(53)	Post	0.18	(0.4)	Stock	**ME3A1JP10**
88.9	(3½)	50.8	(2)	1pc	240	800	6.5	(42)	Post	0.32	(0.7)	Stock	**MB3J2AP2**
92.1	(3⅝)	38.1	(1½)	2pc exp	230/460	650	7.9	(51)	Post	0.23	(0.5)	Stock	**ME3L1JP5**
		38.1	(1½)	2pc exp	230/460	625	6.7	(43)	Post	0.27	(0.6)	Stock	**ME4A1JP11**
		38.1	(1½)	2pc exp	230/460	725	7.8	(50)	Post	0.27	(0.6)	Stock	**ME4A1JP12**
		38.1	(1½)	1pc	240	800	7.4	(48)	Post	0.27	(0.6)	Stock	**MB4A1JP2**
114.3	(4½)	63.5	(2½)	1pc	240	1250	6.2	(40)	Post	0.45	(1.0)	Stock	**MB4J2JP1**
127.0	(5)	38.1	(1½)	2pc exp	240/480	1000	8.1	(52)	Post	0.36	(0.8)	Stock	**ME5A1JP8**
133.4	(5¼)	38.1	(1½)	2pc exp	230/460	600	4.5	(29)	Post	0.32	(0.7)	Stock	**ME5E1JP9**
		38.1	(1½)	2pc exp	240/480	1000	7.4	(48)	Post	0.36	(0.8)	Stock	**ME5E1JP1**
		76.2	(3)	2pc exp	230/460	1700	6.2	(40)	Post	0.68	(1.5)	Stock	**ME5E3AP5**
139.7	(5½)	38.1	(1½)	2pc exp	240/480	1000	7.1	(46)	Post	0.40	(0.9)	Stock	**ME5J1JP1**
152.4	(6)	38.1	(1½)	2pc exp	240/480	1000	6.4	(41)	Post	0.40	(0.9)	Stock	**ME6A1JP2**
165.1	(6½)	38.1	(1½)	2pc exp	240/480	1250	7.3	(47)	Post	0.45	(1.0)	Stock	**ME6J1JP5**
171.5	(6¾)	38.1	(1½)	2pc exp	230/460	815	4.5	(29)	Post	0.40	(0.9)	Stock	**ME6N1JP6**
		38.1	(1½)	2pc exp	230/460	1000	5.6	(36)	Post	0.40	(0.9)	Stock	**ME6N1JP7**
		101.6	(4)	2pc exp	230/460	2600	5.4	(35)	Post	1.1	(2.5)	Stock	**ME6N4AP2**
		127.0	(5)	2pc exp	230/460	3700	6.2	(40)	Post	1.5	(3.2)	Stock	**ME6N5AP3**
		152.4	(6)	2pc exp	230/460	3750	5.1	(33)	Post	1.7	(3.8)	Stock	**ME6N6AP5**
177.8	(7)	38.1	(1½)	2pc exp	240/480	1250	6.6	(43)	Post	0.50	(1.1)	Stock	**ME7A1JP4**
190.5	(7½)	38.1	(1½)	2pc exp	240/480	1500	7.3	(47)	Post	0.50	(1.1)	Stock	**ME7J1JP4**
193.7	(7⅝)	76.2	(3)	2pc exp	230/460	1800	4.3	(28)	Post	1.0	(2.2)	Stock	**ME7L3AP1**
203.2	(8)	38.1	(1½)	2pc exp	240/480	1250	5.7	(37)	Post	0.54	(1.2)	Stock	**ME8A1JP4**
228.6	(9)	38.1	(1½)	2pc exp	240/480	1500	6.0	(39)	Post	0.64	(1.4)	Stock	**ME9A1JP1**
241.3	(9½)	76.2	(3)	2pc exp	230/460	3000	5.7	(37)	Post	1.2	(2.6)	Stock	**ME9J3AP2**
285.8	(11¼)	76.2	(3)	2pc exp	230/460	2400	3.7	(24)	Post	1.5	(3.2)	Stock	**ME11E3AP2**
		127.0	(5)	2pc exp	230/460	5100	4.8	(31)	Post	2.4	(5.2)	Stock	**ME11E5AP1**

How to Order

To order your stock MI Band heater, specify:

- Quantity
- Watlow code number
- Options
- Lead type and length, or terminal type configuration (If code number has an "N" as the last letter in the code, you must specify termination type and lead length. 305 mm (12 in.) leads will be supplied unless otherwise specified).

Availability

Stock: Same day shipment on MI Band heaters with post terminals or 305 mm (12 in.).

Type B leads. Longer lead lengths or other terminations will ship next day.

Made-to-Order: If stock units do not meet application needs, Watlow can manufacture MI Band heaters to special requirements. Please consult a Watlow sales engineer or authorized distributor.

Barrel Heaters

Problem Solvers

Solutions To Common Barrel Heater Problems

Heater replacement intervals can be lengthened or heater problems eliminated by using the optimum heater technology. Check the list below to see if your plastics processing can be improved.

Problem	Heater Solution
High process temperature causing premature heater failure	• High temperature MI band heater • Cast-in heat/cool bands
Power leads deteriorating from over-temperature	• Use MGT 450°C (850°F) rated wire • Fiberglass sleeve over leads
Slow response to temperature control	• High thermal conductive MI band
Exposed electrical terminations	• Ceramic covers over post terminals • Order metallic terminal box with heater
Obstructions on the barrel's surface affecting heater placement	• Increase heater gap • Order heater with holes, cutouts, or notches
Process requires constant heater removal	• Two-piece cast-in or MI band • Order quick disconnect assemblies
Power leads abrading or need physical protection against sharp edges	• Metal braided leads • Stainless steel hose over leads

Barrel Heaters

Case Histories

MI Band Heaters Allow Tighter Temperature Control Than Ceramic Knuckle Band Heaters

Problem:

A plastics processor was using ceramic knuckle heaters on a Krauss-Maffei plastic extruder to make profile shapes with PVC and TFE compounds. Both resins require operating temperatures in excess of 370°C (700°F), During operation, temperature swings in excess of ±24°C (±75°F) were experienced. The PVC and TFE extrusions responded poorly to these wide temperature variations and product quality suffered.

Solution:

Initial attention focused on the temperature controller to see if it was causing the wide temperature fluctuations. Further investigation revealed that construction characteristics inherent to the ceramic knuckle heaters were the true source of the problem. The ceramic knuckle's poor thermal conductivity was unable to conduct heat away from the resistance element fast enough, causing it to operate in excess of 760°C (1400°F). When the power was shut off upon reaching the 370°C (700°F) set point, the 760°C (1400°F) heat stored in the ceramic knuckles' mass continued to be conducted into the barrel.
This over-heating problem was compounded by the additional heat generated by friction in the process itself and the ceramic fiber insulation that trapped the combined heat against the barrel, raising the process/extrusion temperature beyond acceptable limits.

The initial customer was advised by his Watlow representative to replace all ceramic knuckle heaters on one of his extruders with a complete set of MI bands. Although more narrow in width, the MI band heaters covered the same amount of barrel surface area. The same day the MI band heaters were installed, the results were in, the over-temperature problem was gone. The lower mass, faster response and superior thermal conductivity of the MI band heaters kept the extruder operating with a ±3°C (±5°F) of set point. It also came up to operating temperature faster with MI band heaters. As a result, all 35 extruders in the shop were converted from ceramic knuckle heaters to Watlow MI band heaters.

Cast-In Heat/Cool Bands For Plastic Extrusion Machines

Problem:

Plastic extrusion machines produce polymer films, sheets, pipe, rods, filaments and other profiles either independently or as coatings on wire, paper, metal, etc.

Extrusion machines differ from injection molding machines (which primarily use mica heaters) in that they often require heating and cooling. Cooling is required on extruder barrels to offset heat generated by frictional shear as the screw pump pushes plastic melt through the barrel and die head.

Solution:

Watlow's UL® component recognized cast-in aluminum heat/cool bands provide a solution for the extrusion application. Cast-in heat/cool bands are designed to match the heating and cooling needs of extruders by:

1. Offering longer heater life than any other band heater construction
2. Utilizing aluminum, an excellent heat conductor, to deliver a very uniform heat pattern on the barrel
3. Providing rugged construction
4. Offering a 12.7 mm (0.5 in.) O.D. tubing cast in for maximum cooling capacity

Die and Former Heaters

Watlow's Family of Die and Former Heater Solutions

Today's exacting die applications such as blown or cast film, sheet, pipe, profiles and foam require extruders to seek products that provide:

- Superior quality
- Process repeatability
- Rapid startup times.

Regardless of your system, Watlow's full range of thermal solutions provides the high-performance, reliability and accuracy needed to optimize your process. Watlow's die and former heaters are designed with the needs of plastics processors in mind and can be customized to your unique application. The heaters provide high watt densities as well as uniform heat distribution to help reduce melt viscosity.

Watlow's die and former heater family includes:

- Custom cast and IFC heaters
- FIREROD® cartridge heaters
- Metric FIREROD cartridge heaters
- MI strip heaters
- Mica strip heaters
- THINBAND® heaters
- Tubular heaters

Applications

- Larger diameter band heaters for single- or multi-layer blown film dies
- High- and low-watt density cartridge heaters for a variety profile and shape dies
- Cast-in and IFC (Interference Fit Construction) heaters to form cost-effective total heated part dies
- Strip heaters for versatile surface die and former heating

Die and Former Heaters

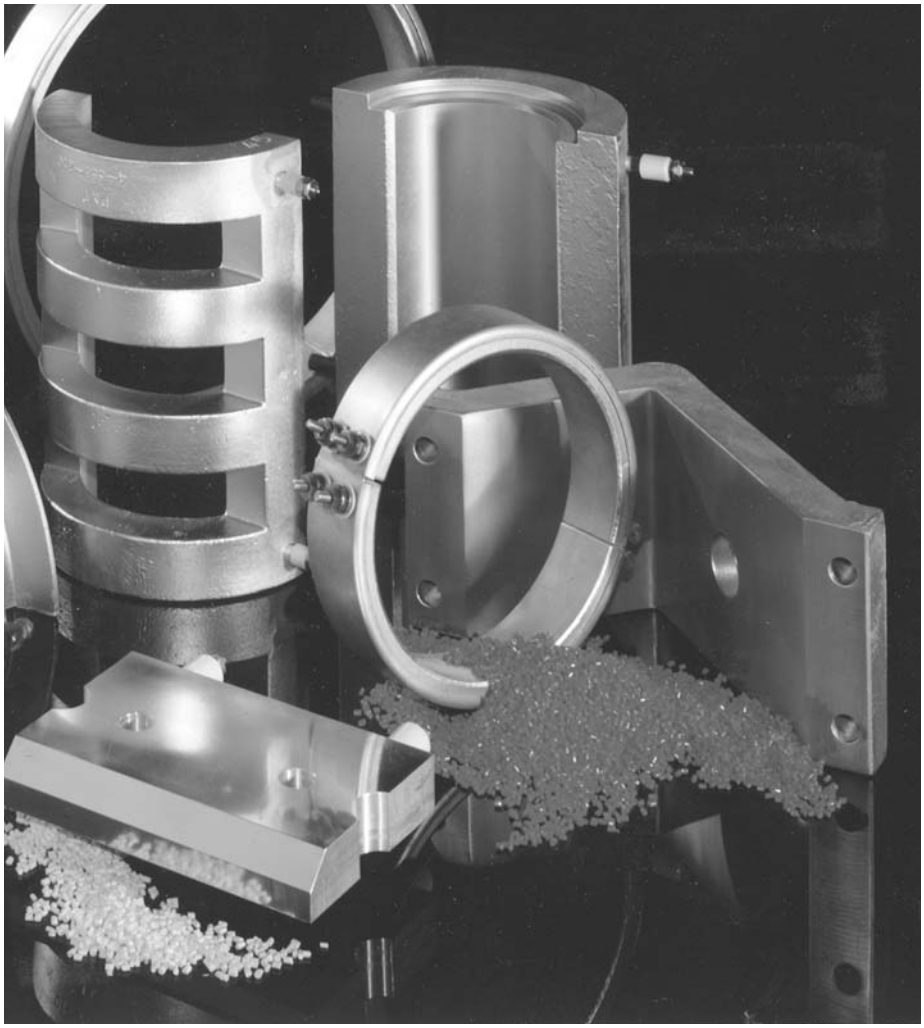
Custom Cast and IFC

Optimally heating extrusion dies can be a challenge due to issues such as high watt densities, high temperatures, harsh environments and atypical configurations. Extrusion houses require continuous close control of the die exit temperature to improve productivity, overall surface finish and product quality.

Watlow's custom cast and IFC (Interference Fit Construction) heaters can help solve these challenges while providing exceptional advantages in design flexibility, improved life and performance. The heaters are available with integrated thermocouples and offer benefits like reduced lead times, minimal tooling and operating temperatures above 350°C (660°F). The sealed heater construction is less prone to contamination problems and allows them to operate at higher temperatures with higher watt densities.

The custom cast and IFC heater construction incorporates a heated part assembly that can be made with stainless steel, nickel or any other metal that a customer requires. These heated parts are designed using formed cable or tubular heaters, much like Watlow's classic aluminum cast-in assembly. Rather than being cast into the part, however, the IFC method employs a press-fit heater into a groove providing intimate contact while reducing hot spots.

Regardless of the heated part technique chosen, both afford the ability to arrange the heater layout for the best temperature uniformity. In addition, the designs are structurally suited to accommodate holes and cutouts without compromising the heater's electrical and mechanical integrity.



Features and Benefits

- **Precisely molded tubular elements** enhance heat transfer patterns.
- **Multiple termination options, shapes and sizes** provide design and application flexibility.
- **Various sized cooling tubes cast into heater body** offer liquid cooling capability.
- **Multiple holes, tap holes and cutout options** optimize design flexibility and expedite mounting.
- **Optional one piece construction** reduces assembly and maintenance costs by offering mounting holes for direct bolting to the mold.

Application

- Profile dies
- Sheet extrusion dies
- Blown film rings
- Screen changers
- Cross head dies
- Platens

Die and Former Heaters

For complete information on FIREROD Cartridge heaters reference pages 70 to 119.

FIREROD® Cartridge Family

Watlow's family of cartridge heaters provides superior heat transfer; uniform temperatures and resistance to oxidation and corrosion even at high temperatures.

Watlow's cartridge heaters are available in high, medium and low-watt density units. The wattage distribution can be configured to yield a uniform heat profile and the overall superior construction allows for rapid heat dissipation into the former heater.

Performance Capabilities—FIREROD Cartridge and Metric Version

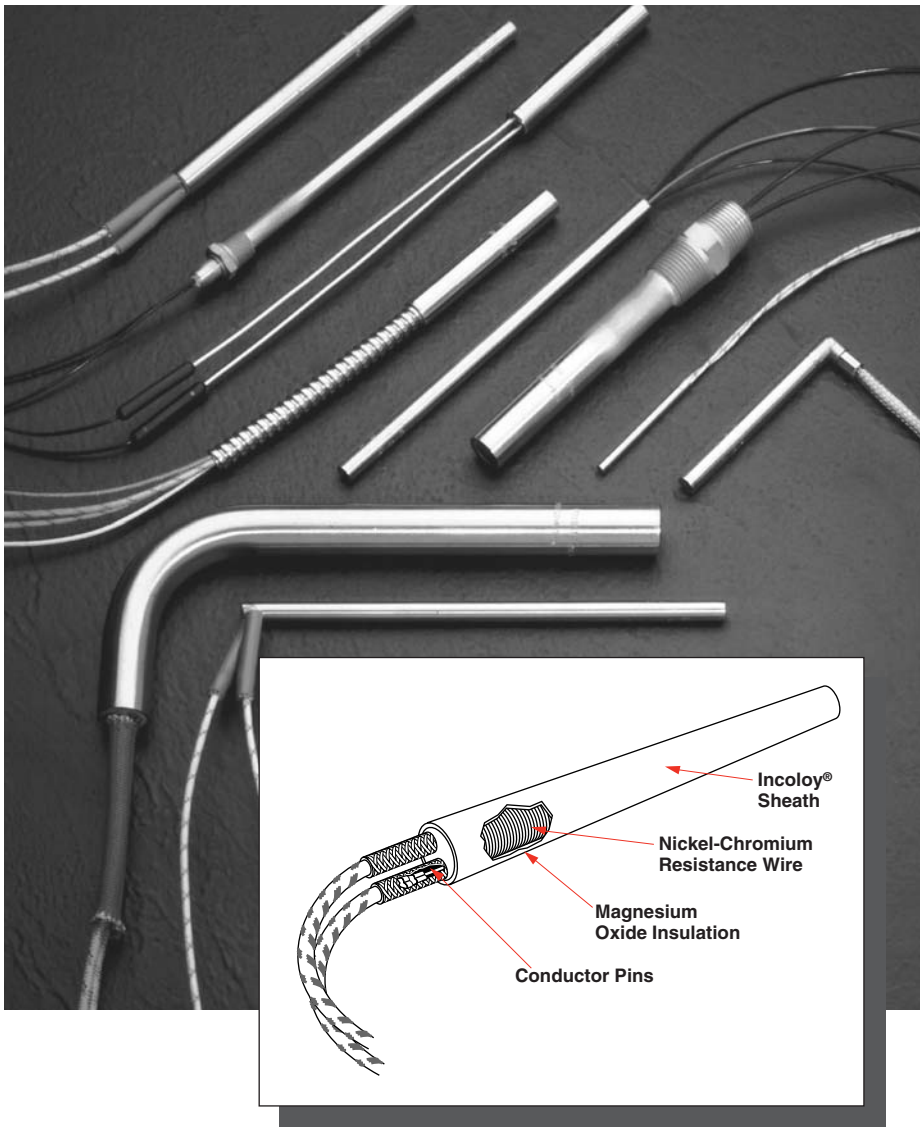
- Temperatures to 760°C (1400°F) on Incoloy® sheath
- Temperatures up to 540°C (1000°F) on optional stainless steel sheath
- Watt densities to 62 W/cm² (400 W/in²)

Performance Capabilities—Metric EB Cartridge

- Part temperatures to 600°C (1100°F)
- Maximum watt density to 30 W/cm² (190 W/in²)
- Maximum voltage to 480V~(ac)

Features and Benefits

- **Nickel-chromium resistance wire,** precisely wound and centered assures even, efficient heat distribution to the sheath.
- **Conductor pins** metallurgically bonded to the resistance wire ensure trouble-free electrical continuity. (The EB version features crimp-connected pins).
- **Magnesium oxide insulation of specific grain and purity,** swaged to the proper density, results in high dielectric strength and contributes to faster heat-up.



- **Incoloy® sheath** resists oxidation and corrosion from many chemicals, heat and atmospheres.
- **Minimal spacing between the element wire and sheath** results in lower internal temperature, giving you the ability to design with fewer or smaller heaters that operate at higher watt densities.
- **UL® and CSA approved flexible stranded wires,** with silicone-fiberglass oversleeve, insulate the wires to temperatures of 250°C (480°F).
- **VDE component recognition** to 230V~(ac) according to VDE 0721 part 1/3.78 and part 2/3.78 Section E in connection with VDE 0720 part 1/11.74.
- **Patented Lead Adapter (LA) method** allows same day shipment on more than 150,000 configurations of stock FIREROD heaters and lead combinations.

Applications

- Extrusion dies
- Formers

Incoloy® is a registered trademark of Special Metals Corporation.
UL® is a registered trademark of Underwriter's Laboratories, Inc.

Die and Former Heaters

Metric K-RING® and Mini K-RING

Watlow's K-RING® and mini K-RING heaters take nozzle heating technology a step ahead of the competition. Thanks to their innovative design, plastic processors no longer have to compromise with sloppy fit tolerances, uneven temperature profiles or short heater life.

Featuring machined brass casting construction, these heaters can handle very high temperatures while providing maximum heat transfer.

Watlow's K-RING and mini K-RING heaters are ideal for applications where space is limited. The heating element fits easily into the small area and heats with precision and efficiency.

The K-RING and mini K-RING heaters feature highly flexible unheated ends which give the customer the ability to form leads to the wire channel. The unit also contains small lead adapters which take up less space in the machine.

With a precision machined inside diameter, the K-RING and mini K-RING heaters fit perfectly—and don't require clamping bands. Precision fit, along with the excellent thermal conductivity of brass, allow the K-RING and mini K-RING to give you an extremely even temperature profile.

Performance Capabilities

- Operating temperature to 650°C (1200°F)
- Maximum watt density on inside diameter to 50 W/cm^2 (320 W/in^2)
- Maximum voltage to 240V~(ac)

Features and Benefits

- **Brass casting construction** protects heater from damage, as well as maximizes transfer of heat to heated parts.
- **Precision machining** of length and inside diameter gives accurate fit tolerances.
- **Sealed construction** of the K-RING and mini K-RING eliminates contamination.
- **Stainless steel outer casing** protects the brass heater body, and acts as an insulator.
- **Distributed wattage** allows heat to be precisely placed for an even temperature profile.
- **Customized diameters** are available to meet specific application needs.

Applications

- Hot melt equipment
- Extrusion dies for rods and/or fibers

Die and Former Heaters

Metric K-RING and Mini K-RING

Technical Data

K-RING and Mini K-RING Comparison Chart

Characteristic	K-RING	Mini K-RING
Maximum voltage	240 volts	240 volts
Maximum amperage	4.5 amps	2.0 amps
Minimum outer diameter	18 mm (0.70 in.)	10 mm (0.39 in.)
Minimum wall thickness	4 mm (0.16 in.)	2.5 mm (0.10 in.)
Maximum element length	L (max) = I.D.* x 6.5 Max. length 250 mm (7.87 in.)	L (max) = I.D.* x 6.5 mm Max. length 250 mm (7.87 in.)
Thermocouple	Internal or external Type J or K	External possible
Lead - T/C insulation	Fiberglass Teflon®	Fiberglass Teflon®
Lead protection	Fiberbraid Stainless steel braid Stainless steel hose	None
Lead adapter	Standard swaged 6.5 mm (0.25 in.) dia.	Hermetic seal 4 mm (0.16 in.) diameter
Lead exit	Single ended	Dual ended
Lead exit length	Standard = 25 mm (1 in.) to adapter longer possible upon request	Standard = 150/200 mm (5/7 in.) staggered to adapter longer or shorter possible upon request
Reinforced lead exit	Yes - Diameter 7.7 mm (0.30 in.) minimum 30 mm (1.18 in.) long	No
Wattage tolerance	±10 percent	±10 percent

* Inner diameter equation applies to all heater sizes.

How to Order

To order your K-RING and mini K-RING heater, specify:

- I.D.
- Maximum possible O.D.
- Length
- Voltage
- Wattage
- No-heat at lead end
- Lead exit
- Lead length
- Wattage distribution

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

Quick Ship • *Same day shipment on all stock units.*

Die and Former Heaters

MI Strip

The Watlow MI strip is a thin, responsive heater that sets unmatched standards for performance and durability. It makes use of the most advanced heater construction techniques, including embedding a nickel chromium element wire in Watlow's exclusive mineral insulation. Only 1.067 mm (0.042 in.) thick, this layer of insulation brings the element wire closer to the heater sheath. The result is heat flows easily from the element wire to the sheath, thus allowing the wire to run cooler than conventional heaters.

Performance Capabilities

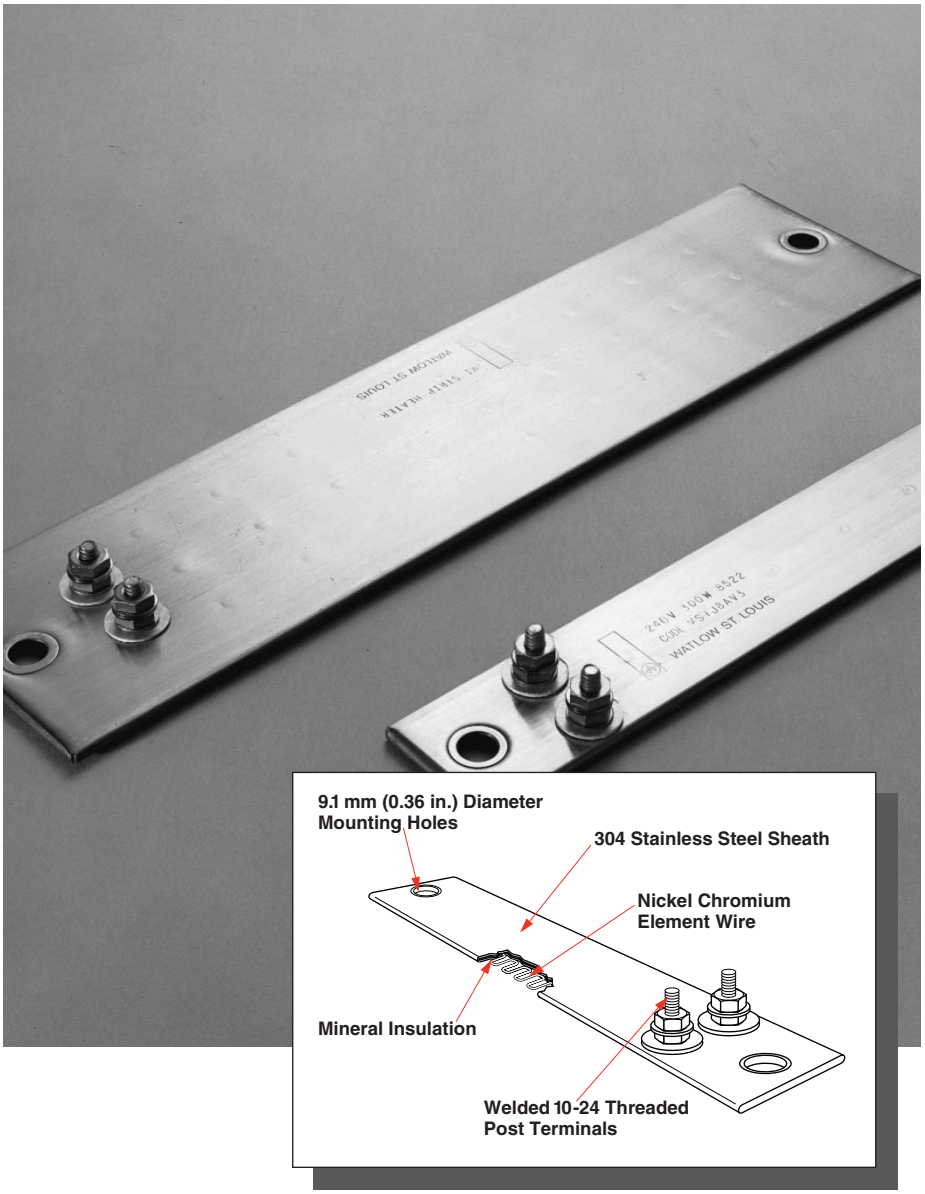
- Sheath temperatures to 760°C (1400°F)
- Watt densities to 15.5 W/cm^2 (100 W/in^2)
- Maximum voltage 480V~(ac)

Features and Benefits

- **Higher watt densities** than any other strip heater contribute to faster heat-up.
- **Exclusive mineral insulation** combines high dielectric strength and superior thermal conductivity which transfers heat rapidly to the sheath.
- **304 stainless steel sheath** is welded together at strategic points to maintain the high compaction of mineral insulation and produce a rigid heater.
- **UL® component recognition** is available in 250V~(ac) or less.

Applications

- Die and mold heating
- High temperature resins
- Platen heating



How to Order

Please specify:

- Watlow code number
- Overall dimensions: length and width
- Wattage: see maximum allowable watt density graph
- Termination type (parallel or one-on-one)
- Mounting holes, if desired
- Quantity

If stock units do not meet specific application needs, Watlow can manufacture MI strip heaters to meet special requirements.

Availability

Stock: Same day shipment

Made-to-order: Consult a Watlow sales engineer or authorized distributor.

Die and Former Heaters

MI Strip

Applications and Technical Data

Calculating Watt Density

Watt density is the amount of wattage per square inch of heated area. To determine watt density, divide the total wattage by the heated area.

$$\text{Watt Density} = \frac{\text{Total Watts}}{\text{Heated Area}}$$

To apply this equation we must define the term "heated area." Heated area is the total contact surface of the heater less areas of no heat that are found around terminals, mounting holes, etc.

Heated Area =
Total Contact Area - No-Heat Area

To calculate the heated area:

1. Locate the **no-heat factor** from the chart on the right that corresponds to the type of heater being considered.
2. To use the formula below, insert the no heat factors, length and width (in inches).

   Heated Area =
   (Length - No-Heat Factor)
   x Width

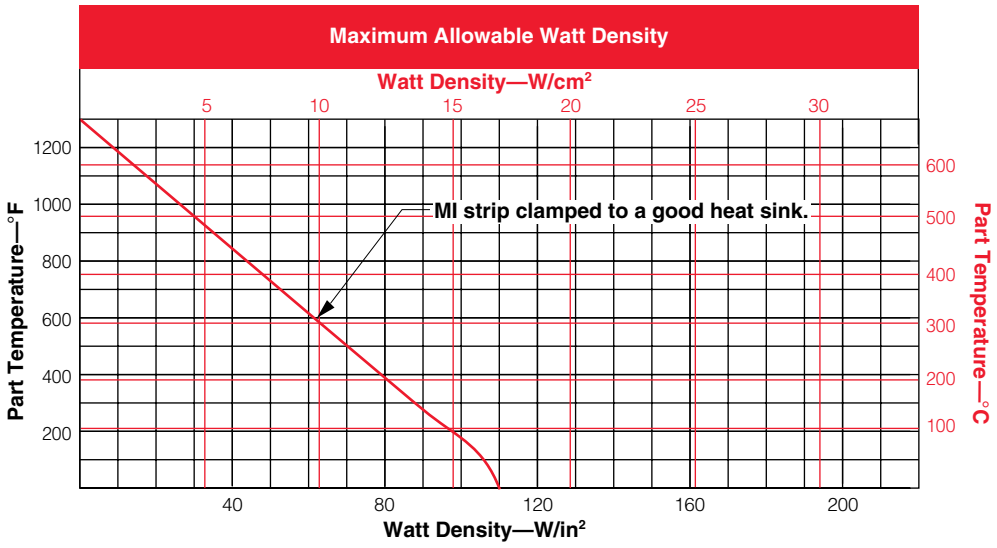
Type	Factor (in.)
1 in. wide post term 1 on 1	1.56
1 in. wide post term 1 on 1 with mounting holes	3.56
1 in. wide post term 2 on 1	1.93
1 in. wide post term 2 on 1 with mounting holes	3.93
For all other widths:	
2 on 1 post terminal	1.18
2 on 1 with mounting holes	3.18

Calculating Watt Density

The sketches on the next page and the graph on this page will help select the correct watt density for a particular application. First, refer to the sketches to determine the heated area of the heater. Then, use the watt density formula and graph to make sure that the maximum watt density of the heater will not be exceeded in the specific application.

$$\text{Watt Density} = \frac{\text{Wattage}}{\text{Heated Area}}$$

Note: Derate maximum allowable watt density by 50 percent when using mounting holes only for clamping.



Die and Former Heaters

MI Strip

Applications and Technical Data

Specifications

Width: 25.4, 38.1, 50.8 mm (1, 1.5 and 2 in.)

Tolerance: ±.0312

Length: 205 to 760 mm (8 to 30 in.)

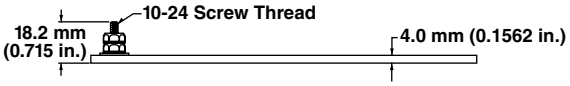
Tolerance: ±.125

Terminations:

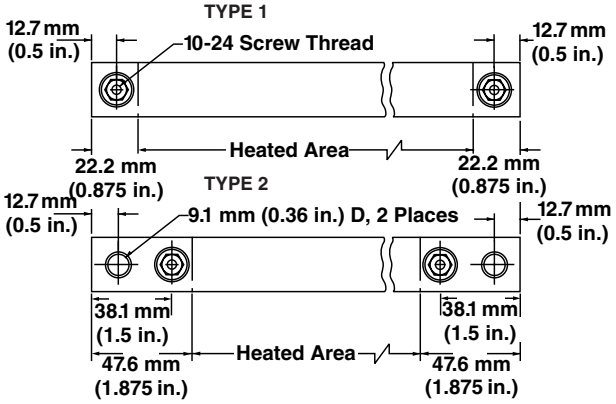
25.4 mm (1 in.) wide—post terminals one-on-one

38.1 to 50.8 mm (1.5 to 2 in.)—post terminals two-on-one

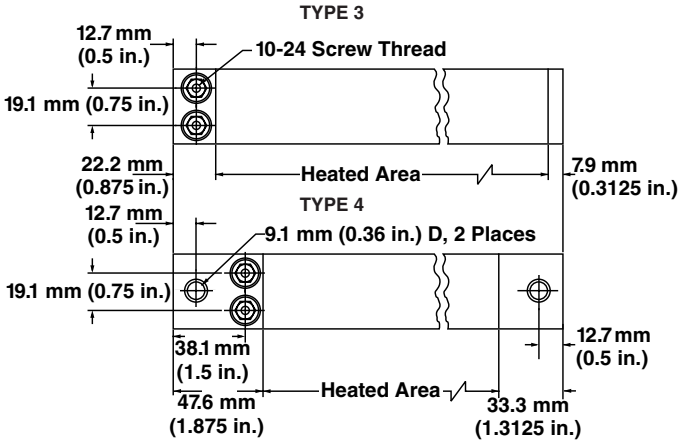
All Widths



25.4 mm (1 in.) Wide



38.1–50.8 mm (1.5–2 in.) Wide



Stock List (Parallel Terminals) Type 3 and 4

Width mm	Width (in.)	Length mm	Length (in.)	Volts	Power (Watts)	Watt Density W/cm²	Watt Density (W/in²)	Approximate Net. Wt. kg	Approximate Net. Wt. (lbs)	Type	Code No.
38.1	(1.5)	203.2	(8)	120	500	7.4	(48)	0.15	(0.3)	3	**MS1J8AS1**
38.1	(1.5)	203.2	(8)	240	500	7.8	(50)	0.15	(0.3)	3	**MS1J8AS3**
38.1	(1.5)	304.8	(12)	120	350	4.0	(26)	0.2	(0.5)	4	**MS1J12AV2** ①
38.1	(1.5)	304.8	(12)	240	350	4.0	(26)	0.2	(0.5)	4	**MS1J12AV3** ①
38.1	(1.5)	304.8	(12)	120	800	7.6	(49)	0.2	(0.5)	3	**MS1J12AS1**
38.1	(1.5)	304.8	(12)	240	800	7.6	(49)	0.2	(0.5)	3	**MS1J12AS2**
38.1	(1.5)	457.2	(18)	120	1000	6.2	(40)	0.3	(0.8)	3	**MS1J18AS1**
38.1	(1.5)	457.2	(18)	240	1000	6.2	(40)	0.3	(0.8)	3	**MS1J18AS2**

① Denotes units with mounting holes. Mounting holes are 9.14 mm (0.36 in.) in diameter, and are intended for use with 6.35 mm (0.25 in.) bolts. Centers of mounting holes are located 12.7 mm (0.5 in.) from the ends of the heater.
Note: Type 1 & 2 are made-to-order only.

Quick Ship

- *Same day shipment on all stock units*

Die and Former Heaters

Mica Strip

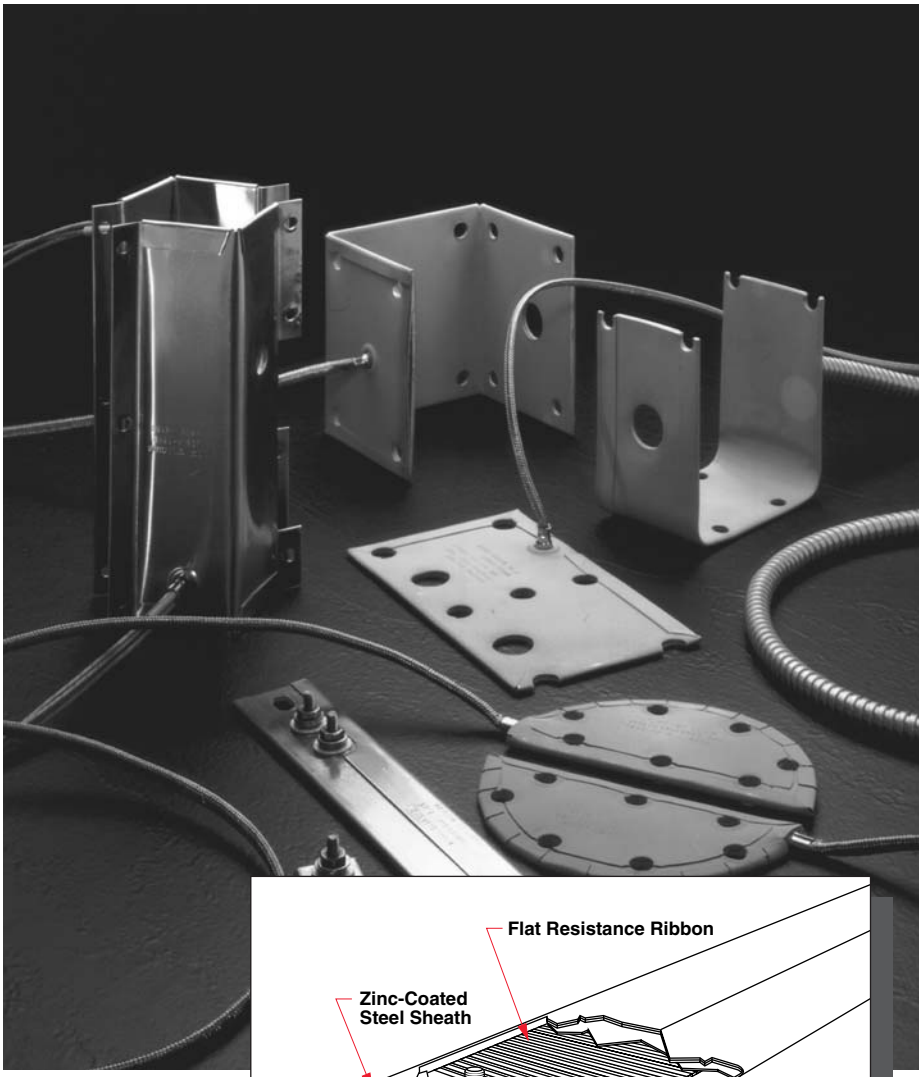
The Watlow mica strip heater is an economical and reliable source of heat for industrial equipment. A mere 15 mils (0.4 mm) thick mica insulator on both sides of the resistance element provides complete electrical insulation and offers little resistance to efficient heat flow. Plus mica withstands high voltage spikes, resists moisture and is inert to most chemicals.

Performance Capabilities

- Sheath temperatures to 480°C (900°F) on zinc-coated units
- Sheath temperatures of 650°C (1200°F) on stainless steel units
- Watt densities to 8.5 W/cm^2 (55 W/in^2)
- Maximum voltage 480V~(ac)

Features and Benefits

- **Low mass construction** heats up faster to provide quick response to control input.
- **Flat resistance ribbon** generates heat over a broad area. This design solution puts the heat source closer to the work.
- **Rust-resistant, zinc-coated steel sheath** is treated to improve emissivity. The strength of this material also gives the heater rigidity.
- **Optional stainless steel sheath** is available for more corrosive atmospheres.
- **Nickel-plated steel terminal posts** are securely riveted to ensure a positive, trouble-free connection to the resistance circuit.
- **Computer aided design engineering** assures the best combination of ribbon gauge, total wattage and winding spacing. This design combination maximizes heat transfer and life of the heater.



- **Excellent dielectric strength** is guaranteed because all incoming mica receives a quality control inspection.
- **UL® component recognition** is available for applications to 480°C (900F°) sheath temperature.

  File number E52951

Applications

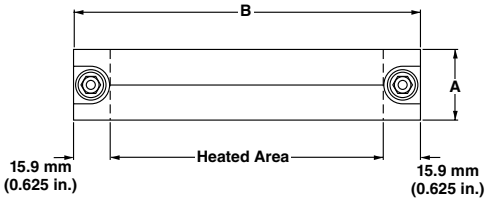
- Dies and molds
- Vulcanizing presses
- Sealing equipment
- Hot plates
- Hot stamping

Die and Former Heaters

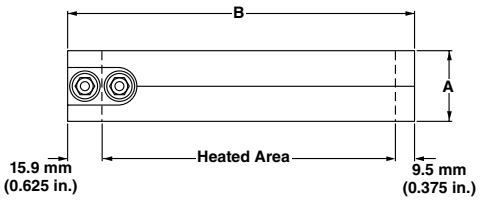
Mica Strip

Applications and Technical Data

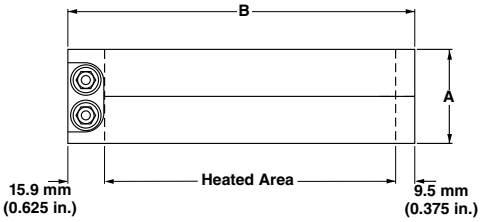
Type 1—Opposite Ends



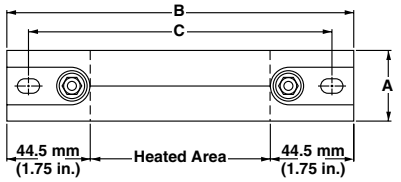
Type 2—Tandem



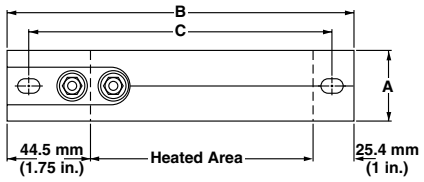
Type 3—Parallel Made-to-Order



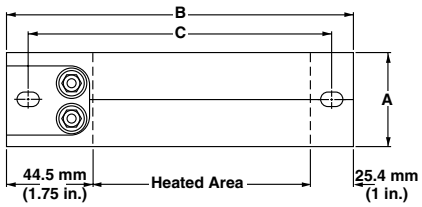
Type 4—Opposite Ends with Holes



Type 5—Tandem with Holes



Type 6—Parallel with Holes



Specify **Type** when ordering.

Physical Limitations of Lead Variations

Heater Type	Width				Length			
	Minimum		Maximum		Minimum		Maximum	
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)
Post Terminal								
Type 1 - Opposite ends	15.8	(⅝)	381	(15)	50.8	(2)	2438.4	(96①)
Type 2 - Tandem	15.8	(⅝)	381	(15)	50.8	(2)	2438.4	(96①)
Type 3 - Parallel	38.1	(1½)	381	(15)	50.8	(2)	2438.4	(96①)
Type 4 - Opposite ends with holes	15.8	(⅝)	381	(15)	139.7	(5½)	2438.4	(96①)
Type 5 - Tandem with holes	15.8	(⅝)	381	(15)	139.7	(5½)	2438.4	(96①)
Type 6 - Parallel with holes	38.1	(1½)	381	(15)	139.7	(5½)	2438.4	(96①)
Leads								
Type C, E. F, H	25.4	(1)	381	(15)	139.7	(5½)	2438.4	(96①)
Type K								
without mounting holes	25.4	(1)	381	(15)	139.7	(5½)	2438.4	(96①)
with mounting holes	38.1	(1½)	381	(15)	139.7	(5½)	2438.4	(96①)
European Plug								
Vertical	25.4	(1)	381	(15)	139.7	(5½)	2438.4	(96①)
Horizontal	63.5	(2½)	381	(15)	159	(6¼)	2438.4	(96①)
Three-Phase	76.2	(3)	381	(15)	139.7	(5½)	2438.4	(96①)
Dual Voltage	76.2	(3)	381	(15)	139.7	(5½)	2438.4	(96①)
Terminal Box②								
Type 2 - Tandem	38.1	(1½)	381	(15)	108	(4¼)	2438.4	(96①)
Type 3 - Parallel	63.5	(2½)	381	(15)	108	(4¼)	2438.4	(96①)
Type 5 - Tandem with holes	38.1	(1½)	381	(15)	159	(6¼)	2438.4	(96①)
Type 6 - Parallel with holes	63.5	(2½)	381	(15)	159	(6¼)	2438.4	(96①)

① Consult the factory if you need to exceed 2438.4 mm (96 in.).
② Not available on stock heaters.

Note: Some combinations of maximum and minimums cannot occur on the same heater.

Terminations

Types 1 through 6, as illustrated, show the placement of terminals for Watlow mica strip heaters. However, please note Type 3 terminals are not available on stock units. Placement is specified in terms of length, width and center-to-center dimensions. These dimensions are as follows:

Length:
Tolerance: ±1.6 mm (0.06 in.)

Width:
Tolerance: ±1.6 mm (0.06 in.)

Thickness:
Nominal: 4.7 mm (0.19 in.)

Types 4, 5 and 6 have 9.5 mm x 6.3 mm (0.38 in. x 0.25 in.) mounting slots. Letters A, B and C, called out in the illustrations, denote the following:
A = width, B = overall length and C = center-to-center dimensions on mounting slots.

Die and Former Heaters

Mica Strip

Applications and Technical Data

Continued

Calculating Watt Density

Watt density is the amount of wattage per square inch of heated area. To determine watt density, divide the total wattage by the heated area.

$$\text{Watt Density} = \frac{\text{Total Watts}}{\text{Heated Area}}$$

To apply this equation we must define the term "heated area." Heated area is the total contact surface of the heater less areas of no heat that are found around terminals, mounting holes, etc.

Heated Area =
Total Contact Area - No-Heat Area

To calculate the heated area:

Heated Area =
(Length - No-Heat) x Width

Maximum Allowable Watt Density

The following derating factors are applicable to the **Maximum Allowable Watt Density** graph. Please review these factors and the graph to determine the maximum watt density for the application.

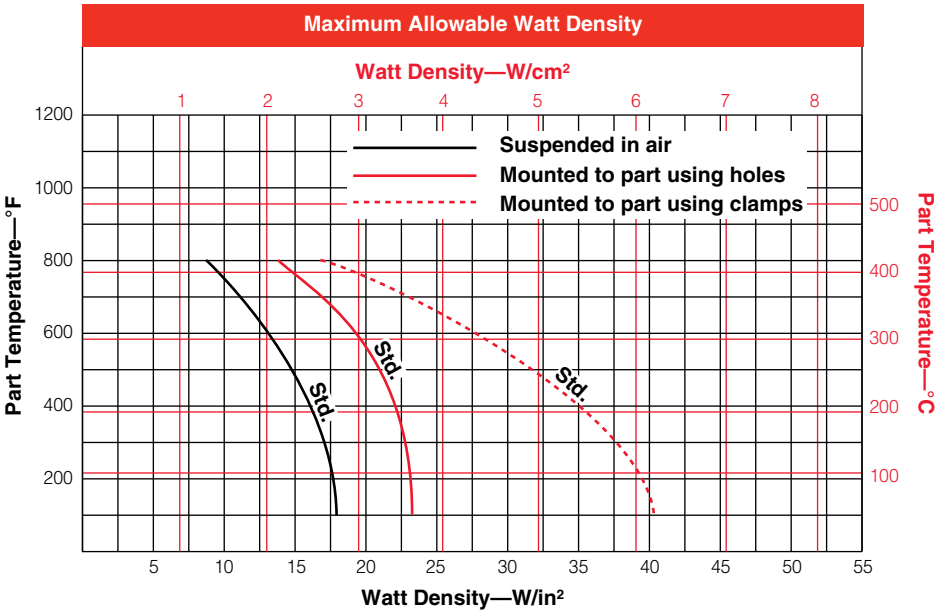
Derating Factors:

- For heaters mounted less than 25 mm (1 in.) apart on a metal part, derate by 5 percent.
- For heaters mounted within 76 mm (3 in.) of a reflective surface, derate by 10 percent.
- For heaters mounted 51 to 150 mm (2 to 6 in.) apart and radiating toward each other, derate by 10 percent.
- For heaters mounted within 25 mm (1 in.) of a reflective surface, derate by 20 percent.
- For heaters mounted less than 51 mm (2 in.) apart and radiating toward each other, derate by 20 percent.
- For termination Types 2 and 5, as well as lead Types C, E and H (see illustrations on pages 226 and 228) that are less than 51 mm (2 in.) wide, derate as follows: zinc-coated units by 10 percent and stainless steel units by 20 percent.

Application Hints

To maximize the performance of a mica strip heater, ensure:

- Small heaters with 32.3 cm^2 (5 in^2) or less of heated area are 120V~(ac). These heaters can be wired in series for a 240V~(ac) power supply.
- The surface to be heated is clean and smooth, so that heat is transferred efficiently. Even small air gaps can cause hot spotting.
- Terminal post nuts are not overly tightened. Although the posts are securely riveted to the elements, excessive torque could break the connection.

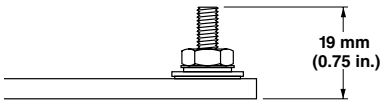


Die and Former Heaters

Mica Strip

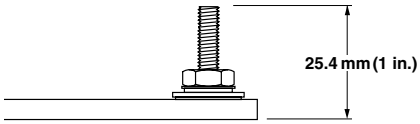
Termination Options

Post Terminals (Standard)



Post terminals have a threaded length of 11 mm (0.44 in.) and require approximately 19 mm (0.75 in). clearance. Specify **standard terminals** when ordering.

Long Terminals

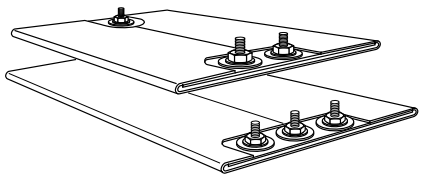


Longer terminals with 17.5 mm (0.69 in.) threaded lengths are available and require approximately 25 mm (1 in.) clearance. Specify **long terminals** when ordering.

Button Terminals

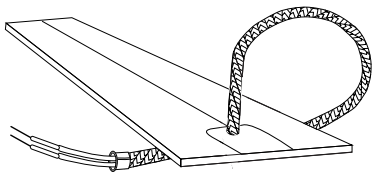
The slotted screw head terminals require only 11 mm (0.44 in.) clearance. Specify **button terminals** when ordering.

Three Terminal Construction



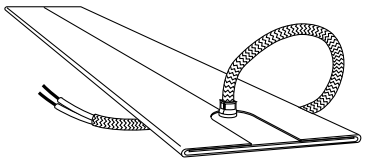
A third terminal can be added to provide dual voltage or three-heat operation. Or, it can be connected to the sheath for easy grounding. Specify **dual voltage** or **three-heat operation** when ordering.

Type E—Loose Metal Braided Leads



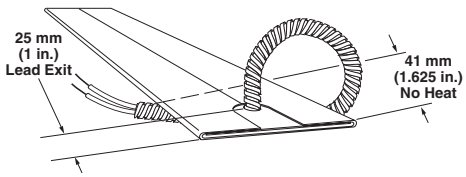
Loose metal braid encloses two fiberglass leads for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than the braid. To order, specify **Type E** and **length**. Leads are two inches longer than braid.

Type C—Metal Overbraid Leads



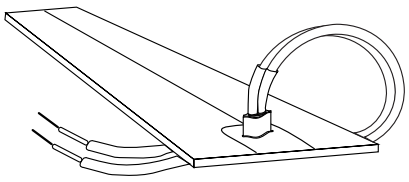
Each fiberglass-insulated lead wire exits in a single metal braid from the back of the heater. This arrangement offers abrasion protection, lead flexibility and convenient wiring for a neat installation. Minimum heater length is 140 mm (5.5 in.). Specify **Type C** and **length** when ordering. Leads are 51 mm (2 in.) longer than braid.

Type H—Flexible Steel Hose Leads (Vertical)

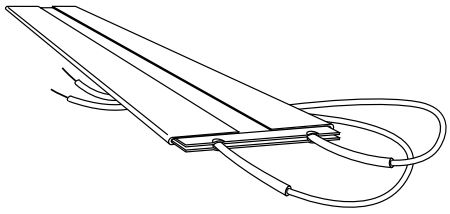


Galvanized, flexible steel hose gives superior mechanical protection where lead abrasion is a particular problem. Minimum heater length is 140 mm (5.5 in.). Specify **Type H** and **lead length** when ordering, leads are typically 51 mm (2 in.) longer than hose.

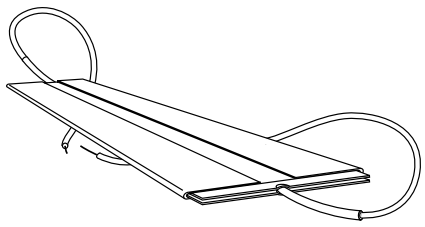
Type K—Flexible Leads



Two on One (Vertical)



Two on One (Horizontal)



One on One (Horizontal)

Type K has two fiberglass-insulated leads. These leads can exit one at each end or both at the same end, so please specify end termination when ordering. Type K is suitable for applications where lead abrasion is not a problem. Specify **Type K orientation** and **length** when ordering.

Die and Former Heaters

Mica Strip

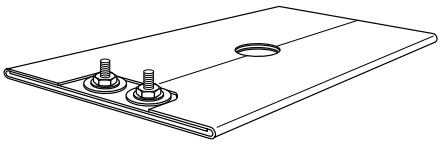
Options

External Finishing

Sheath Material

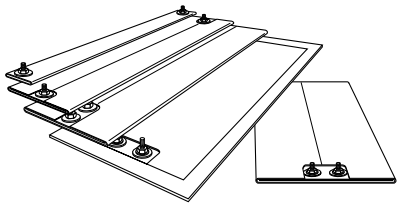
Please specify a **stainless steel sheath** when the part temperature reaches in excess of 370°C (700°F).

Holes or Slots



When required for instrumentation or mounting, holes or slots may be provided as a manufactured variation in nearly any location as long as there is at least 25 mm (1 in.) between the edge of the hole and one side of the heater. Dimensional drawing is required when ordering.

Widths



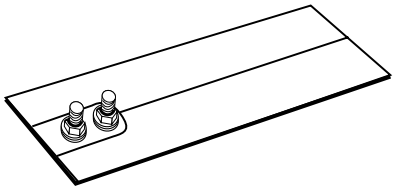
The 38 mm (1.5 in.) wide heater is the most efficient size due to its maximum clamping effect. Heaters are available in widths from 16 mm (0.63 in.) to 610 mm (24 in.).

Heaters 125 mm (5 in.) wide and greater are constructed with end folds and a reinforcement shim rather than full folds. Units less than 35 mm (1.38 in.) wide have the sheath seam on the side opposite the terminals.

Distributed Wattage

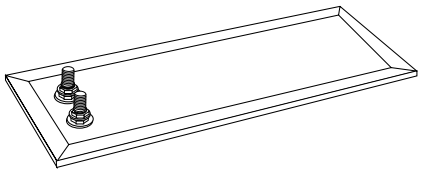
A mica strip heater can be designed with varying heat profile along the length for uneven heat distribution.

Butt Case



Recommended for heating applications where strip heater will be placed in a milled slot between two steel plates. Specify **butt case** construction when ordering.

Four Sides Closed



Mica strip heaters can be closed on all four sides to prevent contamination from getting inside the heater. Standard on strip heaters 127 mm (5 in.) wide and greater.

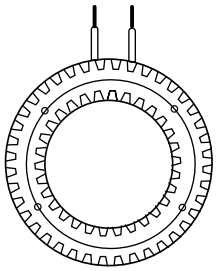
Die and Former Heaters

Mica Strip

Options

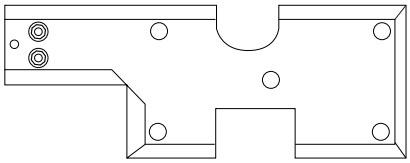
External Finishing

Ring Heaters



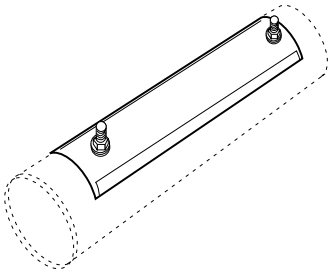
When ordering ring heaters, specify **inside** and **outside diameters**. If mounting holes are required, specify location and hole size.

Irregular Shapes



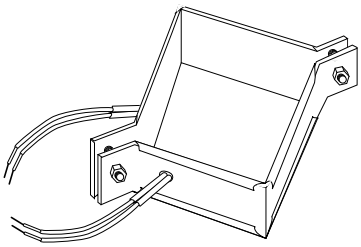
Mica strip heaters can be made into any practical shape and electrical rating. Examples include: cone, flat circular, square, rectangular and hexagon.

Cross Section Formed



Strip heaters can be formed on a cross section for piping applications. Specify diameter of pipe on which heaters are to be mounted.

Square, Rectangular Bands



Square or rectangular heaters are normally used for heating dies on plastic extruders, or the barrels of twin screw extruders. These can be made in either one or two piece construction (see illustrations).

Clamping Styles

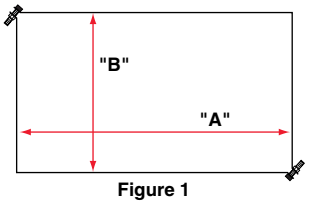


Figure 1

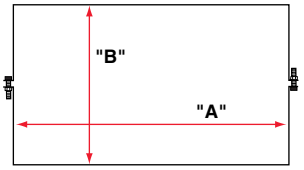


Figure 2

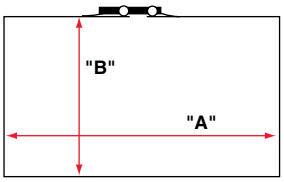
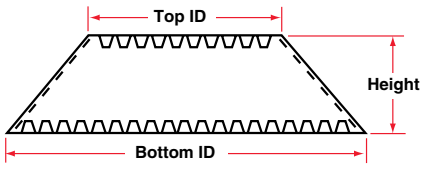


Figure 3

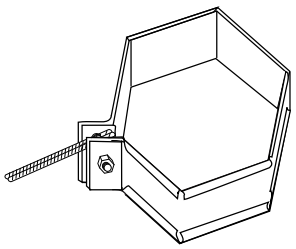
Referring to the illustrations, the preferred design is Figure 1 with bent-up flange clamping due to the uniform applied clamping force at the corners. Next is Figure 2, with bent-up flanges or built-in strapping brackets at the sides. The least preferred design is Figure 3, one-piece heater, due to the lack of uniform applied clamping force.

Cone Shapes



Cone shaped heaters are normally used for special heating applications when heat is required for hoppers or funnels. They are made strictly to customer specifications. The preferred method of attachment is with bent-up flange clamping.

Hex Bands

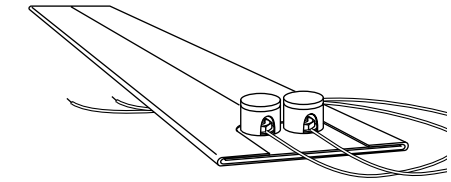


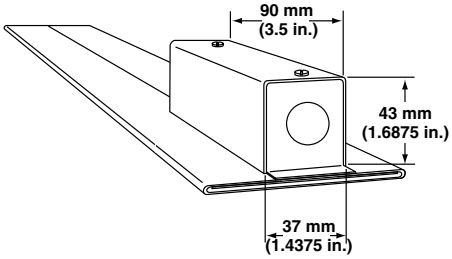
Hex shaped heaters are used on the hex shaped portion of the nozzle on injection molding machines. A drawing is required when ordering.

Die and Former Heaters

Mica Strip

Options





Ceramic Terminal Covers

Ceramic terminal covers are a convenient, economical way to provide safety. Covers are sized for standard 11 mm (0.44 in.) long post terminals, that require approximately 19 mm (0.75 in.) clearance.

The clearance, with ceramic cover cap, is 23.1 mm (0.91 in.). Excluding the thickness of the heater, the clearance is 19 mm (0.75 in.). Screw thread size is 10-24. To order, specify Watlow code number **Z-4918** and quantity.

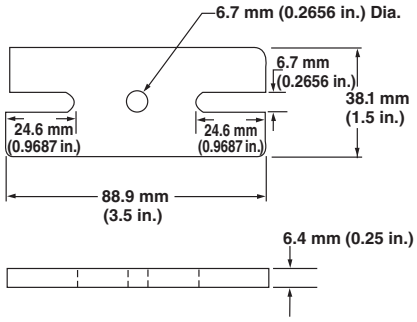
Metallic Terminal Box

A high quality metallic terminal box is welded to the heater sheath. Units with tandem terminals must be at least 38 mm (1.5 in.) wide. Units with parallel terminals must be at least 108 mm (4.25 in.) wide. Minimum length is 108 mm (4.25 in.) without mounting holes or 159 mm (6.25 in.) with holes. When ordering specify **terminal box.**

Accessories

Clamping Variations

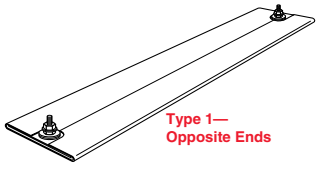
Clamping Bars

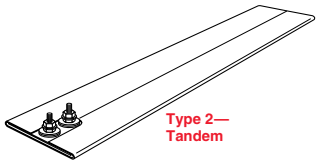


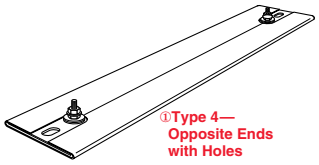
For maximum life and efficient operation, strip heaters must be firmly clamped to the part being heated. Clamping bars 90 mm (3.5 in.) wide can be used to clamp strips with a maximum width of 76 mm (3 in.). Watlow recommends clamping every 150 mm (6 in.). Specify code number **MB101-1** and quantity when ordering clamping bars.

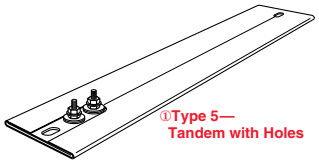
Die and Former Heaters

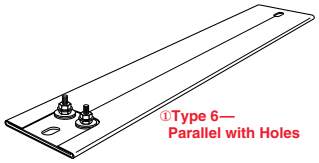
Mica Strip


Type 1—
Opposite Ends


Type 2—
Tandem


①Type 4—
Opposite Ends
with Holes


①Type 5—
Tandem with Holes


①Type 6—
Parallel with Holes

How to Order

To order stock mica strip heater, specify:

- Quantity
- Watlow code number

Availability

Stock: Same day shipment

Made-to-order: If stock units do not meet application needs, Watlow can manufacture mica strip heaters to special requirements. Please consult a Watlow sales engineer or authorized distributor.

Width mm (in.)	Overall Length mm (in.)	Type	Ctr-to-Ctr Mtg Holes mm (in.)	Volts	Power (Watts)	Watt Density W/cm² (W/in²)	Approx. Net Weight lbs (kg)	Avail.	Code No.
25.4 (1)	88.9 (3½)	1	— —	120	50	3.4 (22)	0.04 (0.09)	Stk	**S1A3JP1**
	152.4 (6)	1	— —	120	100	3.3 (21)	0.08 (0.17)	Stk	**S1A6AP1**
	152.4 (6)	1	— —	240	100	3.3 (21)	0.08 (0.17)	Stk	**S1A6AP2**
	304.8 (12)	4	279.4 (11)	120	175	3.3 (21)	0.15 (0.33)	Stk	**S1A12AT1**
	304.8 (12)	4	279.4 (11)	240	175	3.3 (21)	0.15 (0.33)	Stk	**S1A12AT2**
	152.4 (6)	5	133.4 (5¼)	120	100	3.1 (20)	0.08 (0.17)	Stk	**S1A6AU1②**
38.1 (1½)	457.2 (8)	1	— —	120	750	4.6 (30)	0.34 (0.75)	Stk	**S1J18AP1**
	152.4 (6)	2	— —	120	250	5.1 (33)	0.11 (0.25)	Stk	**S1J6AR1**
	203.2 (8)	2	— —	120	400	5.7 (37)	0.15 (0.33)	Stk	**S1J8AR1**
	203.2 (8)	2	— —	240	400	5.7 (37)	0.15 (0.33)	Stk	**S1J8AR2**
	304.8 (12)	2	— —	120	500	4.6 (30)	0.23 (0.50)	Stk	**S1J12AR1**
	304.8 (12)	2	— —	240	500	4.6 (30)	0.23 (0.50)	Stk	**S1J12AR2**
	355.6 (14)	2	— —	120	500	3.9 (25)	0.26 (0.58)	Stk	**S1J14AR1**
	355.6 (14)	2	— —	240	500	3.9 (25)	0.26 (0.58)	Stk	**S1J14AR2**
	457.2 (18)	2	— —	120	800	4.8 (31)	0.34 (0.75)	Stk	**S1J18AR1**
	457.2 (18)	2	— —	240	800	4.8 (31)	0.34 (0.75)	Stk	**S1J18AR2**
	609.6 (24)	2	— —	120	1000	4.5 (29)	0.45 (1.0)	Stk	**S1J24AR1**
	609.6 (24)	2	— —	240	1000	4.5 (29)	0.45 (1.0)	Stk	**S1J24AR2**
	203.2 (8)	4	177.8 (7)	120	150	3.4 (22)	0.15 (0.33)	Stk	**S1J8AT1**
	304.8 (12)	4	279.4 (11)	120	250	3.1 (20)	0.23 (0.50)	Stk	**S1J12AT1**
	304.8 (12)	4	279.4 (11)	240	250	3.1 (20)	0.23 (0.50)	Stk	**S1J12AT2**
	457.2 (18)	4	431.8 (17)	240	500	3.6 (23)	0.34 (0.75)	Stk	**S1J18AT1**
	139.7 (5½)	5	114.3 (4½)	120	125	4.6 (30)	0.11 (0.23)	Stk	**S1J5JU1**
	190.5 (7½)	5	165.1 (6½)	120	150	3.3 (21)	0.15 (0.33)	Stk	**S1J7JU1**
	203.2 (8)	5	177.8 (7)	120	150	2.9 (19)	0.15 (0.33)	Stk	**S1J8AU1**
	203.2 (8)	5	177.8 (7)	240	150	2.9 (19)	0.15 (0.33)	Stk	**S1J8AU2**
	203.2 (8)	5	177.8 (7)	120	175	3.4 (22)	0.15 (0.33)	Stk	**S1J8AU3**
	203.2 (8)	5	177.8 (7)	240	175	3.4 (22)	0.15 (0.33)	Stk	**S1J8AU4**
	203.2 (8)	5	177.8 (7)	120	250	5.0 (32)	0.15 (0.33)	Stk	**S1J8AU5**
	203.2 (8)	5	177.8 (7)	240	250	5.0 (32)	0.15 (0.33)	Stk	**S1J8AU6**
	266.7 (10½)	5	241.3 (9½)	120	250	3.4 (22)	0.19 (0.42)	Stk	**S1J10JU1**
	266.7 (10½)	5	241.3 (9½)	240	250	3.4 (22)	0.19 (0.42)	Stk	**S1J10JU2**
	304.8 (12)	5	279.4 (11)	120	250	2.8 (18)	0.23 (0.50)	Stk	**S1J12AU1**
	304.8 (12)	5	279.4 (11)	240	250	2.8 (18)	0.23 (0.50)	Stk	**S1J12AU2**
	304.8 (12)	5	— —	120	150	1.7 (11)	0.23 (0.50)	Stk	**S1J12AU10③**
	304.8 (12)	5	— —	240	150	1.7 (11)	0.23 (0.50)	Stk	**S1J12AU11③**
	387.4 (15¼)	5	362.0 (14¼)	240	500	4.2 (27)	0.29 (0.63)	Stk	**S1J15EU1**
	454.0 (17⅞)	5	428.6 (16⅞)	120	375	2.6 (17)	0.34 (0.75)	Stk	**S1J17RU1**
	454.0 (17⅞)	5	428.6 (16⅞)	120	500	3.4 (22)	0.34 (0.75)	Stk	**S1J17RU2**
	454.0 (17⅞)	5	428.6 (16⅞)	240	500	3.4 (22)	0.34 (0.75)	Stk	**S1J17RU3**
	533.4 (21)	5	508.0 (20)	240	650	3.7 (24)	0.39 (0.87)	Stk	**S1J21AU1**
	603.3 (23¾)	5	577.9 (22¾)	120	500	2.5 (16)	0.45 (0.99)	Stk	**S1J23NU1**
	603.3 (23¾)	5	577.9 (22¾)	240	500	2.5 (16)	0.45 (0.99)	Stk	**S1J23NU2**
	603.3 (23¾)	5	577.9 (22¾)	120	750	3.7 (24)	0.45 (0.99)	Stk	**S1J23NU3**
	603.3 (23¾)	5	577.9 (22¾)	240	750	3.7 (24)	0.45 (0.99)	Stk	**S1J23NU4**
	647.7 (25½)	5	622.3 (24½)	240	650	2.9 (19)	0.50 (1.10)	Stk	**S1J25JU1**
	774.7 (30½)	5	749.3 (29½)	240	800	2.9 (19)	0.59 (1.30)	Stk	**S1J30JU1**
63.5 (2½)	165.1 (6½)	6	139.7 (5½)	120	225	3.7 (24)	0.20 (0.45)	Stk	**S2J6JV1**
	165.1 (6½)	6	139.7 (5½)	240	225	3.7 (24)	0.20 (0.45)	Stk	**S2J6JV2**
	215.9 (8½)	6	190.5 (7½)	120	350	3.7 (24)	0.27 (0.59)	Stk	**S2J8JV1**
	215.9 (8½)	6	190.5 (7½)	240	350	3.7 (24)	0.27 (0.59)	Stk	**S2J8JV2**
	647.7 (25½)	6	622.3 (24½)	120	1000	2.8 (18)	0.81 (1.78)	Stk	**S2J25JV1**
	647.7 (25½)	6	622.3 (24½)	240	1000	2.8 (18)	0.81 (1.78)	Stk	**S2J25JV2**

① Mounting slots on stock heaters are 12.7 x 7.9 mm (0.25 x 0.31 in.). On made-to-order units, mounting slots are 9.5 x 6.3 mm (0.38 x 0.25 in.).
② This unit has 9.5 x 6.3 mm (0.38 x 0.25 in.) mounting holes.
③ Heaters with code numbers **S1J12AU10** and **S1J12AU11** have zinc-coated steel sheath. All other heaters have stainless steel sheath.

Quick Ship

- *Same day shipment on more than 1000 variations of THINBAND heaters.*

Die and Former Heaters

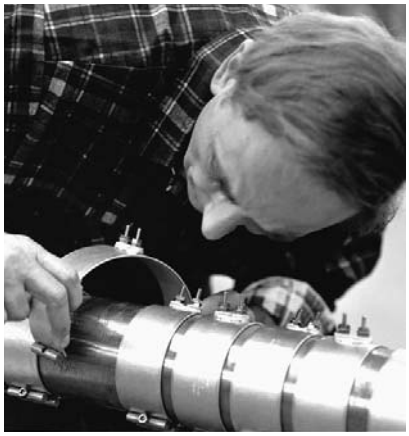
For THINBAND ordering information and part numbers reference pages 36 to 52.

THINBAND® Mica Band

The THINBAND® heater is Watlow's patented redesign of the mica band. THINBAND heaters deliver fast and install easily, keeping costs down and machines running.

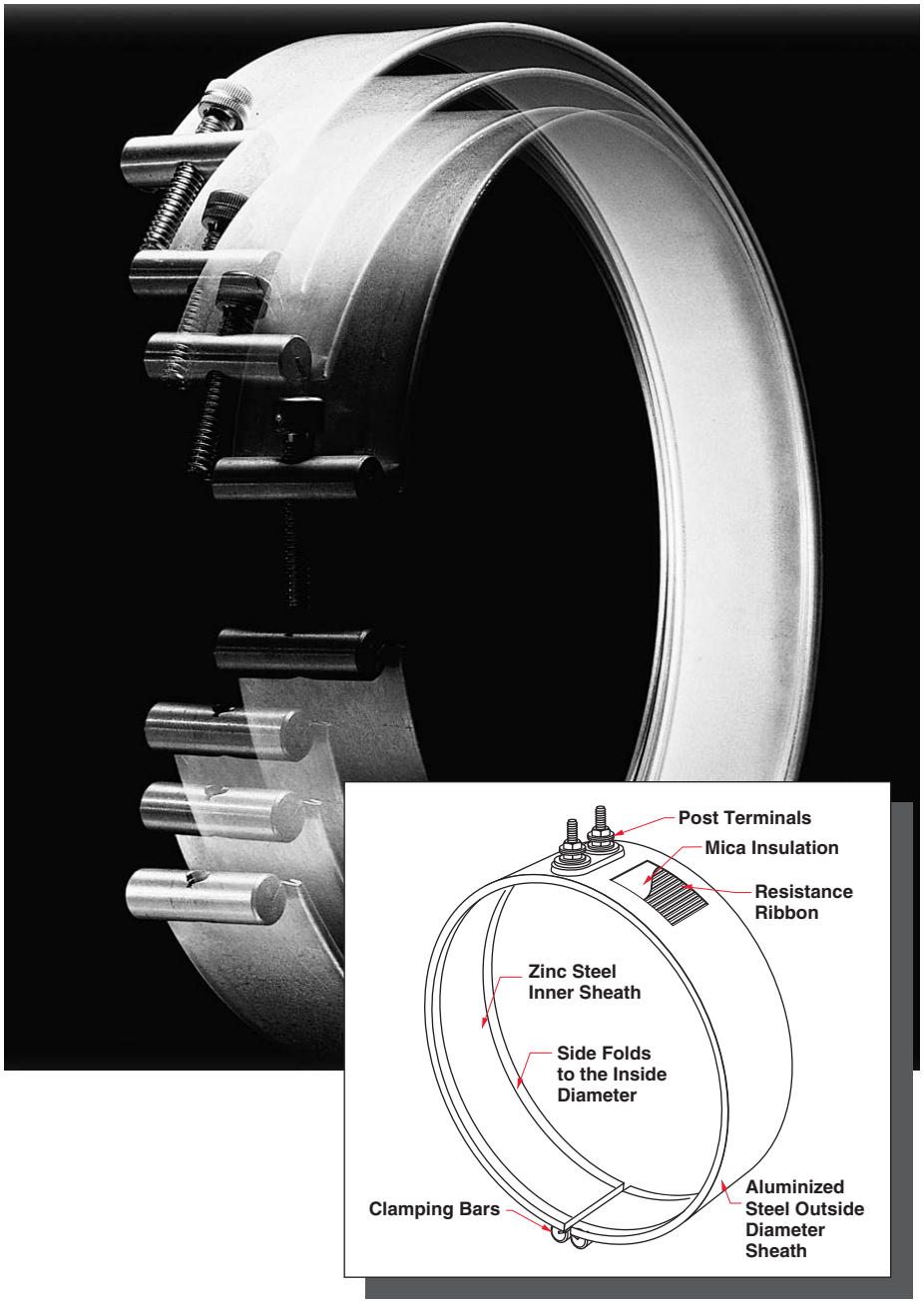
Performance Capabilities

- Sheath temperatures to 480°C (900°F)
- Watt densities to 8.5 W/cm² (55 W/in²)



Features and Benefits

- **New flexible, one-piece design** makes installation faster on plastic processing equipment because the heater can be opened to the full diameter of the barrel or die without internal damage. The THINBAND heater can be installed without removing other band heaters already in place.
- **Same day shipment** on more than 1000 variations of THINBAND lead attachments is due to Watlow's exclusive Lead Adapter—or LA—manufacturing method. Customers can reduce inventories and costly downtime.
- **Only one set of leads or terminals** is needed on the THINBAND heater, unlike the two sets required on the cumbersome two-piece replacement barrel heaters with straps.



- **QUICK CLAMP** opens to fit over barrels and snaps in place with one easy flip of its latching lever. No need to remove other heaters.
- **Permanently attached clamping bars.**
- **Contamination resistance.** No folds on outside of heater.

Applications

- Extruder barrels
- Extruder dies

Die and Former Heaters

THINBAND Mica Band

Applications and Technical Data

Operating Factors

Use as low a watt density rating as your application permits. A close match of the heat supplied to the actual requirements will reduce temperature overshoot, reduce cycling and increase the life of any band heater you use.

Calculate the **safe maximum wattage** for your heater using:

Heated Area x Maximum Watt Density

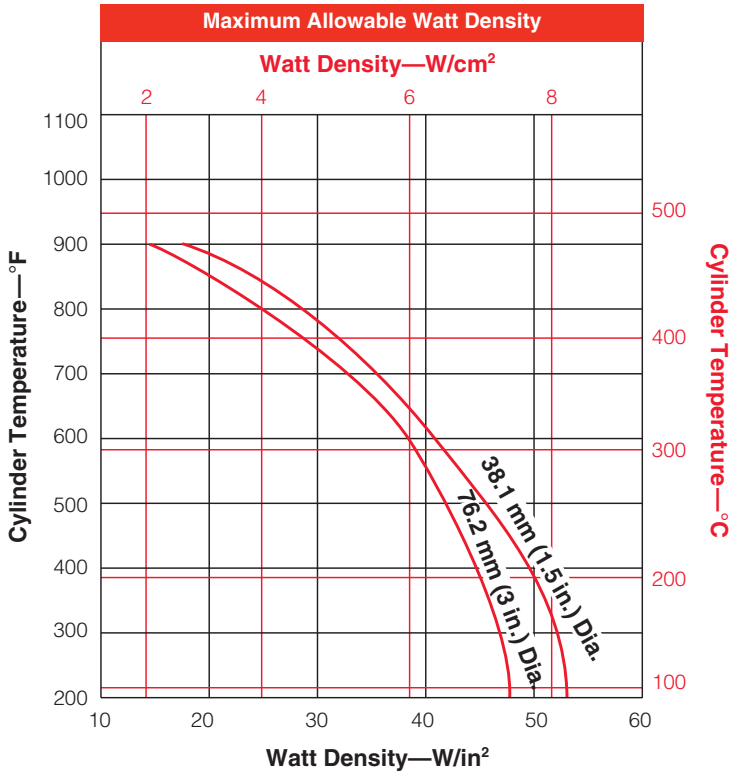
Calculate the **heated area** of your barrel heater by subtracting the no-heat area from the total area in contact with the cylinder (3.14 x I.D. x width). Subtract the no-heat area at the terminals (from table) and any additional no-heat area caused by holes, slots or oversize gaps.

Determine the maximum watt density of your heater from the graph on this page. The curves are based on narrow heaters mounted on a smooth, steel cylinder. Apply the necessary correction factors:

- For heaters 57 mm (2.25 in.) to 127 mm (5 in.) wide, multiply watt density by 0.8.
- For high expansion cylinders (aluminum or brass), reduce the watt density by 0.46 W/cm^2 (3 W/in^2).
- For heaters 57 mm to 127 mm wide (2.25 in. to 5 in.) installed on a high expansion cylinder, reduce watt density by a total of 0.46 W/cm^2 (3 W/in^2) only.
- For regular cylinder surfaces other than smooth, machined finish, reduce watt density by 0.46 W/cm^2 (3 W/in^2).
- For heaters that will be insulated or enclosed, contact Watlow for specific watt densities.
- For units greater than 355 mm (14 in.) diameter, consult recommended clamping graph on page 39.
- For units used in vertical applications, consult factory for application assistance.

No-Heat Area for THINBAND (All Terminations)

Heater Type	Heater Size				No-Heat Area at Terminals	
	Diameter		Width			
	mm	(in.)	mm	(in.)	mm	(in.)
One Piece	63.5	(Less than 2.5)	177.8	(Up to 7)	25.4 (1) x width	
Two Piece	127	(5 or more)	76.2	(More than 3)	50.8 (2) x width	

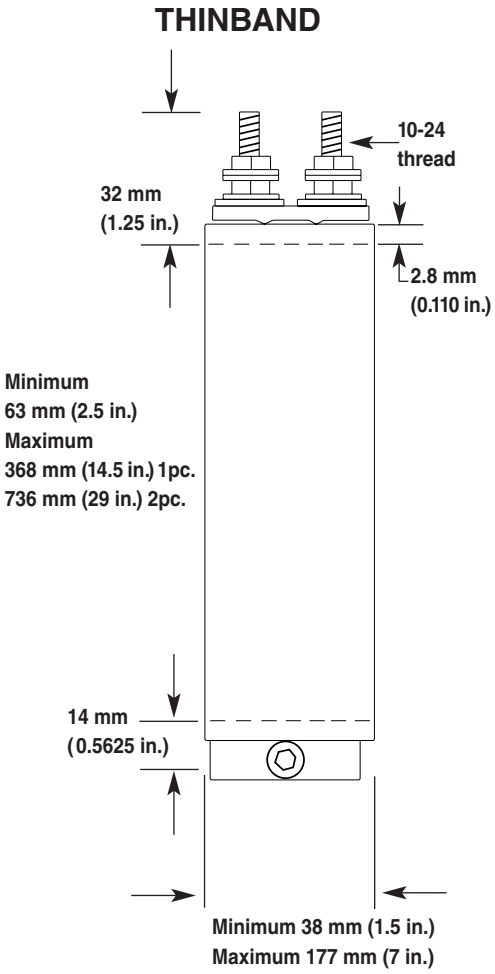


Die and Former Heaters

THINBAND Mica Band

Physical Limitations of Lead Variations

Check the table to be certain the variations and lead arrangements you order are available on the heater size you require. If you need to exceed any limitations please contact a Watlow representative.



Physical Limitations of Lead Variations

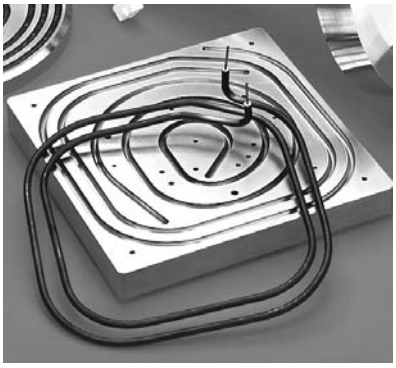
Heater Type	Diameter				Width			
	Min.		Max.		Min.		Max.	
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)
1 pc. const.	25.4	(1)	368.3	(14½)	38.1	(1½)	177.8	(7)
2 pc. const.	127	(5)	736.6	(29)	38.1	(1½)	177.8	(7)
Nozzle								
Type A	25.4	(1)	101.6	(4)	25.4	(1)	152.4	(6)
Type L	25.4	(1)	101.6	(4)	25.4	(1)	152.4	(6)
Barrel								
Type T	63.5	(2½)			38.1	(1½)	177.8	(7)
Type H	63.5	(2½)			38.1	(1½)	177.8	(7)
Type F, FR	63.5	(2½)			38.1	(1½)	177.8	(7)
Type E	63.5	(2½)			38.1	(1½)	177.8	(7)
Type C, BR	63.5	(2½)			38.1	(1½)	177.8	(7)
Type K, KR	63.5	(2½)			38.1	(1½)	177.8	(7)
Terminal Box	88.9	(3½)			38.1	(1½)	177.8	(7)
European Plug								
1 pc. vertical	63.5	(2½)	368.3	(14½)	38.1	(1½)	177.8	(7)
1 pc. horizontal	63.5	(2½)	368.3	(14½)	38.1	(1½)	177.8	(7)
Welded Barrel Nuts								
1 pc.	63.5	(2½)	368.3	(14½)	38.1	(1½)	177.8	(7)

Note: Some combinations of maximums and minimums cannot occur on the same heater. Check the table to be certain the variations and lead arrangements you order are available on the heater size you require. If you need to exceed any limitations, please contact your Watlow representative.

Standard gap is 9.53 mm (0.375 in.) between clamp bars.

Die and Former Heaters

Tubular

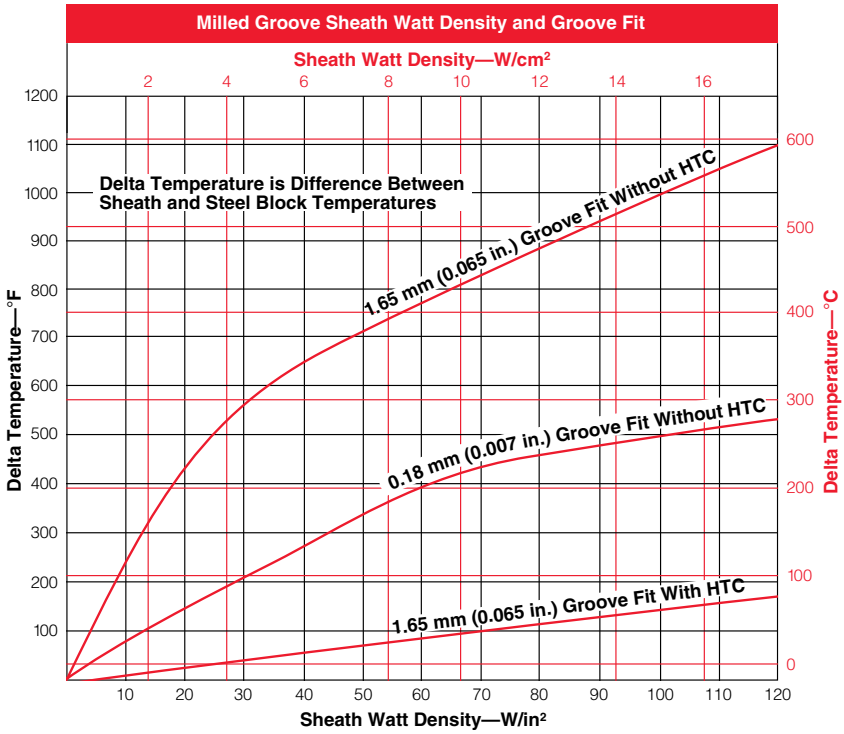


Die and Former Heater

Features and Benefits

- **Precise conformity to customer specifications** ensures easy installation—bending tolerances as low as ± 0.002 inch.
- **Common element diameters** include: 6.6, 8, 8.5, 9.5 and 10.9 mm (0.260, 0.315, 0.335, 0.375 and 0.430 in.).
- **Incoloy® sheath material** for high temperatures, 304 stainless steel for smaller radius bends.
- **Superior resistance coil design** produces even heating.
- **Threaded stud or lead wire termination** as required.

Use the Milled Groove Sheath Watt Density and Groove Fit chart to find the recommended watt density or tightest groove fit. Optimum groove fit, without heat transfer cement, can be determined by plotting the intersect point between the required sheath watt density and the Delta temperature (T). If the Delta T is not known, simply subtract the mold temperature from the maximum 540°C (1000°F) sheath temperature. Any combination of watt density and groove fit which results in a Delta T below the recommended maximum will maximize heater life. Conversely, if the Delta T is greater, less heater life can be expected.



- Recommended maximum watt density = 6.2 to 10.9 W/cm² (40 to 70 W/in²)
- Recommended groove = 1.65 mm (0.065 in.) larger in diameter than sheath diameter, and use heat transfer cement
- Recommended heater sheath diameter = 8 mm (0.315 in.)
- Recommended maximum Delta T = 205°C (400°F)
- Maximum sheath temperature = 540°C (1000°F)
- Recommended sheath material = Incoloy®

How to Order

All milled groove heaters are made-to-order. Due to precision forming requirements, please provide a detailed drawing or electronic file. Consult your Watlow representative for price and shipment details. To help the ordering process, provide the following information:

- Operating temperature
- Volts/watts
- Sheath diameter and material
- No-heat section
- Electrical terminations
- Bend configurations and dimensions
- Groove cross section dimensions
- Quantity

Heat Transfer Cement (HTC)

Heat transfer cement can maximize heater performance and life by increasing thermal conductivity between the sheath and manifold. The maximum exposure temperature is 675°C (1250°F). Available in one quart cans. To order, specify **code number 148-15-2-1.**

Caution

Heat transfer cement conducts electricity. Avoid contact with terminations, wiring and other sources of electric current.

Die and Former Heaters

Problem Solvers

Watlow Solutions To Common Heater Problems

Problem	Heater Solution
Heaters glow red on startup before reaching set point.	1. Wiring Considerations: • If heaters are dual voltage, check wiring to ensure that heater halves are wired in series for higher voltage installation. • Check incoming voltage for over voltage condition. 2. Installation Considerations: • Since most heaters transfer heat through conduction, it is essential that heaters fit tightly to the die. Check installation instructions to insure that heaters are clamped to torque values indicated. See MI, THINBAND, Mica Clamp Torque Chart below. • Insure that dirt and grit are removed prior to installation. Any foreign matter under heater will interfere with proper heat conduction. 3. Thermal Considerations: • Review application and clamping graphs to insure heater watt density is not excessive. • Examine machine to evaluate thermal mass in a particular zone. High thermal mass can conduct heat away from zone being heated, driving up heater temperature as heater expands.

MI, THINBAND, Mica Clamp Torque Chart

	Nickel Plated, Dry Standard	Nickel Plated, Anti-Seize	Black Oxide, Dry	Black Oxide Anti-Seize
Clamp Screw Size	**Torque (in.-lb)**	**Torque (in.-lb)**	**Torque (in.-lb)**	**Torque (in.-lb)**
UNC #6-32	30	20	20	15
UNC #8-32	40	30	25	20
UNC #10-24	55	35	35	30
UNC 1/4-20	80	55	50	45
UNC 1/4-20 w/Springs	40	40	N/A	N/A
M6-1	80	55	50	45
M5-0.8	60	40	35	35

Die and Former Heaters

Problem Solvers

Watlow Solutions To Common Heater Problems

Problem	Heater Solution
Lead wires burn out prematurely.	• Ensure that lead wires have adequate insulation ratings for the temperature of the application. GGS leads are rated for 250°C (482°F) while MGT leads are rated at 450°C (232°F). • If thermal insulation is used, make sure to exit the leads away from the thermal insulation as close to the heater as possible. • If leads are touching the backside of heater, make sure that there is adequate space for air circulation between heater surface and lead wire. • Heater leads can self-heat and should be de-rated if amperage is at the limit of the lead wire and there is significant bundling in an enclosed channel.

Problem	Heater Solution
Machine has GFI protection and trips on machine startup.	Many mineral insulated heaters can pick up moisture if they are not treated with a moisture retardant. This moisture will easily be driven out of an unsealed heater as it heats without causing damage. Check the machine GFI to see if it is adjustable to a higher but safe current leakage value setting to override until heaters dry out. This usually takes no more than a few minutes. If you know ahead of time that insulation resistance is low and nuisance GFI tripping can occur, heaters may be baked or dried at 121°C (250°F) for two to three hours. Where GFIs are known to be required in advance, specify the Watlow Euro Norm or moisture resistant option at no additional cost. Note that Euro Norm construction refers to specifications required to pass the European standard EN-60204.

Die and Former Heaters

Case History

FIREROD® Heaters Make OEM Blown Film Machine A Success

Problem:

A customer was experiencing difficulty processing engineered resins for a blown film line and decided to internally heat the screw of their extruder/gear-pump to optimizing the performance and production of the line.

Solution:

The screw was internally heated by a FIREROD® heater with an internal thermocouple for temperature control. With this approach, approximately 50 percent or more of the energy imparted to the resin came from direct thermal conduction rather than mechanically induced friction. Melting occurred simultaneously at the screw flight's root and the point of contact between the resin particles and barrel wall. In the conventional design, melting only occurred at the barrel wall.

The FIREROD heater's capability to provide multiple pin construction for increased ampacity, internal thermocouple for temperature control and direct hook-up to three-phase power supply were factors in selecting Watlow for this application.

Additional benefits of the new design included lower melt temperatures, higher throughput capacity and improved gear pump energy efficiency (lb/hr/hp).

Temperature Sensors

For complete information on Temperature Sensors reference pages 161 to 166.

Thermocouples

Manufactured to recognized agency standards, Watlow thermocouple temperature sensors deliver reliable, accurate temperature measurement.

Stock Type J thermocouple sensor assemblies meet the most popular demands of the plastics processing industry.

Made-to-order and non-stock ANSI Type E, K and T are also available.

Made-to-Order

If stock units do not meet your application needs, Watlow can custom manufacture to your special requirements. Consult your authorized Watlow Plastics Distributor for price and shipment details.

Available Styles

- Spring Adjustable Style
- Adjustable Armor Style
- Rigid Sheath Style
- Nozzle Style
- Stainless Steel Shim Style
- Newbury Nozzle Style
- Mineral Insulated Hot Runner Style
- Non-Contact Infrared

Temperature Sensors

Raytek® Family

Noncontact Temperature Measurement in Plastic Industries

Watlow offers Raytek infrared thermometers that monitor and control temperature in plastics manufacturing processes. These thermometers measure the temperature processes quickly and efficiently. They measure the temperature of the product directly, instead of the oven or the dryer, allowing you to quickly adjust process parameters to ensure top product quality.

Raytek's infrared thermometers are easily integrated into existing process control systems and have the following benefits:

- Non-destructive: the product is never touched or contaminated
- Fast and reliable: moving objects are measured accurately and quickly
- Flexible: temperature measurements can be made of a large area or a small spot

Small Size, Big Features

These products may be compact, but we haven't compromised features. Using advanced microfabrication techniques, Raytek reduced the cost and size of our sensors while retaining sophisticated features such as emissivity, signal conditioning and T-ambient processing. The wide temperature range in each model allows you to detect process variations and monitor start-up performance.

Infrared Thermocouple

If you're looking for a low-maintenance solution to thermocouples, consider the CI. The CI is a compact, integrated unit with the same output impedance as a thermocouple. It functions accurately—without offset errors—when used in conjunction with the thermocouple break protection circuitry in most controllers, displays and transmitters.

The CI has a rugged stainless steel housing to ensure continuous, long-term performance, even in environments with high ambient temperatures.

Hand Held Infrared Thermometer

Raytek offers hand held infrared thermometers to meet the demands of today's plastics processing applications. The wide temperature range of the Raynger® ST™ 20/30 can fit your need by providing the performance, accuracy and reliability you require.

Raytek Service Ensures Long Use

With over thirty years experience, Raytek knows infrared temperature measurement. Applications specialists are located around the world to help answer your technical questions. Each product includes a two-year warranty. In addition, maintenance, training, calibration and other customized services are available to ensure that you receive the maximum benefits from your Raytek infrared, noncontact thermometer.

For more information on Raytek infrared temperature measurement solutions, contact your Watlow authorized distributor or applications specialist.

Product	Temperature Range	Accuracy	Signal Processing	Display	Power Supply	Outputs
CI	0 to 500°C (32 to 932°F) w/ 2 models	2 percent	N/A	No	12-24V⎓(dc)	*J or K T/C, or mV

*Must specify at time of order.

Temperature Sensors

Problem Solvers

Watlow Solutions To Common Temperature Sensing Problems

Temperature sensing is a vital part of process using a thermal loop. Sensing product temperatures can eliminate problems, reduce costly down time and waste. Check the list below to see if your temperature sensing can be improved.

Contact Sensor Problem	Contact Sensor Solution
High process temperature causing premature sensor failure	• Use a mineral insulated thermocouple assembly
Sensor response too slow for changing temperatures	• Use a lower mass, 3.2 mm (0.125 in.) O.D. thermocouple assembly
Unable to reuse sensor removed from a compression fitting	• Use a thermocouple assembly with an adjustable compression fitting
Fiberglass insulation absorbing moisture or susceptible to contamination	• Use Teflon® insulated lead wire where temperature conditions permit
Process requires greater sensor accuracy than possible with thermocouples	• Use RTD sensors
Connector screws loosen during use	• Use a sensor with a molded-on connector
Sensor lead wires subject to high temperatures or contamination	• Use mineral insulated, metal-sheath cable
Application requires a custom sensor	• Made-to-order sensors, including; ANSI Types B, C*, E, J, K, N, R, S and T; DIN or JIS calibrated RTDs; positive or negative temperature coefficient thermistors

* Not an ANSI symbol

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

Case Histories

Grommet Style Thermocouple Replaces Thermostat, Improves Thermal Performance

Problem:

The extrusion coating and laminating industry demands dies that allow for accurate temperature control and fast adjustment to reduce or eliminate the extruded edge beads, thus providing for material savings associated with traditional overcoat in the process.

A Watlow customer manufactured several sizes of laminating machines that included heated shoe or platen dies. The dies were heated with cartridge heaters and the overall temperature was controlled with a cartridge style thermostat. The heater and thermostat were installed in parallel 15.9 mm (0.625 in.) diameter holes located at the ends of the platen.

The manufacturer wanted to achieve more precise platen temperature control. This necessitated replacing the thermostat with a solid state temperature controller and thermocouple temperature sensor.

Solution:

Watlow furnished a stock, ANSI Type J "grommet" thermocouple to replace the cartridge thermostat. The grommet thermocouple easily mounted with a small screw in the hole formerly used by the cartridge thermostat.

The grommet thermocouple offered easy access for retrofit and allowed continuous use of the existing cast platens. This thermocouple became the universal sensor for several styles of laminating machines.

Multipoint Thermocouple Solves Sensing Reliability

Problem:

A plastics manufacturer company had difficulty achieving its production monitoring objective of measuring the temperature gradient along an extruder barrel's length.

Their original design had several flaws:

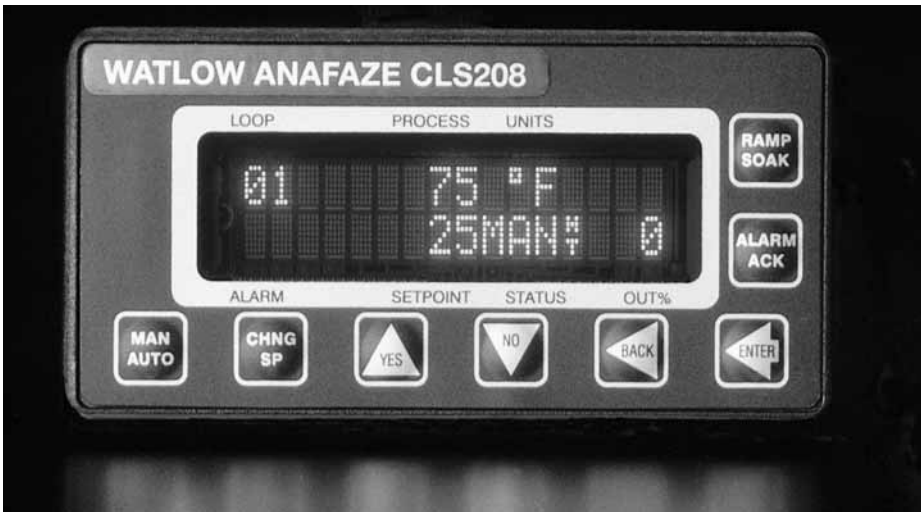
- An excessively expensive and complicated mechanical system used to move a single sensor through the gradient
- Sensor failure caused by movement-induced fatigue
- Reading inaccuracy caused by changing the sensor's gradient along its length

Solution:

Watlow vastly simplified the system while improving reliability and accuracy with a single, fixed-mounted multipoint sensor containing several sensor points. No modification was required on the extruder except removing the old, unreliable system.

Temperature Controllers

4-, 8-, 16-Loop CLS200



The Watlow CLS200 is a powerful line of controllers, combining performance and flexibility with compact design. The four, eight and 16-loop versions provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs is available, including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system, and includes built-in serial communications for computer interface and data acquisition. An enhanced features option offers cascade control, ratio control, differential control, process variable retransmit and remote analog set point.

The CLS200 controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

Features and Benefits

PID control of up to 16 heat and cool loops

- Minimal panel space per loop
- Reduced installation time
- More reliable: fewer parts means fewer failures

Auto-tune

- Less time tuning
- Achieve excellent control with less expertise

Menu-guided operation with full text display

- Quick controller setup
- Easy to operate

Eight jobs stored and recalled

- Quickly change from one process to another

Multiple and mixed inputs

- Simply change sensor types at the last minute
- Less to learn, less inventory

Sensor failure detection

- Reduces time troubleshooting reversed, shorted and open sensors

High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms and process variable retransmit

EIA/TIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

Firmware Options

Choose firmware with the features needed for the application:

- Standard—includes closed-loop PID control, auto-tune, alarms, job memory and failed sensor detection
- Extruder— includes the standard firmware features, with PID control specifically adapted for plastic extruders
- Enhanced Features— includes the standard firmware features with the addition of process variable retransmit, remote analog set point, cascade control, ratio control and differential control algorithms. Each channel can be configured for standard PID control or one of the other control algorithms. Each channel of cascade control or remote analog set point requires two controller channels. Unused control outputs on any channel can be configured for retransmit.

Because the CLS200 has no onboard analog outputs, applications that use process variable retransmit typically require one SDAC module per retransmitted signal.

Watlow's WATVIEW software is ideal to use with the CLS200. See page 180 for more information and ordering details.

UL® and C-UL® are registered trademarks of Underwriter's Laboratories, Inc.

Temperature Controllers

4-, 8-, 16-Loop CLS200

Specifications

Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller configuration can be loaded through the standard serial port

Analog Inputs

- CLS204 4 Differential
- CLS208 8 Differential
- CLS216 16 Single-ended

Noise Rejection

- 120db at 60Hz

Temperature Coefficient

- 40 ppm/˚C

Sensors/Inputs

- Thermocouples: User-selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: (CLS204 and CLS208 only) 2- or 3-wire, platinum, 100Ω @ 0˚C, DIN 0.003850Ω/˚C curve. Two user-selectable ranges offer different resolutions. Requires scaling resistors. See Special/ Linear Inputs in Ordering Information
- Linear: current and voltage signals from linear transmitters
- Pulse input

Input Range and Accuracy

Type B	66 - 1760°C	±4.0°C
	(150 - 3200°F)	(±7.2°F)
Type E	-200 - 787°C	±1.0°C
	(-328 - 1448°F)	(±1.8°F)
Type J	-212 - 760°C	±1.2°C
	(-350 - 1400°F)	(±2.2°F)
Type K	-268 - 1371°C	±1.3°C
	(-450 - 2500°F)	(±2.3°F)
Type R	-18 - 1766°C	±2.8°C
	(0 - 3210°F)	(±5.0°F)
Type S	-18 - 1760°C	±2.8°C
	(0 - 3200°F)	(±5.0°F)
Type T	-268 - 399°C	±1.6°C
	(-450 - 750°F)	(±2.9°F)

RTD's available on CLS204 and CLS208 only

	Range	Accuracy
(RTD1)	-100 - 275°C	1.1°C
	(-148 - 527°F)	(2.0°F)
(RTD2)	-120 - 840°C	1.6°C
	(-184 -1544°F)	(2.9°F)

Note: Accuracy @ 25˚C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 430°C to 1760°C (800˚F to 3200˚F.) RTD is for 100 percent of span

Linear Voltage and Current Inputs

Requires scaling resistors.
See Special Inputs in Ordering Information

0-10mA⎓(dc)
0-20mA⎓(dc)/4-20mA⎓(dc)
0-100mV⎓(dc)
0-500mV⎓(dc)
0-1V⎓(dc)
0-5V⎓(dc)
0-10V⎓(dc)
0-12V⎓(dc)

Other ranges available. Consult factory

Pulse Input

- One TTL-level square wave input up to 2kHz

Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- CLS204: 6 samples per second, (update time: 0.167 sec.)
- CLS208: 3 samples per second, (update time: 0.333 sec.)
- CLS216: 1.5 samples per second, (update time: 0.667 sec.)

Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

Calibration

- Automatic zero and full scale

Digital Inputs

- TTL-level used for selecting recipes or jobs or R/S triggers
- Eight inputs and one pulse input with 50-pin terminal board option
- Two inputs and pulse input or three inputs with 18-pin terminal block option

Digital Outputs

- 34 digital outputs are available with 50-pin terminal board option
- 10 control outputs with 18-pin terminal block option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V⎓(dc)
- 350mA at 5V⎓(dc) available from on-board supply

Analog Outputs

- Use DAC and SDAC accessory modules. For process variable retransmit, use SDAC only. See page 179.

Temperature Controllers

4-, 8-, 16-Loop CLS200

Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- User-programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

Serial Interface

- EIA/TIA-232 or EIA/TIA-485

Baud Rate

- 2400, 9600 or 19200, user-selectable

Communication Protocol

- Modbus™ RTU

Line Voltage/Power

- 15 to 24V⎓(dc) ± 3V⎓(dc) @ 1A (maximum), 300mA (no load)

Agency Approvals

- UL®, C-UL® listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

Dimensions

Overall

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth	203 mm	(8.0 in.)

Bezel

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth	25 mm	(1.0 in.)

Chassis

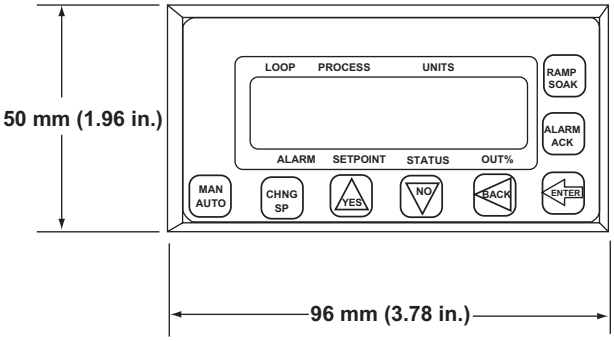
Height:	45 mm	(1.76 in.)
Width:	90 mm	(3.55 in.)
Depth	178 mm	(7.0 in.)

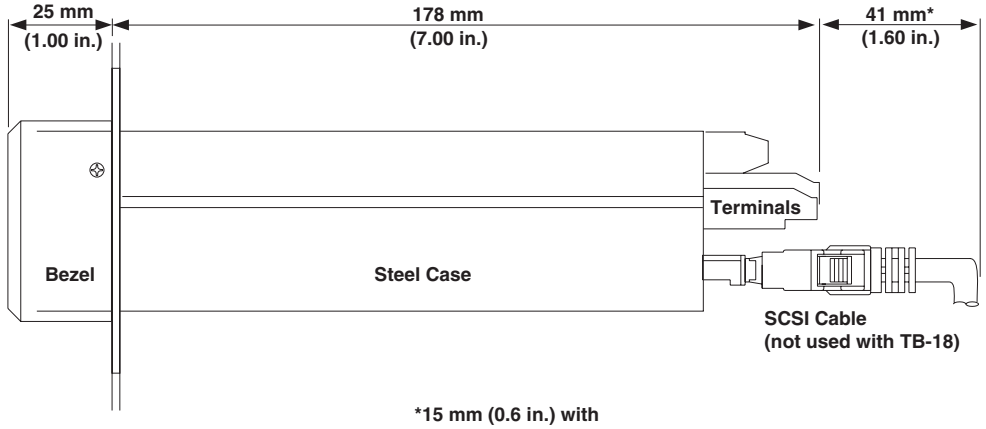
Controller Weight

0.9 kg (1.98 lbs)

Shipping Weight

1.8 kg (4.0 lbs)





*15 mm (0.6 in.) with Right Angle SCSI Connector

Modbus™ is a trademark of Schneider Automation Inc.

Temperature Controllers

4-, 8-, 16-Loop CLS200

Note: Controller is configured for thermocouples and -10 to 60mV⎓(dc) linear inputs. For other sensors order special inputs, see below. For analog outputs order DAC or SDAC modules, see page 179. For easy setup order WATVIEW software, see page 180.

Availability

Up to four weeks, depending on complexity and order release quantity. Consult factory for details.

Ordering Information

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

2 __ -

Number of Channels

04 = 4 channel
08 = 8 channel
16 = 16 channel

Controller Type

1 = Standard EPROM
2 = Extruder
3 = Ramp and soak
4 = Enhanced features

Terminal Block

0 = No terminal block accessory
1 = 18-pin terminal block (CLS204 and CLS208 only)
2 = 50-pin terminal block installed (includes 3 foot SCSI cable)

Power Supply

0 = No power supply
2 = 120/240V~(ac), 50/60Hz power supply adapter (5V⎓[dc], @ 4A, 15V⎓[dc] @ 1.2A) (CE approved)

SCSI Cables

0 = No SCSI cable (3 foot cable included with 50-pin terminal block)
1 = 6 foot SCSI cable
2 = 3 foot right angle SCSI cable
3 = 6 foot right angle SCSI cable

Serial Communication Cables

0 = No serial communications cable
1 = 10 foot serial communications cable (DB-9 female/bare wire)
2 = 25 foot serial communications cable (DB-9 female/bare wire)
3 = 50 foot serial communications cable (DB-9 female/bare wire)

Serial Communication Jumper Settings

0 = EIA/TIA-232
1 = EIA/TIA-485
2 = EIA/TIA-485 terminated

Special Inputs

(Standard unit is configured for thermocouples and -10 to 60 mV linear inputs. For other sensors, order special inputs. See below for ordering instructions. For CLS216 specify two digits, for CLS204 and CLS208 specify one digit.)

0 or 00 = Thermocouples and -10 to 60 mV inputs only
X or XX = Number of current, voltage or RTD inputs

CLSSI __ - __ -

Special/Linear Input Type

(Not required for thermocouple sensor inputs.)

20 = RTD 1: 0.1°, -100.0 to 275.0°C (-148.0 to 527.0°F) Not available on CLS216
21 = RTD 2: 1°, -120 to 840°C (-184 to 1544°F) Not available on CLS216
43 = 0-10mA⎓(dc)
44 = 0-20mA⎓(dc)/4-20mA⎓(dc)
50 = 0-100mV⎓(dc)
52 = 0-500mV⎓(dc)
53 = 0-1V⎓(dc)
55 = 0-5V⎓(dc)
56 = 0-10V⎓(dc)
57 = 0-12V⎓(dc)

Start Channel

XX = Channel number XX

End Channel

XX = Channel number XX

Temperature Controllers

CPC400

The Watlow CPC400 controllers provide performance and flexibility in a compact design and integrate full-featured closed-loop control with user-written logic. Programmable logic can interact with closed-loop control and operate I/O independently.

Four and eight loop versions offer complete control solutions for a broad range of applications. The CPC400 supports thermocouples, RTDs, linear voltage, current and frequency. Built-in diagnostics automatically detect sensor failures including open, shorted and reversed conditions. I/O can also be utilized for closed-loop control, alarms and user programs.

Using the built-in communications port, system designers can interface one or more controllers to a host computer for operator controls and data acquisition. The CPC400 offers PID, cascade, ratio and differential control strategies. Process variable retransmit and remote analog set point can be used to integrate the CPC400 with other devices such as chart recorders.

The CPC400 carries the CE mark and is UL® listed.

Features and Benefits

Combines control loops with programmable logic

- Easy integration of PID control and logic
- Less time reinventing PID control
- Augment closed-loop control with user-written logic
- Add custom functions to controller
- Reduces installation and setup time
- Requires less panel space
- Fewer parts reduces failures and increases reliability

Flexible, easy-to-use interfaces

- Easy setup with menu guided, full-text prompts
- Context-sensitive, on-screen help saves time
- WATVIEW software minimizes setup time
- Integrate with other serial devices using Modbus™
- Connect to system components via analog I/O to retransmit process variables and read set points

Advanced control utilities

- Auto-tune optimizes control with minimal effort and expertise
- Cascade minimizes overshoot and improves control in systems with excessive thermal lag
- Ratio and differential enhances control where the relationship between two or more loops is paramount

Specifications

Operator Interface

- 32-character vacuum florescent display
- Eight-key keypad to access guided menus and prompts, set values and view channel displays
- Controller's configuration can be loaded through the standard serial port
- Built-in context sensitive help

Noise Rejection

- 120dB at 60Hz

Temperature Coefficient

- 40ppm/°C

Programmable Logic

- Programming languages: Ladder Logic, Sequential Function Chart, Function Block Diagram
- Memory: 64k flash (nonvolatile)
- Logic programs run concurrently with closed loop control
- Read/write access: controller I/O and closed loop control parameters

Watlows WATVIEW and LOGICPRO software applications are ideal to use with the CPC400. See pages 180 and 275 for more information and ordering details.

Temperature Controllers

CPC400

Specifications Cont.

Analog Inputs

- Thermocouples: User selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: 2-or 3-wire, platinum, 100Ω @ 0°C, DIN curve. Requires scaling resistors. See Special/ Linear Inputs in Ordering Information
- Linear: current and voltage signals from linear transmitter
- Pulse input: One TTL-level square wave input up to 2kHz

Sensor Range

Sensor Range				Accuracy* at 25°C (77°F) Ambient
Type B	66	to	1760°C	±4.0°C
	(150	to	3200°F)	(±7.2°F)
Type E	-200	to	787°C	±1.0°C
	(-328	to	1448°F)	(±1.8°F)
Type J	-212	to	760°C	±1.2°C
	(-350	to	1400°F)	(±2.2°F)
Type K	268	to	1371°C	±1.3°C
	(-450	to	2500°F)	(±2.4°F)
Type R	-18	to	1766°C	±2.8°C
	(0	to	3210°F)	(±5.0°F)
Type S	-18	to	1760°C	±2.8°C
	(0	to	3200°F)	(±5.0°F)
Type T	-268	to	399°C	±1.6°C
	(-450	to	750°F)	(±2.9°F)
RTD	-200	to	621.1°C	±0.5°C
	(-328	to	1150°F)	(±0.9°F)

* True for 10 percent to 100 percent of span except Type B, which is specified for 430°C to 1760°C (800°F to 3200°F.)

Linear Voltage and Current Inputs

Requires scaling resistors. See Special/Linear Inputs in Ordering Information

0-10mA⎓(dc)

0-20mA⎓(dc)/4-20mA⎓(dc)

0-100mV⎓(dc)

0-500mV⎓(dc)

0-1V⎓(dc)

0-5V⎓(dc)

0-10V⎓(dc)

0-12V⎓(dc)

Other ranges available. Consult factory

Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- CPC404: 6 samples per second, (update time: 0.167 sec.)
- CPC408: 3 samples per second, (update time: 0.333 sec.)

Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

Calibration

- Automatic zero and full scale

Digital Inputs

- TTL level used for logic, remote alarm acknowledge, selecting recipes or jobs
- 8 inputs and 1-pulse input with 50-pin terminal board option
- 3 inputs (1 input configurable as pulse) with 18-pin terminal block option

Digital Outputs

- 34 digital outputs are available with a 50-pin terminal board option
- 11 outputs available with 18-pin terminal block option
- 1 or 2 control outputs are user assigned for each loop
- Each control output can be configured for on-off, time proportioning or distributed zero crossing
- Outputs sink up to 60mA each at 5V⎓(dc)
- 350mA at 5V⎓(dc) available from onboard supply

Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- User programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

Analog Outputs

- Use DAC and SDAC accessory modules. See page 179.

Serial Interface

- EIA/TIA-232 or EIA/TIA-485

Baud Rate

- 2400, 9600 or 19200, user selectable

Communication Protocol

- Modbus™ RTU

Line Voltage/Power

- 12 to 24V⎓(dc) @ 1A (loaded) or 300mA (no load)

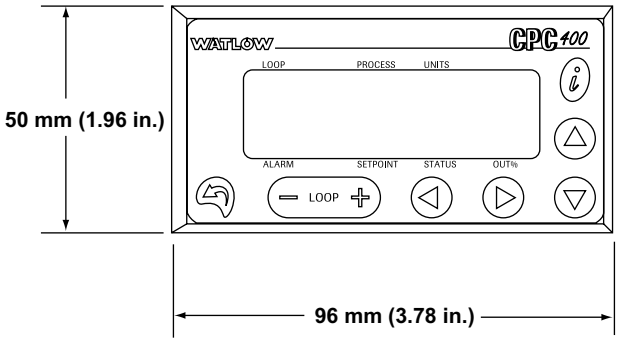
Agency Approvals

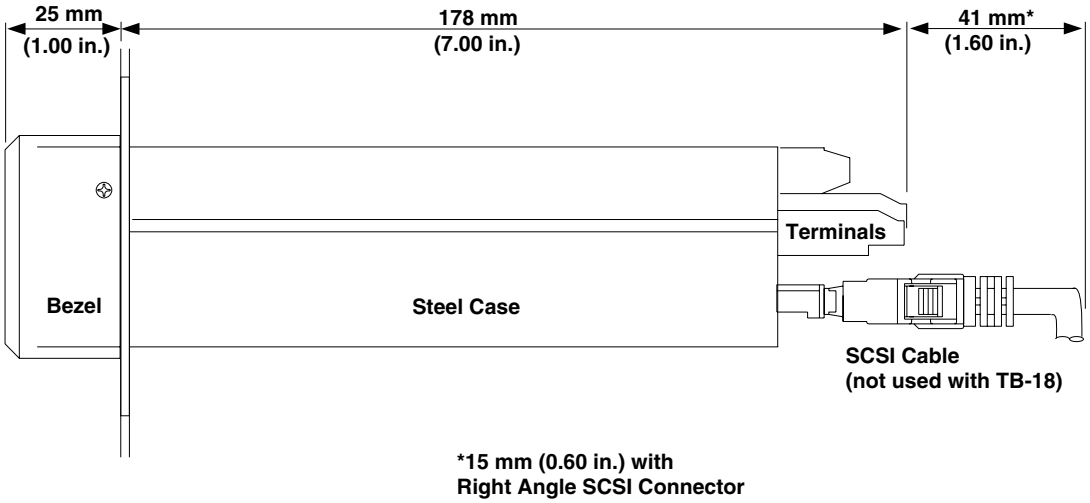
- UL®, C-UL® Listed: UL 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

Temperature Controllers

CPC400

Dimensions





*15 mm (0.60 in.) with
Right Angle SCSI Connector

Temperature Controllers

CPC400

Ordering Information

To order, complete the model number on the right with the information below.

4 0 - 1 _ _ _ _ _ _

Number of Loops
4 = 4 loops
8 = 8 loops

Controller Type
1 = Standard EPROM

Terminal Board
0 = No terminal board accessory
1 = 18-pin terminal block mounted on unit (no SCSI cable required)
2 = 50-pin terminal board (includes 3 foot SCSI cable)

Power Supply
0 = No power supply
2 = 120/240V~(ac), 50/60Hz power supply adapter (5V⎓[dc] @ 4A, 15V⎓[dc] @ 1.2A) (CE approved)

SCSI Cables (For use with 50-pin terminal board)
0 = No special SCSI cable (3 foot cable included with 50-pin terminal block)
1 = 6 foot SCSI cable
2 = 3 foot right angle SCSI cable
3 = 6 foot right angle SCSI cable

Serial Communication Cables (For communications with computer)
0 = No serial communication cable
1 = 10 foot serial communication cable (DB-9 female/bare wire)
2 = 25 foot serial communication cable (DB-9 female/bare wire)
3 = 50 foot serial communication cable (DB-9 female/bare wire)

Serial Communication Jumper Settings
0 = EIA/TIA-232
1 = EIA/TIA-485
2 = EIA/TIA-485 terminated

Special Inputs
(Standard unit is configured for thermocouples and -10 to 60mV linear inputs. For other sensors, order special inputs.)
0 = Thermocouples and -10 to 60mV inputs only
X = Number of current, voltage or RTD inputs

Special Inputs

Specify an input type for each channel or block of channels that needs factory installed resistors. Include a descriptor in the controller part description in the form specified below for each special input type. Make sure the number of special inputs specified is equal to the number of special inputs in the controller part number.

CPCSI _ _ - _ _ -

Special Input Type
(Not required for thermocouple sensor inputs)
23 = RTD
43 = 0-10mA⎓(dc)
44 = 0-20mA⎓(dc)/4-20mA⎓(dc)
50 = 0-100mV⎓(dc)
52 = 0-500mV⎓(dc)
53 = 0-1V⎓(dc)
55 = 0-5V⎓(dc)
56 = 0-10V⎓(dc)
57 = 0-12V⎓(dc)

Start Channel
XX = Channel Number XX

End Channel
XX = Channel Number XX

Availability

Up to 4 weeks, depending on complexity and order release quantity. Consult factory for details.

Temperature Controllers

16-, 32-Loop MLS300

The Watlow MLS300 is a powerful line of controllers that combine performance and flexibility with compact design. The 16 and 32-loop versions provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs is available; including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system, and includes built-in serial communications for computer interface and data acquisition. The enhanced features option offers cascade, ratio and differential control, process variable retransmit and remote analog set point.

The remote analog input options allow for shorter sensor wires and flexible mounting which reduces sensor cost and installation time. Watlow's new CIM option provides OEMs with a space and labor saving alternative to the standard AIM module. This innovation allows users to construct a wiring harness to attach sensors via a connector instead of connecting individual wires to the controller.

The MLS300 controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

Features and Benefits

PID control of up to 16 heat and cool loops or 32 heat loops

- Minimal panel space per loop
- Reduces installation time
- More reliable: fewer parts mean fewer failures

Auto-tuning

- Less time tuning
- Achieve excellent control with less expertise

Menu guided operation with full text display

- Quick controller setup
- Easy to operate

Eight jobs stored and recalled

- Quickly change from one process to another

Multiple and mixed inputs

- Simply change sensor types at the last minute
- Less to learn, less inventory

Sensor fail detection

- Reduces time troubleshooting reversed, shorted and open sensors

High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

TIA/EIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms and process variable retransmit

CIM300 option

- Small footprint per loop
- Reduced installation time

Watlow WATVIEW software is ideal to use with the MLS300. See page 180 for more information and ordering details.

Temperature Controllers

16-, 32-Loop MLS300

Specifications

Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller's configuration can be loaded through the standard serial port

Analog Inputs

- MLS316: 16 Differential
- MLS332: 32 Differential

Noise Rejection

- 120dB at 60Hz

Temperature Coefficient

- 40 ppm/°C

Temperature Sensors

- Thermocouples: User selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: 2- or 3-wire, platinum, 100Ω @ 0°C, DIN 0.003850Ω/°C curve. Two user-selectable ranges offer different resolutions. Requires special inputs. See Ordering Information

Input Range and Accuracy

	Range	Accuracy
Type B	66 - 1760°C	±4.0°C
	(150 - 3200°F)	(±7.2°F)
Type E	-200 - 787°C	±1.0°C
	(-328 - 1448°F)	(±1.8°F)
Type J	212 - 760°C	±1.2°C
	(-350 - 1400°F)	(±2.2°F)
Type K	-268 - 1371°C	±1.3°C
	(-450 - 2500°F)	(±2.3°F)
Type R	-18 - 1766°C	±2.8°C
	(0 - 3210°F)	(±5.0°F)
Type S	-18 - 1760°C	±2.8°C
	(0 - 3200°F)	(±5.0°F)
Type T	-268 - 399°C	±1.6°C
	(-450 - 750°F)	(±2.9°F)
RTD1 (DIN)	-100.0 - 275.0°C	±1.1°C
	(-148.0 - 527.0°F)	(±2.0°F)
RTD2 (DIN)	-120 - 840°C	±1.6°C
	(-184 - 1544°F)	(±2.9°F)

Note: Accuracy @ 25°C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C (800°F) to 1760°C (3200°F). RTD is for 100 percent of span

Linear Voltage and Current Inputs

Requires special inputs.
See Ordering Information

0-10mA⎓(dc)
0-20mA⎓(dc)/4-20mA⎓(dc)
0-100mV⎓(dc)
0-500mV⎓(dc)
0-1V⎓(dc)
0-5V⎓(dc)
0-10V⎓(dc)
0-12V⎓(dc)

Other ranges available. Consult factory

Pulse Input

One TTL-level square wave input up to 2kHz

Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- MLS316: 1.5 samples per second, (update time: 0.667 sec.)
- MLS332: 0.75 samples per second, (update time: 1.33 sec.)

Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

Calibration

- Automatic zero and full scale

Digital Inputs

- TTL level used for selecting recipes or jobs, or R/S triggers
- Eight inputs and one pulse input with 50-pin terminal board option

Digital Outputs

- 34 outputs available with 50-pin terminal board option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off, time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V⎓(dc)

Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- Programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

Analog Outputs

- Use DAC and SDAC accessory modules. For process variable retransmit, use SDAC only, see page 179.

Temperature Controllers

16-, 32-Loop MLS300

Serial Interface

- EIA/TIA-232 or EIA/TIA-485

Baud Rate

- 2400, 9600 or 19200, user-selectable

Communication Protocol

- Modbus™ RTU

Line Voltage/Power

- 15 to 24V⎓(dc) ± 3V⎓(dc) @ 1A

Agency Approvals

- UL®, C-UL® Listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

Firmware Options

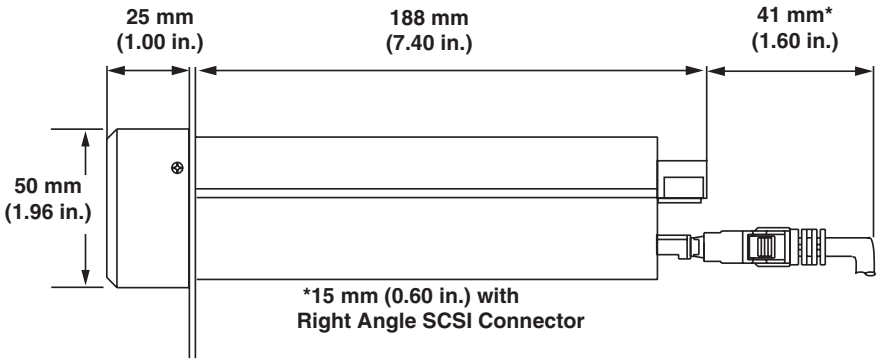
Choose firmware with the features needed for the application:

- Standard—includes closed-loop PID control, auto-tune, alarms, job memory and failed sensor detection
- Extruder— includes the standard firmware features, with PID control specifically adapted for plastic extruders
- Enhanced Features— includes the standard firmware features with the addition of process variable retransmit, remote analog set point, cascade control, ratio control and differential control algorithms. Each channel can be configured for standard PID control or one of the other control algorithms. Each channel of cascade control or remote analog set point requires two controller channels. Unused control outputs on any channel can be configured for retransmit

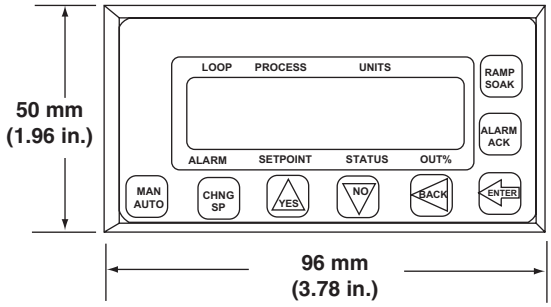
Input Module Options

Choose the input module appropriate for the application:

- AIM316 and AIM332 provides screw terminations for 16 or 32 sensors
- CIM316 and CIM332 provides DB-50 connector terminations for 16 or 32 sensors in a compact size



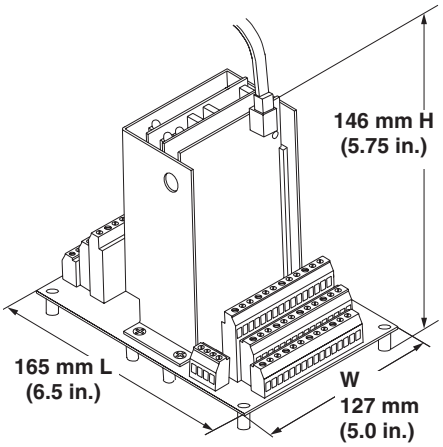
Processor Module (Side)



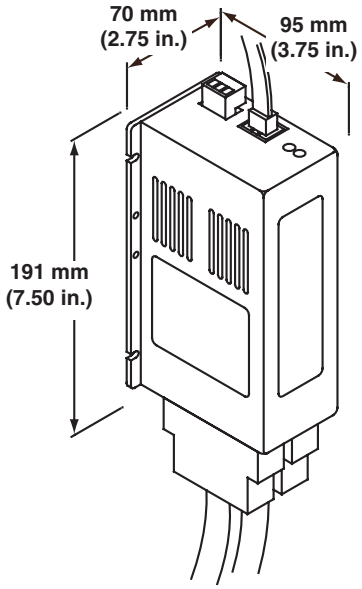
Processor Module (Front)

16-, 32-Loop MLS300

Analog Input Module (AIM332 shown)



Compact Input Module (CIM332 shown)



Availability

Up to four weeks depending on complexity and order release quantity. Consult factory for details.

Ordering Information

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

3 - _ _ _ _ _ _ _ _ _

Input Module
16 = 16 channel analog input module (AIM316)
32 = 32 channel analog input module (AIM332)
C1 = 16 channel compact input module (CIM316)
C2 = 32 channel compact input module (CIM332)

Processor Module (MLS300-PM)
0 = Input module only (No MLS300-PM)
1 = MLS300-PM with standard firmware
2 = MLS300-PM with extruder firmware
3 = MLS300-PM with enhanced features firmware
4 = MLS300-PM with ramp and soak firmware

Terminal Block
0 = No terminal block accessory
1 = 50-pin terminal block, includes 3 foot SCSI cable

Power Supply
0 = None
2 = 120/240V~(ac) 50/60Hz power supply adapter [5V⎓(dc) @ 4A, 15V⎓(dc) @ 1.2A] CE approved

SCSI Cables (For use with 50-pin terminal board)
0 = No special SCSI cable (3 foot cable is included with 50-pin terminal board)
1 = 6 foot SCSI cable
2 = 3 foot right angle SCSI cable
3 = 6 foot right angle SCSI cable

Serial Communication Cables (For communications with computer)
0 = No serial communications cable
1 = 10 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
2 = 25 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
3 = 50 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
7 = EIA/TIA-485 terminal block with 2 foot cable
8 = EIA/TIA-485 terminal block with 4 foot cable

Module Interconnect Cables
0 = No special cable (4 foot cable comes with input module)
1 = 10 foot cable, RJ45 connector/RJ45 connector
2 = 25 foot cable, RJ45 connector/RJ45 connector

Serial Communication Jumper
0 = EIA/TIA-232
1 = EIA/TIA-485
2 = EIA/TIA-485 terminated

Special Inputs
(Standard unit is configured for thermocouples and -10 to 60 mV linear inputs. For other sensors, order special inputs)
00 = Thermocouples and -10 to 60 mV inputs only
XX = Number of current, voltage, or RTD inputs. Include leading zero as needed

MLS300SI _ _ - _ _ - _ _

Special Input Type
20 = RTD 1: 0.1° Platinum, -100 to 275°C (-148 to 527°F)
21 = RTD 2: 1° Platinum, -120 to 840°C (-184 to 1544°F)
43 = 0-10mA⎓(dc)
44 = 0-20mA⎓(dc)/4-20mA⎓(dc)
50 = 0-100mV⎓(dc)
52 = 0-500mV⎓(dc)
53 = 0-1V⎓(dc)
55 = 0-5V⎓(dc)
56 = 0-10V⎓(dc)
57 = 0-12V⎓(dc)

Start Channel
XX = Channel number XX

End Channel
XX = Channel number XX

Temperature Controllers

PPC-2000

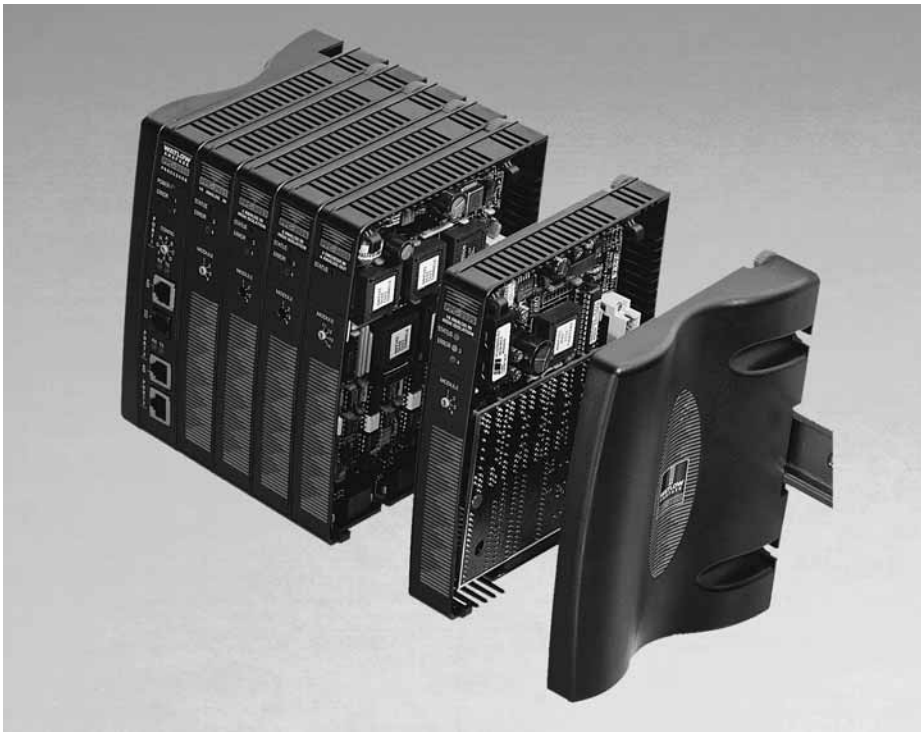
The Watlow PPC-2000 is a powerful, multi-loop programmable process control system that is ideal for extrusion equipment rebuilds. It combines easy-to-set up multi-loop process control and programmable logic control in one integrated package. Its modular design enables users to select a set of hardware and develop a logic control program based on their specific control loop and logic application, making it ideal for integration houses.

The PPC-2000 controls up to 48 PID loops and supports additional analog inputs for logic programming or monitoring. It accepts multiple sensor inputs including thermocouples, RTDs, linear dc voltage or current inputs and counters. The base system has 46 digital I/O for temperature control or programmable logic. Plug-in I/O modules expand the capacity of the base system. Options include modules for pulse inputs, current and voltage analog outputs, digital inputs for ac and dc signals and relay outputs.

Two serial communication ports support read/write access by a host computer and/or operator interface panel using Modbus™ RTU protocol. ANAWIN® 3, the PPC-2000's Human Machine Interface (HMI) software makes it easy to configure, monitor and customize applications.

LOGICPRO, graphical logic programming software package allows integration of programmable logic functionality into this new breed of multi-loop controller. Develop with easy-to-use drag and drop tools, then simulate and debug your program before downloading to the PPC-2000.

Windows® is a registered trademark of the Microsoft Corporation.



Features and Benefits for End Users

Reduction in downtime from control system issues

- Results in higher process yield from uninterrupted cycles leading to additional profit
- Enhances workforce efficiency with easy viewing software and overall process management
- Saves employee time and effort. Data provided with PPC-2000 through trend plotting, data logging, etc., is invaluable for troubleshooting and process optimization

Dual hosting

- Offers flexible system security for different types of users at office and machine levels

Windows®-based system

- Provides excellent visual representation, color coding of processes within the line, trend plotting, alarms, etc.
- Results in less downtime due to ease-of-use

Customizable screens

- Offer special screen views for heat zones of extruder dies in inventory, providing a universal operator understanding of process view, regardless of die supplier
- Allow process parameters to be color-coded; alarm settings, event logs, histograms, etc.

Recipe management

- Permits job storage parameters for line or die changes

Applications

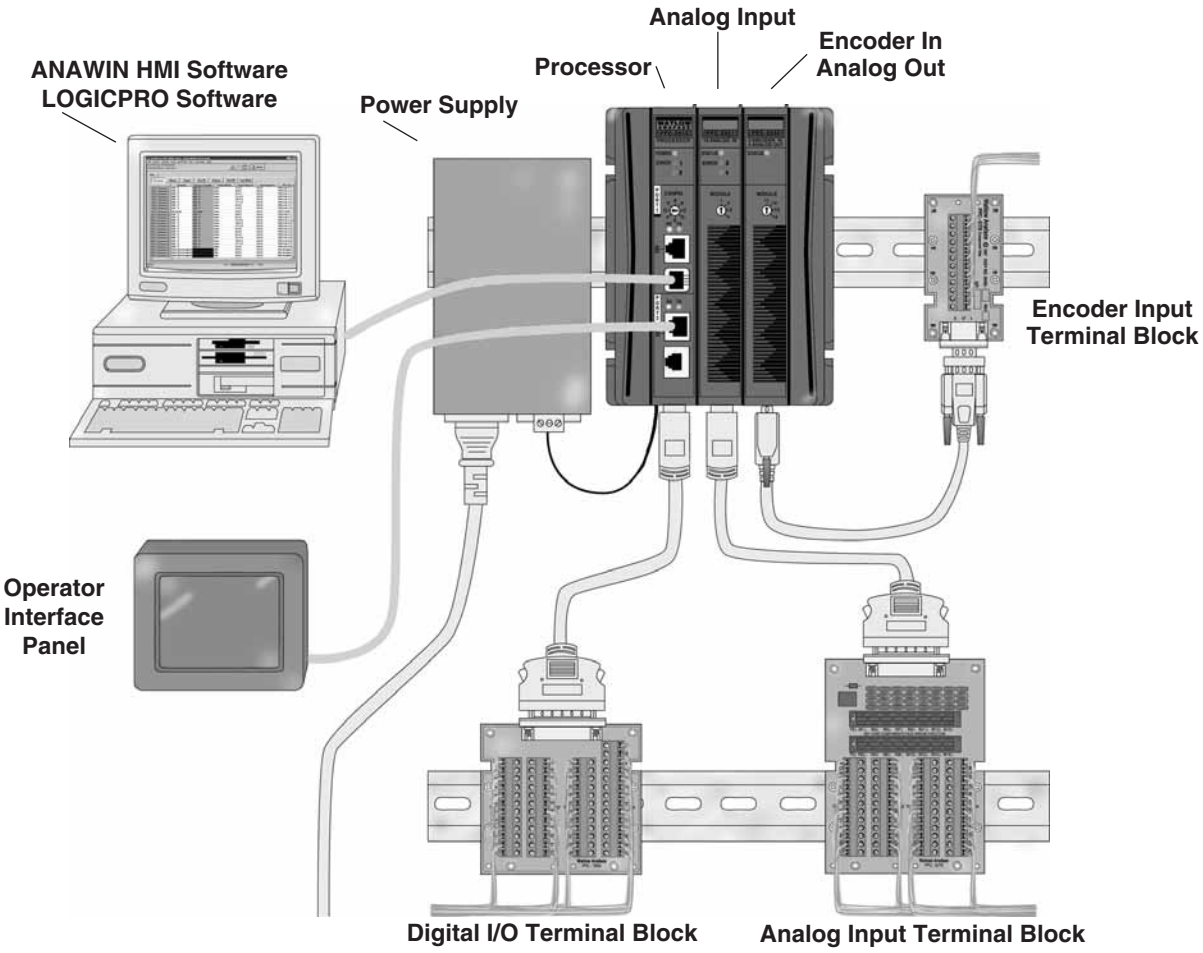
- Plastic extrusion and thermoforming equipment
- Electronic packaging equipment
- Applications requiring 16 or more temperature or analog inputs

Watlow's ANAWIN®3 and LOGICPRO software applications are ideal to use with the PPC-2000. See pages 274 and 275 for more information and ordering details.

Temperature Controllers

PPC-2000

PPC-2000 Single Controller System



PPC-2000 System

Specifications

General

- System power: 12-28V⎓(dc)
- Storage temperature: -20°C to 70°C (-4°F to 158°F)
- Operating temperature: 0°C to 60°C (32°F to 140°F)
- Humidity: 10 to 95 percent, non-condensing
- Mounting: DIN-rail or panel mount
- Module dimensions: 203.2 mm (8.0 in.) H x 82.6 mm (3.25 in.) W x 133.4 mm (5.25 in.) D (add 24.38 mm (0.96 in.) width for each additional module)

CPU Specifications

- Maximum number of modules per system: 10
- Communications: 2 serial ports, EIA-232/EIA-485
- Protocol: Modbus™ RTU
- Programmable logic: Ladder, SFC, FBD
- HMI: ANAWIN3, Windows®95/98/NT/2000/XP

Process Control Specifications

- Control modes: P, PI, PID or on-off
- Outputs/loop: 2; heat, cool or heat/cool
- Control loops: 48 max.
- PID tuning: auto-tune or manual
- Output types: time proportioning, distributed zero crossing or analog
- Alarms: high/low process, deviation with configurable outputs

Safety and Agency Approvals

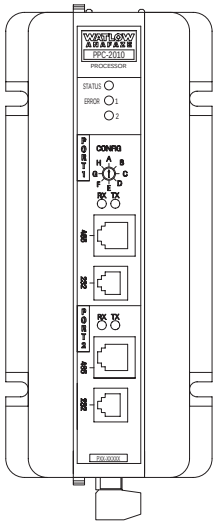
- UL® & C-UL® 3121-1 Listed, File E212113
- CE Safety EN 61010-1
- CE EMC EN 61326, EN 55011 (PPC-2030 excepted)

Temperature Controllers

PPC-2000

PPC-2010 - Processor Module

The PPC-2010 executes PID process control and programmable logic control. This unit contains the CPU, memory, communi-cations and digital I/O.



Specifications

General

- Memory: 512kB flash, 128kB RAM (battery backed)

Digital Inputs and Outputs

- Number of digital I/O: 46 (24 input or output, 22 output only)
- 2 system outputs: System safe, global alarm
- Input limiting and protection: 40V⎓(dc)
- Input logic levels: <0.6V⎓(dc) = Low; >3.8V⎓(dc) = High
- 1 counter input up to 10kHz (16 bit)
- Output current capacity: 100mA continuous sink to power common
- Maximum voltage on outputs: 24V⎓(dc)

Communication Ports

- Ports 1& 2: EIA/TIA-232 3-wire or EIA/TIA-485 5-wire, isolated
- Baud rate: 19,200 or 9,600

TB50-SCSI - Digital I/O Terminal Board

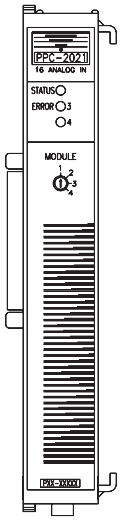
The PPC-TB50-1 connects to the PPC-2010 or PPC-2040 through a SCSI cable. The terminal board is used to interface field wiring to the PPC-2010 or PPC-2040.

Specifications

- Dimensions: 104 mm (4.1 in.) H x 102 mm (4.0 in.) W x 40.6 mm (1.6 in.) D
- Number terminal points: 50
- Mounting: DIN-rail or panel mount
- Discrete terminal type: Captive screw cage clamp

PPC-202X - Analog Input Module

Analog input modules accept a wide variety of signals. A single module can easily be configured for any combination of thermocouple, RTD, linear voltage and linear current signals. Analog input modules are available with high isolation and standard isolation.



Specifications

General

- Maximum number of modules per system: 4

Input

Thermocouple and RTD Ranges

Type	Range	Total Accuracy
B:	0 to 1820°C (32 to 3308°F)	±3.8° (±5.9°F)
C:	0 to 2316°C (32 to 4200°F)	±1.5°C (±2.8°F)
D:	0 to 2316°C (32 to 4200°F)	±1.5°C (±2.8°F)
E:	-270 to 661°C (-454 to 1221°F)	±0.9°C (±1.8°F)
F*:	0 to 1232°C (32 to 2250°F)	±2.3°C (±4.1°F)
G:	0 to 2316°C (32 to 4200°F)	±1.5°C (±2.8°F)
J:	-210 to 870°C (-346 to 1598°F)	±1.2°C (±2.1°F)
K:	-270 to 1232°C (-454 to 2249°F)	±2.2°C (±3.9°F)
N:	-270 to 1300°C (-454 to 2372°F)	±1.5°C (±2.7°F)
R:	-50 to 1768°C (-58 to 3215°F)	±2.4°C (±4.6°F)
S:	-50 to 1768°C (-58 to 3215°F)	±2.3°C (±5.6°F)
T:	-270 to 400°C (-454 to 752°F)	±1.2°C (±2.1°F)
RTD:	-240 to 272°C (-400 to 521°F)	±0.4°C (±0.8°F)

*Also known as Platinel® II

- Differential inputs: PPC-2021, PPC-2024, PPC-2025
- Single-ended inputs: PPC-2022
- Input types supported: thermocouples, 100Ω Platinum RTD, linear voltage, linear current
- Isolation from input to bus: 500V⎓(dc) continuous
- Isolation from input to input (PPC-2021): ±60V~(ac)
- Isolation from input to input (PPC-2024, 2025): 240V~(ac)

Platinel® is a registered trademark of Englehard Industries.

Temperature Controllers

PPC-2000

PPC-202X - Analog Input Module Cont.

- Isolation between input and frame ground: 120V~(ac)
- DC voltage input range: ranges selectable 0-50mV, 0-100mV, 0-500mV, 0-1V, 0-5V or 0-10V
- DC mA input range: ranges selectable 0-20mA or 4-20mA
- T/C open detect: 2.5kΩ or more (upscale)
- Resolution: 0.003 percent greater than 15 bits
- Accuracy (voltage at 25°C (75°F)): 0.05 percent, 0.1 percent (PPC-2022)
- Accuracy (current at 25°C (75°F)): 0.1 percent, 0.75 percent (PPC-2022)
- Temperature coefficient: <50ppm/°C, 0.005 percent/°C
- Input sample and PID update rate PPC-2024: 220ms, 8 channels (4.5Hz)

  PPC-2021, PPC-2025: 380ms, 16 channels (2.6Hz)

  PPC-2022: 666ms, 32 channels (1.5Hz)

PPC-AITB-1 - Analog Input Terminal Board

Sensor wires are terminated on a terminal board. A cable connects the analog input module to the terminal board.

Specifications

General

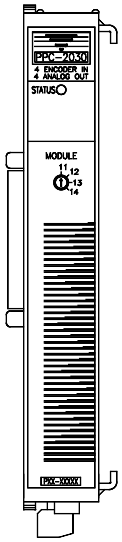
- Dimensions: 129.5 mm (5.1 in.) H x 106.7 mm (4.2 in.) W x 58.4 mm (2.3 in.) D
- Mounting: DIN-rail or panel mount
- Discrete terminal type: captive screw cage clamp

Sensor Keys

The PPC-AITB-1 sensor inputs can be individually configured with sensor keys to accept thermocouples, RTDs, linear voltage and current. Sensor keys used with PPC-2022 configure 2 input channels.

PPC-2030 - Encoder Input Analog Output Module

The PPC-2030 module accepts input signals from high speed pulse output devices such as encoders and generates analog output signals to control variable frequency drives, SCRs and other devices.



Specifications

General

- Maximum number of modules per system: 4

Input System

- Pulse inputs: 4 (high speed counter or encoder)
- Maximum input frequency: 10kHz (single-phase), 32 kHz (quadrature)
- Count range: 16 bits
- Sample rate: 250ms to sample all 4 inputs (4Hz)

Output

- Analog outputs: 4 individually isolated analog outputs
- Isolation: 120V~(ac) to power common or ground
- Resolution: 12 bits
- Range (voltage mode): 0 to +10V @ 10mA max
- Accuracy (voltage mode): 0.3 percent of reading ±0.5 percent of range at 25°C (75°F)
- Range (current mode): 0 to 20mA with 8V minimum compliance (400Ω load)
- Accuracy (current mode): 1.5 percent of reading ±0.2 percent of range at 25°C (75°F)
- Output update time: 0.1 sec

PPC-EITB-1 - Encoder Input Terminal Board

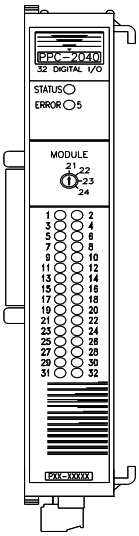
Pulse signal wires are terminated on a terminal board. A cable connects the module to the terminal board.

Specifications

- Dimensions: 101.6 mm (4.0 in.) H x 51 mm (2 in.) W x 38.1 mm (1.5 in.) D
- Mounting: DIN-rail or panel mount
- Discrete terminals: captive screw

PPC-2040 - Digital I/O Module

The PPC-2040 accepts input signals from on-off sensors and high speed pulse output devices. It also drives actuators, relays, etc. Each output is user configurable for control, alarms or logic. Each I/O is user selectable as input or output. Field wiring is terminated on the TB50-SCSI terminal board.



Temperature Controllers

PPC-2000

PPC-2040 - Digital I/O Module Cont.

Specifications

General

- Each point selectable as input or output
- 2 points selectable as input, output or counter/frequency
- Maximum number of modules per system: 6

Counter/Frequency

- Number: 2
- Maximum frequency: 10kHz (single-phase)
  32kHz (quadrature)
- Sample rate: 250 ms (4Hz)
- Count range: 16 bits

Digital Input

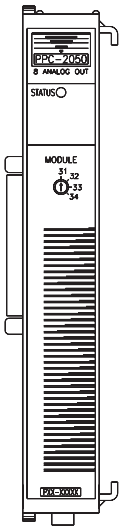
- Number: 32
- Voltage limiting and protection: 40V⎓(dc)
- Logic levels: <0.6V⎓(dc) = Low; >3.8V⎓(dc) = High

Digital Output

- Number: 32
- Maximum voltage: 24V⎓(dc)
- Maximum current: 150mA sink to common

PPC-205X - Analog Output Module

The PPC-205X module generates analog output signals to control power controllers, variable frequency drives and other devices. The analog output module is available with 4 or 8 outputs.



Specifications

General

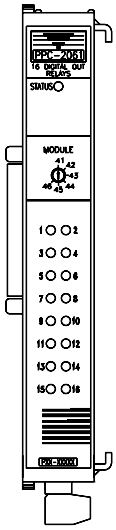
- Maximum number of modules per system: 4

Output

- Number: 4 (isolated) or 8 (pair isolated)
- Current or voltage selectable
- Isolation from power common and earth ground: 120V~(ac)
- Isolation from output to output (PPC-2051): 120V~(ac)
- Isolation between output pairs (PPC-2050): 120V~(ac)
- Voltage range: 0-10V⎓(dc) @ 10mA maximum
- Current range: 0-20mA with 8V maximum compliance (400Ω load)
- Accuracy: ±0.5 percent voltage, ± 0.8 percent current of range at 25°C (75°F)
- Output update time: 0.1 second
- Resolution: 12 bit

PPC-206X - Digital Output Module

The PPC-206X relay output drives actuators, pilot lights and other devices. Each output is user configurable for alarms or logic. The digital output module is available with 8 or 16 relays.



Specifications

General

- Output status LEDs
- Maximum number of modules per system: 6

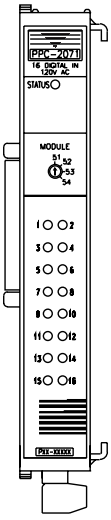
Output

- Number: 8 or 16
- Contact voltage rating: 240V~(ac), 30V⎓(dc)
- Relay type: Form A (SPST, NO on fault or inactive)
- Isolation: 240V~(ac) to power common or ground
- Maximum load current: 2A per relay (PPC-2062), 1A per relay, 5A per common (PPC-2061)
- Commons: 8 (PPC-2062), 2 (PPC-2061)

PPC-2000

PPC-207X - Digital Input Module

The PPC-207X accepts input signals from on-off sensors. The digital input module is available with 8 or 16 inputs.



Specifications

General

- Input status LEDs
- Maximum number of modules per system: 4

Input

- Number: 8 or 16
- Input range: 70-120V~(ac) ± 10 percent (PPC-2070/1), 12-24V≂(ac/dc) ± 10 percent (PPC-2072/3)
- Input response time: 32ms, 64 ms 12-20V~(ac)
- Logic levels: < 20V~(ac) = Low, >70V~(ac) = High (PPC-2070/1); < 3V⎓(dc) = Low, >10V⎓(dc) = High (PPC-2072/3)

PPC-IPS-2 - Power Supply

The PPC-IPS-2 supplies power to a PPC-2000 system which requires a 12 to 28V⎓(dc) power source. The power supply also provides 5V⎓(dc) to drive digital outputs on the processor module.

Specifications

General

- Dimensions: 114.3 mm (4.5 in.) H x 48.3 mm (1.9 in.) W x 215.9 mm (8.5 in.) D
- Mounting: DIN-rail or panel mount
- Input voltage: 120/240V~(ac), 50/60Hz
- Output voltage:
  V1 +5V⎓(dc) at 6 amps
  V2 +24V⎓(dc) at 4 amps
- Peak current output: 9A @ 5V⎓(dc); 6A @ 24V⎓(dc)
- Agency approvals: CE, UL® and C-UL® recognized

PPC-2010 - Processor Module

Ordering Information

To order, complete the model number on the right with the information below.

P P C - 2 0 1 0 -

The PPC-2010 Processor Module includes ANAWIN3-CNF software for PPC-2000 configuration only and a TB50-SCSI digital I/O terminal board. A PPC-2000 system can have up to 10 modules.

Processor Module (with TB50)

Digital I/O Cable
(Cable from module to terminal board)
1 = 3 foot cable (CA-SCSI-3)
2 = 6 foot cable (CA-SCSI-6)

Communication Cable
(Cable between processor and host computer)
1 = 10 foot EIA/TIA-232 cable, Handset plug to DB9F (CA-232-DB910)
2 = 25 foot EIA/TIA-232 cable, Handset plug to DB9F (CA-232-DB925)
3 = 50 foot EIA/TIA-232 cable, Handset plug to DB9F (CA-232-DB950)
4 = 10 foot EIA/TIA-232 cable, Handset plug to DB25F (CA-232-DB2510)
5 = 25 foot EIA/TIA-232 cable, Handset plug to DB25F (CA-232-DB2525)
6 = 50 foot EIA/TIA-232 cable, Handset plug to DB25F (CA-232-DB2550)
A = EIA/TIA-485 terminal block with 2 foot cable
B = EIA/TIA-485 terminal block with 4 foot cable

Power Supply
(DC power for the PPC-2000)
0 = No power supply (customer provides own supply)
2 = PPC-IPS-2 supply; 24V⎓(dc) @ 4 A and 5V⎓(dc) @ 6A

Temperature Controllers

PPC-2000

PPC-202X - Analog Input Module

Ordering Information

To order, complete the model number on the right with the information below.

P P C - 2 0 2 __ - __

Order up to four modules per system to accommodate sensor inputs. Do not exceed 128 inputs total. Only 48 inputs may be used for control. All modules accept T/Cs, current and voltage inputs. Only differential input modules accept RTDs. The high isolation modules provide 240V~(ac) protection between inputs and 120V~(ac) protection between input and ground. Each module includes an analog input terminal board with T/C/linear voltage keys (PPC-AITB-1). For other sensor input keys, see the special inputs section below.

Analog Input Modules (with AITB)

1 = 16 channel module, differential inputs (PPC-2021)
2 = 32 channel module, single-ended inputs (PPC-2022)
3 = 4 channel high isolation module, differential inputs (PPC-2023)
4 = 8 channel high isolation module, differential inputs (PPC-2024)
5 = 16 channel high isolation module, differential inputs (PPC-2025)

Analog Input Cable

(Cable from module to terminal board)
1 = 3 foot cable (CA-SCSI-3)
2 = 6 foot cable (CA-SCSI-6)

PPC-SIKX - PPC Special Input Keys

Ordering Information

To order, complete the model number on the right with the information below.

P P C - S I K __

Each analog input terminal board ships configured with T/C sensor keys (this key can be also used for linear voltage). For other sensor types, choose from the special inputs below.

Input Type

1 = Single ended current (two inputs per key)
2 = Differential current 0-20mA (one input per key)
3 = 3-wire RTD (one input per key)

Note:
Contact the factory for fixed-configuration, analog input terminal boards in quantity.

PPC-2000

PPC-2030 - Encoder Input/Analog Output Module

Ordering Information

To order, complete the model number on the right with the information below.

P P C - 2 0 3 0 - _ _ _

Order up to four modules per system. The PPC-2030 includes four counter or encoder inputs and four analog outputs. Optional encoder input terminal boards with 10 foot or 25 foot cables are available to connect up to two counter or encoder inputs each to the PPC-2030. To connect directly to an encoder without a terminal board, a cable kit is available. The kit includes connector parts only, the customer provides the cable.

Encoder Input/Analog Output Module

Encoder Inputs 1 and 2
1 = Encoder input terminal board with 10 foot cable (PPC-EITB-1-10)
2 = Encoder input terminal board with 25 foot cable (PPC-EITB-1-25)
3 = Encoder input connector kit (customer makes cable)

Encoder Inputs 3 and 4
1 = Encoder input terminal board with 10 foot cable (PPC-EITB-1-10)
2 = Encoder input terminal board with 25 foot cable (PPC-EITB-1-25)
3 = Encoder input connector kit (customer makes cable)

PPC-2040 - Digital I/O Module

Ordering Information

To order, complete the model number on the right with the information below.

P P C - 2 0 4 0 - _

Order up to six modules per system. A separate terminal board is included to interface with devices.

Digital I/O Cable (Cable from module to terminal board)
1 = 3 foot cable (CA-SCSI-3) 2 = 6 foot cable (CA-SCSI-6)

PPC-205X - Analog Output Module

Ordering Information

To order, complete the model number on the right with the information below.

P P C - 2 0 5 _

Order up to four modules per system.
The terminal block is built into the module.

Quantity of Outputs
0 = 8 analog outputs 1 = 4 analog outputs

PPC-206X - Digital Output Module

Ordering Information

To order, complete the model number on the right with the information below.

P P C - 2 0 6 _

Order up to six modules per system.
The terminal block is built into the module.

Quantity of Outputs
1 = 16 relay outputs 2 = 8 relay outputs

PPC-207X - Digital Input Module

Ordering Information

To order, complete the model number on the right with the information below.

P P C - 2 0 7 _

Order up to four modules per system.
The terminal block is built into the module

Quantity and Type of Inputs
0 = 8 point 120V~(ac) 2 = 8 point 24V≂(ac/dc)
1 = 16 point 120V~(ac) 3 = 16 point 24V≂(ac/dc)

Temperature Controllers

SERIES F4S

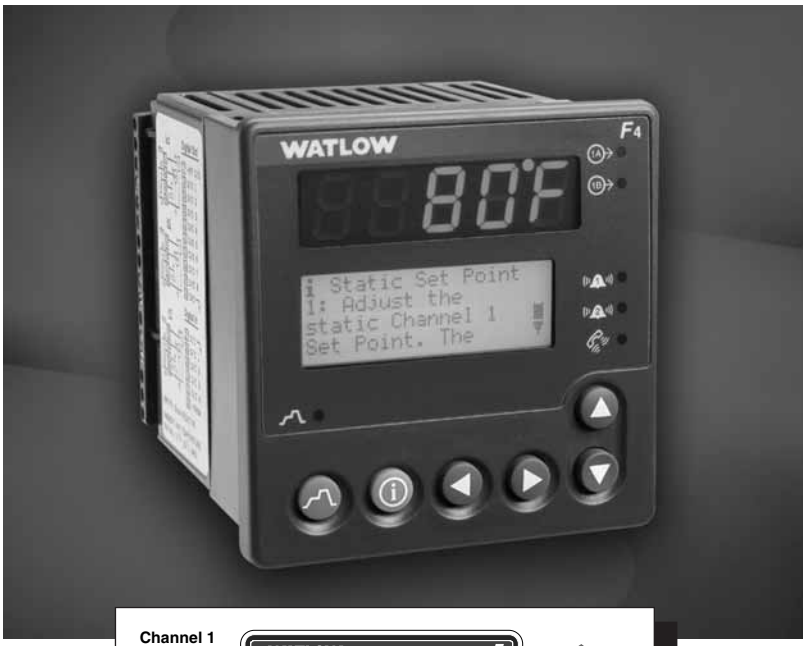
The SERIES F4S ¼ DIN industrial ramping controllers offer an easy to set up and operate solution for the most demanding ramp and soak processing applications. The features and performance of these units make them ideally suited for environmental chamber or furnace and oven applications.

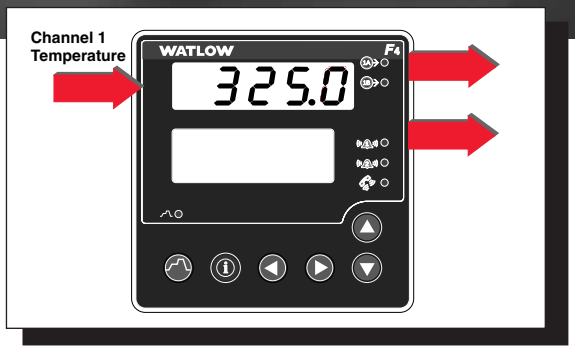
The SERIES F4S is a competitively priced controller which features a four line, high definition LCD interface display that makes profile programming and controller configuration significantly faster and easier. A 16 bit microprocessor supports all the accuracy and performance advantages you have come to expect from a Watlow controller.

Up to 256 steps can be programmed into as many as 40 nameable profiles. Profiles can be programmed to wait for events or for up to three different process variables. A guaranteed soak feature allows you to set how closely your process needs to be controlled.

The four digital event inputs can be programmed to remotely start, pause or terminate any of your preprogrammed process recipes. The eight event outputs are segment programmable, or three of them can be assigned to programmable compressor and boost heat/boost cool control. A real time clock can be used to start a profile at any time.

Serial communication and dual alarm relays are included in the base unit. The SERIES F4S ramping controllers are packaged with a NEMA 4X front face to withstand harsh environments and a 101.6 mm (4.0 in.) deep case with removable connectors for wiring convenience.





Features and Benefits

Guided 256 step, 40 profile ramp and soak programmable memory

- Supports a wide range of processing applications

High definition four line LCD controller interface display

- Simplifies setup and operation

Menu customization

- Offers enhanced process monitoring

High performance 16 bit microprocessor

- Precise process control
- 20Hz update rate on input 1
- 10Hz update rate on inputs 2 and 3

Field upgradeable firmware

- Downloads available @ no charge from www.watlow.com/F4
- Reduces downtime
- Eliminates the need for an RMA

Universal inputs

- Provide application versatility

Expandable modular construction

- Field upgradable

Enhanced environmental chamber control

- Supports humidity, compressor, boost heat/boost cool control

Cascade control

- Provides precise two variable control
- Auxiliary inputs required (ordering option)

Real time clock with battery backup

- Offers operational flexibility and peace of mind

Temperature Controllers

SERIES F4S

Set Point Ramp and Soak Programming

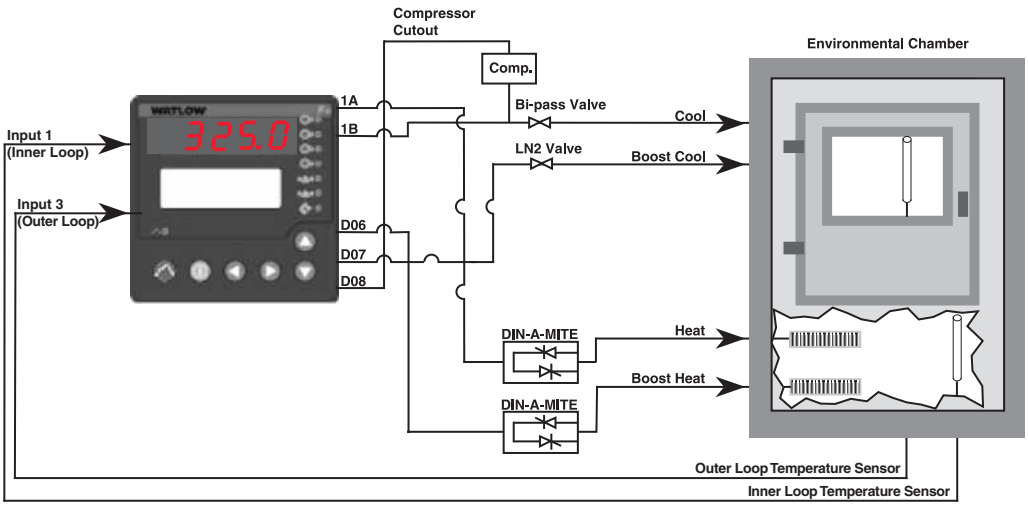
The enhanced programming features found in the SERIES F4S ramping controllers are the result of listening to our customers' demand for greater capabilities with reduced programming complexity.

A profile guide leads the programmer through the programming process by offering choices for step configuration. For better operator recognition, profiles and digital I/O used for events can be given names of up to 10 characters in length.

Five step types including ramp, soak, jump, auto start and end offer the programmer complete flexibility.

Ramp steps can be based on time or rate. Ramp and soak steps can be programmed to wait for up to four event inputs and three process variables. Up to eight event outputs are step selectable. Since your thermal systems characteristics may change over the operating range, up to 10 sets of PID heat/cool parameters are step selectable. The auto start step can start a profile based on a set date, a day of the week or daily, the choice is yours. The jump step can be used to jump within a profile or to another profile. The end step terminates a program with the control outputs programmed to your process needs.

Temperature Chamber Application with Cascade

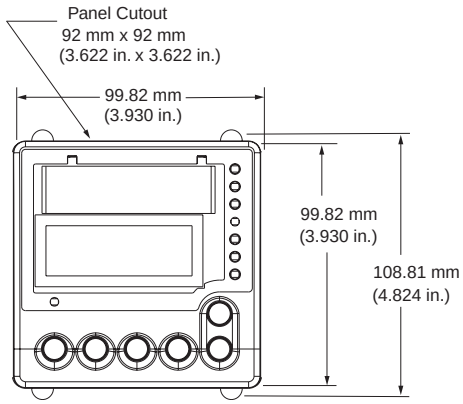


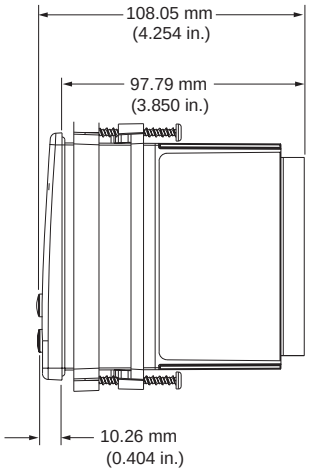
Serial Communication

EIA/232 and EIA/485 serial communication interfaces are included in the base unit of both the SERIES F4S (single channel) and the SERIES F4D (dual channel) controllers. The baud rate is selectable as either 9600 or 19200 baud. The protocol is Modbus™.

Alarms

Two Form "C" electromechanical alarm relays are included in the base units. These alarms can be programmed as either process or deviation alarms. The alarms can be tied to up to three process variables.





Optional Retransmit(s)

Optional retransmit capability is available to retransmit one or two variables. These variables include up to three process variables, control set points or percent load power.

Temperature Controllers

SERIES F4S

Specifications

Dimensions

- Width x height x depth
  99 mm x 99 mm x 97 mm panel mount (3.93 in. x 3.93 in. x 3.85 in.)

Universal Analog Inputs 1 (2 and 3 Optional)

- Updates rates, IN1 = 20Hz, IN2 and IN3 = 10HZ

Thermocouple

- Type J, K, T, N, E, C (W5), D (W3), PTII, R, S, B
- Input impedance 20MΩ

RTD

- 2- or 3-wire platinum, 100, 500 or 1000Ω
- JIS or DIN-curves, 1.0 or 0.1 indication

Process

- Input resolution ≈50,000 bits at full scale
- Range selectable: 0-10V⎓(dc), 0-5V⎓(dc), 1-5V⎓(dc), 0-50mV, 0-20mA, 4-20mA
- Voltage input impedance 20KΩ
- Current input impedance 100Ω

Digital Inputs (4)

- Update rate = 10Hz
- Contact or dc voltage (36V⎓(dc) maximum)
- 10KΩ input impedance

Control Outputs (1A, 1B)

- Update rate = 20Hz

Open Collector/Switched dc

- Internal load switching (nominal):
  Switched dc, 22 to 28V⎓(dc), limited @ 30mA
- External load switching (maximum):
  Open collector 42V⎓(dc) @ 0.5A

Solid State Relay

- Zero switched, optically coupled, 0.5A @ 24V~(ac) minimum, 253V~(ac) maximum

Process Outputs (Optional Retransmit)

- Update rate = 1Hz
- User selectable 0-10V⎓(dc), 0-5V⎓(dc), 1-5V⎓(dc) @ 1KΩ min., 0-20mA, 4-20mA @ 800Ω max.
- Resolution:
  dc ranges = 2.5mV nominal
  mA ranges = 5µA nominal
- Calibration accuracy:
  dc ranges = ±15mV
  mA ranges = ±30µA
- Temperature stability 100ppm/°C

Alarm Outputs

- Output update rate = 1Hz
- Electromechanical relay, Form C, 2A @ 30V⎓(dc) or 240V~(ac) maximum

Digital Outputs (8)

- Update rate = 10Hz
- Open collector output
- Off = 42V⎓(dc) max @ 10µA
- On = 0.2V⎓(dc) max @ 50mA sink
- Internal supply: 5V⎓(dc), @ 80mA

Communications

EIA-232 and EIA-485 serial communications with Modbus™ RTU protocol

Safety and Agency Approvals

- UL®/C-UL® 916 listed, File # E185611, process control equipment
- IP65 and NEMA 4X
- CE to EN 61010-1 and 631326

Terminals

- Touch-safe removable terminal blocks, accepts 12 to 22 gauge wire

Power

- 100-240V~(ac), -15 percent, +10 percent; 50/60Hz, ±5 percent
- 24-28V≂(ac/dc), -15 percent, +10 percent (order option)
- 39VA maximum power consumption
- Data retention upon power failure via nonvolatile memory (seven years for battery backed ram)
- Sensor input isolation from input to input to output to communi-cation circuitry is 500V~(ac)

Operating Environment

- 0 to 55°C (32 to 130°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 70°C (-40 to 158°F)

Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span ±1°C @ 25°C ±3°C (77°F ±5°F) ambient and rated line voltage ±10 percent with the following exceptions:

  Type T: 0.12 percent of span for -200°C to -50°C (-328°F to -58°F)

  Types R and S: 0.15 percent of span for 0°C to 100°C (32°F to 212°F)

  Type B: 0.24 percent of span for 870°C to 1700°C (1598°F to 3092°F)
- Accuracy span: Less than or equal to operating ranges, 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.1°F/°F) rise in ambient for thermocouples

  ±0.05°C/°C (±0.05°F/°F) rise in ambient for RTD sensors

Displays

- Process: Five, seven segment LED, red
- Control interface display: high definition LCD, green

Temperature Controllers

SERIES F4S

Sensor Operating Ranges:

Type J:	0	to	815°C
	(32	to	1500°F)
Type K:	-200	to	1370°C
	(-328	to	2500°F)
Type T:	-200	to	400°C
	(-328	to	750°F)
Type N:	0	to	1300°C
	(32	to	2372°F)
Type E:	-200	to	800°C
	(-32	to	1470°F)
Type C: (W5)	0	to	2315°C
	(32	to	4200°F)
Type D: (W3)	0	to	2400°C
	(32	to	4352°F)
Type PTII:	0	to	1395°C
	(32	to	2543°F)
Type R:	0	to	1760°C
	(32	to	3200°F)
Type S:	0	to	1760°C
	(32	to	3200°F)
Type B:	0	to	1816°C
	(32	to	3300°F)
RTD (DIN):	-200	to	800°C
	(-328	to	1472°F)
RTD (JIS):	-200	to	800°C
	(-328	to	1166°F)

Process:-19,999 to 30,000 units

Sensor Accuracy Ranges:

Input ranges

Type J:	0	to	750°C
	(32	to	1382°F)
Type K:	-200	to	1250°C
	(-328	to	2282°F)
Type T:	-200	to	350°C
	(-328	to	662°F)
Type N:	0	to	1250°C
	(32	to	2282°F)
Type E:	-200	to	800°C
	(-328	to	1470°F)
Type C(W5):	0	to	2315°C
	(32	to	4200°F)
Type D(W3):	0	to	2400°C
	(32	to	4352°F)
Type PTII:	0	to	1393°C
	(32	to	2540°F)
Type R:	0	to	1450°C
	(32	to	2642°F)
Type S:	0	to	1450°C
	(32	to	2642°F)
Type B:	870	to	1700°C
	(1598	to	3092°F)
RTD (DIN):	-200	to	800°C
	(-328	to	1472°F)
RTD (JIS):	-200	to	630°C
	(-328	to	1166°F)

Process:-19,999 to 30,000 units

Ordering Information

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

F4 S - A -

SERIES F4S = ¼ DIN, Single Channel Ramping Controller

Single Channel Ramping Controller
1 universal analog input, 4-digital inputs, 8-digital outputs, 2 alarms, EIA-232/485 comms

Power Supply
H = 100-240V≂(ac/dc)
L = 24-28V≂(ac/dc)

Output 1A
C = Open collector/switched dc
F = Process, 0-5, 1-5, 0-10V⎓(dc), 0-20mA, 4-20mA
K = Solid state Form A 0.5 amp relay

Output 1B
A = None
C = Open collector/switched dc
F = Process, 0-5, 1-5, 0-10V⎓(dc), 0-20mA, 4-20mA
K = Solid state Form A 0.5 amp relay

Auxiliary Input Module
0 = None
6 = Dual universal inputs

Auxiliary Retransmit Module
0 = None
1 = Single retransmit output 0-5, 1-5, 0-10V⎓(dc), 0-20mA, 4-20mA
2 = Dual retransmit outputs 0-5, 1-5, 0-10V⎓(dc), 0-20mA, 4-20mA

Language and RTD Options
1 = English with 100Ω RTD
2 = German with 100Ω RTD
3 = French with 100Ω RTD
4 = Spanish with 100Ω RTD
5 = English with 500 and 1KΩ RTD
6 = German with 500 and 1KΩ RTD
7 = French with 500 and 1KΩ RTD
8 = Spanish with 500 and 1KΩ RTD

Display and Custom Options
RG = Standard display (Red/Green display only)
XX = Custom options: software, setting parameters, overlay

Temperature Controllers

SERIES PD

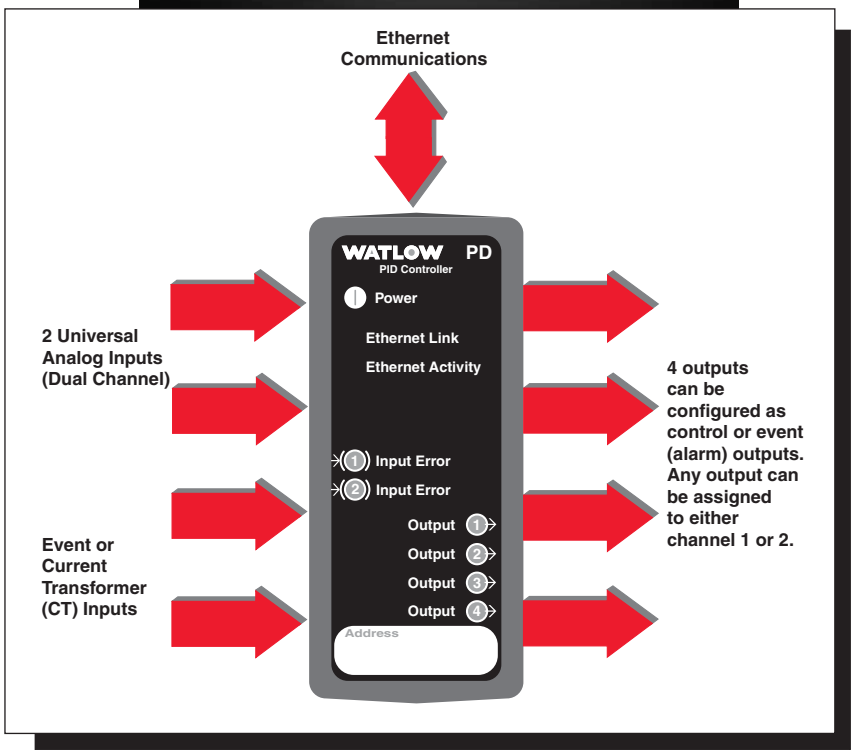
Watlow's SERIES PD controllers utilize embedded Ethernet technology to provide a convenient, economical means for setting up and viewing key process variables such as temperature, pressure and humidity. Available in single or dual channel versions, the DIN-rail mount SERIES PD controllers offer up to four control/alarm outputs, as well as a digital/current transformer input associated with each channel.

Watlow's SERIES PD controllers are ideally suited for a wide range of temperature or process control applications where the operator interface is supported from a remote location. The SERIES PD provides interfacing via embedded firmware which serves dedicated web pages. These pages support key functions including operation, alarm monitoring, configuration and are displayed using standard web browser software. The SERIES PD is also capable of generating e-mail messages for remote alarm notification.

Ethernet-based products are rapidly gaining popularity in industrial applications because they allow an instantaneous exchange of information between processing equipment and the company's management system.

Advanced features of the SERIES PD controllers include internal data logging of key control parameters, smart sensor technology, heater burn out detection and an enhanced control algorithm.

The SERIES PD controller is backed by a three-year warranty from Watlow Winona and is UL® 508, C-UL®, CSA and CE approved.



Features and Benefits

Ethernet connectivity

- Convenient, easy to use operator interface
- Simplified process monitoring

DIN-rail sub panel mounting

- Quick, economic installation

Watlow INFOSENSE™ sensor technology

- INFOSENSE™ technology improves sensor accuracy by a minimum of 50 percent

Advanced control algorithm

- Tighter process control

Temperature Controllers

SERIES PD

Features and Benefits Cont.

Heater burn out detection

- Improved process yields

Internal data logging

- Reduces external hardware demands

Single or dual channel versions

- Provides application versatility

Virtual or hardware alarms with e-mail delivery

- Improves quality control and reduces maintenance costs

Specifications

Power

- 24V≂(ac/dc), +10/-15 percent, 50/60Hz, ±5 percent
- 12VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

Environment

- 0 to 65°C (32 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

Agency Approvals

- UL® 508, C-UL®, CSA and CE

Controller

- Microprocessor based user-selectable control modes
- Single or dual channel universal inputs
- Current transformer inputs/digital inputs
- Up to four programmable outputs
- Update rates, inputs = 10Hz, outputs = 10Hz

Operator Interface

- Browser based HMI

Wiring Termination

- Touch safe removable terminals
- 14 to 22 AWG

Universal Inputs (Electrically Isolated)

- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum, 100Ω @ 0°C calibration to DIN-curve (0.00385 Ω/Ω/°C)
- Process 0-20mA @ <100Ω, or 0-10V⎓(dc) @ 10kΩ input impedance (50,000 bits @ full scale)

Digital Inputs

- Contact or dc voltage
- 10KΩ input impedance

Current Transformer Inputs

- 0 to 50mA CT input into 100Ω impedance

Allowable Input Operating Range

Type J:	0	to	815°C
	(32	to	1500°F)
Type K:	-200	to	1370°C
	(-328	to	2500°F)
Type T:	-200	to	400°C
	(-328	to	750°F)
Type N:	0	to	1300°C
	(32	to	2372°F)
Type E:	-200	to	800°C
	(-328	to	1470°F)
Type C:	0	to	2315°C
	(32	to	4200°F)
Type D:	0	to	2315°C
	(32	to	4200°F)
Type PTII:	0	to	1395°C
	(32	to	2543°F)
Type R:	0	to	1760°C
	(32	to	3200°F)
Type S:	0	to	1760°C
	(32	to	3200°F)
Type B:	0	to	1815°C
	(32	to	3300°F)
RTD (DIN):	-200	to	800°C
	(-328	to	1470°F)

Process V: 0 to 10V⎓(dc)
Process I: 0 to 20mA

Control/Alarm Outputs (1 - 4)

- User selectable as: on-off, P, PI, PD, PID, heat, cool, alarm action or retransmit with process output type hardware
- Open collector/switched dc
- Open collector 42V⎓(dc) maximum @ 0.5A
- Switched dc 22 to 28V⎓(dc) limited @ 30mA
- Solid state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression

Process Output (Optional Retransmit)

- User-selectable 0-10V⎓(dc), 1KΩ minimum, scalable, 0-20mA @ 800Ω maximum, scalable
- Electromechanical relay. Form C, rated 5A @ 120V~(ac) or 5A @ 240V~(ac) or 5A @ 30V⎓(dc)
- Ethernet communications
- Ethernet RJ 45 connector, 10 base T
- HTTP interface
- DHCP, auto IP or fixed IP address

Dimensions

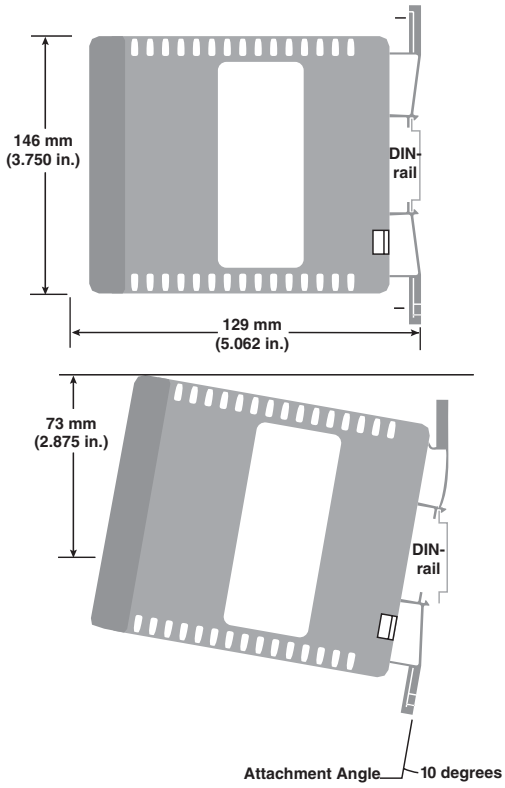
- Width x height x depth

  42 mm x 116 mm x 132 mm
  (1.64 in. x 4.56 in. x 5.19 in.)
  DIN-rail or chassis mount,
  DIN-rail spec DIN 5022
  35 mm x 7.5 mm
  (1.38 in. x 0.30 in.)

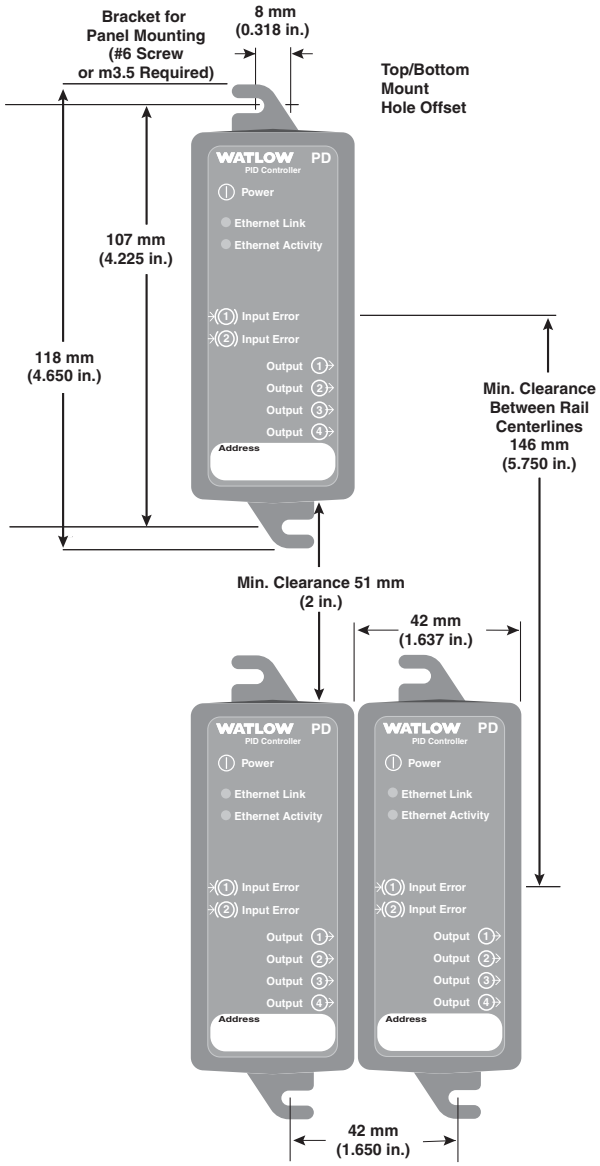
Temperature Controllers

SERIES PD

Side View



Front View



SERIES PD

Ordering Information

To order, complete the code number on the right with the information below.

P D D - - - - A

Auxiliary Inputs

1 = Dual digital inputs
2 = One CT input and one digital input
3 = Dual CT inputs (dual channel only)

Output 1

C = Switched dc, open collector
K = SSR, Form A, 0.5A
F = Universal process
E = Mechanical relay, Form C, 2A①

Output 2

A = None
C = Switched dc, open collector
K = SSR, Form A, 0.5A
E = Mechanical relay, Form C, 2A①

Output 3

A = None
C = Switched dc, open collector
K = SSR, Form A, 0.5A
F = Universal process
E = Mechanical relay, Form C, 2A①

Output 4

A = None
C = Switched dc, open collector
K = SSR, Form A, 0.5A
E = Mechanical relay, Form C, 2A①

On Board Data Logging

0 = None
K = 16 megabytes of memory

Custom Options

AA = Watlow logo
BB = No logo

① Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

Temperature Controllers

For complete information on SERIES SD temperature controllers reference pages 174 to 178.

SERIES SD

The features and performance offered by Watlow's family of SERIES SD PID controllers make them ideally suited for a broad range of applications in temperature and process control.

Watlow's SERIES SD single channel controllers include a universal sensor input with up to three outputs that can be programmed for heat or cool temperature control, or to operate as process or deviation alarms. Programming Inverse Scaling is also simplified with the user-friendly set-up menu, providing additional value without additional cost.

Advanced features of SERIES SD controllers include EIA-485 Modbus™ Serial Communications, Watlow's INFOSENSE™ sensor technology, Infrared Remote Communications operation, Watlow's patented User Definable Menu System and a "Save and Restore" feature that allows the restoration of either factory or user-defined settings. Two non-linear PID curves have also been added to improve performance in plastics extruder applications.

Available in 1/32, 1/16, 1/8 and 1/4 DIN panel mount sizes, Watlow's SERIES SD family is backed by an industry leading three-year warranty from Watlow. The SERIES SD controllers are UL® and C-UL® listed, CSA, CE and NSF-2 certified and include the IP65/NEMA 4X seal.

SERIES SD6_D

The SERIES SD6_D has been successfully tested for use with ODVA for DeviceNet™ on CAN networks. The controller includes a universal sensor input with two outputs that can be configured as heat, cool or alarm. The DeviceNet™ communications interface is supplied with a five-position removable screw terminal connector. For more information on the SERIES SD6_D controller, turn to page 175.

SERIES SD31

The SERIES SD31 offers improved accuracy of 0.1 percent of span as well as a faster sampling rate of 6.5Hz in a 1/32 DIN package. Users can also select between 11 different thermocouples, a 100 Ohm RTD, a 0 to 20mA or 0 to 10V process input- all from the front panel- that eliminates the need for dip-switches. For more information on the SERIES SD31 controller, turn to page 177.

Features and Benefits

Watlow's INFOSENSE™ sensor technology

- Thermal sensing technology improves sensor accuracy by a minimum of 50 percent

Watlow's patented User Defined Menu System

- Allows the user to assign up to 20 parameters in the operations menu
- Improves operational efficiency

"Save and Restore" feature for user settings

- Allows the user to save individual or factory settings
- Eliminates the need to contact the OEM or factory to restore settings

WATVIEW HMI (Human Machine Interface)

- Permits operation, configuration and data logging via a standard Windows® PC

Infrared communications

- Allows easier controller setup, operation and monitoring

Up to three outputs (two for 1/32 DIN)

- Results in application versatility

Dual display on all models

- Provides better recognition of process changes

Ramp to set point

- Controls temperature rise

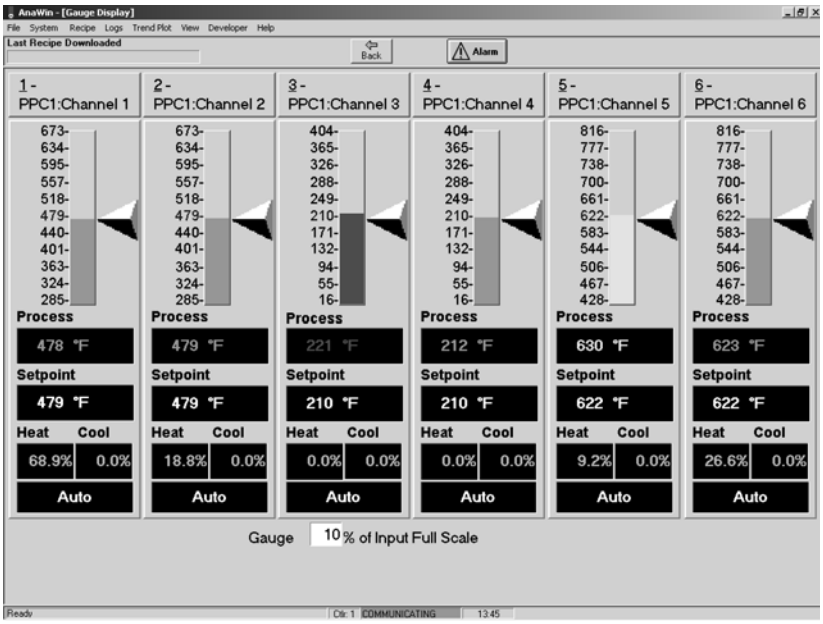
Variable burst fire

- Prolongs heater life

DeviceNet™ is a registered trademark of the Open DeviceNet Vendors Association.

ANAWIN®3 HMI Software for PPC-2000

ANAWIN®3 is Watlow HMI (Human/Machine Interface) software designed specifically for PPC-2000. Use it to set up and monitor up to 32 controllers. With easy controller setup, a recipe and alarm manager, data-logging and trend plot graphing capabilities, animated custom overview screens and a superior online help system, you can be assured that ANAWIN3 is the ideal software for your application.



ANAWIN3 Editions:

ANAWIN3 is available in three editions making your software decision quick and effortless.

- **ANAWIN3-R: The Run-Time Edition**
  Provides trend plot graphing, setup screens, data-logging, recipe manager with calendar-start, spreadsheet data editor, system activity log and alarm manager. The Run-Time Edition will "play back" custom screens created with the Developer Edition.
- **ANAWIN3-D: The Developer Edition**
  Includes all functions of the Run-Time Edition plus a custom screen designer and user-defined variables.
- **ANAWIN3-C: The Configurator Edition**
  Includes only spreadsheet data editor, recipe manager without calendar-start and system activity log.

Features and Benefits

Easy controller setup

- Use ANAWIN3's built-in setup screens to adjust the controller parameters, or the simple "spreadsheet view" for a quick, intuitive interface. The spreadsheet categorizes all controller parameters according to their parameter groupings.

Recipe manager

- All editions of ANAWIN3 include the ability to create recipes (arrays of controller settings). Recipes can be created, edited, stored and downloaded to the controllers. Use recipes to store commonly used controller settings, to speed up repetitive controller setups, and to create a "snapshot" of your setups. The Run-Time and Developer Editions also include a calendar-start function, allowing users to automatically download recipes on a one-time or repeating schedule.

Alarm manager

- ANAWIN Run-Time and Developer Editions receive alarms from controllers, maintain a log of alarms and allow users to clear and acknowledge alarms.

Data-logging and trend plot graphs

- ANAWIN3 Run-Time and Developer Editions include continuous data-logging of the parameters you choose. You can export the collected data to an Excel®-compatible spreadsheet file, or view multiple data items on ANAWIN3 trend plot graph. An unlimited number of graphs may be named and stored for simple future retrieval.

Colorful, animated custom overview screens

- Use ANAWIN3 Developer edition to create custom screens, easily! ANAWIN3's Custom Overviews (COVs) incorporate your graphic images (such as digital camera photos) with real-time data from the controllers, to make a custom interface. You can also use ANAWIN3's AnaMator program to create animated sequences, which can show your actual process in action. Custom Overviews created with the Developer edition can be used with any ANAWIN3 edition.

Ordering Information

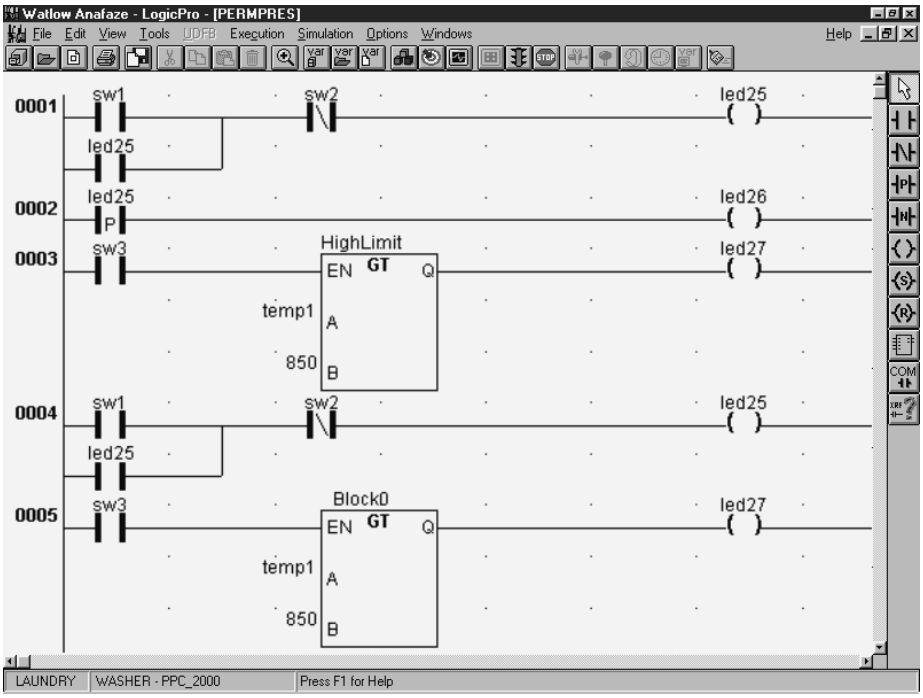
ANAWIN3-C: ANAWIN3 HMI Configurator Edition
ANAWIN3-R: ANAWIN3 HMI Runtime Edition
ANAWIN3-D: ANAWIN3 HMI Developer Edition

Controllers Supported

- PPC-2000

Temperature Controllers

LOGICPRO™: Logic Programming Software for PPC-2000 and CPC400



LOGICPRO™

LOGICPRO is a Windows®-based graphical logic programming software package. LOGICPRO is the perfect counterpart to the powerful multi-loop PID control features in the PPC-2000 and CPC400. Develop programs in a choice of three logic programming languages: ladder diagram, sequential function chart or function block diagram.

Features and Benefits

Develops custom logic programs with easy-to-use, drag-and-drop tools, then simulates and debugs on the development PC before downloading to the PPC-2000

- Reduces time and cost during system start-up, trouble-shooting and fine tuning

Real-time monitoring

- Reduces time to verify system logic operation

Integrates programmable logic and PID control in a single controller

- Eliminates cumbersome and inflexible communications schemes between separate process and logic controllers, saving development time and costs

Full set of logic functions and programming tools

- Adds value by easily customizing your process

LOGICPRO Editions

LOGICPRO-S supports up to 150 I/O driver points. I/O driver points are physical I/O and any data table accessed parameters.

LOGICPRO-P supports an unlimited number of I/O points. Both utilize keys, which are attached to the development computer's parallel port.

System requirements:

- IBM compatible PC
- EIA-232 serial port
- Pentium® processor, 166 MHz minimum
- Windows® 95/98 or Windows® NT
- 32 MB RAM
- 40 MB minimum hard disk space
- Parallel port

Ordering Information

LOGICPRO-S: LOGICPRO Standard Edition

LOGICPRO-P: LOGICPRO Professional Edition

Controllers Supported

- CPC400
- PPC-2000

Pentium® is a registered trademark of Intel Corporation.

Temperature Controllers

Problem Solvers

Watlow Solutions To Common Temperature Control Problems

Temperature control performance problems can be greatly reduced or eliminated by using the optimum temperature controller for the application. Check the list below to see if Watlow temperature controllers can improve your process.

Problem	Temperature Control Solution
Scrap product caused by out-of-tolerance temperature range	• Watlow SERIES SD and PD with deviation alarm can stop process or alert operator when temperature deviates outside a plus or minus window
Process operating outside of designated temperature range	• Watlow SERIES SD and PD with process alarms to disable feed screw mechanism, shut process down or activate a light or buzzer to indicate temperature is too high or low
Unnecessary process shut down caused by temperature sensor failure	• Watlow SERIES SD and PD with bumpless transfer will continue process operation at last stable power level. Watlow SERIES SD can also go to a preselected power level upon sensor failure
Temperature over- and undershoot	• Watlow SERIES SD and PD with autotune will automatically select correct PID values to minimize temperature variations
Temperature over- and undershoot on both heating and cooling cycles	• Watlow SERIES SD and PD with PID autotune on both heat and cool outputs
Heating and cooling outputs energizing at the same time	• Watlow SERIES SD and PD with deadband offsets cool set point from the heat set point to prevent concurrent energizing
Undetected heater failure creating uneven heating profiles and/or scrap product	• Watlow SERIES PD with current monitor can detect a failed heater
Unauthorized control setting changes	• Watlow SERIES SD and PD with programmable user lockout
Need limit control to conform with requirements and regulations	• Watlow SERIES SD, LV and LF are economical, FM approved limit controls with convenient optional DIN-rail mounting

Temperature Controllers

Case History

Watlow's PPC-2000 Controller Provides Immediate Benefits to Large User Blown-Film Plant

Problem:

Pliant, one of the world's largest blown film facilities, was looking to upgrade their controller technology. Their South Deerfield, MA location operates blown mono and coex film lines producing film and packaging products for personal care, medical, food industrial and agricultural markets. Two of their three-layer lines, which had five heat/cool zones per extruder barrel and over 30 temperature control zones overall, were controlled by an older analog unit that gave no insight into the process. With no means to monitor controller performance and frequent downtime, Pliant decided to improve their system.

Solution:

This Pliant facility worked with a local authorized Watlow distributor who also had control system integration capabilities to develop a solution. This partner was instrumental in implementing a customized and complete system solution based on the PPC-2000 controller.

Watlow's PPC-2000 provided a powerful and cost-effective approach for their applications where other controllers were awkward, time-consuming and did not adequately control the process. The PPC-2000 combined easy to setup multi-loop process control and programmable logic control in one complete package. The controller also offered them a very user-friendly alternative to strategies employing PLCs with discrete controls.

The integration incorporated a third party touch screen with Watlow's menu-driven, customizable ANAWIN HMI software to provide Pliant with data logging, graphing capability, auto-tuning, recipe management and built-in alarm handling features. The modularized design of the PPC-2000 also allowed it to grow with Pliant's system. Various analog and digital I/O modules plus control loops could now be centralized into one compact unit and programmed as an integrated system.

Pliant was able to speed time to market with their customized PPC-2000 and the benefits were realized company-wide:

- Machine operators were able to give direct input into how to customize the control system
- Managers and supervisors were able to use remote screens to monitor the line, collect and view historical data to identify trends and make adjustments
- Management benefits included reduced downtime, lower power costs, the ability to optimize resin usage and repeatable production runs

The robustness, ease of use and expandability of the PPC-2000 combined to make Pliant's production more efficient and cost effective. Due to this success, future plans called for retrofitting other blown film line controllers with the PPC-2000 controller.

COMPLIES WITH EUROPEAN EMC DIRECTIVE
EN 61326 (1997-98) and EN 50178
Available on Request...
Consult Your Watlow Representative

For complete information on the DIN-A-MITE® family reference pages 183 to 193.

Power Controllers

DIN-A-MITE® Family

Made in the United States of America, Watlow's DIN-A-MITE® family of solid state power controllers provide SCR control, heatsink, wiring and touch-safe exterior in one package. By designing the DIN-A-MITE as a total power controller unit, the need to prep wires for terminals, find the right heat sink and determine adequate terminations is eliminated. It's a complete package you can install with Control Confidence®.

Performance Capabilities

Four DIN-A-MITE styles meet most power controller needs with ratings from 18 to 100 amps with voltages from 120 to 600V~(ac).

Features and Benefits

DIN-rail or sub-panel mounting

- Simple, fast installation

No mercury

- Environmentally safe product

Compact size

- Reduced panel space; less cost

Touch-safe exterior

Increased safety for installer/user

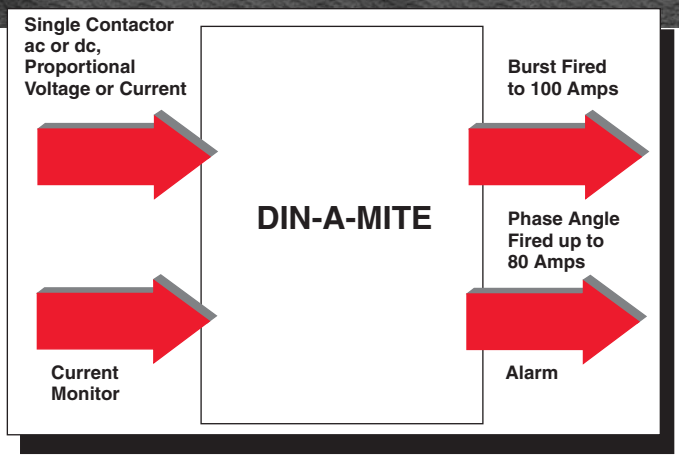
Easy Installation

Installation is simple and fast; saving time and money. All you have to do is strip wires and make connections.

- Sub-panel or DIN-rail mounting
- No drilling and tapping necessary
- Same footprint as comparably rated MDRs

Agency Approvals

- UL® 508 Listed and C-UL®
- UL® 50, UL® 1604, and CE



Achieve Optimum Temperature Control With Variable Time Base Control

Variable time base control meets the rapid switching demands of PID temperature control to deliver more accurate process control. It also increases heater life by reducing temperature over- and undershoot.

Low Electrical Noise

Burst firing switches ac current at zero cross (zero potential) to produce minimal RFI and EMI electric noise (radio frequency interference/electromagnetic interference). This low electrical noise quality helps prevent interference with sensor circuits and particularly sensitive equipment in your system.

Rugged, Back-to-Back SCR Design Insures Long Term Reliability

With solid state components, there's no limit on the number of switching cycles the DIN-A-MITE can perform. The four DIN-A-MITE styles meet most application requirements by tolerating harsh industrial environments, electrical spikes and dissipating less power. When properly applied, the DIN-A-MITE will outlast all other types of non-electronic power controllers.

UL® and C-UL® are registered trademarks of the Underwriter's Laboratories, Inc.

Power Controllers

DIN-A-MITE Family

	DIN-A-MITE Style A	DIN-A-MITE Style B	DIN-A-MITE Style C	DIN-A-MITE Style D
1-Phase①	Up to 25 amps @ 600V~(ac)	Up to 40 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Up to 100 amps @ 600V~(ac)
3-Phase, 2-leg①	No	Up to 33 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Gang 2 units
3-Phase, 3-leg①	No	Up to 22 amps @ 600V~(ac)	Up to 70 amps @ 600V~(ac)	Gang 3 units
V~(ac) & V⎓(dc) - Burst Fire Contactor Input	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)
Multizone V~(ac) & V⎓(dc) Input	No	Yes	Yes	No
4-20mA⎓(dc) Input - Variable Time Base Output	Yes	Yes	Yes	Yes
Phase-Angle Fire Output②	No	No	Yes 1-phase only	No
Manual Control Via Potentiometer Input, or 0-5, 1-5 or 0-10V⎓(dc) Linear Voltage Input	No	No	Yes	No
Shorted SCR Alarm	No	Yes	Yes	Yes
Open Heater Alarm	No	No	Yes With "S" input only	Yes
Load Current Monitor CT	No	No	No	Yes
On Board Semiconductor Fusing	No	No	No	Yes
DIN-rail Mount	Yes	Yes	Yes	No
Sub-Panel Mount	Yes	Yes	Yes	Yes
Cabinet Thru-Wall Heatsink Mount UL® 50 and UL® 1604	No	No	Yes	No
Electrically Touch-Safe Package	Yes	Yes	Yes	Yes
Back-to-Back SCR Design	Yes	Yes	Yes	Yes
UL® 508 Listed/C-UL®/CE w/filter	Yes	Yes	Yes②	Yes
Dimensions	(95 X 45 X 98 mm) 3.7 H X 1.8 W X 3.9 in. D	(95 X 80 X 124 mm) 3.7 H X 3.1 W X 4.9 in. D	(150 X 80 X 146 mm) 6.0 H X 3.1 W③ X 5.7 in. D	(185 X 65 X 240 mm) 7.25 H X 2.5 W X 9.4 in.D
Controller Weight: kg (lbs)	0.32 (0.71)	0.68 (1.5)	1.18 (2.6)	2.95 (6.5)
Controller Weight w/fan: kg (lbs)	N/A	N/A	1.45 (3.2)	N/A

① Refer to curves on page 186 for your specific application ratings.
② Phase-angle fire is not CE approved.
③ Will fit within the width dimension of most comparable MDRs.

Power Controllers

E-SAFE® RELAY

The E-SAFE® mercury-free relay from Watlow provides reliable and accurate power switching for processing applications.

This relay can exceed the performance of typical mercury relays while fitting within the same footprint. The E-SAFE RELAY bridges the gap between mercury displacement relays (MDRs) and solid state relays (SSRs) by providing superior power switching in a non-mercury solution at a lower cost. This mercury-free relay also provides longer contact life and higher performance than typical mechanical relays used in equipment.

The E-SAFE RELAY eliminates mercury, reduces arcing and electrical noise and provides processors with an excellent solution for equipment power switching. The absence of mercury in the E-SAFE RELAY reduces toxic metal hazards in processing environments.

Performance Capabilities

- Up to 40 amps
- 240 V~(ac)

Features and Benefits

High current transient suppression

- High reliability
- Extended contact life
- Low electrical noise
- Out performs mechanical contactors

Compact size

- Fits footprint of definite purpose relays and most 30 to 50 amp mercury relays
- Easily retrofittable

Environmentally safer than mercury contactors

- Eliminates toxic waste (mercury) from the application environment and disposal from failed mercury contactors

Agency approvals

- UL® 508 listed and C-UL® approved

Specifications

- Output rating: from 20A to 40A maximum resistive load at -30 to 55°C (-22 to 130°F)
- Maximum power switching voltage: 208/240V~(ac), three pole
- Coil voltage: 24V~(ac), 120V~(ac) and 220V~(ac)
- Maximum operating ambient temperature: 55°C (130°F)
- Maximum cycle rate: 30 cycles per minute

Control Mode

- Zero cross switching output
- Form A outputs, without arcing
- Cycle rate: 30 cycles per minute, maximum

Input Command Signal

- 24V~(ac) (+10 / -15 percent), 120V~(ac) (+10 / -10 percent) 220V~(ac) (+10 / -15 percent)
- 50/60Hz, less than 9VA

Note: Do not place an R/C snubber (filter) on the E-SAFE RELAY input command signal.

Output Rating

- 20A to 40A max. per pole into a resistive load
- 208/240V~(ac), 50/60Hz, each pole
- Three pole

Operating Life

- 1,000,000 switching cycles at max. rating

Weight/Dimensions

- Weight: 0.560 kg (1.25 lbs.)
- 96.0 mm (3.78 in.) high x 82.3 mm (3.24 in.) wide x 90.2 mm (3.55 in.) deep

Terminals

- Controller input: Compression, accept #22 to 10 (0.2 to 6 mm^2) AWG wire. Torque to 7 in.-lbs (0.8 Nm) max.
- Output: Compression, accept #14 to 6 (2.5 to 16 mm^2) AWG wire. Torque to 35 in.-lbs max. (3.95 Nm)

E-SAFE RELAY

Specifications Cont.

Operating Environment

- Operating temperature up to -30 to 55°C (-22 to 130°F)
- 5 to 85 percent RH, non-condensing
- Shipping and storage temperature -40 to 85°C (-40 to 185°F)

Mounting

- Definite purpose relay and MDR mounting footprint

Agency Approvals

- UL® 508 listed, C-UL® approved, File #E213822

Ordering Information

To order, complete the code number on the right with the information below.

E S - - -

E-SAFE RELAY = Hybrid zero cross contactor

Amperage

20 = 20 amp
40 = 30 amp

Number of Poles

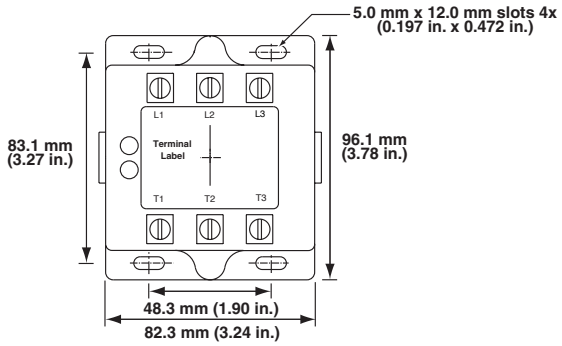
3 = Three-pole

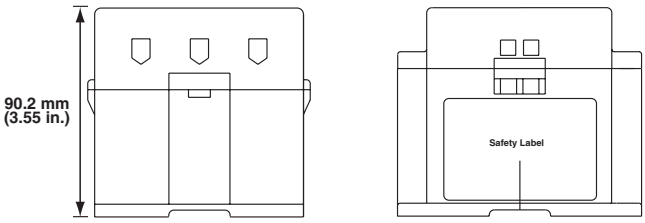
Control Voltage

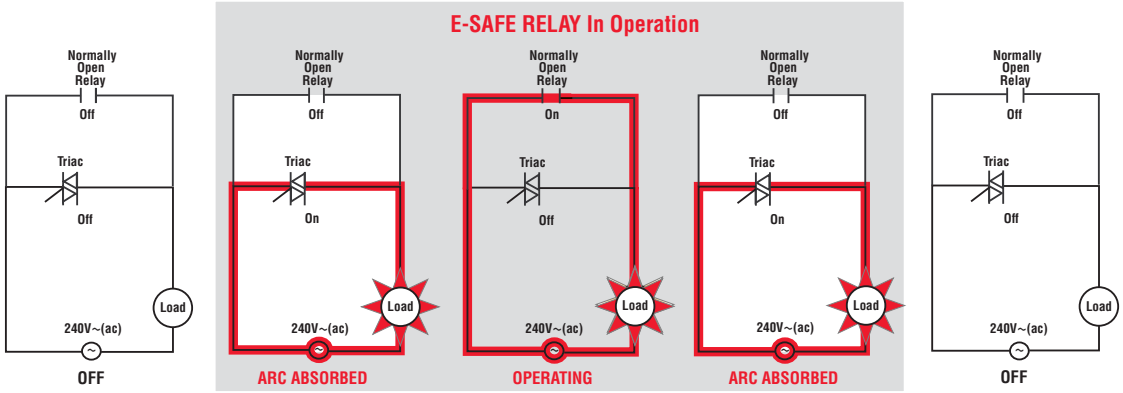
024-AC = 24V~(ac)
120-AC = 120V~(ac)
220-AC = 220V~(ac)

Label Options

00 = Standard product







Power Controllers

Solid State Relays (SSRs)

Lower cost and longer heater life is the main advantage provided by Watlow solid state relays (SSRs). A unique loop-powered firing card permits a very fast time proportional cycle rate of less than one-tenth of a second that allows using higher watt density heating elements and/or increasing heater life. In addition, temperature control accuracy is optimized with this fast cycle card.

Watlow SSRs can be ordered with all the components necessary for hassle-free mounting, including heatsinks, thermal foil and bevel washers.

Performance Capabilities

- Burst firing, 10 to 75 amps
- Operating environment -25 to 50°C (-13 to 122°F) with proper heatsink
- Can switch up to 575V~(ac)

Features and Benefits

Fast cycle card

- Heater life is increased, temperature control is optimized and higher watt density heaters can be used

Zero cross firing[1]

- Minimal electrical noise

Back-to-back SCR design

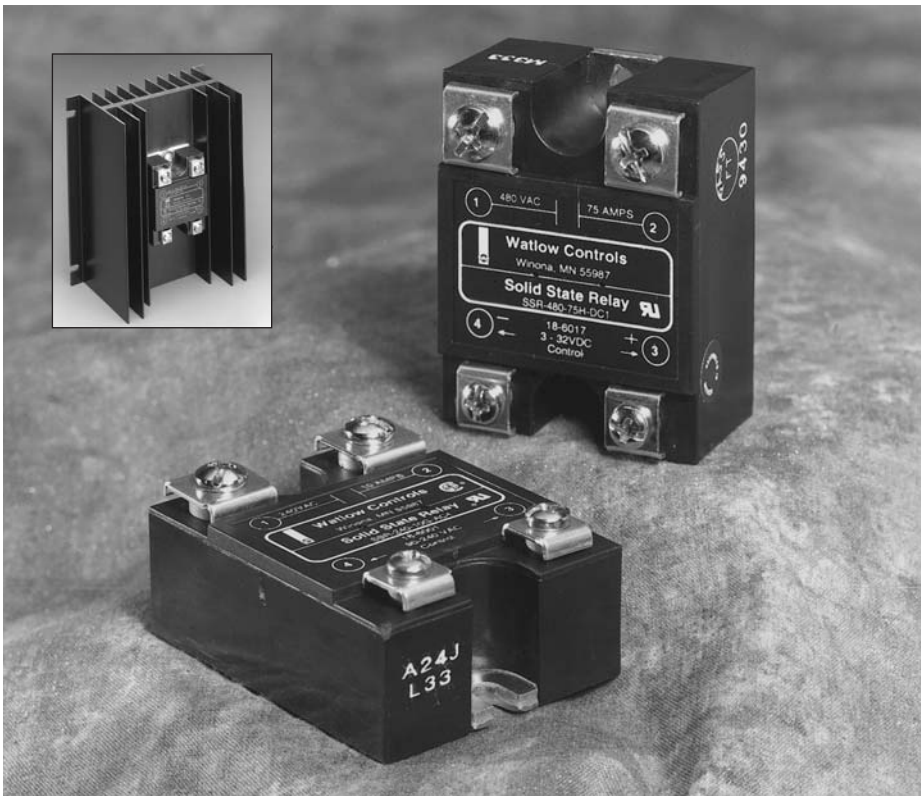
- Will withstand harsh or hostile environments

UL® recognized, CSA certified, VDE licensed

- For applications requiring agency approval

Applications

- Lighting equipment
- Resistive heating



Specifications

Standard to all SSRs:

Agency Approvals

- UL® 873, File #E151484, E73741
- CSA #LR700195
- VDE 0805 EN60950, File #90995ÜG
- CE 60950

Dielectric Strength

- 4000 Volts RMS

DC Control Input

Voltage range

- 3-32V⎓(dc), model no. dependent
- 4-32V⎓(dc), model no. dependent

Input current

- 4mA @ 5V⎓(dc)

Turn on voltage

- 3V⎓(dc) minimum

Turn off voltage

- 1V⎓(dc) maximum

AC Control Input

Voltage range

- 90-280V~(ac)

Input current

- 2mA max. @ 120V~(ac)

Turn on voltage

- 90V~(ac) minimum

Turn off voltage

- 10V~(ac) maximum

Output (Maximum)

Forward voltage drop

- 1.5V~(ac) typically

Minimum holding current

- 50mA~(ac)

Turn on-off time

- 8.3ms

Storage Temperature

- -40 to 85°C (-40 to 185°F)

SSR Weight

- 0.090 kg (0.21 lb)

Shipping Weight

- 0.045 kg (1.0 lb)

[1] Not available on random fired models.

Solid State Relays (SSRs)

Ordering Information — Order by selecting the code number from the specifications table below.

Code Number	Output Current (Amps)	Output Voltage	Input Control Voltage	Off State Leakage	One Cycle Surge Current Amps	A^2 Sec. I^2t For Fuse	Thermal Resistance	Frequency Range	Output Voltage Range	PIV Rating
SSR-240-10A-DC1	10	120/ 240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-DC1	25	120/ 240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-DC1	40	120/ 240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-DC1	50	120/ 240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-DC1	75	120/ 240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-10A-AC1	10	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-AC1	25	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-AC1	40	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-AC1	50	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-AC1	75	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-25A-DC1	25	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-DC1	50	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-DC1	75	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-25A-AC1	25	480V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-AC1	50	480V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-AC1	75	480V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-DC1	25	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-DC1	50	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-DC1	75	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-AC1	25	600V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-AC1	50	600V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-AC1	75	600V~(ac)	90-280V~(ac) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-240-10A-RND	10	240V~(ac)	4-32V⎓(dc) Random	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-50A-RND	50	480V~(ac)	4-32V⎓(dc) Random	10mA	625	1620	0.63°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-480-75A-RND	75	480V~(ac)	4-32V⎓(dc) Random	10mA	1000	4150	0.31°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-100-20A-DC1	20	100V⎓(dc)	3-32V⎓(dc)	0.3mA	NA	NA	1.06°C/W	N/A	0-100V⎓(dc)	N/A

Availability

Stock: Same day shipment

Power Controllers

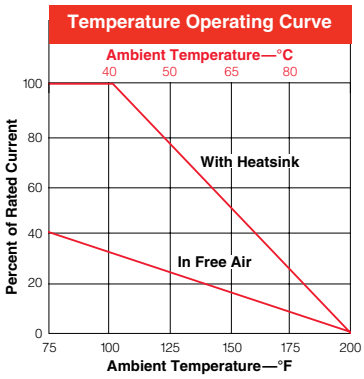
Solid State Relays (SSRs)

Application Hints

Thermal Transfer

A thermal foil is provided with each solid state relay for mounting on the base of the relay to improve heat transfer. In addition, two bevel washers are supplied to provide the proper pressure for the transfer of heat. Use two #8-32 screws, 15.8 mm (0.625 in.) long to secure the relay to the heatsink. See the derating curve, Temperature Operating Curve, for operation without heatsinks.

Note: This rating curve applies only to 10 and 25 amp SSRs. 40 through 75 amp SSRs should not exceed a seven amp load without using a heatsink.



Replacing Contactors or MDRs

Improvements in heater life and control accuracy can be anticipated with solid state relays operated with rapid cycle times as compared to slower operating electromechanical relays or even mercury displacement relays in some applications. When replacing these types of relays with the SSR, it is important to consider two aspects:

1. Heat

Solid state devices require a small voltage to turn on, which is consumed as heat (1.5 watts/amp). This heat must be removed from the device, and is usually accomplished by mounting the relay on heatsinks.

2. Failure Mode

Solid state devices should last for many years when properly protected with voltage and RC suppressors mounted on appropriate heatsinks, and when fused against the high currents caused by electrical shorts.

However, if the unit fails, the most probable condition will be a short. Both mechanical relays mentioned above also have a good probability of failing short. In all cases where uncontrolled full power can cause damage, it is recommended that a high limit temperature controller and contactor be used for protection.

System Diagrams

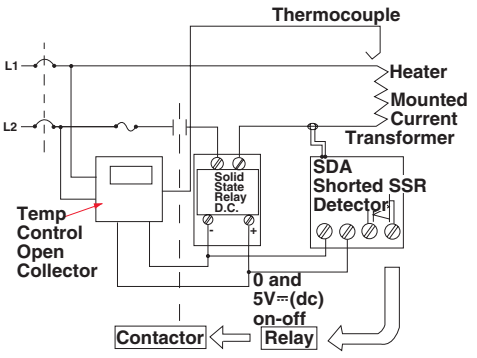
Shorted SSR Alarm—SDA

The most prevalent concern when using solid state relays is the possibility of a relay failing in a shorted condition. With this in mind, Watlow has designed a cost effective "Shorted SSR Alarm" SDA.

The device monitors the output (current through the heater) and activates a triac (alarm) if there is no command signal from the temperature controller.

The triac can be wired to a bell, or to a normally closed latching relay to remove power to the heater.

Single-Phase—SDA



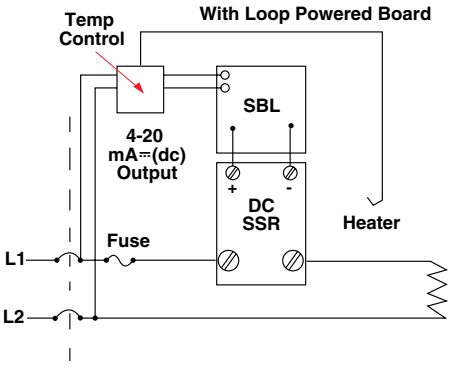
Single-Phase—SBL

4-20mA loop powered firing card for direct mounting on a dc solid state relay. Can be used in three-phase mode with two dc input solid state relays.

Single-Phase—AT and BT

Requires external power switching transformer. Consult factory for part number and voltage required.

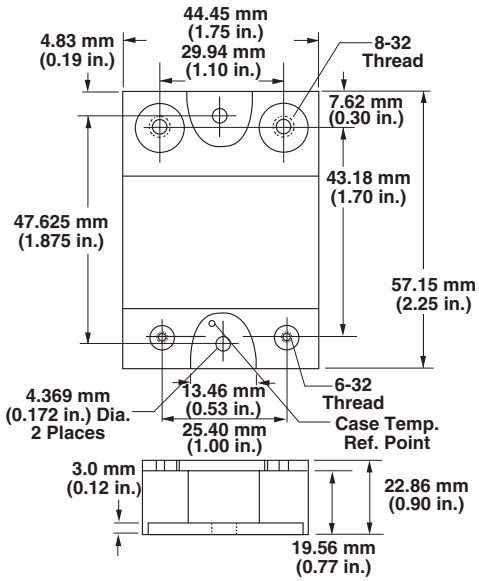
SSR Card	Description	Code No.
SBL	Burst firing 4-20mA only loop powered card for dc input relays only	**08-5399**
SDA	Shorted SSR alarm for dc input relays only	**08-5386**
AT	Single-phase, phase-angle firing	**08-5422**
BT	Single-phase variable time base, single cycle, burst firing transformer power. 4-20mA input	**08-5406**



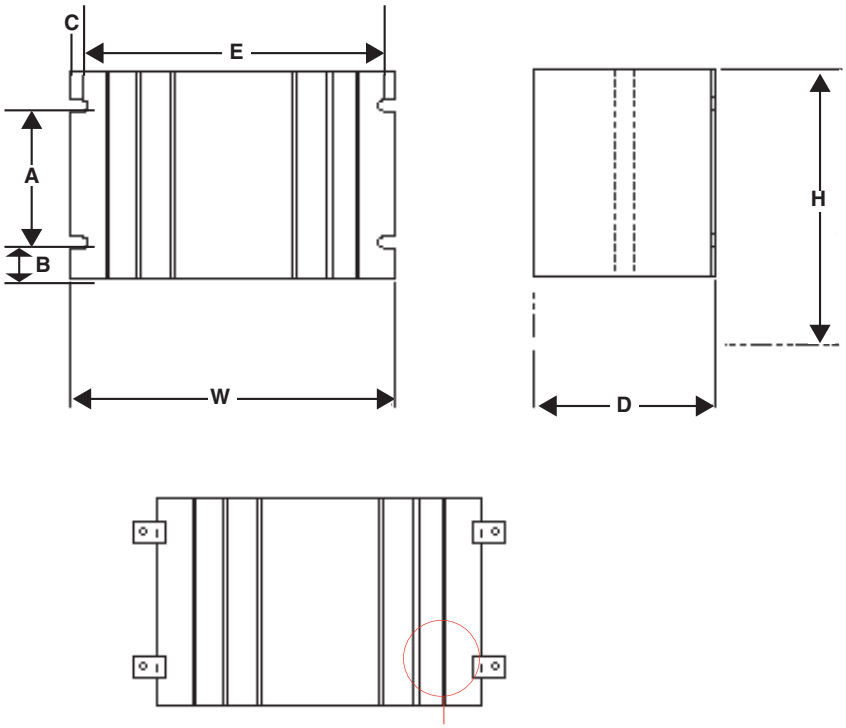
Solid State Relays (SSRs)

Dimensions

Solid State Relay



Heatsinks



Note: The 50 amp, 1-phase width mounting dimension has four mounting clips instead of the ½ round cutouts.

Heatsinks – 1-Phase

Amps	Maximum Overall Dimensions						Mounting Dimensions								Fan Cooled	Code Number
	Height (H)		Width (W)		Depth (D)		A		B		C		E			
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)		
10	100	(4.00)	115	(4.50)	25	(1.03)	75	(3.00)	12	(0.50)	4	(0.15)	105	(4.20)	No	**HS-10**
25	75	(3.00)	120	(4.75)	65	(2.60)	115	(2.00)	12	(0.50)	4	(0.15)	115	(4.45)	No	**HS-25**
40	140	(5.50)	120	(4.75)	65	(2.60)	115	(4.50)	12	(0.50)	4	(0.15)	115	(4.45)	No	**HS-40**
50	230	(9.00)	125	(5.00)	90	(3.50)	115	(7.00)	N/A	N/A	N/A	N/A	115	(5.90)	No	**HS-50**
75	190	(7.50)	125	(5.00)	140	(5.50)	175	(7.00)	25	(1.00)	4	(0.15)	120	(4.70)	Yes[2]	**HS-75-1**
75	190	(7.50)	125	(5.00)	140	(5.50)	175	(7.00)	25	(1.00)	4	(0.15)	120	(4.70)	Yes[3]	**HS-75-2**

[2] Heatsink includes fan; requires customer to supply and wire 120V~(ac) to the fan.
[3] Heatsink includes fan; requires customer to supply and wire 240V~(ac) to the fan.

Power Controllers

Accessories

Noise Suppression Devices

Description	Code No.
MOV, 150V~(ac), 20 joule	**0802-0273-0000**
MOV, 275V~(ac), 15 joule	**0802-0266-0000**
Quencharc® (250V~(ac) max)	**0804-0147-0000**

CE Filters for DIN-A-MITE Products

Code Number	Description	Stocked
14-0019	Single-phase, parallel connected filter	Yes
14-0020	Three-phase, parallel connected filter	Yes

Replacement Fuses for Power Series

Watlow Code No.	Description	Ferraz Part No.	Bussmann Part No.
0808-0102-0100	100 amp @ 600V~(ac)	L330037	170M1317
0808-0102-0125	125 amp @ 600V~(ac)	M330038	170M1318
0808-0102-0160	160 amp @ 600V~(ac)	N330039	170M1319
0808-0102-0200	200 amp @ 600V~(ac)	P330040	170M1320
0808-0102-0250	250 amp @ 600V~(ac)	Q330041	170M1321
0808-0102-0315	315 amp @ 600V~(ac)	R330042	170M1322

Quencharc® is a registered trademark of ITW Paktron.

Accessories

Semiconductor Fuse Selection Guidelines

The following steps will help you identify the proper semiconductor fuse for your application.

1. Semiconductor fuses are required for SCR protection.
2. In North America, semiconductor fuses are considered a specialty fuse and not yet approved for branch circuit or cable protection.
3. All fuses should be rated at 125 percent of the connected load (or the next standard fuse rating above 125 percent). Do not exceed 160 percent of the DIN-A-MITE.

   For example:

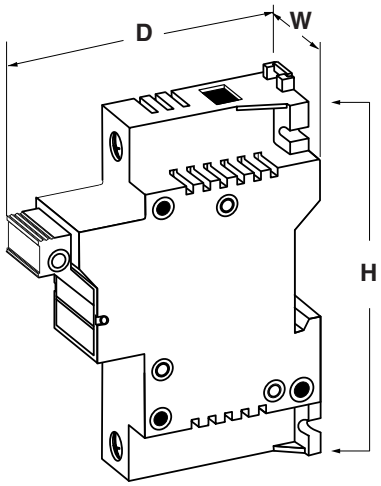
   A 30 amp Style B DIN-A-MITE with a 20 amp connected load should use a 25 amp semiconductor fuse.
4. Due to special applications, cooler ambient temperatures, small loads, etc., the connected load should be the determining factor—although the semiconductor fuse I^2t rating must not exceed the SCR I^2t requirement.

The following charts may be modified following the above guide lines.

Semiconductor Fuses for DIN-A-MITE Power Controllers

Styles A, B, C and D...Can Also Be Used For VPAC and SSRs

Dimensions



DIN-Rail Mount Semiconductor Fuses and Holders

Fuse Amp Rating	Fuse Voltage Rating	Watlow Fuse Part No.	Ferraz Fuse Part No.	Bussman Equiv. Fuse Part No.	Watlow Holder Part No.
12	600	17-8012	H330011	FWC-12A10F	17-5110
20	600	17-8020	K330013	FWC-20A10F	17-5110
25	600	17-8025	L330014	FWC-25A10F	17-5110
32	700	17-8030	M330015	FWP-32A14F	17-5114
40	700	17-8040	A93909	FWP-40A14F	17-5114
50	700	17-8050	B093910	FWP-50A14F	17-5114
63	700	17-8063	T094823	FWP-63A22F	17-5122
65	660	0808-0096-0000	N /A	170N3437	See Note 1
80	700	17-8080	A94829	FWP-80A22F	17-5122
100	700	17-8100	N/A	FWP-100A22F	17-5122

Note 1: Replacement fuse for DIN-A-MITE Style D.
Note 2: On part number 17-8030 the Ferraz fuse is a 32 ampere fuse.

DIN-Rail Mount Fuse Holders Maximum Dimensions

Holder Part No.	Height mm (in.)	Width mm (in.)	Depth mm (in.)	Fuse Type (mm)
17-5110	81 (3.18)	18 (0.71)	61 (2.40)	10 X 38
17-5114	95 (3.74)	26 (1.02)	79 (3.11)	14 X 51
17-5122	128 (5.04)	35 (1.38)	83 (3.29)	22 X 58

CE Filters for DIN-A-MITE Products

Code Number	Description	Stocked
14-0017	Single-phase, series connected filter	Yes
14-0018	Three-phase, series connected filter	Yes
14-0019	Single-phase, parallel connected filter	Yes
14-0020	Three-phase, parallel connected filter	Yes

Note: There is a one year limited warranty on CE filters.

Power Controllers

Problem Solvers

Watlow Solutions To Common Power Controller Problems

Power controller replacement intervals can be lengthened or problems eliminated by using the optimum power controller for the application. Check the list below to see if Watlow power controllers can improve your process.

Problem	Power Control Solution
Premature heater failure	• Stabilize heater element temperature and reduce thermal stress by using a solid state power control along with a PID temperature controller to reduce the temperature control cycle time
Excessive contactor failure	• Replace electromechanical contactors with solid state relays. Use E-SAFE® RELAY for long cycle times, solid state relays for short cycle times and PID control
Wasted power	• Reduce temperature overshoot and power consumption by smoothing out temperature/heating cycles with solid state power control and PID temperature control
Unsafe panel wiring	• The DIN-A-MITE power controllers, when properly wired are totally safe from finger and palm electrical shock
Environmental concerns about mercury	• Replace with solid state power controller or E-SAFE RELAY. The DIN-A-MITE has the same footprint as many MDRs
Excessive EMI causing problems in control circuits	• Correct wire routing for minimum EMI pick-up; change from electromechanical and mercury relays, and/or phase-angle fired solid state devices to zero cross (burst firing) solid state power control

Case History

Power Controllers Prove High Reliability for High Ambient Application

Problem:

Dairy Blowmolding Specialists was experiencing failures in their single and three-phase SCR relays from another supplier. Watlow wanted to understand the reason for the failure before sampling a solution, so Watlow offered to assist in diagnosing the problem.

After evaluating a failed unit, it was established that although Dairy Blowmolding Specialists had taken steps to keep the ambient temperature in the enclosure below the competitor's rating, the unit had failed due to overtemperature

Solution:

Watlow sampled a 22 mm (0.86 in.) SERIES CZR for their single-phase application. The extra space provided by the controller's small footprint, in addition to the superior internal heat transfer, ensured the SERIES CZR's chance for survival. Dairy Blowmolding Specialists purchased Watlow's DIN-A MITE® B for their three-phase application.

Both power controllers are stock items and were available to ship the same day.

Dairy Blowmolding Specialists and Watlow are pleased with the results. Both power controllers are perfect fits for the application and have proven to be reliable. Six months after installation there are zero failures.

Heaters

The RAYMAX® Family

Watlow's diverse RAYMAX® heater line allows you to solve virtually any application that requires radiant heat. Our capabilities cover a wide range of needs, from contamination-resistant surfaces, to fast responding high temperature panels, to replaceable tubular elements.

Applying radiant heaters can be complicated. Watlow's engineering staff has the level of training and expertise required to help meet your application requirements, providing a high degree of technical support such as conducting testing for your application at our facility, calculating your watt density and temperature requirements and recommending system components such as sensors and controllers. With our experience in a wide range of industries, chances are Watlow has already helped someone handle a radiant heating application like yours.

Features and Benefits

- **The full RAYMAX line** offers a variety of styles and capabilities to match the ideal temperature and watt density requirements of your application.
- **Engineering and application support** from Watlow makes your projects run more smoothly.
- **Custom designs** can be quickly adapted for particular needs such as special wattage zoning.
- **Watlow sensors and controllers** are completely compatible with RAYMAX heaters for a single source thermal system that is reliable and designed just for your application.

Applications

- Thermoforming
- Shrink packaging
- Laminating

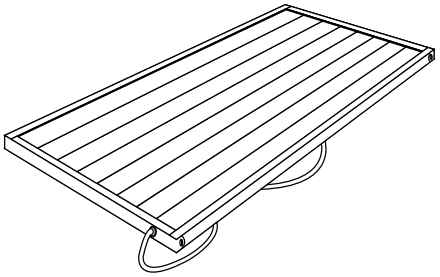
Caution: *Fire Hazard*

Radiant heaters must not be operated in the presence of flammable vapors, gases or combustible materials without proper ventilation and safety precautions. Radiant heaters must be properly wired and controlled to comply with all applicable electrical codes.

The RAYMAX Family

Panel Variations

Low Profile

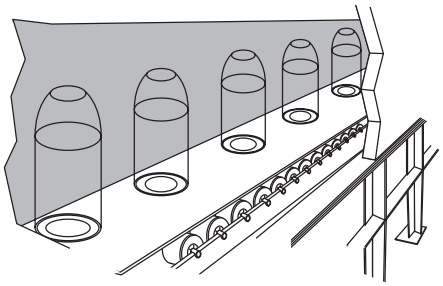


This design may be required where mounting space is limited, for example, when converting existing equipment or designs to radiant panels.

Available options may vary from the standard units when you specify a low profile design. Consult Watlow for further information.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Zoning



Watt densities can be varied across the entire width of RAYMAX heaters. If desired, each zone can have an individually controlled power supply.

Zoning can be very valuable when part of the product requires more heat, or when you must compensate for heat losses at the edges. By separately turning off part of the heated width, you can adjust for various widths of material.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

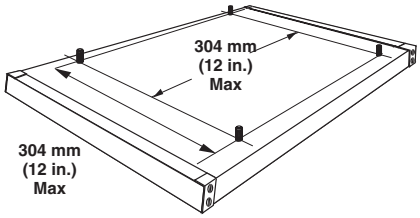
Heaters

The RAYMAX Family

Mounting Accessories

Application note: Allow for some thermal expansion of the heater case during operation. An expansion of up to one percent can occur when the case reaches its normal maximum limit of 595°C (1100°F). If your equipment has mounting screws to connect to the slots in the mounting legs, allow for a small amount of extra length. If you are using mounting holes to interface with the mounting studs on the back of the RAYMAX case, make sure your holes are oversized. Also, use washers and avoid overtightening.

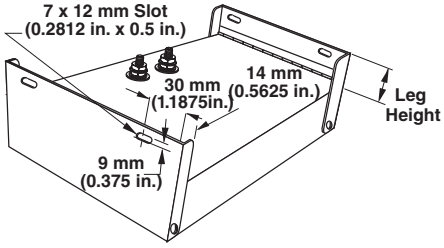
Mounting Studs



Standard M6 X 40 (0.25 X 20 X 1.5 in.) steel studs are welded to the case. For best support, studs should be approximately located on 304 mm (12 in.) centers. Consult Watlow for exact locations on specific heaters.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Mounting Legs



Mounting legs are extensions of the steel end caps with mounting slots for bolting directly to field support members. There is no extra charge for legs; they can be supplied in half inch increments from 12.5 mm (0.5 in.) to 76 mm (3 in.). No slots are provided in legs less than 25 mm (1 in.) long.

For panels over 610 mm (24 in.) long, mounting studs are recommended for the best panel support.

Available with RAYMAX 1120, 1220 and 2030.

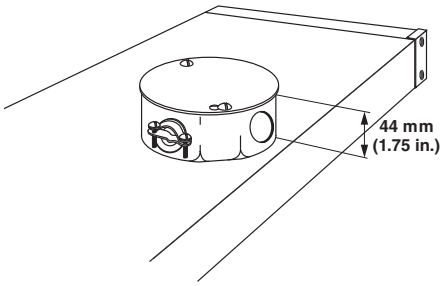
Terminal Accessories

Special Terminal Locations

If the standard terminal locations shown will not meet your needs special locations can be designed.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Terminal Box

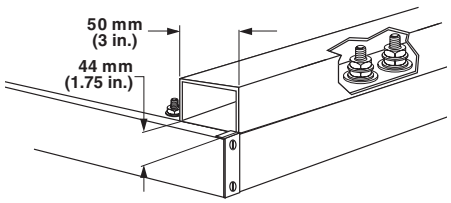


To protect electrical connections, a standard NEMA terminal box is available. The standard size is 102 X 102 X 41 mm (4 X 4 X 1.625 in.) with knockouts for 12.5 mm (0.5 in.) conduit. Other NEMA sizes are also available.

Care should be taken to use lead wire capable of withstanding the ambient temperatures.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Wiring Raceway



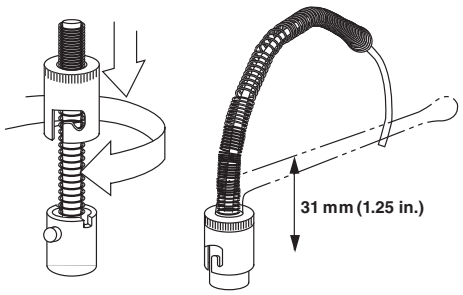
Custom designed to your specific requirements, a steel raceway provides electrical and physical protection for all terminal connections. This can be particularly useful for multi-zone panels.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

The RAYMAX Family

Temperature Control

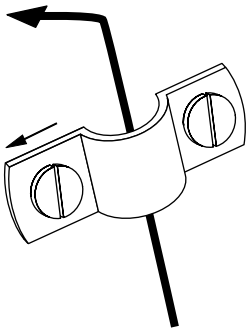
Thermowells



A thermowell allows you to use a thermocouple with a bayonet fitting to monitor heater temperature. The thermowell is located on the back of the panel to allow easy access for thermocouple replacement. Spring tension holds the tip of the thermocouple in contact for close control of the heater temperature. Thermocouple not included.

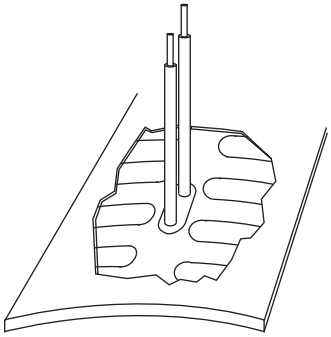
Available with RAYMAX 1010, 1120 and 1330.

Thermocouple Clamps



A thermocouple mounting clamp can be provided on the end of the heater case. The clamp is suitable for use with 3.175 mm (0.125 in.) and 6.35 mm (0.25 in.) O.D. sheath thermocouples, which should be bent 90 degrees so that the sensing tip is just above and lightly touching the hot face at an element location. **Available with RAYMAX 1220 and 2030.**

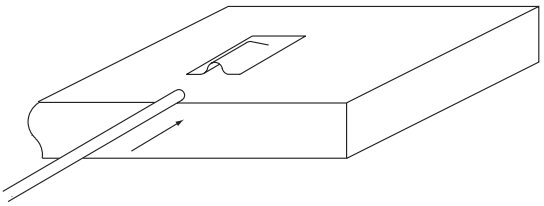
Welded Thermocouple



A thermocouple junction is welded to the emitting surface to provide optimum temperature sensing accuracy and responsiveness. This option permits the actual radiating face temperature to be precisely monitored and controlled.

Available with RAYMAX 1010, 1120 and 1330.

Thermocouple Pocket



A thermocouple pocket is welded to the emitting surface. The pocket accepts a 1.6 mm (0.063 in.) diameter thermocouple (not included). This option provides accurate temperature sensing and easy thermocouple replacement.

Available with RAYMAX 1010, 1120 and 1330.

Heaters

Quartz

The Watlow quartz tube radiant heater provides medium wave infrared energy and fast heat up and cool down. With element temperatures around 930°C (1700°F), the heater produces infrared radiation with a peak energy wavelength of 2.5 microns. Lower operating temperatures produce longer wave lengths. The majority of the energy is transmitted through the translucent quartz tube without being absorbed.

Most designs reach full output in 30 to 60 seconds and typically cool down to 50 percent output in under 15 seconds. The quartz tube heater is ideal for applications where frequent line stoppages are anticipated or quick heat up or cool down is necessary. Heaters can be turned off between production runs to save energy. Unique control schemes are possible that adjust the wattage output of the heaters during the heating cycle.

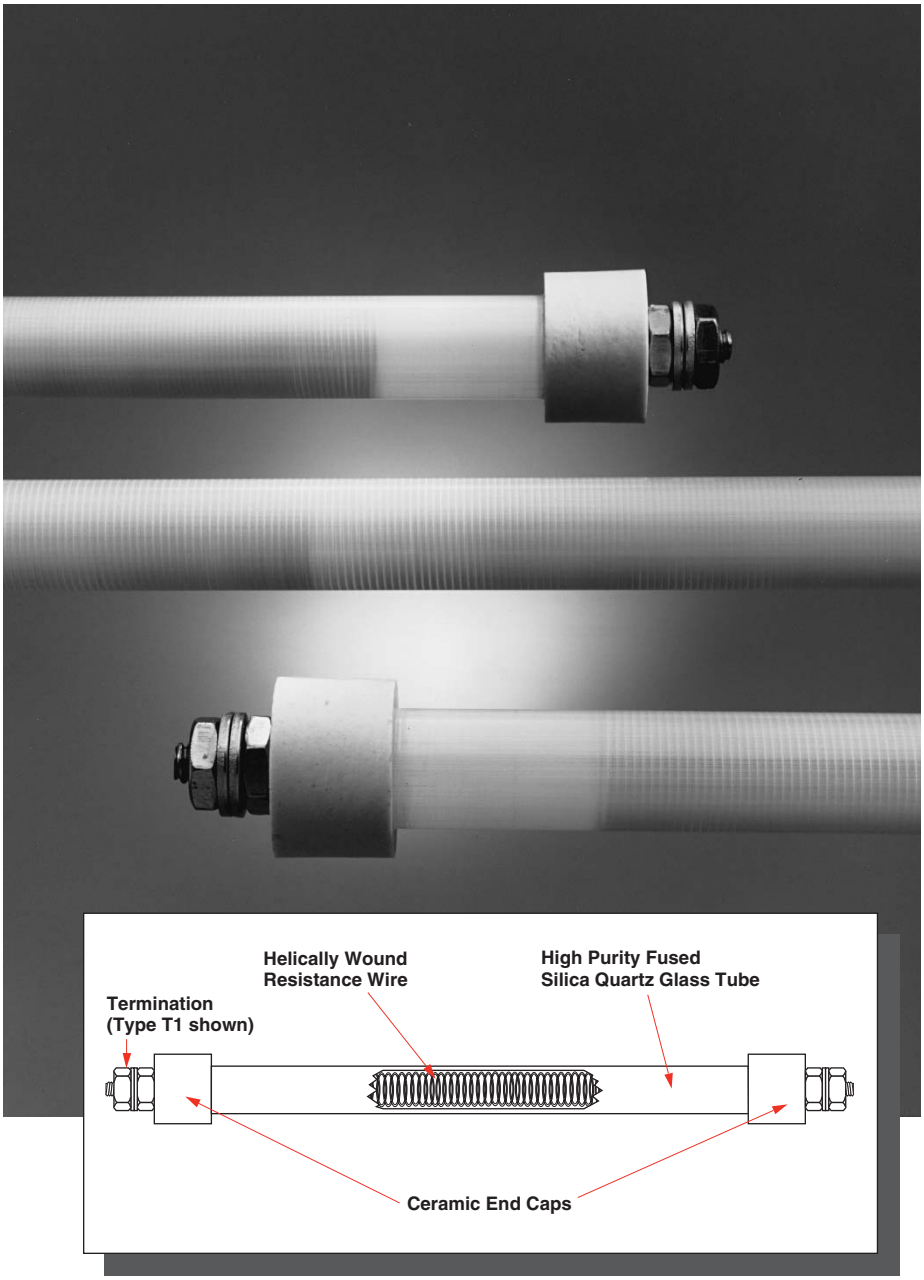
Performance Capabilities

- Element temperatures up to 930°C (1700°F)
- Tube watt densities up to 23.6 W/cm of heated length (60 W/in.of heated length)

Features and Benefits

Horizontal operation only

- **Fast delivery** on all standard replacement elements means less downtime waiting for parts.
- **Termination styles** are available for virtually every enclosure on the market.
- **Ceramic end caps**, bonded to the quartz tubing ends, provide a rigid support for terminations. RTV bonding also available.
- **Heaters usually do not need to be retracted** during line stoppages.



- **No objectionable glare** is created due to low emission in the visible spectrum.
- **No process contamination** occurs with this clean thermal energy source.

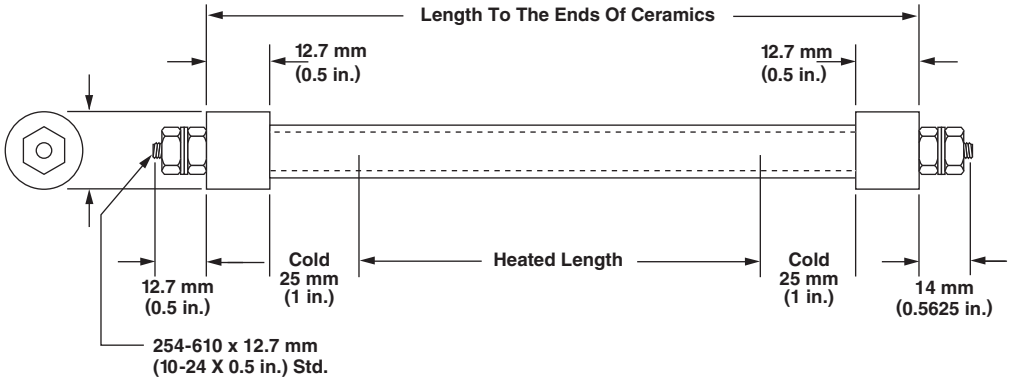
Applications

- Thermoforming
- Shrink packaging
- Laminating

Heaters

Quartz

Applications and Technical Data



Specifications

Outside diameter (nominal/actual):

10 mm (0.6 in./0.394 in.)

13 mm (0.5 in./0.512 in.)

16 mm (0.625 in./0.630 in.)

Ceramic end caps:

16 X 13 mm tube: 0.375 in. (0.6875 in. dia. x 0.5 in. long)

19 X 13 mm tube: 0.5 in. (0.75 in. dia. x 0.5 in. long)

22 X 13 mm tube: 0.625 in. (0.9375 in. dia. X 0.5 in. long)

Available lengths: 200 mm to 1829 mm (8 in. to 72 in.) 0.375 in. diameter, 60 in. maximum length

Length tolerances:

Sheath: ±3.2 mm (0.125 in.)
Heated length: ±6.3 mm (0.25 in.)

No-Heat length: 25 mm (1 in.) standard

Screw terminal: 10-24 thread

Termination: Type T1, T2, T3, T4, T5, T6

Electrical

Resistance tolerance:

NEMA standard +10 percent, -5 percent

Wattage tolerance:

NEMA standard +5 percent, -10 percent

Maximum volts: Consult factory

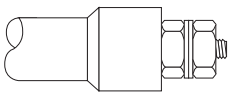
Maximum amperage: 20A

Maximum watt density:

Consult factory

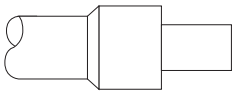
Standard Terminations

Type T1



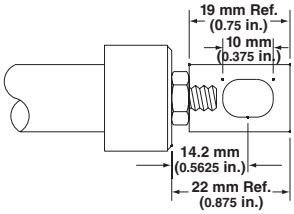
Standard termination: 10-24 stainless steel screw thread terminals.

Type T2



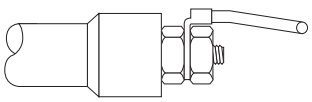
Quick disconnect fuse style: 9.5 mm X 12.7 mm long (0.4375 in. dia. X 0.5 in.) terminals.

Type T3



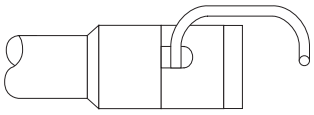
Tabs with slotted holes: SS Tabs 12.7 mm wide X 19 mm long (0.5 in. X 0.25 in.). Slots 7.1 mm X 9.5 mm (0.2812 in. X 0.375 in.).

Type T4



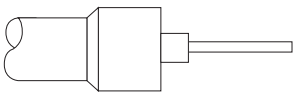
Flexible lead termination: 305 mm (12 in.) flexible leads; if longer leads are required, please specify.

Type T5



Flexible lead termination: 10-24 SS screw thread terminals insulated with ceramic terminal covers. Terminals are pre-wired with 305 mm (12 in.) flexible lead wire. If longer leads are required, please specify.

Type T6



305 mm (12 in.) flexible leads exit the ceramic cap. There are no post terminals. Please specify if longer leads are required.

Mounting Frames for Watlow Quartz Heaters

See Raymax 1626 on page 303.

Heaters

RAYMAX® 1010

Designed to resist contamination, the RAYMAX® 1010 is ideal for use in low heat applications. The heater's "sealed face" keeps contaminants away from the heating element, and this metal surface can be easily wiped or brushed clean whenever needed.

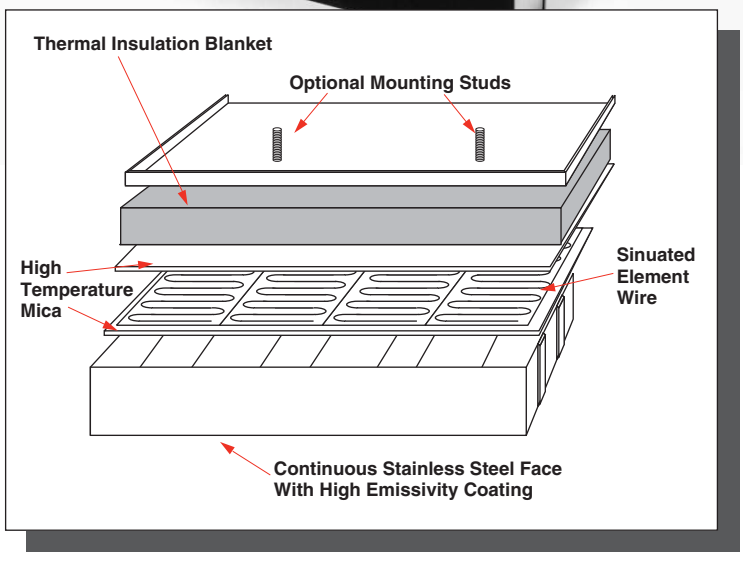
The rugged all-metal construction results in a shock-proof, shatter-proof heater that is durable and long lasting. No fragile glass, ceramic or fiber is used.

Performance Capabilities

- Face temperature: 540°C (1000°F) max.
- Watt densities: 1.5 W/cm^2 (10 W/in^2) max.
- 50 amps maximum

Features and Benefits

- **Uniform full surface heat** source provides better, more even heat.
- **No reflectors** to clean or replace.
- **Accurate, repeatable temperature** sensing options.
- **Convenient ready-to-use package** makes installation easier.
- **25 mm (1 in.) thick** backside insulation reduces losses.
- **No fragile glass or ceramic** elements to worry about.



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

RAYMAX 1010

Applications and Technical Data

Sizes and Ratings

Thickness: 47.4 mm (1.87 in.)

Volts: 120, 240, 480V~(ac), 1-phase. 3-phase available on unit widths divisible by 6

Watt density: Up to 1.5 W/cm² (10 W/in²), 50 amps max.

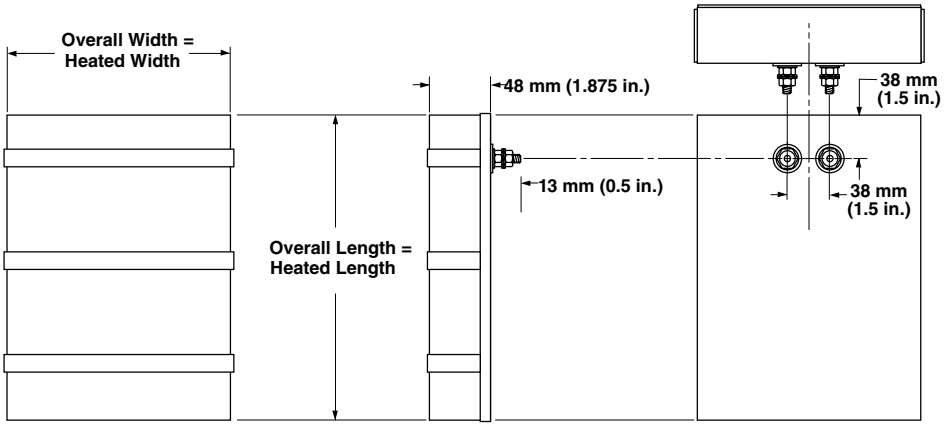
Face temperature: Up to 540°C (1000°F)

Typical peak energy wavelength: 3.5-4 microns

Specifications

Heater Dimensions	Min.	Max.	Increments
Width: mm (in.)	101.6 (4)	508 (20)	50.8 (2)
Length: mm (in.)	254 (10)	1727.2 (68)	any
Area: cm² (in²)		5574 (864)	any

Note: Less than maximum length x width may exceed maximum area.



Options

- Terminal box
- Thermowell (VAT style thermocouple required)
- Thermocouple pocket (thermocouple required)
- Thermocouple welded to hot face
- Mounting studs
- Totally sealed construction
- Food-safe surface treatment

How to Order

All units are **made-to-order**. Please specify the following information when placing an order:

- Width and length
- Total wattage
- Voltage and phase
- Mounting studs, if desired
- Terminal location, if non-standard
- Terminal box, if desired
- Internally welded thermocouple or thermowell, if desired

Availability

Please consult Watlow for lead time required.

Quick Ship • *Next day shipment on all stock units.*

Heaters

RAYMAX® 1120

The RAYMAX® 1120 is a lightweight, yet sturdy and durable radiant heater panel. The emitter sheath is stainless steel with a black coating that makes it a highly efficient radiating surface. In addition, the heater's low mass allows rapid start-up and fast response to controls.

The patented RAYMAX heater features 25 mm (1 in.) wide emitter strips that are individually replaceable for lower maintenance costs. Weighing only 26.8 kg/m² (5.5 lbs/ft²), the heater is easy to mount.

Performance Capabilities

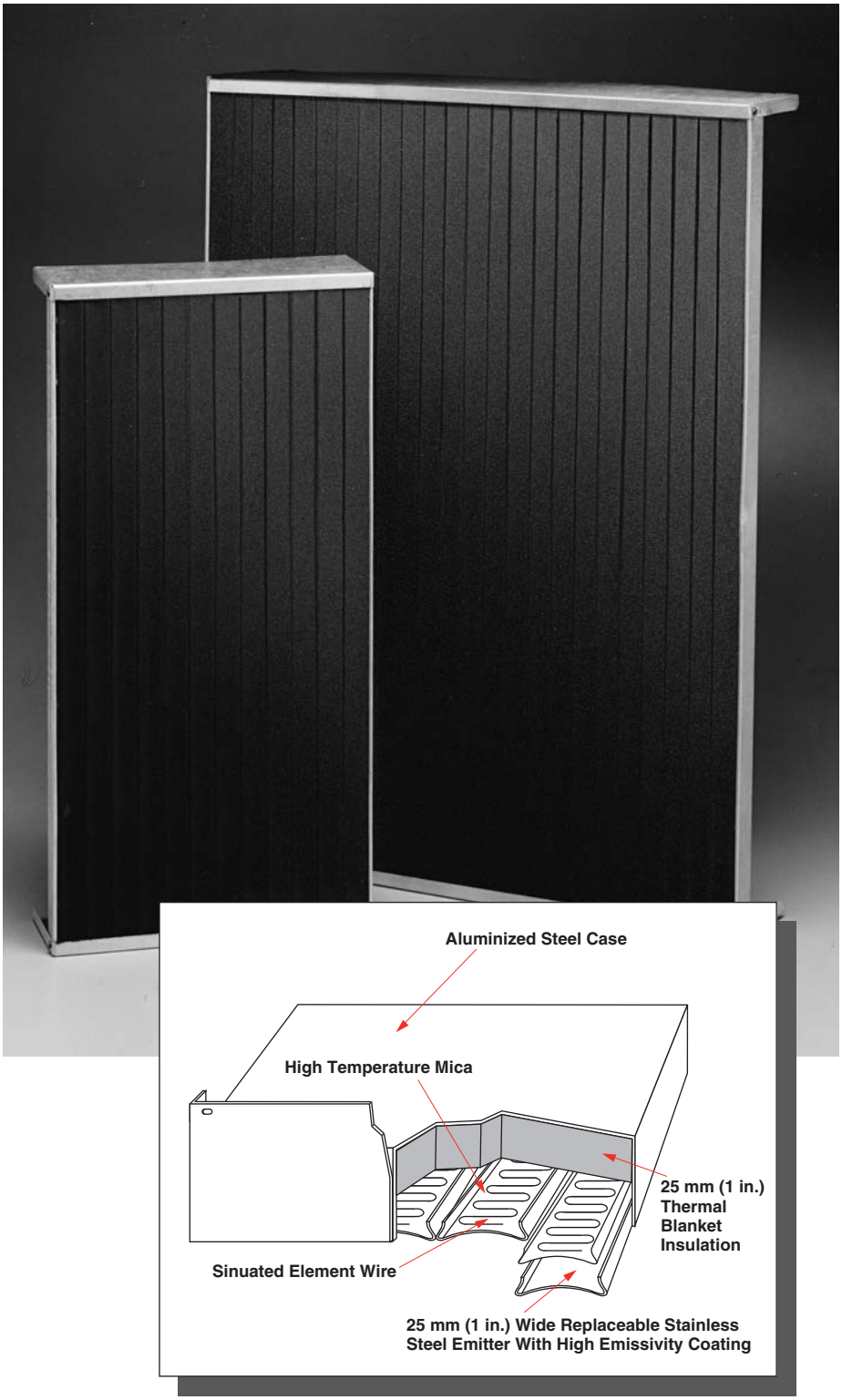
- Face temperature: 595°C (1100°F) max.
- Watt density: 3 W/cm² (20 W/in²) max.

Features and Benefits

- **Replaceable emitters** reduce your costs.
- **High temperature mica** electrically insulates nickel chromium resistance wire, permitting longer heater life.
- **High emissivity coating** on emitter strips improves radiant heating efficiency.
- **Thermal insulation,** 25 mm (1 in.) thick, backs the emitter strips to reduce backside losses.
- **Uniform full surface heat source** provides better, more even heat.
- **Special requirements** are easily met with custom sizes and ratings.
- **No fragile glass or ceramic** elements to worry about.
- **Next day shipment** is available on stock sizes.

Applications

- Thermoforming
- Packaging
- Forming bubble pack



Heaters

RAYMAX 1120

Applications and Technical Data

Face Temperature: 595°C maximum (1100°F)

Wattage: Watt densities up to 3 W/cm² (20 W/in²)

Standard Voltage: 120, 240, 480V~(ac), 1-phase. Balanced 3-phase available on unit widths divisible by three. Other voltages are available.

Terminals: Non-standard locations are available. Please specify.

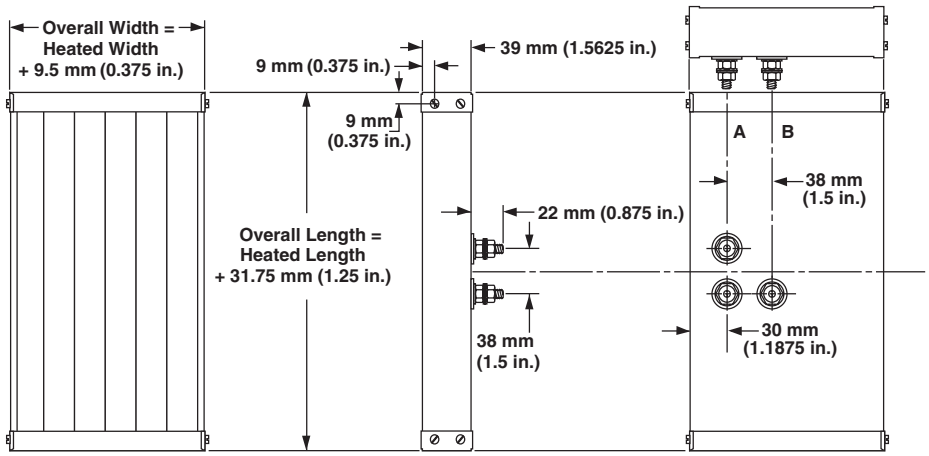
Standard Dimensions: ±0.0625 mm (0.0625 in.)

Typical Peak Energy Wavelength: 3-3.5 microns

Specifications

Heater Dimensions	Min.	Max.	Increments
Width: mm (in.)	25.4 (1)	914.4 (36)	25.4 (1)
Length: mm (in.)	152.4 (6)	1778 (70)	any
Area: cm² (in²)	38.7 (6)	5574.2 (864)	any

Note: Less than maximum length x width may exceed maximum area.



Panel Overall Size mm (in.) Width	Panel Overall Size mm (in.) Length	Panel Heated Size mm (in.) Width	Panel Heated Size mm (in.) Length	Volts	Watts	Watt Density W/cm² (W/in²)	Approx. Net Wt. kg (lbs)	Availability	Code No.
161.93 (6⅜)	641.35 (25¼)	152.4 (6)	609.6 (24)	240	2880	3.1 (20)	2.7 (6)	Stock	**P0624AX050**
314.33 (12⅜)	336.55 (13¼)	304.8 (12)	304.8 (12)	240	2880	3.1 (20)	2.7 (6)	Stock	**P1212AX030**
314.33 (12⅜)	641.35 (25¼)	304.8 (12)	609.6 (24)	240	5760	3.1 (20)	5.4 (12)	Stock	**P1224AX062**
314.33 (12⅜)	1250.95 (49¼)	304.8 (12)	1219.2 (48)	480, 3-phase	11520	3.1 (20)	10.8 (24)	Stock	**P1248AX073**

Note:
- Panels are equipped with terminal box, thermocouple well with bayonet adapter and mounting studs.
- Watlow stock radiant panels must be properly applied for safe operation.
- Please consult Watlow with your application before ordering.

How to Order

To order your stock RAYMAX heater, specify:

- RAYMAX 1120
- Quantity
- Watlow code number

If our stock units do not meet your application needs, Watlow can manufacture RAYMAX heaters to your special requirements. For **made-to-order** heaters, specify the following:

- Heated width and length. Three-phase panels must have width divisible by three.
- Total wattage of each panel.
- Exact voltage and phase. A five percent variation in voltage at the oven will cause a 10 percent variation in power.
- Zoning. Indicate dimensions and wattage of each zone.
- Mounting legs or mounting studs, if desired. For studs, give number and location or indicate standard location.
- Terminal location if non-standard.
- Terminal box or wire raceway, if required.

Supplying a drawing with an order or request for quotation can be very helpful in clarifying design information.

Availability

Stock: Next day shipment

Made-to-Order: Consult Watlow

Heaters

RAYMAX® 1330

The RAYMAX® 1330 is the only radiant heater that features specially insulated heater emitter strips for higher performance. Watlow developed a unique compacted mineral insulation to electrically insulate the element wire, with a result of superior heat transfer and higher operating capabilities.

Because of its rugged stainless steel construction, the RAYMAX 1330 is long-lasting. And this heater features a high emissivity black coating and a uniform, full surface heat source for better efficiency.

Performance Capabilities

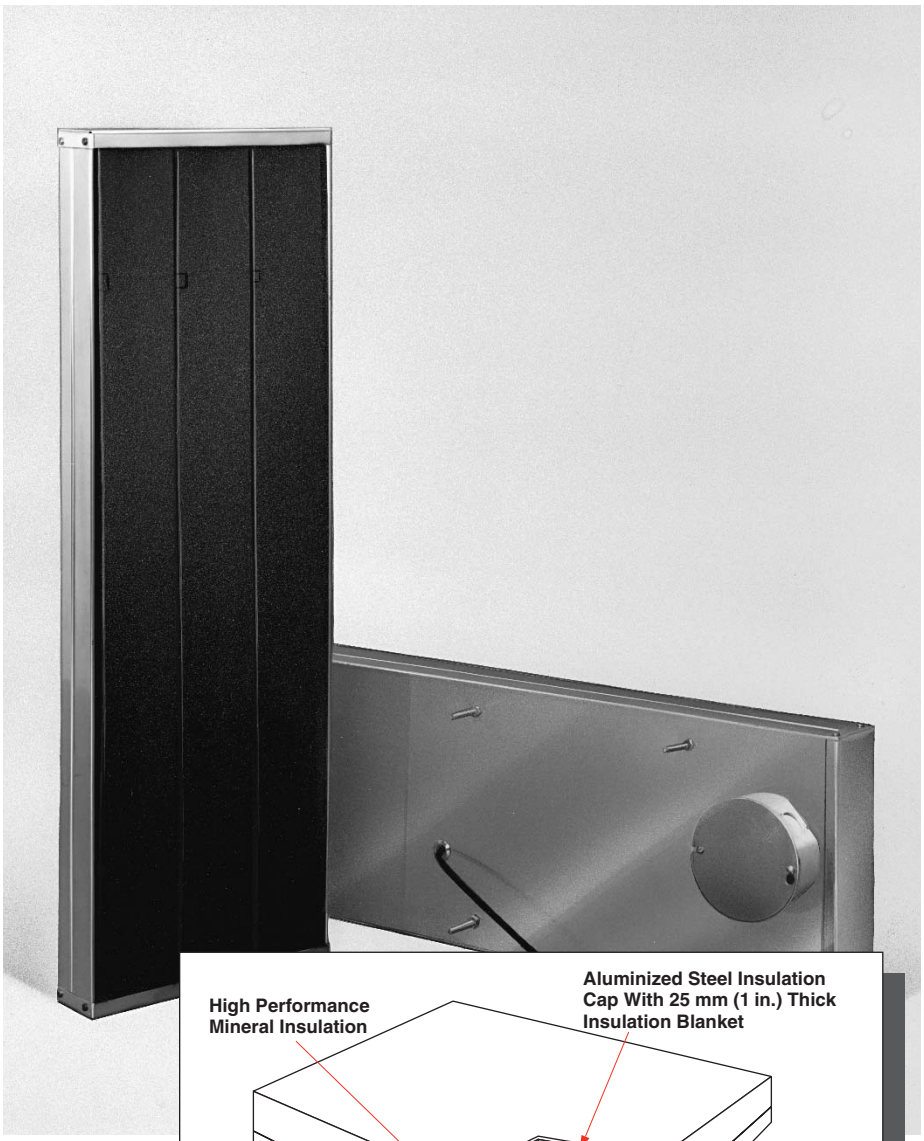
- Maximum face temperature: 700°C (1300°F)
- Maximum watt density: 4.7 W/cm² (30 W/in²)
- Typical peak energy wavelength: 3-3.6 microns

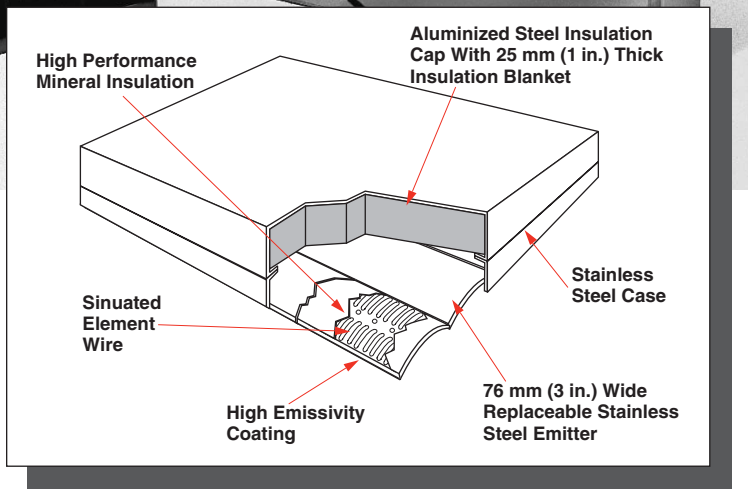
Features and Benefits

- **Field replaceable emitter strips** allow you to avoid the cost of buying a new radiant heater.
- **Rugged metal construction** protects heater from contaminants.
- **Accurate, responsive** face temperature sensing options are available.
- **No reflectors** to be cleaned or replaced.
- **No fragile glass or ceramic** elements to worry about.
- **Backside insulation** is 25 mm (1 in.) thick, resulting in better heating efficiency.

Applications

- Thermoforming
- Heat shrinking
- High temp composites
- Packaging





RAYMAX 1330

Applications and Technical Data

Sizes and Ratings

Thickness: 65 mm (2.562 in.)

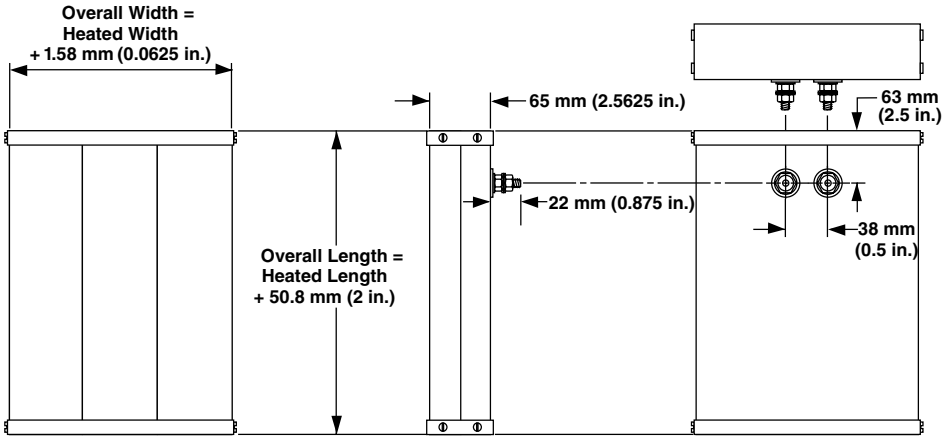
Volts: 120, 240, 480V~(ac), 1-phase. 3-phase available on units with three or six emitters.

Maximum Watt Density: 4.7 W/cm^2 (30 W/in^2)

Maximum Face Temperature: 700°C (1300°F)

Typical Peak Energy Wavelength: 3 microns

Heater Dimensions	Minimum	Maximum	Increments
Heated width:	81 mm (3.187 in.)	485.77 mm (19.125 in.)	81 mm (3.187 in.)
Length:	305 mm (12 in.)	775 mm (30.5 in.)	any



How to Order

The RAYMAX 1330 and radiant band/strip emitters are available **made-to-order** only. It is helpful to have the following information available:

- Heated width and length (or diameter for band emitters)
- Total wattage
- Voltage and phase
- Mounting studs, if desired
- Mounting legs and leg height, if desired
- Terminal location
- Terminal box, if desired
- Thermocouple or thermowell, if desired

Availability

Made-to-Order: Consult Watlow

Heaters

RAYMAX® 1626

Watlow's RAYMAX® 1626 quartz tube panel is a fast responding and very efficient source of radiant thermal energy. With heat-up and cool down capabilities of 40 to 50 seconds, the quartz heater is ideal for use in operations where frequent line stoppages are anticipated or immediate heat-up and cool-down is necessary. Custom sizes are available up to 27 inches wide in three inch increments and 70 inches long.

Performance Capabilities

Horizontal operation only

- Watt densities to 3.1 W/cm^2 (20 W/in^2) measured across the reflector area
- Element temperatures to 930°C (1700°F)

Features and Benefits

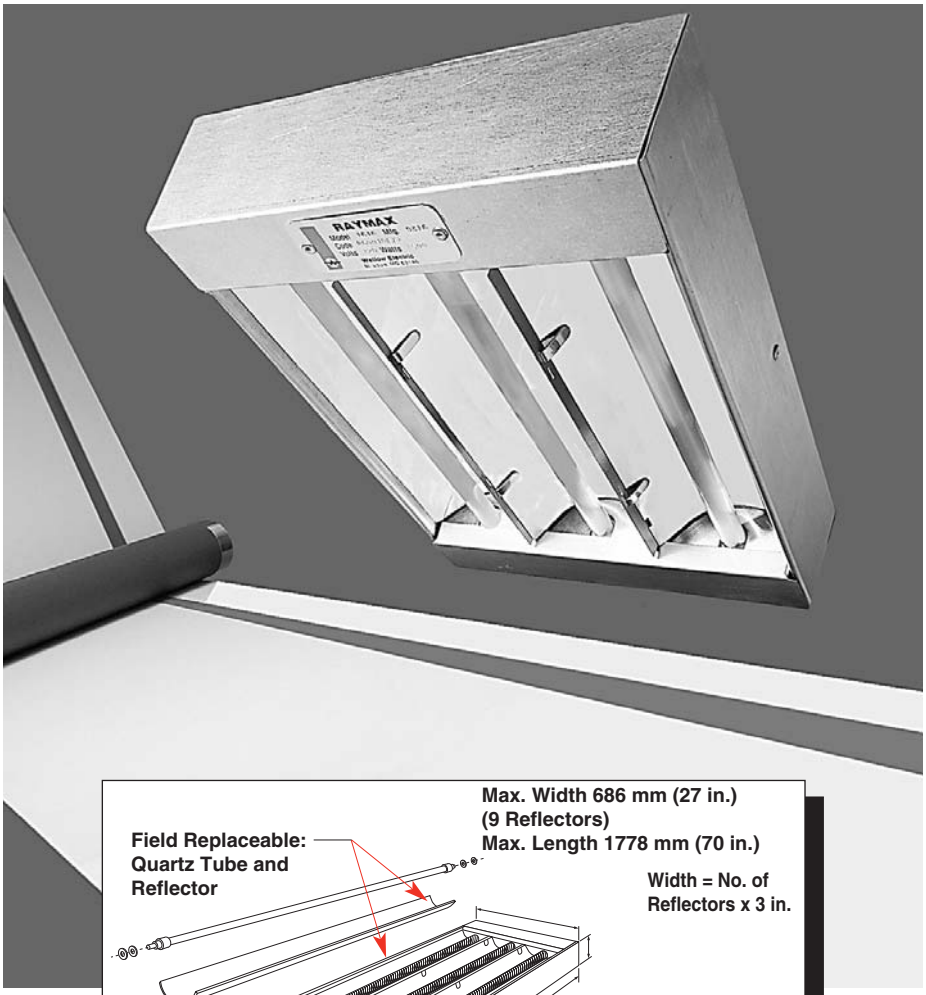
- **Quartz tubes and reflectors are easy to replace** from front of heater for less downtime.
- **Polished parabolic aluminum reflectors** direct radiant energy from the back for efficient heating.
- **Little residual heat** to reduce possibility of product damage during line stoppage.
- **Fast heat-up, cool down allows heater turn off during gaps in production** for more energy savings.

Applications

- Thermoforming
- Heating plastic films
- Web processing

Options

Thermocouple clamp is located on the end cap. The clamp is used to hold a 3.17 mm (0.125 in.) one eighth inch diameter thermocouple (not included) in front of the reflector to intercept the radiated energy to provide a control temperature. The thermocouple should be painted with a high temperature black paint to improve absorption.



How to Order

The RAYMAX 1626 is **made-to-order** only. It is helpful to have the following information available:

- Heated width 76.2 mm (3 in.) and length
- Total wattage
- Voltage and phase (balanced 3-phase on three, six and nine tube units only)
- Mounting studs, if desired

Availability

Made-to-Order: Consult Watlow

RAYMAX® 1525

Watlow's RAYMAX® 1525 is a rugged radiant heater with a unique design that allows quick removal and replacement of the element and reflectors. Instead of dismantling the heater, the parts are simply removed from the front. Replacing dirty reflectors often can improve heating efficiency by up to 30 percent.

The RAYMAX 1525 is available with either a fast responding quartz element or an Incoloy® sheathed WATROD tubular element. Both are supported by stainless steel hardware in an extruded aluminum housing.

All stock units come with 41.27 mm (1.625 in.) long, 9.5 mm (0.375 in.) 16 thread mounting bolts that slide along the heater's length to accommodate mounting considerations.

Performance Capabilities

- Element temperatures to 870°C (1600°F)
- Watt densities measured across the reflector area up to 3.9 W/cm^2 (25 W/in^2)

Features and Benefits

- **Fast and easy replacement** of the tubular element and reflectors for quick servicing.
- **Variety of element styles:** single or dual element, hairpin, liquid tight housing and quartz element.
- **Assembly stock availability** provides quick three-day shipment from order receipt.
- **Optional single end wiring**, available on most units, simplifies installation.
- **Polished aluminum reflector** efficiently directs heat to the work.

Applications

- Thermoforming
- Web processing

Options

Single End Wiring

Single end wiring permits power leads to be brought into only one end of the unit. Standard units with straight elements must be wired at both ends.

Power Leads

Appropriate power leads come attached to the heating element(s). To order, simply specify **length** and **flexible conduit**, if required.

Protective Grille

A stainless steel grille section that snaps in to reduce the possibility of personnel or product coming in contact with the heating elements.

Incoloy® is a registered trademark of Special Metals Incorporated.

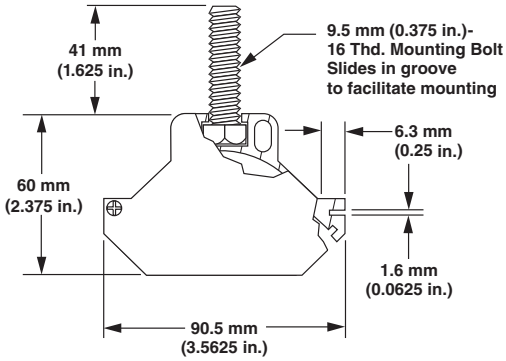
Heaters

RAYMAX 1525

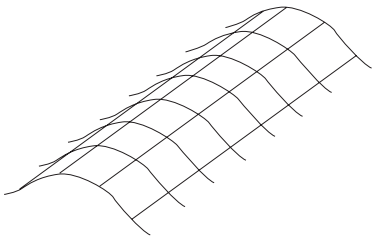
Options

Continued

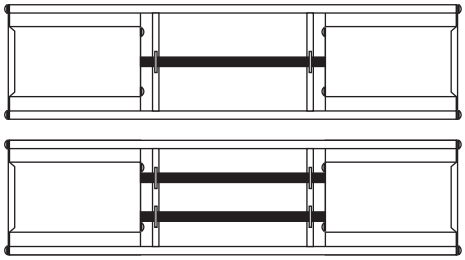
Element Styles



Protective Grille

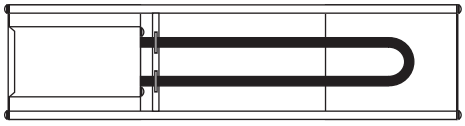


Single and Dual Elements



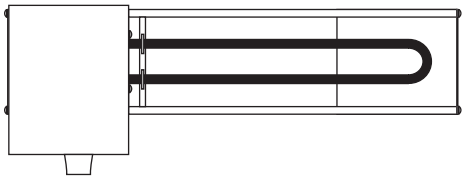
Straight length WATROD tubular elements come in single or dual styles. The dual style produces twice the wattage of the same length single element. Dual elements can also be jumpered to permit single end wiring and operating at twice the rated voltage up to 480V~(ac).

Hairpin Element



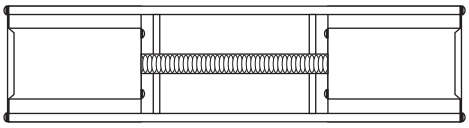
A WATROD hairpin-shaped tubular element provides the convenience of single end wiring and a reduced no-heat area on the non-terminal end.

Liquid Tight Housing



On this style, the hairpin element terminates in a liquid tight housing to permit operation in a hose-down area or exposure to weather. The cast aluminum housing has a 13 mm (0.5 in.) NPT conduit fitting. The box is 71.43 x 85.73 x 133.35 mm (2.8125 in. x 3.375 in. x 5.25 in.) including conduit hub.

Quartz Tube Element



Watlow quartz elements provide the advantage of faster heat-up and cool-down—important when encountering frequent line stoppages. A standard 13 mm (0.5 in.) diameter quartz tube provides strength and long resistance wire life.

How to Order

To order, specify:

- Watlow code number
- Watts/volts
- Options
- Quantity

If our stock units do not meet your application needs, Watlow can manufacture to meet your special requirements. For **made-to-order** units, please specify:

- Overall or heated length
- Element style
- Volts/watts
- Options
- Quantity

Availability

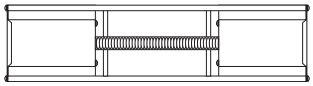
Assembly Stock: Three working days

Made-to-Order: Consult Watlow

Heaters

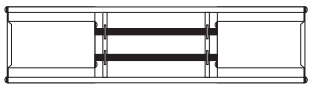
RAYMAX 1525

Single Element



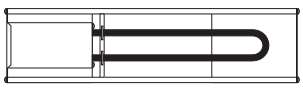
Overall Length mm	(in.)	Heated Length mm	(in.)	Volts	kW	Approx Net Wt. kg	(lbs)	Availability	Code No.	Replacement Element Code No.	Replacement Reflector Code No.
345	(13 5/8)	185	(7 1/4)	120	0.40	0.88	(1.9)	Assy. Stock	**RT1A013L00**	**RDN10E1**	**RR1013L00**
510	(20 5/8)	345	(13 5/8)	120	0.65	1.3	(2.7)	Assy. Stock	**RT1A020A00**	**RDN16L1**	**RR1020A00**
620	(24 3/8)	425	(16 13/16)	120	0.80	1.5	(3.2)	Assy. Stock	**RT1A024G00**	**RDN21B1**	**RR1024G00**
620	(24 3/8)	425	(16 13/16)	240	0.80	1.5	(3.2)	Assy. Stock	**RT1G024G00**	**RDN21B10**	**RR1024G00**
780	(30 5/8)	580	(22 7/8)	120	1.10	1.8	(4.0)	Assy. Stock	**RT1A030L00**	**RDN27C1**	**RR1030L00**
780	(30 5/8)	580	(22 7/8)	240	1.10	1.8	(4.0)	Assy. Stock	**RT1G030L00**	**RDN27C10**	**RR1030L00**
910	(35 7/8)	710	(27 7/8)	240	1.30	2.2	(4.7)	Assy. Stock	**RT1G035R00**	**RDN32C10**	**RR1035R00**
910	(35 7/8)	710	(27 7/8)	480	1.30	2.2	(4.7)	Assy. Stock	**RT1P035R00**	**RDN32C11**	**RR1035R00**
1185	(46 5/8)	980	(38 5/8)	240	1.80	2.7	(5.8)	Assy. Stock	**RT1G046L00**	**RDN42R10**	**RR1046L00**
1185	(46 5/8)	980	(38 5/8)	480	1.80	2.7	(5.8)	Assy. Stock	**RT1P046L00**	**RDN42R11**	**RR1046L00**
1560	(61 3/8)	1350	(53 1/4)	240	2.50	3.4	(7.5)	Assy. Stock	**RT1G061G00**	**RDN57J10**	**RR1061G00**
1560	(61 3/8)	1350	(53 1/4)	480	2.50	3.4	(7.5)	Assy. Stock	**RT1P061G00**	**RDN57J11**	**RR1061G00**
1875	(73 3/4)	1650	(65 5/8)	240	3.00	4.1	(9.0)	Assy. Stock	**RT1G073N00**	**RDN69E10**	**RR1073N00**
1875	(73 3/4)	1650	(65 5/8)	480	3.00	4.1	(9.0)	Assy. Stock	**RT1P073N00**	**RDN69E11**	**RR1073N00**
2180	(85 3/4)	1955	(77 5/8)	240	3.60	4.7	(10.2)	Assy. Stock	**RT1G085N00**	**RDN81E10**	**RR1085N00**
2180	(85 3/4)	1955	(77 5/8)	480	3.60	4.7	(10.2)	Assy. Stock	**RT1P085N00**	**RDN81E11**	**RR1085N00**

Dual Element



345	(13 5/8)	185	(7 1/4)	120	0.80	1.0	(2.2)	Assy. Stock	**RT2A013L00**	**RDN10E1**	**RR2013L00**
510	(20 5/8)	345	(13 5/8)	120	1.30	1.3	(2.9)	Assy. Stock	**RT2A020A00**	**RDN16L1**	**RR2020A00**
620	(24 3/8)	425	(16 13/16)	120	1.60	1.5	(3.4)	Assy. Stock	**RT2A024G00**	**RDN21B1**	**RR2024G00**
620	(24 3/8)	425	(16 13/16)	240	1.60	1.5	(3.4)	Assy. Stock	**RT2G024G00**	**RDN21B10**	**RR2024G00**
780	(30 5/8)	580	(22 7/8)	120	2.20	1.9	(4.1)	Assy. Stock	**RT2A030L00**	**RDN27C1**	**RR2030L00**
780	(30 5/8)	580	(22 7/8)	240	2.20	1.9	(4.1)	Assy. Stock	**RT2G030L00**	**RDN27C10**	**RR2030L00**
910	(35 7/8)	710	(27 7/8)	240	2.60	2.1	(4.7)	Assy. Stock	**RT2G035R00**	**RDN32C10**	**RR2035R00**
910	(35 7/8)	710	(27 7/8)	480	2.60	2.1	(4.7)	Assy. Stock	**RT2P035R00**	**RDN32C11**	**RR2035R00**
1185	(46 5/8)	980	(38 5/8)	240	3.60	2.7	(6.0)	Assy. Stock	**RT2G046L00**	**RDN42R10**	**RR2046L00**
1185	(46 5/8)	980	(38 5/8)	480	3.60	2.7	(6.0)	Assy. Stock	**RT2P046L00**	**RDN42R11**	**RR2046L00**
1560	(61 3/8)	1350	(53 1/4)	240	5.00	3.5	(7.7)	Assy. Stock	**RT2G061G00**	**RDN57J10**	**RR2061G00**
1560	(61 3/8)	1350	(53 1/4)	480	5.00	3.5	(7.7)	Assy. Stock	**RT2P061G00**	**RDN57J11**	**RR2061G00**
1875	(73 3/4)	1650	(65 5/8)	240	6.00	4.1	(9.1)	Assy. Stock	**RT2G073N00**	**RDN69E10**	**RR2073N00**
1875	(73 3/4)	1650	(65 5/8)	480	6.00	4.1	(9.1)	Assy. Stock	**RT2P073N00**	**RDN69E11**	**RR2073N00**
2180	(85 3/4)	1950	(77 5/8)	240	7.20	4.8	(10.5)	Assy. Stock	**RT2G085N00**	**RDN81E10**	**RR2085N00**
2180	(85 3/4)	1950	(77 5/8)	480	7.20	4.8	(10.5)	Assy. Stock	**RT2P085N00**	**RDN81E11**	**RR2085N00**

Hairpin Element

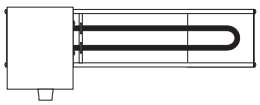


325	(12 3/4)	210	(8 3/8)	120	0.80	0.95	(2.1)	Assy. Stock	**RU1A012N00**	**RDN21B1UAAB**	**RR3012N00**
325	(12 3/4)	210	(8 3/8)	240	0.80	0.95	(2.1)	Assy. Stock	**RU1G012N00**	**RDN21B10UAAA**	**RR3012N00**
405	(15 7/8)	290	(11 7/16)	120	1.10	1.1	(2.4)	Assy. Stock	**RU1A015R00**	**RDN27C1UAAA**	**RR3015R00**
405	(15 7/8)	290	(11 7/16)	240	1.10	1.1	(2.4)	Assy. Stock	**RU1G015R00**	**RDN27C10UAAC**	**RR3015R00**
605	(23 3/4)	490	(19 3/16)	240	1.80	1.5	(3.3)	Assy. Stock	**RU1G023N00**	**RDN42R10UAAC**	**RR3023N00**
605	(23 3/4)	490	(19 3/16)	480	1.80	1.5	(3.3)	Assy. Stock	**RU1P023N00**	**RDN42R11UAAB**	**RR3023N00**
795	(31 1/4)	675	(26 9/16)	240	2.50	1.9	(4.2)	Assy. Stock	**RU1G031E00**	**RDN57J10UAAJ**	**RR3031E00**
795	(31 1/4)	675	(26 9/16)	480	2.50	1.9	(4.2)	Assy. Stock	**RU1P031E00**	**RDN57J11UAAB**	**RR3031E00**
945	(37 1/4)	825	(32 7/16)	240	3.00	2.2	(4.9)	Assy. Stock	**RU1G037E00**	**RDN69E10UAAB**	**RR3037E00**
945	(37 1/4)	825	(32 7/16)	480	3.00	2.2	(4.9)	Assy. Stock	**RU1P037E00**	**RDN69E11UAAB**	**RR3037E00**
1150	(43 3/8)	975	(38 7/16)	240	3.60	2.5	(5.6)	Assy. Stock	**RU1G043G00**	**RDN81E10UAAB**	**RR3043G00**
1150	(43 3/8)	975	(38 7/16)	480	3.60	2.5	(5.6)	Assy. Stock	**RU1P043G00**	**RDN81E11UAAB**	**RR3043G00**

Heaters

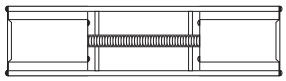
RAYMAX 1525

Hairpin Element with Liquid Tight Housing



Overall Length mm	Overall Length (in.)	Heated Length mm	Heated Length (in.)	Volts	kW	Approx Net Wt. kg	Approx Net Wt. (lbs)	Availability	Code No.	Replacement Element Code No.	Replacement Reflector Code No.
325	(12 ¾)	210	(8⅜)	120	0.80	1.1	(2.5)	Assy. Stock	**RS1A012N00**	**RDN21B1BAAB**	**RR4012N00**
325	(12 ¾)	210	(8⅜)	240	0.80	1.1	(2.5)	Assy. Stock	**RS1G012N00**	**RDN21B10BAAA**	**RR4012N00**
405	(15 ⅞)	290	(11⅞)	120	1.10	1.3	(2.9)	Assy. Stock	**RS1A015R00**	**RDN27C1BAAB**	**RR4015R00**
405	(15 ⅞)	290	(11⅞)	240	1.10	1.3	(2.9)	Assy. Stock	**RS1G015R00**	**RDN27C10BAAA**	**RR4015R00**
605	(23 ¾)	490	(19⅜)	240	1.80	1.7	(3.8)	Assy. Stock	**RS1G023N00**	**RDN42R10BAAD**	**RR4023N00**
605	(23 ¾)	490	(19⅜)	480	1.80	1.7	(3.8)	Assy. Stock	**RS1P023N00**	**RDN42R11BAAD**	**RR4023N00**
795	(31 ¼)	675	(26⅝)	240	2.50	2.2	(4.8)	Assy. Stock	**RS1G031E00**	**RDN57J10BAAB**	**RR4031E00**
795	(31 ¼)	675	(26⅝)	480	2.50	2.2	(4.8)	Assy. Stock	**RS1P031E00**	**RDN57J11BAAA**	**RR4031E00**
945	(37 ¼)	825	(32⅞)	240	3.00	2.5	(5.5)	Assy. Stock	**RS1G037E00**	**RDN69E10BAAD**	**RR4037E00**
945	(37 ¼)	825	(32⅞)	480	3.00	2.5	(5.5)	Assy. Stock	**RS1P037E00**	**RDN69E11BAAD**	**RR4037E00**
1150	(43 ⅜)	975	(38⅜)	240	3.60	2.8	(6.2)	Assy. Stock	**RS1G043G00**	**RDN81E10BAAB**	**RR4043G00**
1150	(43 ⅜)	975	(38⅜)	480	3.60	2.8	(6.2)	Assy. Stock	**RS1P043G00**	**RDN81E11BAAA**	**RR4043G00**

Quartz Tube Element

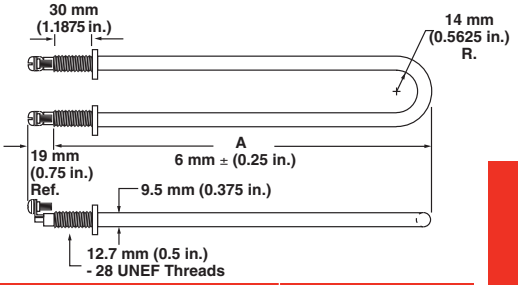


Note: Quartz tube elements must be operated in a horizontal position.

460	(18 1⁄16)	255	(10)	120	0.50	1.1	(2.4)	Assy. Stock	**RG1A018B00**	**RQB12FA05001B**	**RR5018B00**
660	(26 1⁄16)	455	(18)	120	0.90	1.4	(3.2)	Assy. Stock	**RG1A026B00**	**RQB20EA09001B**	**RR5026B00**
660	(26 1⁄16)	455	(18)	240	0.90	1.4	(3.2)	Assy. Stock	**RG1G026B00**	**RQB20EG09001B**	**RR5026B00**
840	(33 1⁄16)	635	(25)	120	1.25	1.7	(3.9)	Assy. Stock	**RG1A033B00**	**RQB27GA12001B**	**RR5033B00**
840	(33 1⁄16)	635	(25)	240	1.25	1.7	(3.9)	Assy. Stock	**RG1G033B00**	**RQB27GG12001B**	**RR5033B00**
1165	(45 ⅞)	965	(38)	240	1.90	2.3	(5.1)	Assy. Stock	**RG1G045S00**	**RQB40DG19001B**	**RR5045S00**
1165	(45 ⅞)	965	(38)	480	1.90	2.3	(5.1)	Assy. Stock	**RG1P045S00**	**RQB40DP19001B**	**RR5045S00**
1550	(60 ⅞)	1345	(53)	240	2.65	3.0	(6.6)	Assy. Stock	**RG1G060S00**	**RQB55HG26001B**	**RR5060S00**
1550	(60 ⅞)	1345	(53)	480	2.65	3.0	(6.6)	Assy. Stock	**RG1P060S00**	**RQB55HP26001B**	**RR5060S00**

Tubular Replacement Elements for Reflector Style Radiant Heaters

The following tubular radiant heating elements are available for replacing popular non-Watlow radiant elements.



Hairpin (U-Shaped) Element With Liquid Tight Bulkheads Stock Chart

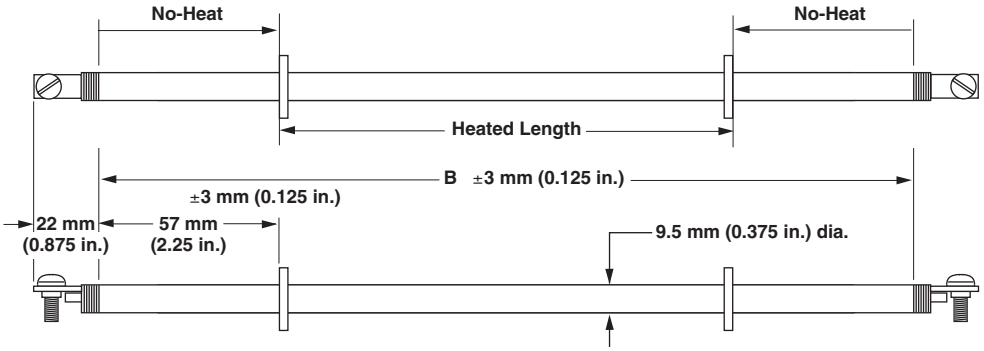
Hairpin A Dimension mm	Hairpin A Dimension (in.)	Volts	Watts	Approx. Net Wt. g	Approx. Net Wt. (oz)	Availability	Chromalox® PCN	Chromalox® Catalog No.	Watlow Code No.
266	(10 5⁄16)	120	800	170	(6)	Assy. Stock	106673	UTU-2LT	**RDN21B1B**
266	(10 5⁄16)	240	800	170	(6)	Assy. Stock	106681	UTU-2LT	**RDN21B10B**
344	(13 5⁄16)	120	1100	225	(8)	Assy. Stock	106690	UTU-3LT	**RDN27C1B**
344	(13 5⁄16)	240	1100	225	(8)	Assy. Stock	106702	UTU-3LT	**RDN27C10B**
541	(21 3⁄16)	240	1800	370	(13)	Assy. Stock	106710	UTU-4LT	**RDN42R10B**
541	(21 3⁄16)	480	1800	370	(13)	Assy. Stock	106729	UTU-4LT	**RDN42R11B**
728	(28½)	240	2500	455	(16)	Assy. Stock	106737	UTU-5LT	**RDN57J10B**
728	(28½)	480	2500	455	(16)	Assy. Stock	106745	UTU-5LT	**RDN57J11B**
878	(34⅜)	240	3000	540	(19)	Assy. Stock	106753	UTU-6LT	**RDN69E10B**
878	(34⅜)	480	3000	540	(19)	Assy. Stock	106761	UTU-6LT	**RDN69E11B**
1030	(40⅝)	240	3600	625	(22)	Assy. Stock	106770	UTU-7LT	**RDN81E10B**
1030	(40⅝)	480	3600	625	(22)	Assy. Stock	106788	UTU-7LT	**RDN81E11B**

Chromalox® is a registered trademark of Emerson Electric Co.

Heaters

RAYMAX 1525

Tubular Replacement Elements for Reflector Style Radiant Heaters



Straight Element Stock Chart

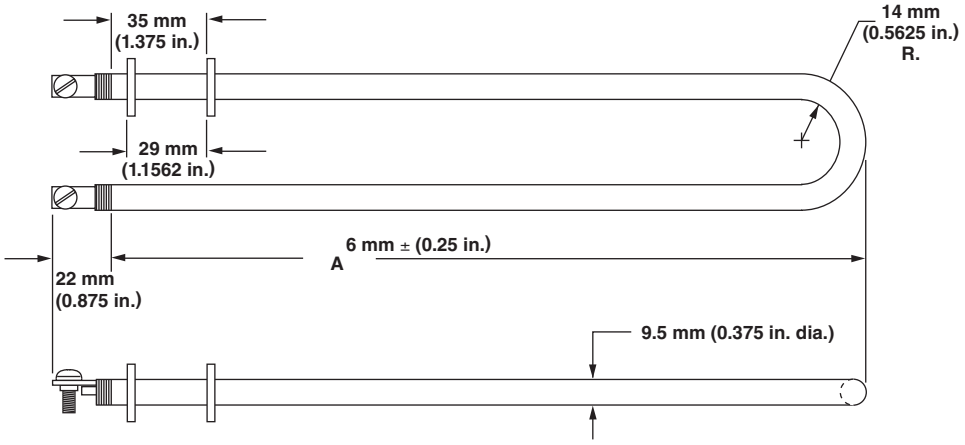
Sheath B Dimension		Heated Length		No-Heat Length		Volts	Watts	Approx. Net wt.		Availability	Chromalox®		Watlow Code No.
mm	(in.)	mm	(in.)	mm	(in.)			g	(oz)		PCN	Catalog No.	
260	(10¼)	184	(7¼)	38	(1½)	120	400	85	(3)	Assy. Stock	147766	RTU-2063AX35	**RDN10E1**
422	(16⅝)	346	(13⅝)	38	(1½)	120	650	140	(5)	Assy. Stock	147774	RTU-2063AX29	**RDN16L1**
535	(21⅛)	409	(16⅛)	54	(2⅛)	120	800	170	(6)	Assy. Stock	106112	RTU-2083A	**RDN21B1**
535	(21⅛)	409	(16⅛)	54	(2⅛)	208	800	170	(6)	Standard	106120	RTU-2083AV	**RDN21B2**
535	(21⅛)	409	(16⅛)	54	(2⅛)	240	800	170	(6)	Assy. Stock	106139	RTU-2083A	**RDN21B10**
535	(21⅛)	409	(16⅛)	54	(2⅛)	277	800	170	(6)	Standard	106147	RTU-2083AV	**RDN21B4**
688	(27⅛)	580	(22⅞)	54	(2⅛)	120	1100	225	(8)	Assy. Stock	106155	RTU-3113A	**RDN27C1**
688	(27⅛)	580	(22⅞)	54	(2⅛)	208	1100	225	(8)	Standard	106163	RTU-3113AV	**RDN27C2**
688	(27⅛)	580	(22⅞)	54	(2⅛)	240	1100	225	(8)	Assy. Stock	106171	RTU-3113A	**RDN27C10**
688	(27⅛)	580	(22⅞)	54	(2⅛)	277	1100	225	(8)	Standard	106180	RTU-3113AV	**RDN27C4**
816	(32⅛)	580	(22⅞)	54	(2⅛)	240	1300	255	(9)	Assy. Stock	108409	RTU-3133A	**RDN32C10**
816	(32⅛)	580	(22⅞)	54	(2⅛)	480	1300	255	(9)	Assy. Stock	108396	RTU-3133A	**RDN32C11**
1090	(42⅞)	905	(38⅝)	54	(2⅛)	208	1800	370	(13)	Standard	106198	RTU-4183AV	**RDN42R2**
1090	(42⅞)	905	(38⅝)	54	(2⅛)	240	1800	370	(13)	Assy. Stock	106200	RTU-4183A	**RDN42R10**
1090	(42⅞)	905	(38⅝)	54	(2⅛)	277	1800	370	(13)	Standard	106219	RTU-3133AV	**RDN42R4**
1090	(42⅞)	905	(38⅝)	54	(2⅛)	480	1800	370	(13)	Assy. Stock	106227	RTU-3133A	**RDN42R11**
1460	(57½)	1350	(53¼)	54	(2⅛)	208	2500	455	(16)	Standard	106235	RTU-5253AV	**RDN57J2**
1460	(57½)	1350	(53¼)	54	(2⅛)	240	2500	455	(16)	Assy. Stock	106243	RTU-5253A	**RDN57J10**
1460	(57½)	1350	(53¼)	54	(2⅛)	277	2500	455	(16)	Standard	106251	RTU-5253AV	**RDN57J4**
1460	(57½)	1350	(53¼)	54	(2⅛)	480	2500	455	(16)	Assy. Stock	106260	RTU-5253A	**RDN57J11**
1760	(69¼)	1650	(65)	54	(2⅛)	208	3000	540	(19)	Standard	106278	RTU-6303AV	**RDN69E2**
1760	(69¼)	1650	(65)	54	(2⅛)	240	3000	540	(19)	Assy. Stock	106286	RTU-6303A	**RDN69E10**
1760	(69¼)	1650	(65)	54	(2⅛)	277	3000	540	(19)	Standard	106294	RTU-6303AV	**RDN69E4**
1760	(69¼)	1650	(65)	54	(2⅛)	480	3000	540	(19)	Assy. Stock	106307	RTU-6303A	**RDN69E11**
2065	(81¼)	1955	(77)	54	(2⅛)	208	3600	625	(22)	Standard	106315	RTU-7363AV	**RDN81E2**
2065	(81¼)	1955	(77)	54	(2⅛)	240	3600	625	(22)	Assy. Stock	106323	RTU-7363A	**RDN81E10**
2065	(81¼)	1955	(77)	54	(2⅛)	277	3600	625	(22)	Standard	106331	RTU-7363AV	**RDN81E4**
2065	(81¼)	1955	(77)	54	(2⅛)	480	3600	625	(22)	Assy. Stock	106340	RTU-7363A	**RDN81E11**
2775①	(109¼)	2665	(105)	54	(2⅛)	240	4000	905	(32)	Standard	106358	RTU-7303AX10	**RDN109E10**
3415①	(134½)	3245	(127¾)	85	(3⅜)	240	5000	1050	(37)	Standard	106366	RTU-7303AX13	**RDN134J10**
3895①	(153⅜)	3700	(145⅝)	101	(4)	240	5500	1135	(40)	Standard	106374	RTU-7303AX9A	**RDN153R10**
4550①	(179¼)	4350	(171¼)	101	(4)	240	6500	1445	(51)	Standard	106382	RTU-7363AX38	**RDN179E10**

① Assembly Stock with catalog options.

Heaters

RAYMAX 1525

Tubular Replacement Elements for Reflector Style Radiant Heaters



Hairpin (U-Shaped) Element Stock Chart

Hairpin A Dimension mm	(in.)	Volts	Watts	Approx. Net Wt. g	(oz)	Availability	Chromalox® PCN	Chromalox® Catalog No.	Watlow Code No.
266	(10½)	120	800	170	(6)	Assy. Stock	106438	UTU-2	**RDN21B1U**
266	(10½)	240	800	170	(6)	Assy. Stock	106454	UTU-2	**RDN21B10U**
266	(10½)	277	800	170	(6)	Standard	106462	UTU-2V	**RDN21B4U**
344	(13⁹⁄₁₆)	120	1100	225	(8)	Assy. Stock	106470	UTU-3	**RDN27C1U**
344	(13⁹⁄₁₆)	240	1100	225	(8)	Assy. Stock	106497	UTU-3	**RDN27C10U**
344	(13⁹⁄₁₆)	277	1100	225	(8)	Standard	106500	UTU-3V	**RDN27C4U**
541	(21⁵⁄₁₆)	208	1800	370	(13)	Standard	106518	UTU-4V	**RDN42R2U**
541	(21⁵⁄₁₆)	240	1800	370	(13)	Assy. Stock	106526	UTU-4	**RDN42R10U**
541	(21⁵⁄₁₆)	480	1800	370	(13)	Assy. Stock	106542	UTU-4	**RDN42R11U**
728	(28¹¹⁄₁₆)	208	2500	455	(16)	Standard	106550	UTU-5V	**RDN57J2U**
728	(28¹¹⁄₁₆)	240	2500	455	(16)	Assy. Stock	106569	UTU-5	**RDN57J10U**
728	(28¹¹⁄₁₆)	277	2500	455	(16)	Standard	106577	UTU-5V	**RDN57J4U**
728	(28¹¹⁄₁₆)	480	2500	455	(16)	Assy. Stock	106585	UTU-5	**RDN57J11U**
878	(34⁹⁄₁₆)	240	3000	540	(19)	Assy. Stock	106606	UTU-6	**RDN69E10U**
878	(34⁹⁄₁₆)	480	3000	540	(19)	Assy. Stock	106622	UTU-6	**RDN69E11U**
1030	(40⁹⁄₁₆)	240	3600	625	(22)	Assy. Stock	106649	UTU-7	**RDN81E10U**
1030	(40⁹⁄₁₆)	277	3600	625	(22)	Standard	106657	UTU-7V	**RDN81E4U**
1030	(40⁹⁄₁₆)	480	3600	625	(22)	Assy. Stock	106665	UTU-7	**RDN81E11U**

Chromalox® is a registered trademark of Emerson Electric Co.

How to Order

For units listed in the stock charts, please specify:

- Watlow code number
- Volts/watts
- Style (straight length, hairpin or hairpin with bulkheads)
- Quantity

If our stock elements do not meet your needs, Watlow can provide a **made-to-order** unit.

Details on constructions, materials and options are contained in ***Tubular and Process Assemblies***—WATROD Heating Elements. For **made-to-order** units, please specify:

- Volts/watts
- Sheath material and diameter
- Sheath length and no-heat length
- Terminations or terminal pin length
- Bend configuration, if applicable
- Mounting method
- Quantity

Availability

Assembly Stock: Three to five days

Standard: 10 working days

Modified Stock ①: Five to seven working days

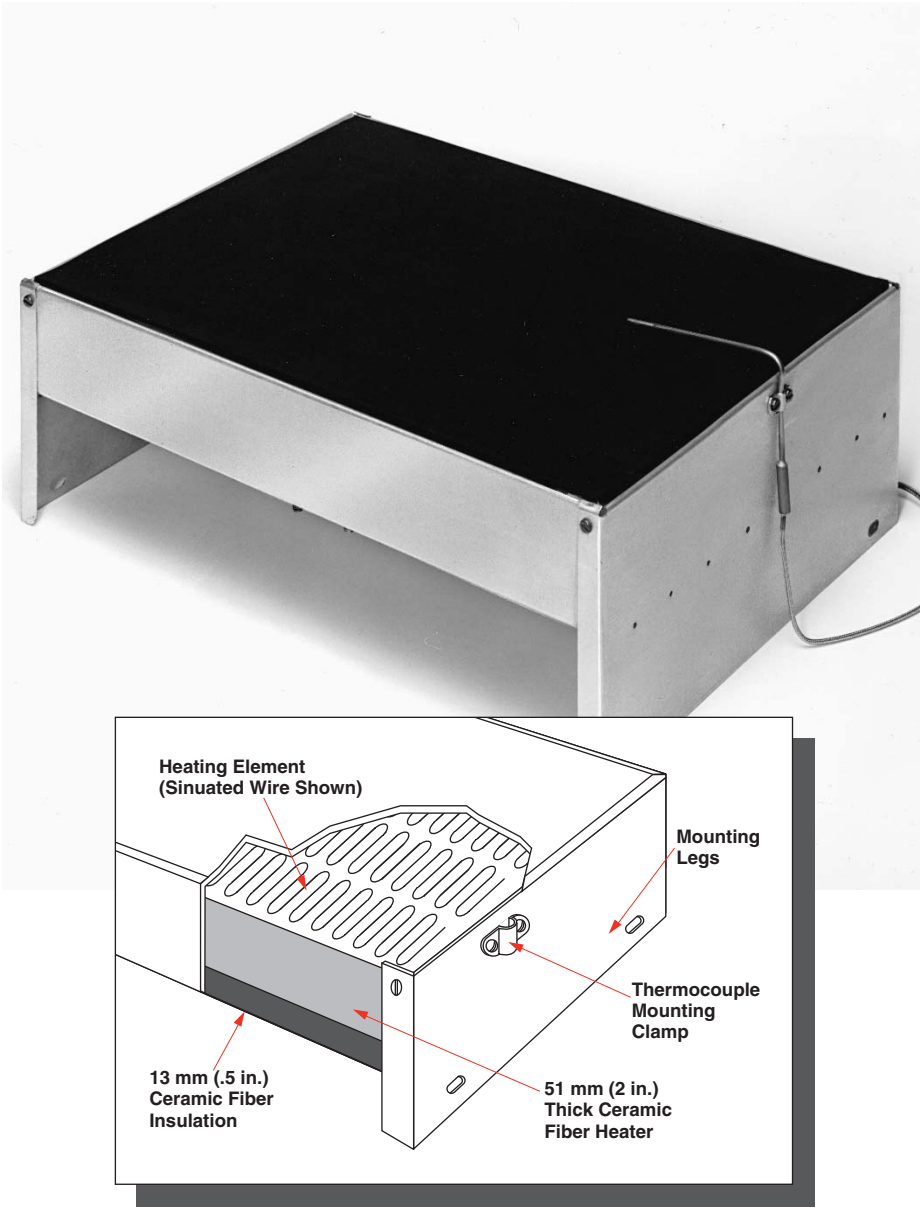
Made-to-Order: Four to six weeks

① Assembly Stock with catalog options.

RAYMAX® 1220 and 2030

Easy to install and capable of high surface temperatures, the RAYMAX® 1220 and 2030 are ideal for many process heating applications requiring “hot face” temperatures above 540°C (1000°F).

Each unit consists of a ceramic fiber heater mounted in a 64 mm (2.5 in.) deep sheet metal case that provides thermal insulation. The case includes post terminals for electrical connections and provides a mounting system that can be used with virtually any flat ceramic fiber unit, whether it is a stock, standard or custom size. Since any of the flat unit heating element configurations can be used—exposed sinuated, embedded coil or foil elements—watt density and temperature capabilities can be tailored to meet a specific radiant application.



Performance Capabilities

- RAYMAX 2030 (uses sinuated or coil elements): temperatures up to 1095°C (2000°F); watt densities up to 4.7 W/cm² (30 W/in²)
- RAYMAX 1220 (uses an etched foil element): temperatures up to 650°C (1200°F); watt densities up to 3 W/cm² (20 W/in²)

Features and Benefits

- **Lightweight, low mass design** allows fast response to controls.
- **High efficiency** results from high degree of self insulation with 64 mm (2.5 in.) thick mounting case.
- **Adaptable** with any stock or standard sized flat ceramic fiber units.
- **Thermocouple mounting clamp** makes process system control easier.
- **Aluminized steel case** can handle temperatures up to 595°C (1100°F). Other case materials are available, depending on the expected exposure of the case to other operating conditions.
- **Special hot face** heating patterns can be designed specifically for an application using an etched foil RAYMAX 1220.

Applications

- Conveyor furnaces
- High temperature vessel heating
- Tempering and annealing processes for glass, wire, ceramics and metals
- Coating, curing and drying of plastics and films, inks and paints

Heaters

RAYMAX 1220 and 2030

Applications and Technical Data

Specifications

Weight: Under 31.75 kg/m² (6.5 lbs/ft²)

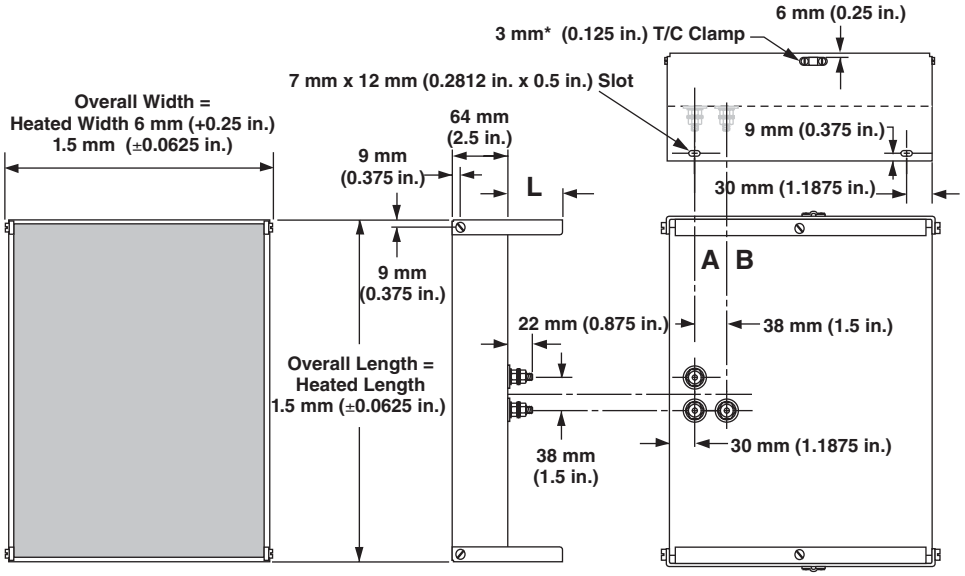
Voltage and Wattage: Ratings are based on the ceramic fiber heater module which is mounted in the case. Up to 600V~(ac) is possible.

Terminals: Terminals are .25-20 threaded studs. Two terminals plus ground for single-phase, and three terminals plus ground for three-phase, are standard. These will be located on the center line of the length unless otherwise specified. Terminals can be located anywhere along lines A and B (see illustration to the right), but not closer than 51 mm (2 in.) to the case ends.

Mounting Legs: 25 mm (1 in.) standard; 76 mm (3 in.) optional from stock. For made-to-order units, mounting legs can be supplied in any incremental length **L** from 13 mm (0.5 in.) to 76 mm (3 in.). No slots are provided in legs less than 25 mm (1 in.) long.

Heater Dimensions	Min.	Max.	Increments
Width: mm (in.)	51 (2)	760 (30)	Any
Length: mm (in.)	152 (6)	1320 (52)	Any

Note: Units will be 6 mm (0.25 in.) wider than the nominal size of the ceramic fiber heater. Overall length is equal to heater length, but thermocouple clamp not included in length.



Application Hints

A thermocouple mounting clamp will be provided on one end of the case, with holes on both ends for alternate locations. The standard clamp can be used with 3 mm (0.125 in.) O.D. sheath thermocouples. The standard clamp is 4.8 mm (0.1875 in.) high, but can be removed for flush mounting*.

The maximum recommended surface temperature of the heater is based on the rating of the ceramic fiber heater module. This can vary from 1095°C (2000°F) at lower watt densities, to higher watt densities at reduced surface temperatures. Note that maximum wattages cannot be achieved at the maximum temperatures simultaneously.

* 3 mm (0.125 in.) is standard. 4.8 mm (0.1875 in.) and 6 mm (0.25 in.) are available upon request.

Options

Several options are available with RAYMAX 1220 and 2030 models. From the following list, the first four are illustrated on pages 292 to 293. Consult Watlow for more information on any of the options.

- Single-phase non-standard location power terminals
- Terminal box
- Zoning
- Mounting studs and legs
- Three-phase construction
- Thermocouple mounting tubes
- Alternate case materials

Heaters

RAYMAX 1220

Ceramic Fiber, with Foil Element

Panel Overall Size 1.5 mm (± .0625 in.)				Panel Nominal Heated Size mm (in.)				Volts	Watts	Watt Density		Approx. Net Wt.		Availability	Code No.
Width		Length ①		Width		Length				W/cm²	(W/in²)	kg	(lbs)		
110	(4¼)	305	(12)	102	(4)	305	(12)	120	950	3.1	(19.8)	1.3	(2.8)	Stock	**VP504A12F**
110	(4¼)	610	(24)	102	(4)	610	(24)	240	1900	3.1	(19.8)	2.2	(4.8)	Stock	**VP504A24F**
210	(8¼)	305	(12)	200	(8)	305	(12)	240	1900	3.1	(19.8)	2.1	(4.5)	Stock	**VP508A12F**
210	(8¼)	610	(24)	200	(8)	610	(24)	240	3800	3.1	(19.8)	3.5	(7.7)	Standard	**VP508A24F**

All units in this table are suitable for use up to 650°C (1200°F) maximum surface temperature.
① Thermocouple clasp is not included in the length.

RAYMAX 2030

Ceramic Fiber, with Sinuated Element

Nominal Heated Width		Nominal Heated Length		Volts	Watts	Watt Density		Approx Net Wt.		Availability	Code No.
mm	(in.)	mm	(in.)			W/cm²	(W/in²)	kg	(lbs)		
102	(4)	152	(6)	60	500	3.2	(20.8)	0.9	(1.9)	Standard	**VP504A06T**
		305	(12)	120	1050	3.4	(21.9)	1.4	(3.1)	Stock	**VP504A12T**
		460	(18)	120	1500	3.2	(20.8)	1.9	(4.1)	Standard	**VP504A18T**
		610	(24)	240	2100	3.4	(21.9)	2.4	(5.2)	Stock	**VP504A24T**
		760	(30)	240	2500	3.2	(20.8)	2.9	(6.3)	Standard	**VP504A30T**
		915	(36)	240	3000	3.2	(20.8)	3.3	(7.4)	Standard	**VP504A36T**
152	(6)	152	(6)	60	650	2.8	(18.1)	1.1	(2.4)	Standard	**VP506A06T**
		305	(12)	120	1250	2.7	(17.4)	1.9	(4.1)	Standard	**VP506A12T**
		460	(18)	240	2000	2.9	(18.5)	2.6	(5.8)	Standard	**VP506A18T**
		610	(24)	120② or 240②	2500	2.7	(17.4)	3.3	(7.4)	Assy. Stock②	**VP506A24T②**
		760	(30)	240	3400	2.9	(18.9)	4.1	(9.0)	Standard	**VP506A30T**
		915	(36)	240	4000	2.9	(18.5)	4.8	(10.6)	Standard	**VP506A36T**
205	(8)	305	(12)	120	1800	2.9	(18.8)	2.4	(4.7)	Stock	**VP508A12T**
		460	(18)	240	3000	3.2	(20.8)	3.3	(7.4)	Stock	**VP508A18U**
		610	(24)	240	3600	2.9	(18.8)	4.3	(9.5)	Stock	**VP508A24T**
		760	(30)	240	5000	3.2	(20.8)	5.3	(11.7)	Stock	**VP508A30T**
		915	(36)	240	6000	3.2	(20.8)	6.3	(13.9)	Standard	**VP508A36T**
255	(10)	305	(12)	120	2000	2.6	(16.7)	2.9	(6.3)	Standard	**VP510A12T**
		460	(18)	240	3600	3.1	(20.0)	4.1	(9.0)	Standard	**VP510A18T**
		610	(24)	240②	4500	2.8	(17.9)	5.3	(11.7)	Assy. Stock②	**VP510A24T②**
		760	(30)	240	6000	3.1	(20.0)	6.5	(14.4)	Standard	**VP510A30T**
		915	(36)	240	7000	3.0	(19.4)	7.8	(17.1)	Standard	**VP510A36T**
305	(12)	305	(12)	120② or 240②	2500	2.7	(17.4)	3.3	(7.4)	Assy. Stock②	**VP512A12T②**
		460	(18)	240	4000	2.9	(18.5)	4.8	(10.6)	Standard	**VP512A18T**
		610	(24)	240②	6000	3.2	(20.8)	6.3	(13.9)	Assy. Stock②	**VP512A24T②**
		760	(30)	240	7200	3.1	(20.0)	7.8	(17.1)	Standard	**VP512A30T**
		915	(36)	240	8400	3.0	(19.4)	9.2	(20.3)	Standard	**VP512A36T**

CONTINUED

All units in this table are suitable for use up to 982°C (1800°F) maximum surface temperature.
② Stocked ceramic fiber heaters can be used to make this RAYMAX 2030 heater panel. These are **assembly stock** units. For those units rated at 120V~(ac) (code numbers ending in ...T), an alternate 240V~(ac) unit (code numbers ending in ...U) is available as a standard design.

Heaters

RAYMAX 2030

Nominal Heated Width mm	(in.)	Nominal Heated Length mm	(in.)	Volts	Watts	Watt Density W/cm²	(W/in²)	Approx Net Wt. kg	(lbs)	Availability	Code No.
355	(14)	305	(12)	240	3500	3.2	(20.8)	3.8	(8.5)	Stock	**VP514A12T**
		460	(18)	240	4900	3.0	(19.4)	5.5	(12.2)	Standard	**VP514A18T**
		610	(24)	240	7000	3.2	(20.8)	7.3	(16.0)	Standard	**VP514A24T**
		760	(30)	240	8400	3.1	(20.0)	9.0	(19.8)	Standard	**VP514A30T**
		915	(36)	240/240③	9800	3.0	(19.4)	10.7	(23.6)	Standard	**VP514A36T**
405	(16)	305	(12)	240	3600	2.9	(18.8)	4.3	(9.5)	Standard	**VP516A12T**
		460	(18)	240	5700	3.1	(19.8)	6.3	(13.9)	Standard	**VP516A18T**
		610	(24)	240	7100	2.9	(18.5)	8.2	(18.2)	Standard	**VP516A24T**
		760	(30)	240/240③	9600	3.1	(20.0)	10.2	(22.5)	Standard	**VP516A30T**
		915	(36)	240/240③	11500	3.1	(20.0)	12.2	(26.8)	Standard	**VP516A36T**

All units in this table are suitable for use up to 982°C (1800°F) maximum surface temperature.

② Stocked ceramic fiber heaters can be used to make this RAYMAX 2030 heater panel. These are **assembly stock** units. For those units rated at 120V~(ac) (code numbers ending in ...T), an alternate 240V~(ac) (code numbers ending in ...U) unit is available as a standard design.

③ Dual element unit. Four power terminals provided.

How to Order

To order a **stock, assembly stock,** or **standard** heater, specify:

- RAYMAX 1220 or 2030
- Quantity
- Watlow code number
- Mounting studs, if desired

Note: 25 mm (1 in.) mounting legs are provided. 76 mm (3 in.) legs are available from stock upon request.

If stock or standard units do not meet application needs, Watlow can manufacture radiant heaters to fit special requirements.

For **made-to-order** units, please specify, in addition to previous information:

- Heated width and length, and overall size
- Total wattage
- Voltage, and phases or zones required
- Load temperature expectations
- Mounting studs, if desired
- Mounting legs and leg height, if desired (25 mm (1 in.) is provided unless otherwise specified)
- Location of terminals
- Terminal box, if desired
- Thermowell (specify size and location if standard end clamp is not sufficient)

Availability

Stock: Shipment in one to two days

Assembly Stock: Shipment in two weeks

Standard: Shipment in three to four weeks

Made-to-Order: Consult Watlow

MI Strip

The Watlow MI strip is a thin, responsive heater that sets unmatched standards for performance and durability. It makes use of the most advanced heater construction techniques, including embedding a nickel chromium element wire in Watlow's exclusive mineral insulation. Only 1.067 mm (0.042 in.) thick, this layer of insulation brings the element wire closer to the heater sheath. The result is that heat flows easily from the element wire to the sheath, thus allowing the wire to run cooler than conventional heaters.

Performance Capabilities

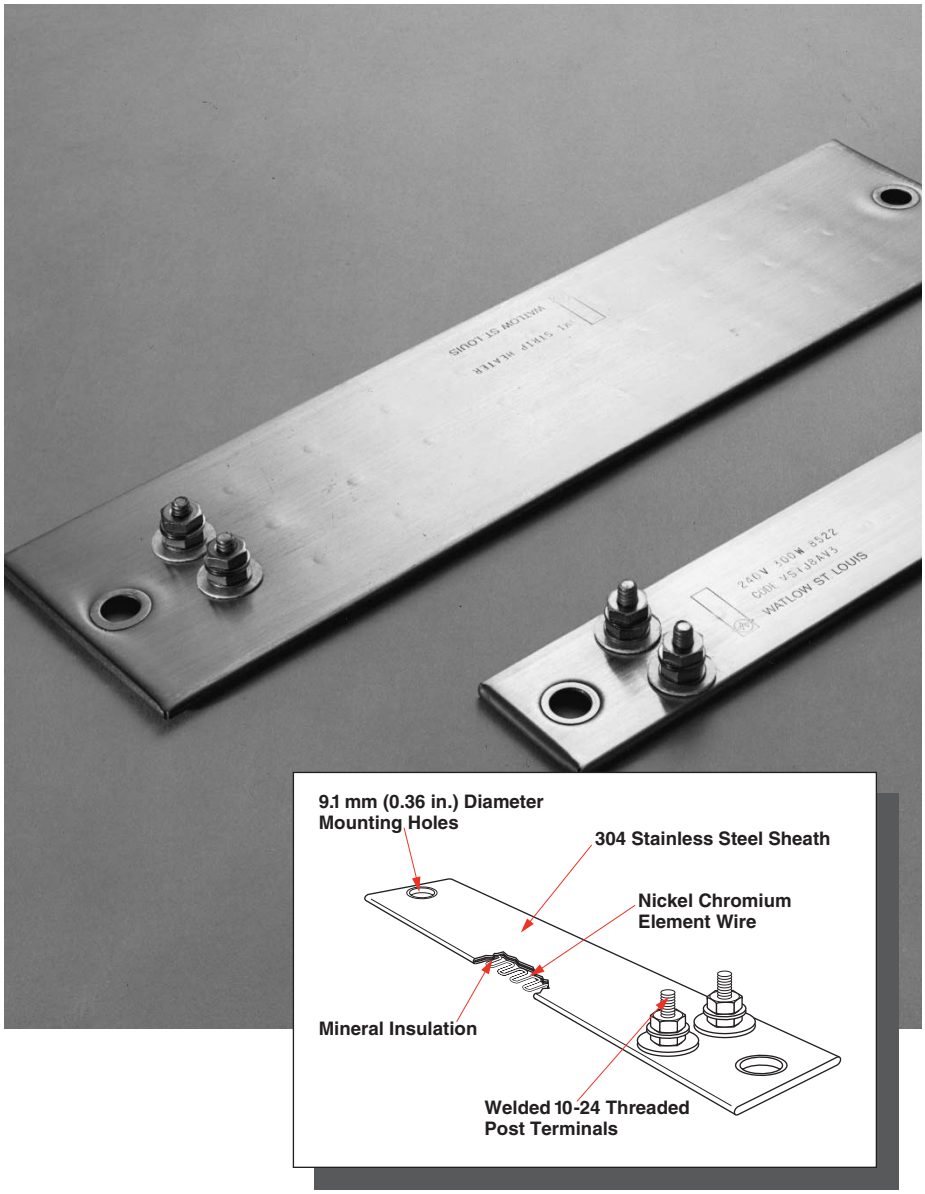
- Sheath temperatures to 760°C (1400°F)
- Watt densities to 15.5 W/cm^2 (100 W/in^2)
- Maximum voltage 480V~(ac)

Features and Benefits

- **Higher watt densities** than any other strip heater contribute to faster heat-up.
- **Exclusive mineral insulation** combines high dielectric strength and superior thermal conductivity which transfers heat rapidly to the sheath.
- **304 stainless steel sheath** is welded together at strategic points to maintain the high compaction of mineral insulation and produce a rigid heater.
- **UL® component recognition** is available in 250V~(ac) or less.

Applications

- Thermoforming decks
- Solder pots
- Zinc die-casting equipment
- Dies and mold heating
- High temperature resins
- Tank and platen heating
- Ovens
- Packaging equipment



How to Order

Please specify:

- Watlow code number
- Overall dimensions: length and width
- Wattage: see maximum allowable watt density graph
- Termination type (parallel or one-on-one)
- Mounting holes, if desired
- Quantity

If stock units do not meet specific application needs, Watlow can manufacture MI strip heaters to meet special requirements.

Availability

Stock: Same day shipment

Made-to-order: Consult a Watlow sales engineer or authorized distributor.

Heaters

MI Strip

Applications and Technical Data

Calculating Watt Density

Watt density is the amount of wattage per square inch of heated area. To determine watt density, divide the total wattage by the heated area.

$$\text{Watt Density} = \frac{\text{Total Watts}}{\text{Heated Area}}$$

To apply this equation we must define the term "heated area." Heated area is the total contact surface of the heater less areas of no heat that are found around terminals, mounting holes, etc.

Heated Area =
Total Contact Area - No-Heat Area

To calculate the heated area:

1. Locate the **no-heat factor** from the chart on the right that corresponds to the type of heater being considered.
2. To use the formula below, insert the no heat factors, length and width (in inches).

   Heated Area =
   (Length - No-Heat Factor)
   x Width

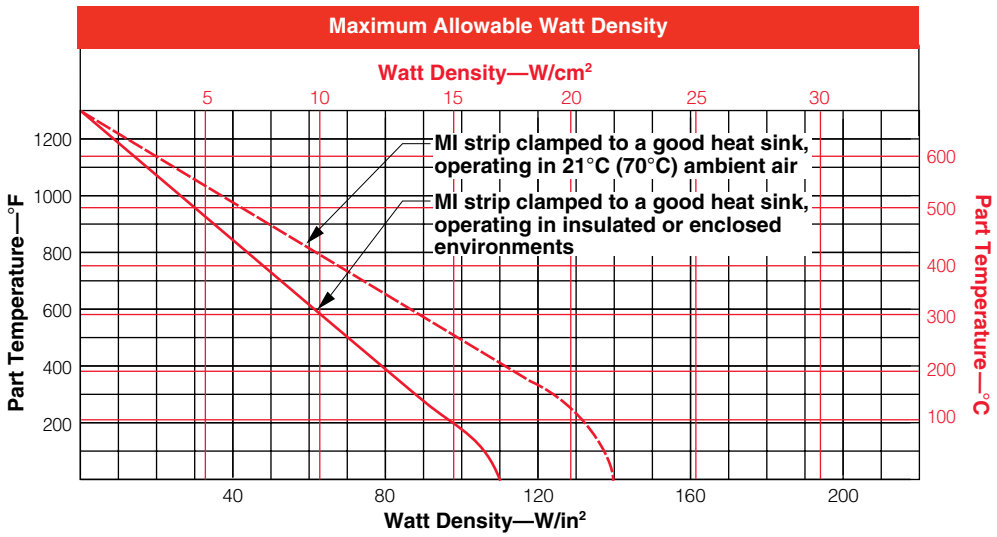
Type	Factor (in.)
1 in. wide post term 1 on 1	(1.56)
1 in. wide post term 1 on 1 with mounting holes	(3.56)
1 in. wide post term 2 on 1	(1.93)
1 in. wide post term 2 on 1 with mounting holes	(3.93)
For all other widths:	
2 on 1 post terminal	(1.18)
2 on 1 with mounting holes	(3.18)

Calculating Watt Density

The sketches on the next page and the graph on this page will help select the correct watt density for a particular application. First, refer to the sketches to determine the heated area of the heater. Then, use the watt density formula and graph to make sure that the maximum watt density of the heater will not be exceeded in the specific application.

$$\text{Watt Density} = \frac{\text{Wattage}}{\text{Heated Area}}$$

Note: Derate maximum allowable watt density by 50 percent when using mounting holes only for clamping.



Heaters

MI Strip

Applications and Technical Data

Specifications

Width: 25.4, 38.1, 50.8 mm (1, 1.5 and 2 in.)

Tolerance: ± 0.312

Length: 205 to 760 mm (8 to 30 in.)

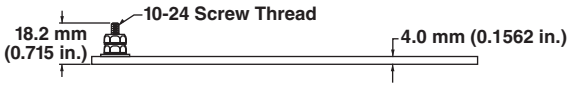
Tolerance: ± 0.125

Terminations:

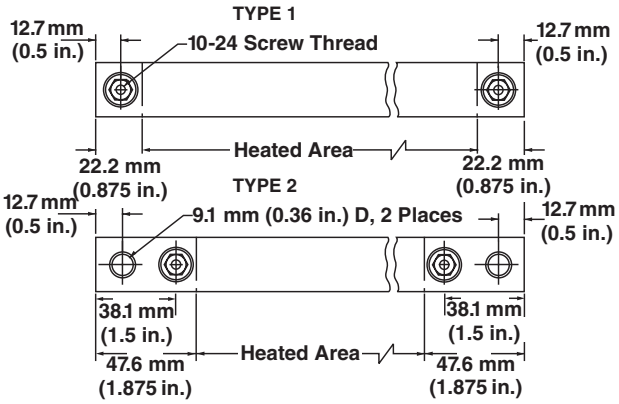
25.4 mm (1 in.) wide—post terminals one-on-one

38.1 to 50.8 mm (1.5 to 2 in.)—post terminals two-on-one

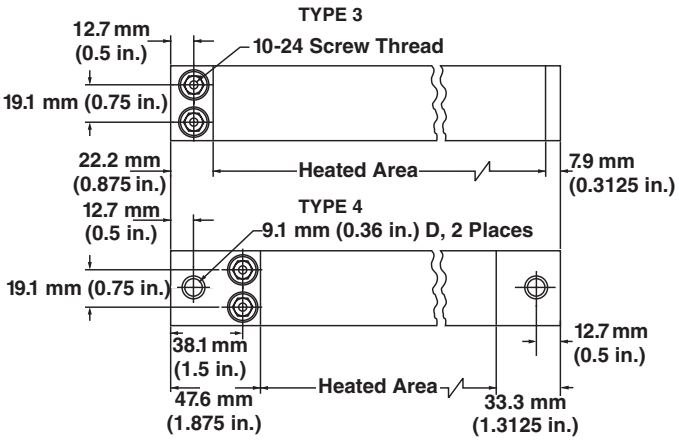
All Widths



25.4 mm (1 in.) Wide



38.1–50.8 mm (1½–2 in.) Wide



Stock List (Parallel Terminals) Type 3 and 4

Width mm	Width (in.)	Length mm	Length (in.)	Volts	Power (Watts)	Watt Density W/cm²	Watt Density (W/in²)	Approximate Net. Wt. kg	Approximate Net. Wt. (lbs)	Type	Code No.
38.1	(1.5)	203.2	(8)	120	500	7.4	(48)	0.15	(0.3)	3	**MS1J8AS1**
38.1	(1.5)	203.2	(8)	240	500	7.8	(50)	0.15	(0.3)	3	**MS1J8AS3**
38.1	(1.5)	304.8	(12)	120	350	4.0	(26)	0.2	(0.5)	4	**MS1J12AV2** ①
38.1	(1.5)	304.8	(12)	240	350	4.0	(26)	0.2	(0.5)	4	**MS1J12AV3** ①
38.1	(1.5)	304.8	(12)	120	800	7.6	(49)	0.2	(0.5)	3	**MS1J12AS1**
38.1	(1.5)	304.8	(12)	240	800	7.6	(49)	0.2	(0.5)	3	**MS1J12AS2**
38.1	(1.5)	457.2	(18)	120	1000	6.2	(40)	0.3	(0.8)	3	**MS1J18AS1**
38.1	(1.5)	457.2	(18)	240	1000	6.2	(40)	0.3	(0.8)	3	**MS1J18AS2**

① Denotes units with mounting holes. Mounting holes are 9.14 mm (0.36 in.) in diameter, and are intended for use with 6.35 mm (0.25 in.) bolts. Centers of mounting holes are located 12.7 mm (0.5 in.) from the ends of the heater.
Note: Type 1 & 2 are made-to-order only.

Quick Ship

- *Same day shipment on all stock units*

Heaters

Mica Strip

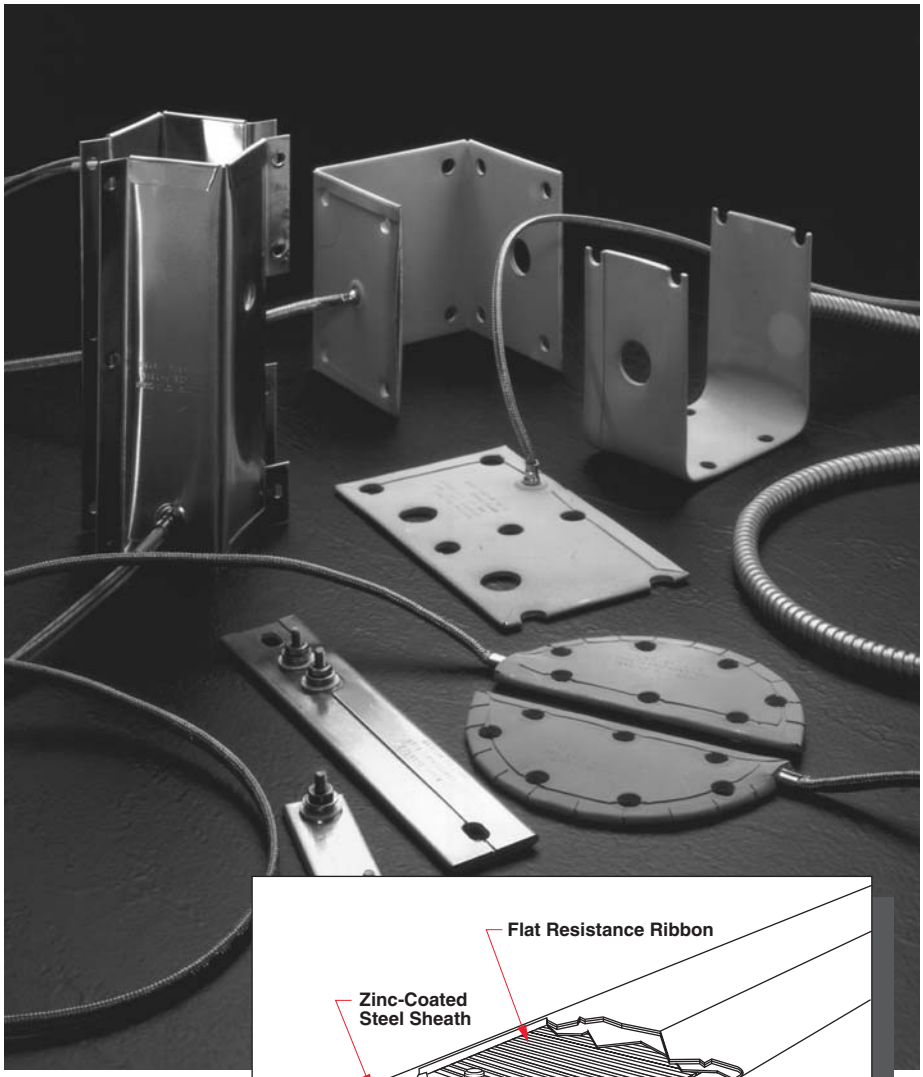
The Watlow mica strip heater is an economical and reliable source of heat for industrial equipment. A mere 4 mm (0.015 in.) thick mica insulator on both sides of the resistance element provides complete electrical insulation and offers little resistance to efficient heat flow. Plus mica withstands high voltage spikes, resists moisture and is inert to most chemicals.

Performance Capabilities

- Sheath temperatures to 480°C (900°F) on zinc-coated units
- Sheath temperatures of 650°C (1200°F) on stainless steel units
- Watt densities to 8.5 W/cm^2 (55 W/in^2)
- Maximum voltage 480V~(ac)

Features and Benefits

- **Low mass construction** heats up faster to provide quick response to control input.
- **Flat resistance ribbon** generates heat over a broad area. This design solution puts the heat source closer to the work.
- **Rust-resistant, zinc-coated steel sheath** is treated to improve emissivity. The strength of this material also gives the heater rigidity.
- **Optional stainless steel sheath** is available for more corrosive atmospheres.
- **Nickel-plated steel terminal posts** are securely riveted to ensure a positive, trouble-free connection to the resistance circuit.
- **Computer aided design engineering** assures the best combination of ribbon gauge, total wattage and winding spacing. This design combination maximizes heat transfer and life of the heater.



- **Excellent dielectric strength** is guaranteed because all incoming mica receives a quality control inspection.
- **UL® component recognition** is available for applications to 480°C (900F°) sheath temperature.

  File number E52951

Applications

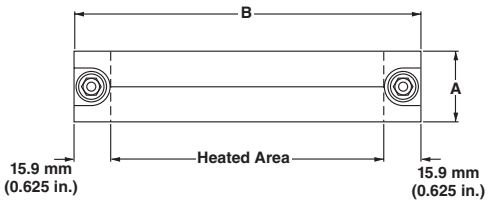
- Thermoforming
- Dies and molds
- Hot stamping
- Hot plates
- Vulcanizing presses
- Sealing equipment
- Tin melting
- Packaging equipment

Heaters

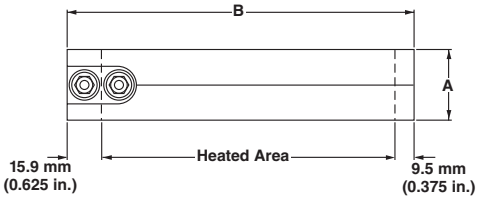
Mica Strip

Applications and Technical Data

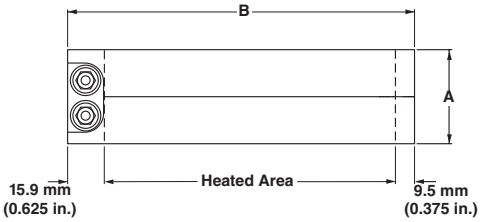
Type 1—Opposite Ends



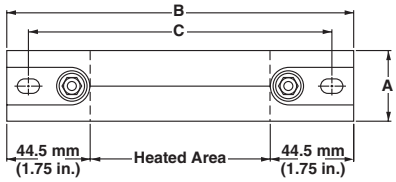
Type 2—Tandem



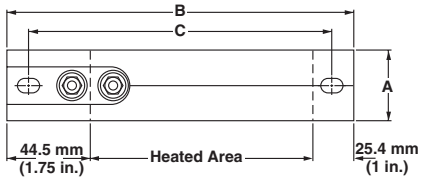
Type 3—Parallel Made-to-Order



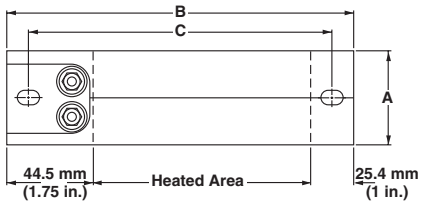
Type 4—Opposite Ends with Holes



Type 5—Tandem with Holes



Type 6—Parallel with Holes



Specify **Type** when ordering.

Physical Limitations of Lead Variations

Heater Type	Width				Length			
	Minimum		Maximum		Minimum		Maximum	
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)
Post Terminal								
Type 1 - Opposite ends	15.8	(⅝)	381	(15)	50.8	(2)	2438.4	(96①)
Type 2 - Tandem	15.8	(⅝)	381	(15)	50.8	(2)	2438.4	(96①)
Type 3 - Parallel	38.1	(1½)	381	(15)	50.8	(2)	2438.4	(96①)
Type 4 - Opposite ends with holes	15.8	(⅝)	381	(15)	139.7	(5½)	2438.4	(96①)
Type 5 - Tandem with holes	15.8	(⅝)	381	(15)	139.7	(5½)	2438.4	(96①)
Type 6 - Parallel with holes	38.1	(1½)	381	(15)	139.7	(5½)	2438.4	(96①)
Leads								
Type C, E. F, H	25.4	(1)	381	(15)	139.7	(5½)	2438.4	(96①)
Type K								
without mounting holes	25.4	(1)	381	(15)	139.7	(5½)	2438.4	(96①)
with mounting holes	38.1	(1½)	381	(15)	139.7	(5½)	2438.4	(96①)
European Plug								
Vertical	25.4	(1)	381	(15)	139.7	(5½)	2438.4	(96①)
Horizontal	63.5	(2½)	381	(15)	159	(6¼)	2438.4	(96①)
Three-Phase	76.2	(3)	381	(15)	139.7	(5½)	2438.4	(96①)
Dual Voltage	76.2	(3)	381	(15)	139.7	(5½)	2438.4	(96①)
Terminal Box②								
Type 2 - Tandem	38.1	(1½)	381	(15)	108	(4¼)	2438.4	(96①)
Type 3 - Parallel	63.5	(2½)	381	(15)	108	(4¼)	2438.4	(96①)
Type 5 - Tandem with holes	38.1	(1½)	381	(15)	159	(6¼)	2438.4	(96①)
Type 6 - Parallel with holes	63.5	(2½)	381	(15)	159	(6¼)	2438.4	(96①)

① Consult the factory if you need to exceed 2438.4 mm (96 in.).
② Not available on stock heaters.

Note: Some combinations of maximum and minimums cannot occur on the same heater.

Terminations

Types 1 through 6, as illustrated, show the placement of terminals for Watlow mica strip heaters. However, please note Type 3 terminals are not available on stock units. Placement is specified in terms of length, width and center-to-center dimensions. These dimensions are as follows:

Length:
Tolerance: ±1.6 mm (0.06 in.)

Width:
Tolerance: ±1.6 mm (0.06 in.)

Thickness:
Nominal: 4.7 mm (0.19 in.)

Types 4, 5 and 6 have 9.5 mm x 6.3 mm (0.38 in. x 0.25 in.) mounting slots. Letters A, B and C, called out in the illustrations, denote the following:
A = width, B = overall length and C = center-to-center dimensions on mounting slots.

Heaters

Mica Strip

Applications and Technical Data

Continued

Calculating Watt Density

Watt density is the amount of wattage per square inch of heated area. To determine watt density, divide the total wattage by the heated area.

$$\text{Watt Density} = \frac{\text{Total Watts}}{\text{Heated Area}}$$

To apply this equation we must define the term "heated area." Heated area is the total contact surface of the heater less areas of no heat that are found around terminals, mounting holes, etc.

Heated Area =
Total Contact Area - No-Heat Area

To calculate the heated area:

Heated Area =
(Length - No-Heat) x Width

Maximum Allowable Watt Density

The following derating factors are applicable to the **Maximum Allowable Watt Density** graph. Please review these factors and the graph to determine the maximum watt density for the application.

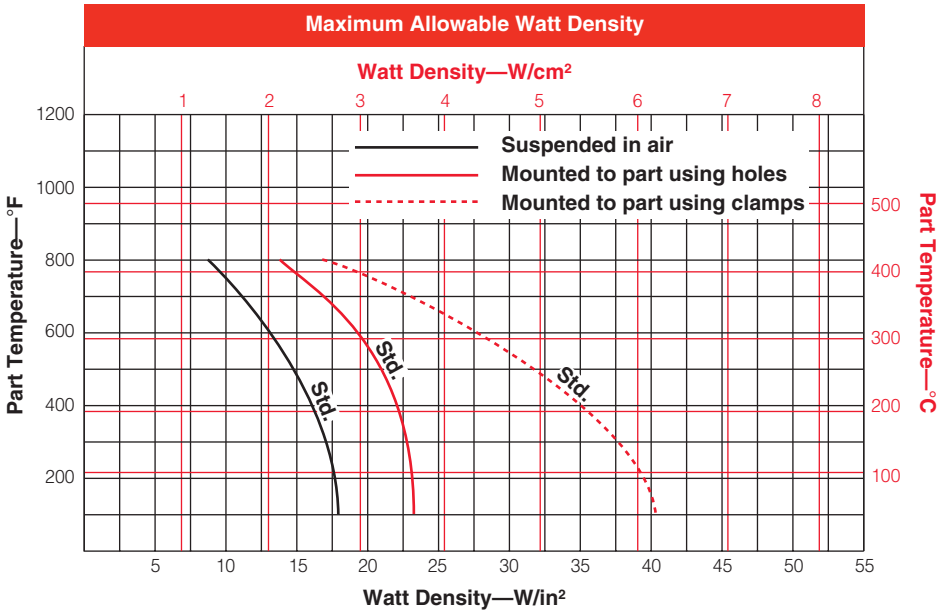
Derating Factors:

- For heaters mounted less than 25 mm (1 in.) apart on a metal part, derate by 5 percent.
- For heaters mounted within 76 mm (3 in.) of a reflective surface, derate by 10 percent.
- For heaters mounted 51-150 mm (2-6 in.) apart and radiating toward each other, derate by 10 percent.
- For heaters mounted within 25 mm (1 in.) of a reflective surface, derate by 20 percent.
- For heaters mounted less than 51 mm (2 in.) apart and radiating toward each other, derate by 20 percent.
- For termination Types 2 and 5, as well as lead Types C, E and H (see illustrations on page 318 that are less than 51 mm (2 in.) wide, derate as follows: zinc-coated units by 10 percent and stainless steel units by 20 percent.

Application Hints

To maximize the performance of a mica strip heater, ensure:

- Small heaters with 32.3 cm^2 (5 in^2) or less of heated area are 120V~(ac). These heaters can be wired in series for a 240V~(ac) power supply.
- The surface to be heated is clean and smooth, so that heat is transferred efficiently. Even small air gaps can cause hot spotting.
- Terminal post nuts are not overly tightened. Although the posts are securely riveted to the elements, excessive torque could break the connection.

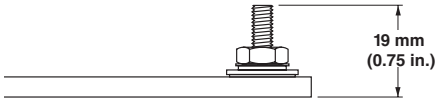


Heaters

Mica Strip

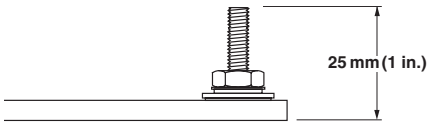
Termination Options

Post Terminals (Standard)



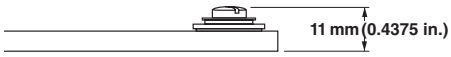
Post terminals have a threaded length of 11 mm (0.44 in.) and require approximately 19 mm (0.75 in). clearance. Specify **standard terminals** when ordering.

Long Terminals



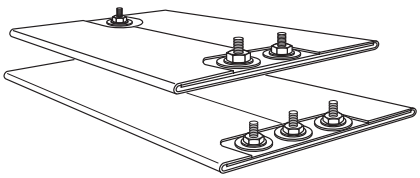
Longer terminals with 17.5 mm (0.69 in.) threaded lengths are available and require approximately 25 mm (1 in.) clearance. Specify **long terminals** when ordering.

Button Terminals



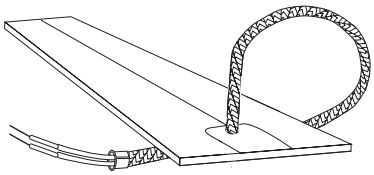
The slotted screw head terminals require only 11 mm (0.44 in.) clearance. Specify **button terminals** when ordering.

Three Terminal Construction



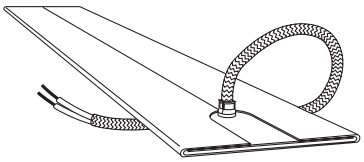
A third terminal can be added to provide dual voltage or three-heat operation. Or, it can be connected to the sheath for easy grounding. Specify **dual voltage** or **three-heat operation** when ordering.

Type E—Loose Metal Braided Leads



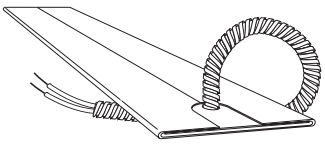
Loose metal braid encloses two fiberglass leads for good abrasion protection, lead flexibility and wiring convenience. Leads are 51 mm (2 in.) longer than the braid. To order, specify **Type E** and **length**. Leads are 51 mm (2 in.) longer than braid.

Type C—Metal Overbraid Leads



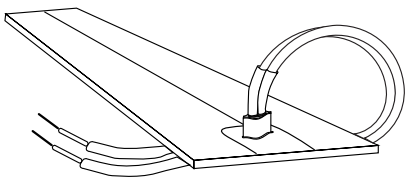
Each fiberglass-insulated lead wire exits in a single metal braid from the back of the heater. This arrangement offers abrasion protection, lead flexibility and convenient wiring for a neat installation. Minimum heater length is 140 mm (5.5 in.). Specify **Type C** and **length** when ordering. Leads are 51 mm (2 in.) longer than braid.

Type H—Flexible Steel Hose Leads (Vertical)

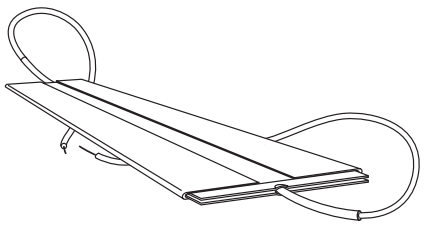


Galvanized, flexible steel hose gives superior mechanical protection where lead abrasion is a particular problem. Minimum heater length is 140 mm (5.5 in.). Specify **Type H** and **lead length** when ordering, leads are typically 51 mm (2 in.) longer than hose.

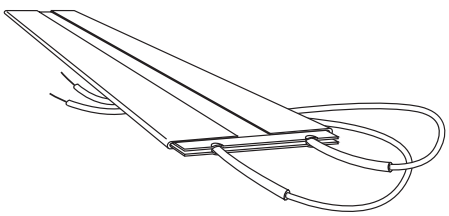
Type K—Flexible Leads



Two on One (Vertical)



One on One (Horizontal)



Two on One (Horizontal)

Type K has two fiberglass-insulated leads. These leads can exit one at each end or both at the same end, so please specify end termination when ordering. Type K is suitable for applications where lead abrasion is not a problem. Specify **Type K orientation** and **length** when ordering.

Heaters

Mica Strip

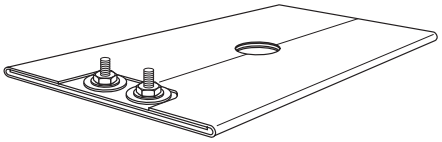
Options

External Finishing

Sheath Material

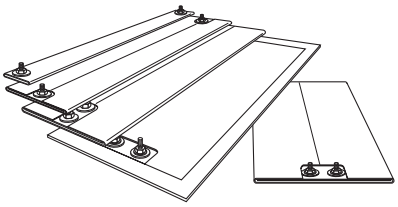
Please specify a **stainless steel sheath** when the part temperature reaches in excess of 370°C (700°F).

Holes or Slots



When required for instrumentation or mounting, holes or slots may be provided as a manufactured variation in nearly any location as long as there is at least 25 mm (1 in.) between the edge of the hole and one side of the heater. Dimensional drawing is required when ordering.

Widths



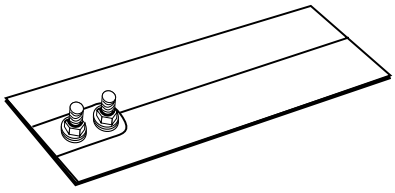
The 38 mm (1.5 in.) wide heater is the most efficient size due to its maximum clamping effect. Heaters are available in widths from 16 mm (0.63 in.) to 610 mm (24 in.).

Heaters 125 mm (5 in.) wide and greater are constructed with end folds and a reinforcement shim rather than full folds. Units less than 35 mm (1.38 in.) wide have the sheath seam on the side opposite the terminals.

Distributed Wattage

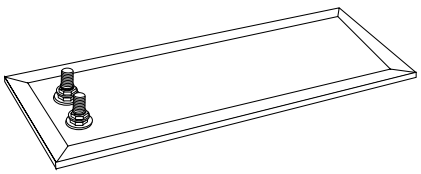
A mica strip heater can be designed with varying heat profile along the length for uneven heat distribution.

Butt Case



Recommended for heating applications where strip heater will be placed in a milled slot between two steel plates. Specify **butt case** construction when ordering.

Four Sides Closed



Mica strip heaters can be closed on all four sides to prevent contamination from getting inside the heater. Standard on strip heaters 127 mm (5 in.) wide and greater.

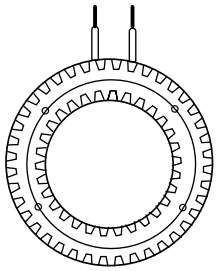
Heaters

Mica Strip

Options

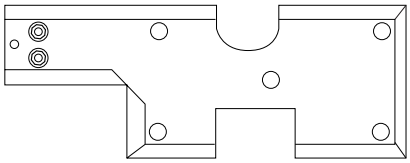
External Finishing

Ring Heaters



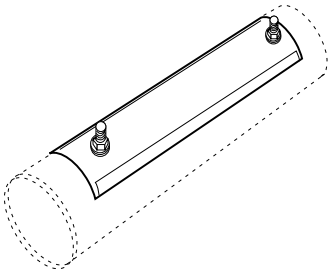
When ordering ring heaters, specify **inside** and **outside diameters**. If mounting holes are required, specify location and hole size.

Irregular Shapes



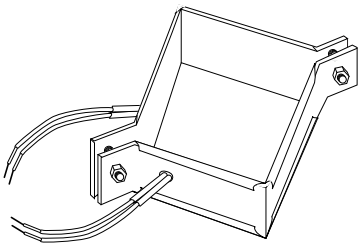
Mica strip heaters can be made into any practical shape and electrical rating. Examples include: cone, flat circular, square, rectangular and hexagon.

Cross Section Formed



Strip heaters can be formed on a cross section for piping applications. Specify **diameter of pipe** on which heaters are to be mounted.

Square, Rectangular Bands



Square or Rectangular heaters are normally used for heating dies on plastic extruders, or the barrels of twin screw extruders. These can be made in either one or two piece construction (see illustrations).

Clamping Styles

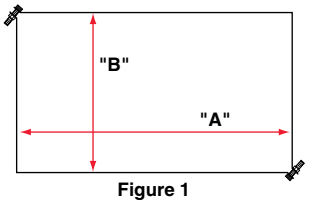


Figure 1

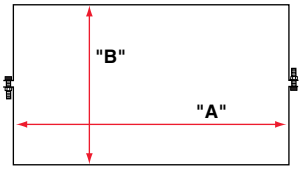


Figure 2

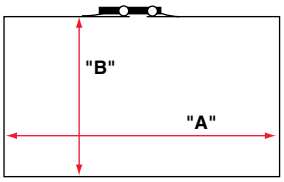
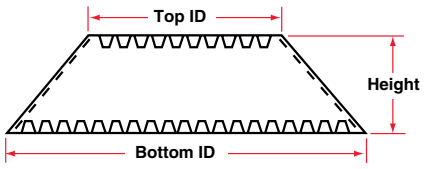


Figure 3

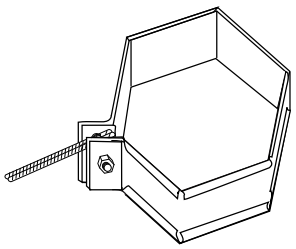
Referring to the illustrations, the preferred design is Figure 1 with bent-up flange clamping due to the uniform applied clamping force at the corners. Next is Figure 2, with bent-up flanges or built-in strapping brackets at the sides. The least preferred design is Figure 3, one-piece heater, due to the lack of uniform applied clamping force.

Cone Shapes



Cone shaped heaters are normally used for special heating applications when heat is required for hoppers or funnels. They are made strictly to customer specifications. The preferred method of attachment is with bent-up flange clamping.

Hex Bands

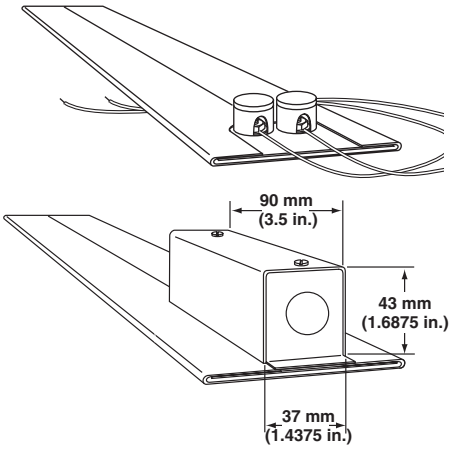


Hex shaped heaters are used on the hex shaped portion of the nozzle on injection molding machines. A drawing is required when ordering.

Heaters

Mica Strip

Options



Ceramic Terminal Covers

Ceramic terminal covers are a convenient, economical way to provide safety. Covers are sized for standard 11 mm (0.44 in.) long post terminals, that require approximately 19 mm (0.75 in.) clearance. The clearance, with ceramic cover cap, is 23.1 mm (0.91 in.). Excluding the thickness of the heater, the clearance is 19 mm (0.75 in.). Screw thread size is 10-24. To order, specify Watlow code number **Z-4918** and quantity.

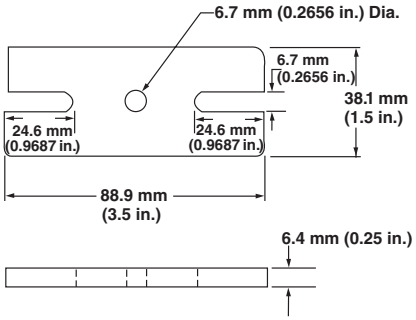
Metallic Terminal Box

A high quality metallic terminal box is welded to the heater sheath. Units with tandem terminals must be at least 38 mm (1.5 in.) wide. Units with parallel terminals must be at least 108 mm (4.25 in.) wide. Minimum length is 108 mm (4.25 in.) without mounting holes or 159 mm (6.25 in.) with holes. When ordering specify **terminal box.**

Accessories

Clamping Variations

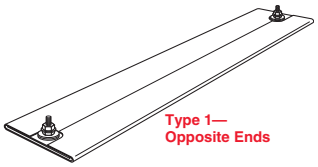
Clamping Bars



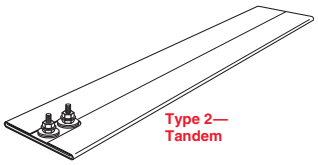
For maximum life and efficient operation, strip heaters must be firmly clamped to the part being heated. Clamping bars 90 mm (3.5 in.) wide can be used to clamp strips with a maximum width of 76 mm (3 in.). Watlow recommends clamping every 150 mm (6 in.). Specify code number **MB101-1** and quantity when ordering clamping bars.

Heaters

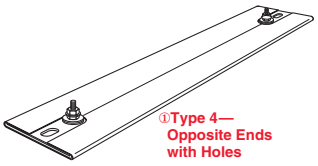
Mica Strip



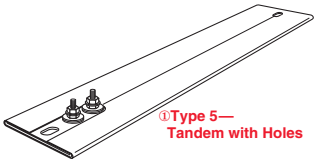
Type 1—
Opposite Ends



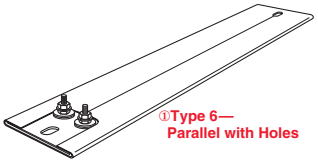
Type 2—
Tandem



①Type 4—
Opposite Ends
with Holes



①Type 5—
Tandem with Holes



①Type 6—
Parallel with Holes

How to Order

To order stock mica strip heater, specify:

- Quantity
- Watlow code number

Availability

Stock: Same day shipment

Made-to-Order: If stock units do not meet application needs, Watlow can manufacture mica strip heaters to special requirements. Please consult a Watlow sales engineer or authorized distributor.

Width mm (in.)	Overall Length mm (in.)	Type	Ctr-to-Ctr Mtg Holes mm (in.)	Volts	Power (Watts)	Watt Density W/cm² (W/in²)	Approx. Net Weight lbs (kg)	Avail.	Code No.
25.4 (1)	88.9 (3½)	1	— —	120	50	3.4 (22)	0.04 (0.09)	Stk	**S1A3JP1**
	152.4 (6)	1	— —	120	100	3.3 (21)	0.08 (0.17)	Stk	**S1A6AP1**
	152.4 (6)	1	— —	240	100	3.3 (21)	0.08 (0.17)	Stk	**S1A6AP2**
	304.8 (12)	4	279.4 (11)	120	175	3.3 (21)	0.15 (0.33)	Stk	**S1A12AT1**
	304.8 (12)	4	279.4 (11)	240	175	3.3 (21)	0.15 (0.33)	Stk	**S1A12AT2**
	152.4 (6)	5	133.4 (5¼)	120	100	3.1 (20)	0.08 (0.17)	Stk	**S1A6AU1②**
38.1 (1½)	457.2 (8)	1	— —	120	750	4.6 (30)	0.34 (0.75)	Stk	**S1J18AP1**
	152.4 (6)	2	— —	120	250	5.1 (33)	0.11 (0.25)	Stk	**S1J6AR1**
	203.2 (8)	2	— —	120	400	5.7 (37)	0.15 (0.33)	Stk	**S1J8AR1**
	203.2 (8)	2	— —	240	400	5.7 (37)	0.15 (0.33)	Stk	**S1J8AR2**
	304.8 (12)	2	— —	120	500	4.6 (30)	0.23 (0.50)	Stk	**S1J12AR1**
	304.8 (12)	2	— —	240	500	4.6 (30)	0.23 (0.50)	Stk	**S1J12AR2**
	355.6 (14)	2	— —	120	500	3.9 (25)	0.26 (0.58)	Stk	**S1J14AR1**
	355.6 (14)	2	— —	240	500	3.9 (25)	0.26 (0.58)	Stk	**S1J14AR2**
	457.2 (18)	2	— —	120	800	4.8 (31)	0.34 (0.75)	Stk	**S1J18AR1**
	457.2 (18)	2	— —	240	800	4.8 (31)	0.34 (0.75)	Stk	**S1J18AR2**
	609.6 (24)	2	— —	120	1000	4.5 (29)	0.45 (1.0)	Stk	**S1J24AR1**
	609.6 (24)	2	— —	240	1000	4.5 (29)	0.45 (1.0)	Stk	**S1J24AR2**
	203.2 (8)	4	177.8 (7)	120	150	3.4 (22)	0.15 (0.33)	Stk	**S1J8AT1**
	304.8 (12)	4	279.4 (11)	120	250	3.1 (20)	0.23 (0.50)	Stk	**S1J12AT1**
	304.8 (12)	4	279.4 (11)	240	250	3.1 (20)	0.23 (0.50)	Stk	**S1J12AT2**
	457.2 (18)	4	431.8 (17)	240	500	3.6 (23)	0.34 (0.75)	Stk	**S1J18AT1**
	139.7 (5½)	5	114.3 (4½)	120	125	4.6 (30)	0.11 (0.23)	Stk	**S1J5JU1**
	190.5 (7½)	5	165.1 (6½)	120	150	3.3 (21)	0.15 (0.33)	Stk	**S1J7JU1**
	203.2 (8)	5	177.8 (7)	120	150	2.9 (19)	0.15 (0.33)	Stk	**S1J8AU1**
	203.2 (8)	5	177.8 (7)	240	150	2.9 (19)	0.15 (0.33)	Stk	**S1J8AU2**
	203.2 (8)	5	177.8 (7)	120	175	3.4 (22)	0.15 (0.33)	Stk	**S1J8AU3**
	203.2 (8)	5	177.8 (7)	240	175	3.4 (22)	0.15 (0.33)	Stk	**S1J8AU4**
	203.2 (8)	5	177.8 (7)	120	250	5.0 (32)	0.15 (0.33)	Stk	**S1J8AU5**
	203.2 (8)	5	177.8 (7)	240	250	5.0 (32)	0.15 (0.33)	Stk	**S1J8AU6**
	266.7 (10½)	5	241.3 (9½)	120	250	3.4 (22)	0.19 (0.42)	Stk	**S1J10JU1**
	266.7 (10½)	5	241.3 (9½)	240	250	3.4 (22)	0.19 (0.42)	Stk	**S1J10JU2**
	304.8 (12)	5	279.4 (11)	120	250	2.8 (18)	0.23 (0.50)	Stk	**S1J12AU1**
	304.8 (12)	5	279.4 (11)	240	250	2.8 (18)	0.23 (0.50)	Stk	**S1J12AU2**
	304.8 (12)	5	— —	120	150	1.7 (11)	0.23 (0.50)	Stk	**S1J12AU10③**
	304.8 (12)	5	— —	240	150	1.7 (11)	0.23 (0.50)	Stk	**S1J12AU11③**
	387.4 (15¼)	5	362.0 (14¼)	240	500	4.2 (27)	0.29 (0.63)	Stk	**S1J15EU1**
	454.0 (17⅞)	5	428.6 (16⅞)	120	375	2.6 (17)	0.34 (0.75)	Stk	**S1J17RU1**
	454.0 (17⅞)	5	428.6 (16⅞)	120	500	3.4 (22)	0.34 (0.75)	Stk	**S1J17RU2**
	454.0 (17⅞)	5	428.6 (16⅞)	240	500	3.4 (22)	0.34 (0.75)	Stk	**S1J17RU3**
	533.4 (21)	5	508.0 (20)	240	650	3.7 (24)	0.39 (0.87)	Stk	**S1J21AU1**
	603.3 (23¾)	5	577.9 (22¾)	120	500	2.5 (16)	0.45 (0.99)	Stk	**S1J23NU1**
	603.3 (23¾)	5	577.9 (22¾)	240	500	2.5 (16)	0.45 (0.99)	Stk	**S1J23NU2**
	603.3 (23¾)	5	577.9 (22¾)	120	750	3.7 (24)	0.45 (0.99)	Stk	**S1J23NU3**
	603.3 (23¾)	5	577.9 (22¾)	240	750	3.7 (24)	0.45 (0.99)	Stk	**S1J23NU4**
	647.7 (25½)	5	622.3 (24½)	240	650	2.9 (19)	0.50 (1.10)	Stk	**S1J25JU1**
	774.7 (30½)	5	749.3 (29½)	240	800	2.9 (19)	0.59 (1.30)	Stk	**S1J30JU1**
63.5 (2½)	165.1 (6½)	6	139.7 (5½)	120	225	3.7 (24)	0.20 (0.45)	Stk	**S2J6JV1**
	165.1 (6½)	6	139.7 (5½)	240	225	3.7 (24)	0.20 (0.45)	Stk	**S2J6JV2**
	215.9 (8½)	6	190.5 (7½)	120	350	3.7 (24)	0.27 (0.59)	Stk	**S2J8JV1**
	215.9 (8½)	6	190.5 (7½)	240	350	3.7 (24)	0.27 (0.59)	Stk	**S2J8JV2**
	647.7 (25½)	6	622.3 (24½)	120	1000	2.8 (18)	0.81 (1.78)	Stk	**S2J25JV1**
	647.7 (25½)	6	622.3 (24½)	240	1000	2.8 (18)	0.81 (1.78)	Stk	**S2J25JV2**

① Mounting slots on stock heaters are 12.7 x 7.9 mm (0.9 x 0.31 in.). On made-to-order units, mounting slots are 9.5 x 6.3 mm (0.38 x 0.25 in.).
② This unit has 9.5 x 6.3 mm (0.38 x 0.9 in.) mounting holes.
③ Heaters with code numbers **S1J12AU10** and **S1J12AU11** have zinc-coated steel sheath. All other heaters have stainless steel sheath.

Heaters

Radiant Band and Strip Emitters

Constructed using Watlow's exclusive mineral insulation, rugged stainless steel sheath and high emissivity coating, these heaters can operate at temperatures to (700°C) 1300°F and 4.7 W/cm² (30 W/in²).

Sizes

Strip Emitters

Width: 76.2 mm (3 in.)

Length: 152.4 mm (6 in. min.)
787.4 mm (31 in. max.)

Band Emitters

Width: 25.4 mm (1 in.)
50.8 mm (2 in.)
76.2 mm (3 in.) max.

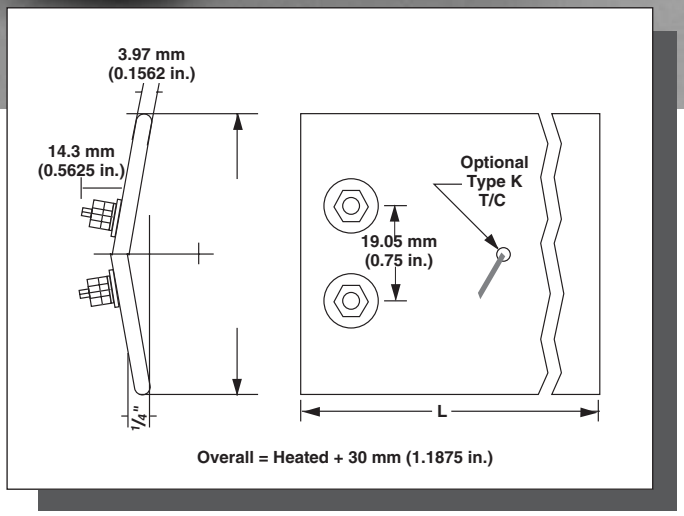
- Segment Length: 152.4 mm (6 in.) min. to 1066.8 mm (42 in.) max.
- Partial arcs to full 360° coverage: Consult Watlow.
- High emissivity coating on inside standard. For high emissivity coating on outside: Consult Watlow.
- Post terminals standard; high temperature Type H leads available.

Options

- Mounting studs
- Mounting clips for 76.2 mm (3 in.) wide emitter strips, part #MM6063
- Thermocouple welded to sheath
- Thermocouple pocket welded to sheath
- Bayonet fitting for VAT style thermocouple

Applications

- Precise toning in thermoforming
- Heating rotating drums and rollers
- Small spot heating
- Heat shrinking and curing wire coatings



How to Order

The radiant band/strip emitters are available **made-to-order** only. It is helpful to have the following information available:

- Heated width and length (or diameter for band emitters)
- Total wattage
- Voltage, single-phase only
- Mounting studs, if desired
- Thermocouple or thermowell or thermocouple pocket, if desired

Availability

Made-to-order: Consult Watlow

Problem Solvers

Watlow Solutions To Common Radiant Heater Problems

Heater replacement intervals can be lengthened or heating problems eliminated by using the optimum heater for the application. Check the list below to see if Watlow's family of RAYMAX radiant heaters can improve your process.

Problem	Heater Solution
High energy cost	• Replace tubular heater/reflector radiant oven with Watlow radiant panels
Non-uniform plastic sheet heating	• Use properly zoned radiant panels with infrared temperature sensing and Watlow controllers
Plastic falling on and contaminating lower heaters	• Use RAYMAX 1010 sealed face radiant panels on bottom oven deck
Plastic sheet burning when web stops moving	• Use RAYMAX 1626 quartz tube radiant heaters for quick cool-down during line stoppage
High maintenance costs	• Use RAYMAX 1120 or1330 panels with replaceable emitters
No application information	• Contact your authorized Watlow Plastics Distributor for application assistance

Caution: Fire Hazard

Radiant heaters must not be operated in the presence of flammable vapors, gases or combustible materials without proper ventilation and safety precautions. Radiant heaters must be properly wired and controlled to comply with all applicable electrical codes.

Heaters

Case History

Radiant Heaters Make Thermoplastic Sheets Stampable

Problem:

A customer utilized polypropylene-based, glass reinforced structural plastic in automobile front-ends and parts, power mower shrouds, snow shovels and guitar cases. This glass-reinforced polypropylene had a critical softening temperature, and could be stamped with metal-forming equipment already in the plant. Therefore, the process required a low facilities investment, but a method of heating the plastic sheet was needed.

Solution:

Watlow's RAYMAX 1120 panel type radiant heaters were used to preheat the plastic sheet material, which was then conveyed to a die where the final configuration was formed.

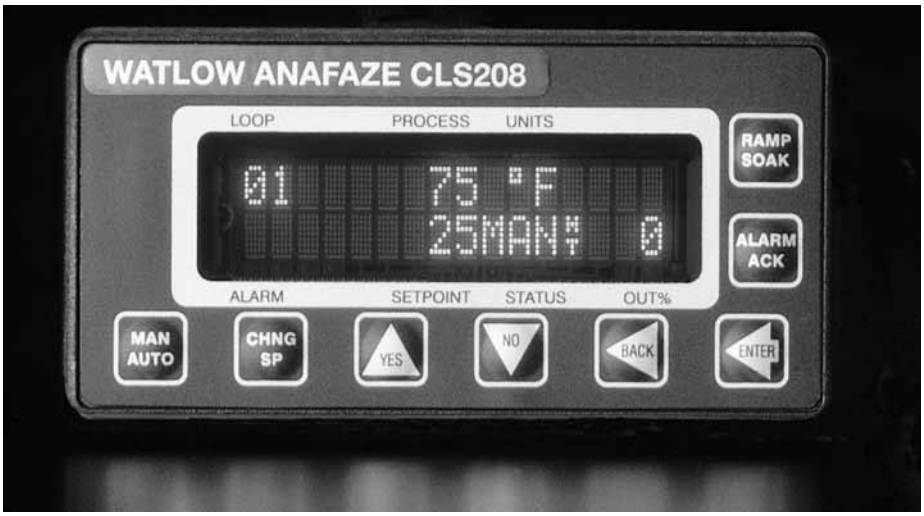
Originally, the customer purchased a competitor's radiant heater with quartz tubes. Their uneven heating caused some of the plastic to burn. The irregular heat also caused the material to have a high surface temperature and cool inner temperature resulting in poor stamping.

The Watlow RAYMAX 1120 radiant heater, operating at a lower temperature than quartz tubes, emitted a greater percentage of infrared energy, with minimal wavelength, for penetrating the plastic material. The heater met the need for even temperature and even penetration, and three zones in the radiant oven enabled rapid processing. Watlow specified and designed the complete system within two weeks.

Temperature Controllers

For complete information on CLS200 controllers reference pages 169 to 172.

4-, 8-, 16-Loop CLS200



The Watlow CLS200 is a powerful line of controllers, combining performance and flexibility with compact design. The four, eight and 16-loop versions provide complete control solutions for thermoforming and other plastics processes. Support for multiple types of sensor inputs is available, including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system, and includes built-in serial communications for computer interface and data acquisition. An enhanced features option offers cascade control, ratio control, differential control, process variable retransmit and remote analog set point.

The CLS200 controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

Features and Benefits

PID control of up to 16 heat and cool loops

- Minimal panel space per loop
- Reduced installation time
- More reliable: fewer parts means fewer failures

Auto-tune

- Less time tuning
- Achieve excellent control with less expertise

Menu-guided operation with full text display

- Quick controller setup
- Easy to operate

Eight jobs stored and recalled

- Quickly change from one process to another

Multiple and mixed inputs

- Simply change sensor types at the last minute
- Less to learn, less inventory

Sensor failure detection

- Reduces time troubleshooting reversed, shorted and open sensors

High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms and process variable retransmit

EIA/TIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

Firmware Options

Choose firmware with the features needed for the application:

- Standard—includes closed-loop PID control, auto-tune, alarms, job memory and failed sensor detection
- Extruder— includes the standard firmware features, with PID control specifically adapted for plastic extruders
- Enhanced Features— includes the standard firmware features with the addition of process variable retransmit, remote analog set point, cascade control, ratio control and differential control algorithms. Each channel can be configured for standard PID control or one of the other control algorithms. Each channel of cascade control or remote analog set point requires two controller channels. Unused control outputs on any channel can be configured for retransmit.

Because the CLS200 has no onboard analog outputs, applications that use process variable retransmit typically require one SDAC module per retransmitted signal.

Watlow's WATVIEW software is ideal to use with the CLS200. See page 180 for more information and ordering details.

UL® and C-UL® are registered trademarks of Underwriter's Laboratories, Inc.

Temperature Controllers

For complete information on CPC400 controllers reference pages 249 to 252.

CPC400

The Watlow CPC400 controllers provide performance and flexibility in a compact design and integrate full-featured closed-loop control with user-written logic. Programmable logic can interact with closed-loop control and operate I/O independently.

Four and eight loop versions offer complete control solutions for a broad range of plastics applications. The CPC400 supports thermocouples, RTDs, linear voltage, current and frequency. Built-in diagnostics automatically detect sensor failures including open, shorted and reversed conditions. I/O can also be utilized for closed-loop control, alarms and user programs.

Using the built-in communications port, system designers can interface one or more controllers to a host computer for operator controls and data acquisition. The CPC400 offers PID, cascade, ratio and differential control strategies. Process variable retransmit and remote analog set point can be used to integrate the CPC400 with other devices such as chart recorders.

The CPC400 carries the CE mark and is UL® listed.

Features and Benefits

Combines control loops with programmable logic

- Easy integration of PID control and logic
- Less time reinventing PID control
- Augment closed-loop control with user-written logic
- Add custom functions to controller
- Reduces installation and set up time
- Requires less panel space
- Fewer parts reduces failures and increases reliability

Flexible, easy-to-use interfaces

- Easy setup with menu guided, full-text prompts
- Context-sensitive, on-screen help saves time
- WATVIEW software minimizes setup time
- Integrate with other serial devices using Modbus™
- Connect to system components via analog I/O to retransmit process variables and read set points

Advanced control utilities

- Auto-tune optimizes control with minimal effort and expertise
- Cascade minimizes overshoot and improves control in systems with excessive thermal lag
- Ratio and differential enhances control where the relationship between two or more loops is paramount

Watlows WATVIEW and LOGICPRO software applications are ideal to use with the CPC400. See pages 180 and 275 for more information and ordering details.

Modbus™ is a trademark of Schneider Automation Incorporated.

Temperature Controllers

For complete information on MLS300 controllers reference pages 253 to 256.

16-, 32-Loop MLS300

The Watlow MLS300 is a powerful line of controllers that combine performance and flexibility with compact design. The 16 and 32-loop versions provide complete control solutions for plastics applications. Support for multiple types of sensor inputs is available; including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system, and includes built-in serial communications for computer interface and data acquisition. The enhanced features option offers cascade, ratio and differential control, process variable retransmit and remote analog set point.

The remote analog input options allow for shorter sensor wires and flexible mounting which reduces sensor cost and installation time. Watlow's new CIM option provides OEMs with a space and labor saving alternative to the standard AIM module. This innovation allows users to construct a wiring harness to attach sensors via a connector instead of connecting individual wires to the controller.

The MLS300 controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

Features and Benefits

PID control of up to 16 heat and cool loops or 32 heat loops

- Minimal panel space per loop
- Reduces installation time
- More reliable: fewer parts mean fewer failures

Auto-tuning

- Less time tuning
- Achieve excellent control with less expertise

Menu guided operation with full text display

- Quick controller setup
- Easy to operate

Eight jobs stored and recalled

- Quickly change from one process to another

Multiple and mixed inputs

- Simply change sensor types at the last minute
- Less to learn, less inventory

Sensor fail detection

- Reduces time troubleshooting reversed, shorted and open sensors

High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

TIA/EIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms and process variable retransmit

CIM300 option

- Small footprint per loop
- Reduced installation time

Watlow's WATVIEW software is ideal to use with the MLS300. See page 180 for more information and ordering details.

Temperature Controllers

For complete information on PPC-2000 controllers reference pages 257 to 264.

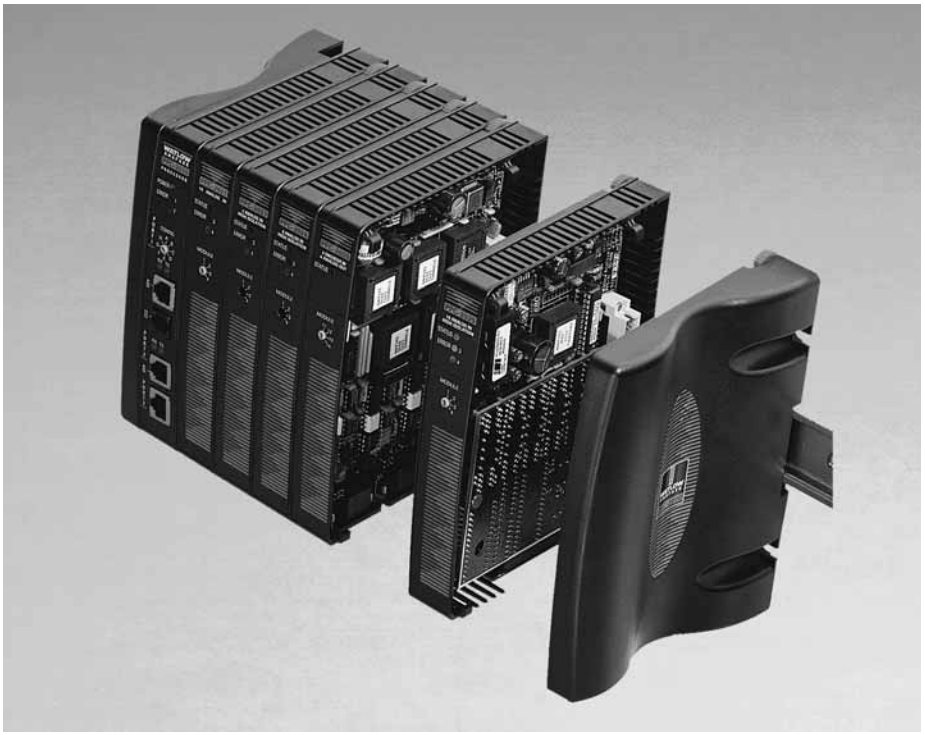
PPC-2000

The Watlow PPC-2000 is a powerful, multi-loop programmable process control system. It combines easy-to-set up multi-loop process control and programmable logic control in one integrated package. Its modular design enables users to select a set of hardware and develop a logic control program based on their specific control loop and logic application, making it ideal for OEMs and rebuilders.

The PPC-2000 controls up to 48 PID loops and supports additional analog inputs for logic programming or monitoring. It accepts multiple sensor inputs including thermocouples, RTDs, linear dc voltage or current inputs and counters. The base system has 46 digital I/O for temperature control or programmable logic. Plug-in I/O modules expand the capacity of the base system. Options include modules for pulse inputs, current and voltage analog outputs, digital inputs for ac and dc signals and relay outputs.

Two serial communication ports support read/write access by a host computer and/or operator interface panel using Modbus™ RTU protocol. ANAWIN®3, the PPC-2000's Human Machine Interface (HMI) software makes it easy to configure, monitor and customize applications.

LOGICPRO, graphical logic programming software package allows integration of programmable logic functionality into this new breed of multi-loop controller. Develop with easy-to-use drag and drop tools, then simulate and debug your program before downloading to the PPC-2000.



Features and Benefits

Up to 48 PID control loops

- Precisely control a large number of temperature zones and process loops with a single controller

Advanced auto-tune on all loops

- Quickly optimize PID parameters

Integrated programmable logic control

- Eliminates hard-wired relay logic or stand alone PLC
- Shares data between process control and logic functions

Fill-in-the-blank setup

- Easily setup and monitor closed-loop control

High density mixed analog input modules

- Connect any combination of T/C, RTDs, linear dc current or voltage on the same input module

Flexible and expandable I/O platform

- Saves cost and space by customizing a system to the exact I/O requirement

ANAWIN and LOGICPRO graphical software tools

- Easily configure, monitor and maintain processes
- Add custom functionality to support application requirements

Applications

- Plastic extrusion and thermoforming equipment
- Electronic packaging equipment
- Applications requiring 16 or more temperature or analog inputs

Watlow's ANAWIN3 and LOGICPRO software applications are ideal to use with the PPC-2000. See pages 274 and 275 for more information and ordering details.

Temperature Controllers

SERIES D8

The Watlow SERIES D8 is a powerful line of controllers that combines performance and flexibility with compact design. Compliance with the ODVA and Semiconductor SIG standards means this controller is easy to integrate into systems with DeviceNet™ networks on CAN (Controller Area Network).

The four and eight loop versions of SERIES D8 controllers provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs including thermocouples, RTDs, linear voltage and current is also available.

Each loop can be individually configured for on-off control or PID control. Loops can be combined to achieve cascade, ratio or differential control. Process variable retransmit and remote analog set point are included.

The SERIES D8 controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

Features and Benefits

PID control of up to eight loops

- Minimal panel space per loop
- Reduced installation time
- More reliable: fewer parts mean fewer failures

Complies with ODVA (Open DeviceNet™ Vendors Association) and Semiconductor SIG (Special Interest Group) specifications for DeviceNet™ on CAN (Controller Area Network)

- Integrates with other DeviceNet™ nodes and software
- Sealed micro connector minimizes installation time and footprint while maximizing reliability
- Rotary baud rate and node address switches simplify setup
- Network and module status LEDs simplify commissioning and troubleshooting a network

Flexible, easy-to-use interface

- Easy set up with menu guided, full-text prompts
- Context-sensitive, on-screen help saves time

Advanced control utilities

- Auto-tune optimizes control with minimal effort and expertise
- Cascade minimizes overshoot and improves control in systems with excessive thermal lag
- Ratio and differential enhance control in areas where the relationship between two or more loops is paramount

Specifications

Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, set values and view channel displays
- Built-in context sensitive help

Noise Rejection

- 120dB at 60Hz

Temperature Coefficient

- 40ppm/°C

Analog Inputs

- Thermocouples: User selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: 2- or 3-wire, platinum, 100Ω @ 0°C, DIN-curve. Requires scaling resistors. See special inputs in ordering information
- Linear: current and voltage signals from linear transmitter

DeviceNet™ CONFORMANCE TESTED

DeviceNet™ is a trademark of the Open DeviceNet Vendors Association.

Temperature Controllers

SERIES D8

Specifications Cont.

Input Range and Accuracy

	Range	Accuracy
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.4°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)
RTD (DIN)	-200.0 to 621.0°C (-328.0 to1150.0°F)	±0.5°C (±0.9°F)

Note: Accuracy @ 25°C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C (800°F) to 1760°C (3200°F). RTD is for 100 percent of span

Linear Voltage and Current Inputs

Requires scaling resistors.
See special inputs in Ordering Information

0-10mA⎓(dc)
0-20mA⎓(dc)/4-20mA⎓(dc)
0-100mV⎓(dc)
0-500mV⎓(dc)
0-1V⎓(dc)
0-5V⎓(dc)
0-10V⎓(dc)
0-12V⎓(dc)

Other ranges available. Consult factory

Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- D84: Six samples per second, (update time: 0.167 sec.)
- D88: Three samples per second, (update time: 0.333 sec.)

Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

Calibration

- Automatic zero and full scale

Digital Inputs

- TTL level used for logic, remote alarm acknowledge, selecting recipes or jobs
- Eight inputs with 50-pin terminal board option
- Three inputs with 18-pin terminal block option

Digital Outputs

- 18 digital outputs available with a 50-pin terminal board option
- 11 outputs available with 18-pin terminal block option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off, time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V⎓(dc)

Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- User programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

Analog Outputs

- Use DAC and SDAC accessory modules. See page 179.

DeviceNet™ Interface

- Fully compliant with the interface guidelines for DeviceNet™ on semiconductor manufacturing tools
- Supports predefined master/slave connection set
- Group two only slave device
- Module status and network status LEDs
- Rotary baud rate and node address switches
- Hardware and software selectable baud rates: 125K, 250K and 500K
- Hardware and software selectable node address: 0 to 63
- Supports polled I/O and explicit messaging connections
- Polled I/O response: less than 1 millisecond
- Explicit message response: less than 50 milliseconds
- EDS (Electronic Data Sheet)
- Connector: 5-pin, micro style, sealed, male
- Optically isolated CANBUS interface
- Bus plugable while hot
- Bus miswire protection

Line Voltage/Power

- 15 to 24V⎓(dc) ± 3V⎓(dc) @ 1A (loaded) or 300mA (no load)

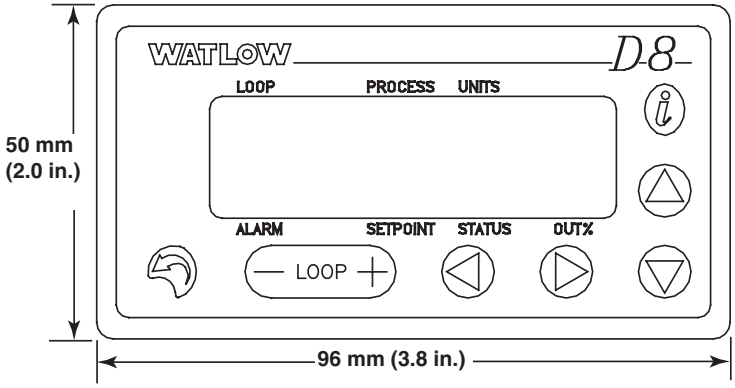
Agency Approvals

- UL®, C-UL® Listed: UL® 916, standard for energy management equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC
- ODVA conformance tested DeviceNet™

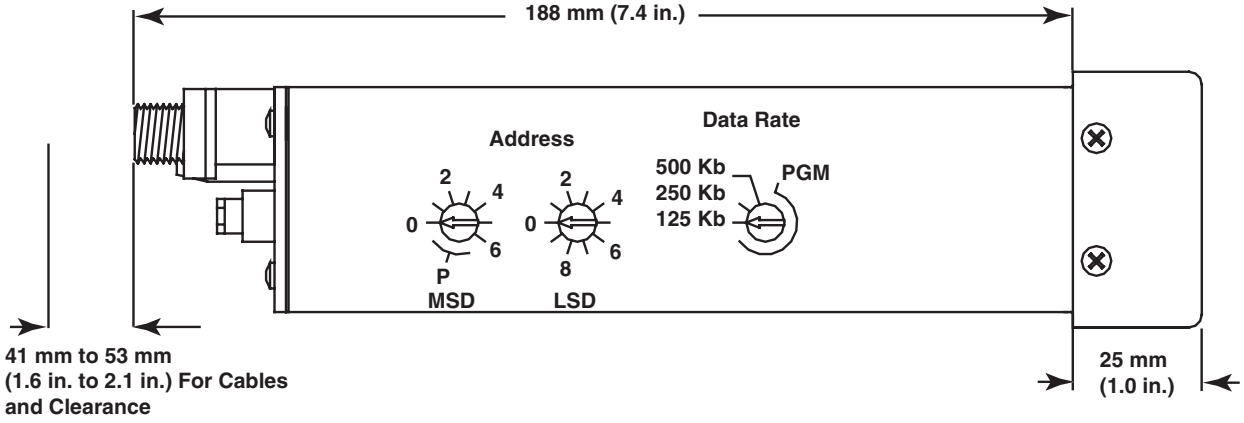
Temperature Controllers

SERIES D8

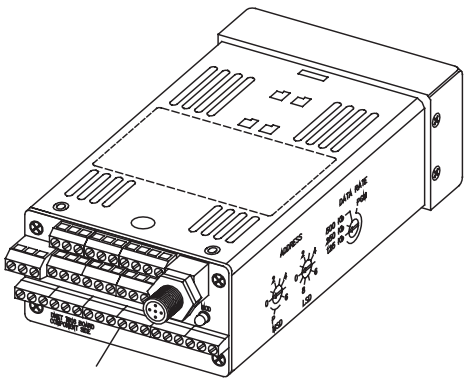
Front View



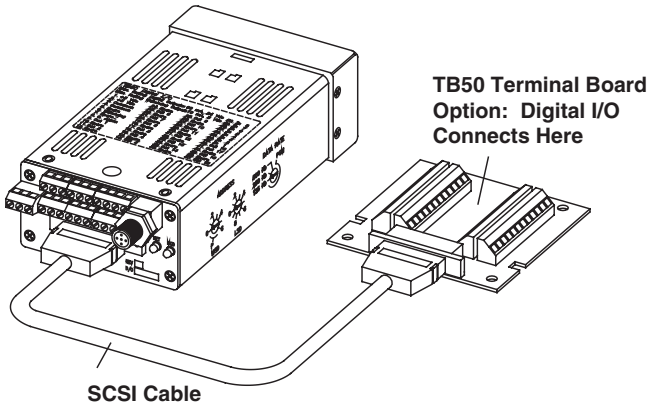
Side View



D8 with TB18 Option for Digital I/O



D8 with SCSI/TB50 Option for Digital I/O



Temperature Controllers

SERIES D8

Ordering Information

To order, complete the code number on the right with the information below.

D8 _ 0 - 0 0 0 0 - _ _ 0

Number of Loops

4 = 4 loop controller
8 = 8 loop controller

Digital I/O Terminations

0 = TB18 (Screw terminals on the controller)
1 = SCSI connector, no terminal board or cable
2 = SCSI connector, TB50 terminal board and 3-foot cable
3 = SCSI connector, TB50 and 6-foot cable
4 = SCSI connector, TB50 and 3-foot right angle cable
5 = SCSI connector, TB50 and 6-foot right angle cable

Power Supply

0 = No power supply
1 = CE power supply

Special Inputs

0 = Thermocouples and -10 to 60 mV inputs only
X = Number of current, voltage and RTD inputs

Special Inputs

Specify an input type for each channel or block of channels that needs factory installed resistors. Include a descriptor in the controller part description in the form specified below for each special input type. Make sure the number of special inputs specified is equal to the number of special inputs in the controller part number

D8SI _ _ - _ _ - _

Special Input Type

(Not required for thermocouple sensor inputs)

23 = RTD
43 = 0-10mA⎓(dc)
44 = 0-20mA⎓(dc)/4-20mA⎓(dc)
50 = 0-100mV⎓(dc)
52 = 0-500mV⎓(dc)
53 = 0-1V⎓(dc)
55 = 0-5V⎓(dc)
56 = 0-10V⎓(dc)
57 = 0-12V⎓(dc)

Start Channel

XX = Channel Number XX

End Channel

XX = Channel Number XX

Availability

Up to four weeks, depending on complexity and order release quantity. Consult factory for details

Temperature Controllers

SERIES PD
Single Loop

Watlow's SERIES PD controller utilizes embedded Ethernet technology to provide a convenient, economical means for setting up and viewing key process variables such as temperature, pressure and humidity. The DIN-rail mount SERIES PD controller offers up to four control/alarm outputs, as well as a digital/current transformer input.

Watlow's SERIES PD controller is ideally suited for a wide range of temperature or process control applications where the operator interface is supported from a remote location. The SERIES PD provides interfacing via embedded firmware which serves dedicated web pages. These pages support key functions including operation, alarm monitoring, configuration and are displayed using standard web browser software. The SERIES PD is also capable of generating e-mail messages for remote alarm notification.

Ethernet-based products are rapidly gaining popularity in industrial applications because they allow an instantaneous exchange of information between processing equipment and the company's management system.

Advanced features of the SERIES PD controller include internal data logging of key control parameters, INFOSENSE™-P technology, heater burn out detection and an enhanced control algorithm.

The SERIES PD controller is backed by a three-year warranty from Watlow Winona and is UL® 508, C-UL®, CSA and CE approved.

Features and Benefits

Ethernet connectivity

- Convenient, easy to use operator interface
- Simplified process monitoring

DIN-rail sub panel mounting

- Quick, economic installation

Watlow INFOSENSE™ sensor technology

- INFOSENSE™ technology improves sensor accuracy by a minimum of 50 percent

Advanced control algorithm

- Tighter process control

Heater burn out detection

- Improved process yields

Internal data logging

- Reduces external hardware demands

Virtual or hardware alarms with e-mail delivery

- Remote alarm notification

Temperature Controllers

SERIES PD
Single Loop

Specifications

Power

- 24V≂(ac/dc), +10/-15 percent, 50/60Hz, ±5 percent
- 12VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

Environment

- 0 to 65°C (32 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

Agency Approvals

- UL® 508, C-UL®, CSA and CE

Controller

- Microprocessor based user-selectable control modes
- Single or dual channel universal inputs
- Current transformer inputs/digital inputs
- Up to four programmable outputs
- Update rates, inputs = 10Hz, outputs = 10Hz

Operator Interface

- Browser based HMI (Human Machine Interface)

Wiring Termination

- Touch-safe removable terminals
- 14 to 22 AWG

Universal Inputs (Electrically Isolated)

- Thermocouple, grounded or ungrounded sensors
- RTD 2-or 3-wire, platinum, 100Ω @ 0°C calibration to DIN-curve (0.00385 Ω/Ω/°C)
- Process 0-20mA @ <100Ω, or 0-10V⎓(dc) @ 10kΩ input impedance (50,000 bits @ full scale)

Digital Inputs

- Contact or dc voltage
- 10KΩ input impedance

Current Transformer Inputs

- 0 to 50mA CT input into 100Ω impedance

Allowable Input Operating Range

Type J:	-200	to	1200°C
	(-340	to	2192°F)
Type K:	-270	to	1370°C
	(-454	to	2500°F)
Type T:	-270	to	400°C
	(-454	to	750°F)
Type N:	-270	to	1300°C
	(-454	to	2372°F)
Type E:	-270	to	975°C
	(-454	to	1790°F)
Type C:	0	to	2315°C
	(32	to	4200°F)
Type D:	0	to	2315°C
	(32	to	4200°F)
Type PTII:	0	to	1395°C
	(32	to	2543°F)
Type R:	0	to	1760°C
	(32	to	3200°F)
Type S:	0	to	1760°C
	(32	to	3200°F)
Type B:	0	to	1815°C
	(32	to	3300°F)
RTD (DIN):	-200	to	800°C
	(-328	to	1470°F)
Process V:	0	to	10V⎓(dc)
Process I:	0	to	20mA

Control/Alarm Outputs (1 - 4)

- User selectable as: on-off, P, PI, PD, PID, heat, cool, alarm action or retransmit with process output type hardware
- Open collector/switched dc
- Open collector 42V⎓(dc) maximum @ 0.5A
- Switched dc 22 to 28V⎓(dc) limited @ 30mA
- Solid state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression
- User-selectable 0-10V⎓(dc), 1KΩ minimum, scalable, 0-20mA @ 800Ω maximum, scalable
- Electromechanical relay. Form C, rated 5A @ 120V~(ac) or 5A @ 240V~(ac) or 5A @ 30V⎓(dc)

Communications

- TCP/IP/Ethernet
- Modbus™ TCP
- Ethernet RJ 45 connector, 10 base T
- HTTP interface
- DHCP, auto IP or fixed IP address

Dimensions

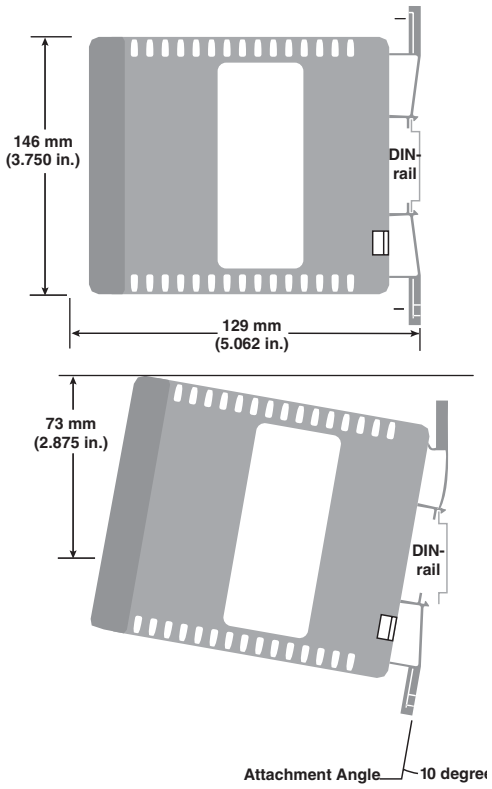
- Width x height x depth

  42 mm x 116 mm x 132 mm (1.64 in. x 4.56 in. x 5.19 in.)
  DIN-rail or chassis mount, DIN-rail spec DIN 5022
  35 mm x 7.5 mm (1.38 in. x 0.30 in.)

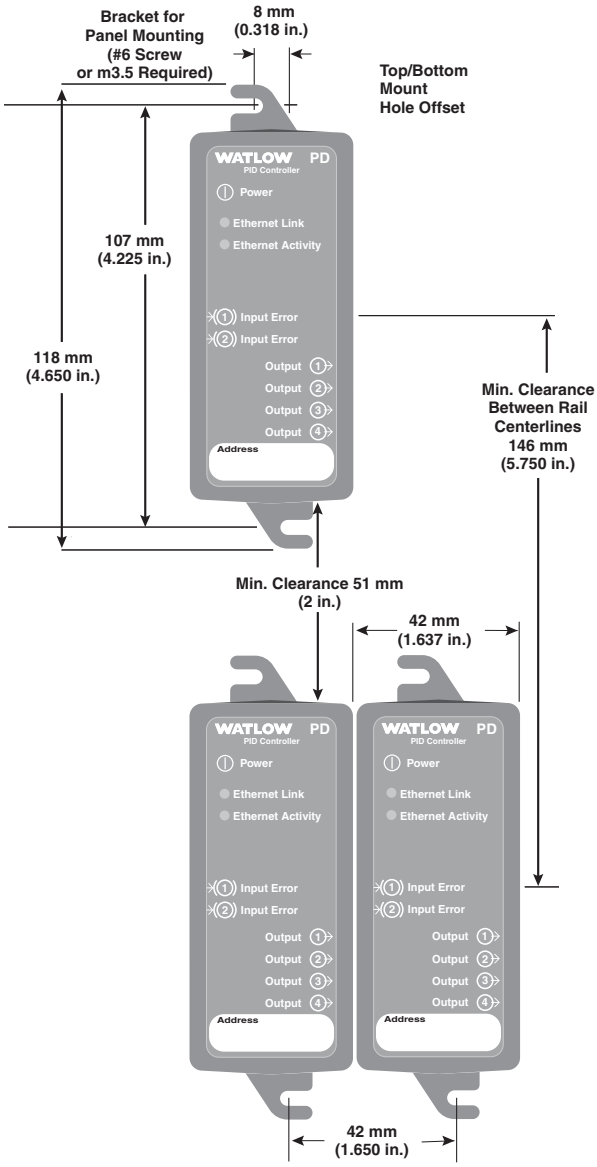
Temperature Controllers

SERIES PD
Single Loop

Side View



Front View



SERIES PD
Single Loop

Ordering Information

To order, complete the model number on the right with the information below.

P D S - - - A

Control Type

Auxiliary Inputs

1 = Dual digital inputs
2 = One CT input and one digital input
3 = Dual CT inputs (dual channel only)

Output 1

C = Switched dc, open collector
K = SSR, Form A, 0.5A
F = Universal process
J = Mechanical relay, Form A, 2A

Output 2

A = None
C = Switched dc, open collector
K = SSR, Form A, 0.5A
E = Mechanical relay, Form C, 2A

Output 3

A = None
C = Switched dc, open collector
K = SSR, Form A, 0.5A
F = Universal process
E = Mechanical relay, Form C, 2A

Output 4

A = None
C = Switched dc, open collector
K = SSR, Form A, 0.5A
E = Mechanical relay, Form C, 2A

On Board Data Logging

0 = None
1 = 16 megabytes of memory

Custom Options

AA = Watlow logo
BB = No logo

Temperature Controllers

For complete information on SERIES SD controllers reference pages 174 to 178.

SERIES SD

The features and performance offered by Watlow's family of SERIES SD PID controllers make them ideally suited for a broad range of applications in temperature and process control.

Watlow's SERIES SD single channel controllers include a universal sensor input with up to three outputs that can be programmed for heat or cool temperature control, or to operate as process or deviation alarms. Programming Inverse Scaling is also simplified with the user-friendly set-up menu, providing additional value without additional cost.

Advanced features of SERIES SD controllers include EIA-485 Modbus™ Serial Communications, Watlow's INFOSENSE™ sensor technology, Infrared Remote Communications operation, Watlow's patented User Definable Menu System and a "Save and Restore" feature that allows the restoration of either factory or user-defined settings. Two non-linear PID curves have also been added to improve performance in plastics extruder applications.

Available in 1/32, 1/16, 1/8 and 1/4 DIN panel mount sizes, Watlow's SERIES SD family is backed by an industry leading three-year warranty from Watlow. The SERIES SD controllers are UL® and C-UL® listed, CSA, CE and NSF-2 certified and include the IP65/NEMA 4X seal.

SERIES SD6_D

The SERIES SD6_D has been successfully tested for use with ODVA for DeviceNet™ on CAN networks. The controller includes a universal sensor input with two outputs that can be configured as heat, cool or alarm. The DeviceNet™ communications interface is supplied with a five-position removable screw terminal connector. For more information on the SERIES SD6_D controller, turn to page 175.

SERIES SD31

The SERIES SD31 offers improved accuracy of 0.1 percent of span as well as a faster sampling rate of 6.5Hz in a 1/32 DIN package. Users can also select between 11 different thermocouples, a 100 Ohm RTD, a 0 to 20mA or 0 to 10V process input- all from the front panel- that eliminates the need for dip-switches. For more information on the SERIES SD31 controller, turn to page 177.

Features and Benefits

Watlow's INFOSENSE™ sensor technology

- Thermal sensing technology improves sensor accuracy by a minimum of 50 percent

Watlow's patented User Defined Menu System

- Allows the user to assign up to 20 parameters in the operations menu
- Improves operational efficiency

"Save and Restore" feature for user settings

- Allows the user to save individual or factory settings
- Eliminates the need to contact the OEM or factory to restore settings

WATVIEW HMI (Human Machine Interface)

- Permits operation, configuration and data logging via a standard Windows® PC

Infrared communications

- Allows easier controller setup, operation and monitoring

Up to three outputs (two for 1/32 DIN)

- Results in application versatility

Dual display on all models

- Provides better recognition of process changes

Ramp to set point

- Controls temperature rise

Variable burst fire

- Prolongs heater life

DeviceNet™ is a registered trademark of the Open DeviceNet Vendors Association.

Problem Solvers

Watlow Solutions To Common Control System Problems

Control system performance problems can be greatly reduced or eliminated by using the optimum temperature controller for the application. Check the list below to see if Watlow control system controllers can improve your process.

Problem	Temperature Control Solution
Scrap product caused by out-of-tolerance temperature range	• Watlow SERIES SD and PD with deviation alarm can stop process or alert operator when temperature deviates outside a plus or minus window
Process operating outside of designated temperature range	• Watlow SERIES SD and PD with process alarms to disable feed screw mechanism, shut process down or activate a light or buzzer to indicate temperature is too high or low
Unnecessary process shut down caused by temperature sensor failure	• Watlow SERIES SD and PD with bumpless transfer will continue process operation at last stable power level. Watlow SERIES SD can also go to a preselected power level upon sensor failure
Temperature over- and undershoot	• Watlow SERIES SD and PD with autotune will automatically select correct PID values to minimize temperature variations
Temperature over- and undershoot on both heating and cooling cycles	• Watlow SERIES SD and PD with PID autotune on both heat and cool outputs
Heating and cooling outputs energizing at the same time	• Watlow SERIES SD and PD with deadband offsets cool set point from the heat set point to prevent concurrent energizing
Undetected heater failure creating uneven heating profiles and/or scrap product	• Watlow's SERIES PD with current monitor can detect a failed heater
Unauthorized control setting changes	• Watlow SERIES SD and PD with programmable user lockout
Need limit control to conform with requirements and regulations	• Watlow SERIES SD, LV and LF are economical, FM approved limit controls with convenient optional DIN-rail mounting

Temperature Sensors

For complete information on Temperature Sensors reference pages 161 to 166.

Thermocouples

Manufactured to recognized agency standards, Watlow thermocouple temperature sensors deliver reliable, accurate temperature measurement.

Stock Type J thermocouple sensor assemblies meet the most popular demands of the plastics processing industry.

Made-to-order and non-stock ANSI Type E, K and T are also available.

Made-to-Order

If stock units do not meet your application needs, Watlow can custom manufacture to your special requirements. Consult your authorized Watlow Plastics Distributor for price and shipment details.

Available Styles

- Spring Adjustable Style
- Adjustable Armor Style
- Rigid Sheath Style
- Nozzle Style
- Stainless Steel Shim Style
- Newbury Nozzle Style
- Mineral Insulated Hot Runner Style
- Non-Contact Infrared

Temperature Sensors

Raytek® Family

Noncontact Temperature Measurement in Plastic Industries

Watlow offers Raytek® infrared thermometers that monitor and control temperature in plastics manufacturing processes. These thermometers measure the temperature processes quickly and efficiently. They measure the temperature of the product directly, instead of the oven or the dryer, allowing you to quickly adjust process parameters to ensure top product quality.

Raytek's infrared thermometers are easily integrated into existing process control systems and have the following benefits:

- Non-destructive: the product is never touched or contaminated
- Fast and reliable: moving objects are measured accurately and quickly
- Flexible: temperature measurements can be made of a large area or a small spot

Small Size, Big Features

These products may be compact, but we haven't compromised features. Using advanced microfabrication techniques, Raytek reduced the cost and size of our sensors while retaining sophisticated features such as emissivity, signal conditioning and T-ambient processing. The wide temperature range in each model allows you to detect process variations and monitor start-up performance.

Infrared Thermocouple

If you're looking for a low-maintenance solution to thermocouples, consider the CI. The CI is a compact, integrated unit with the same output impedance as a thermocouple. It functions accurately—without offset errors—when used in conjunction with the thermocouple break protection circuitry in most controllers, displays and transmitters.

The CI has a rugged stainless steel housing to ensure continuous, long-term performance, even in environments with high ambient temperatures.

Hand Held Infrared Thermometer

Raytek offers hand held infrared thermometers to meet the demands of today's plastics processing applications. The wide temperature range and reliability of the Raynger® ST™ 20/30 can fit your need by providing the performance and accuracy you require.

Raytek Service Ensures Long Use

With over thirty years experience, Raytek knows infrared temperature measurement. Applications specialists are located around the world to help answer your technical questions. Each product includes a two-year warranty. In addition, maintenance, training, calibration and other customized services are available to ensure that you receive the maximum benefits from your Raytek infrared, noncontact thermometer.

For more information on Raytek infrared temperature measurement solutions, contact your Watlow authorized distributor or applications specialist.

Product	Temperature Range	Accuracy	Signal Processing	Display	Power Supply	Outputs
CI	0 to 500°C (32 to 932°F) w/ 2 models	2 percent	N/A	No	12-24V⎓(dc)	*J or K T/C, or mV

*Must specify at time of order.

Temperature Sensors

Raynger®ST™ 20/30 Pro

Choose the Raynger® ST™ Pro when you need a dependable, professional tool for day-to-day applications. You won't find other noncontact thermometers with the temperature range, ability to measure so small an area, and comparable laser sighting at this price. Whether you choose the ST20 with single point laser sighting, or the ST30 with offset eight point circular laser sighting, gathering temperature data has just become easier. Simply point, shoot and read.

With a wide temperature range, MAX temperature display and choice of laser sighting options, the ST Pro makes temperature measurement a breeze. Both the ST20 and ST30 feature rugged rubber overmolding, and the ability to be tripod mounted.

Choose the infrared noncontact thermometer that millions of professionals use worldwide. Call today and discover the Raytek advantage- fast, easy and safe temperature measurement backed by over 35 years of experience and top-quality customer service.

Raytek Infrared Noncontact Thermometers are the professional's choice for:

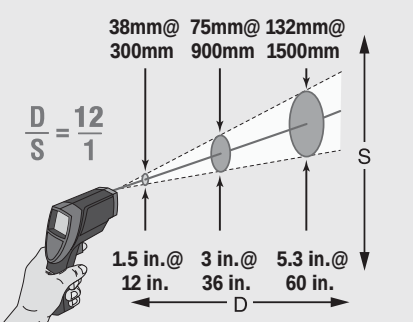
- Blown film extrusion
- Cast film extrusion
- Originally oriented film extrusion
- Sheet extrusion
- Extrusion coating
- Laminating and bossing
- Thermoforming
- Hazardous locations (ST80-IS)

Temperature Sensors

Raynger® ST™ 20/30 Pro

Features

Models	ST20 Pro	ST30 Pro
Features	ST20 Pro	ST30 Pro
Distance to Spot (D:S)	12:1	12:1
Emissivity	pre-set at 0.95	pre-set at 0.95
Laser Sighting	single point	offset 8 point circular
MAX Temperature Display	✔	✔
Display Hold (7 seconds)	✔	✔
LCD Backlight	✔	✔
Display Resolution	0.2°C (0.5°F)	0.2°C (0.5°F)
Hard Carrying Case	✔	✔



ST20 and ST30 ProPlus Target Spot Sizes D:S = 12:1 at Focus Point

Part Numbers

RAYST20XXUS - Stock unit, Raynger ST20 Pro handheld infrared thermometer

RAYST30XXUS - Stock unit, Raynger ST30 Pro handheld infrared thermometer

Specifications

Temperature Range

ST20 Pro

-32 to 400˚C (-25 to 750˚F)

ST30 Pro

-32 to 545˚C (-25 to 950˚F)

Accuracy

@ 23˚C (73˚F) ambient operating temperature

- 1 percent or ±1˚C (±2˚F), whichever is greater above 23˚C (73˚F)
- ±2˚C (±3˚F) @ -18 to 23˚C (0 to 73˚F)
- ±2.5˚C (±4˚F) @ -26 to -18˚C (-15 to 0˚F)
- ±3˚C (±5˚F) @ -32 to -26˚C (-25 to -15˚F)

Repeatability

≤ ±0.5 percent or ≤ ±1˚C (±2˚F) whichever is greater

Response Time

≤ 0.5 second (95 percent of reading)

Ambient Operating Range

0 to 50˚C (32 to 120˚F)

Power

9V Alkaline or NiCd Battery

Weight

320g (11oz)

Temperature Sensors

Raytek CI™

The CI™ provides the advantages of infrared temperature measurement in a compact, low cost integrated sensor. Designed for easy integration into a standard 4-wire system, the CI can easily replace traditional contact probes with a type J or type K thermocouple output, or with a 0-5 volt output if your application is susceptible to noise or requires a longer cable run.

The CI is the suggested replacement for the IR Junior and is designed to measure target temperatures ranging from 0 to 500°C (32 to 932°F). The CI's onboard electronics are protected by a rugged IP 65 (NEMA-4) stainless steel housing and the sensor can function in ambient temperatures to 70°C (160°F) without cooling. With water cooling, the CI can withstand ambient temperatures to 260°C (500°F).

Because the CI has the same 50 Ohm output impedance as a thermocouple, it functions accurately—without offset errors—when used in conjunction with the thermocouple break protection circuitry in most controllers, displays, and transmitters.

Compact. Easy to install. Affordable. The CI is ideal for both OEM and end-user applications.

Highlights:

- Type J or K, or 0-5 V output
- Two models cover temperature ranges from 0 to 500°C (32 to 932°F)
- IP 65 (NEMA-4) stainless steel electronics housing
- 4:1 optics at 90 percent energy
- 350 mSec (95 percent) response time
- Powered by 12-24 V⎓(dc) at 20 mA
- Accessories for cooling and air purging

Temperature Sensors

Raytek CI

Ordering Information

R A Y C I - _ _

Model Number

1 = Type J thermocouple output
2 = Type K thermocouple output
3 = Voltage Output (linear 10mV/˚C, scaled 0-5V)

Temperature Range

A = ±2 percent or ±3˚C accuracy between 0 and 115˚C (32 - 240˚F)
B = ±2 percent or ±3˚C accuracy between 100 and 500˚C (212 - 932˚F)

Stock List

RAYCI1A
RAYCI1A10L
RAYCI1B
RAYCI1B10L

Measurement Specifications

Spectral Response	7 to 18 microns
System Repeatability	±1 percent of measured value or ±1°C (2°F), whichever is greater
Temperature Resolution	<0.5°C or 1°F
Response Time (95%)	350 mSec
Emissivity	Fixed at 0.95

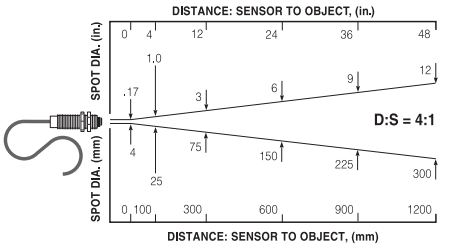
Electrical Specifications

Outputs:	User-selectable thermocouple output (model specific, either J or K) or Voltage output 10 mV/°C
Cable Length	0.9 m (3 ft) standard, longer cables optional
Output Impedance	50 ohms
Minimum Load Impedance	50K ohms
Power Supply	12-24 VDC (£2.5 percent ripple) @ 20 mA

General Specifications

Environmental Rating	IP 65 (NEMA-4)
Ambient Temperature Range:	0 to 70°C (32 to 160°F)
With air cooling With water cooling	0 to 90°C (32 to 200°F) 0 to 260°C (32 to 500°F)
Storage Temperature	-30 to 85°C (-22 to 185°F)
Relative Humidity	10 to 95 percent RH, non-condensing
Shock	IEC 68-2-27 (MIL STD 810D) 50 g's, 11 mSec, any axis
Vibration	IEC 68-2-27 (MIL STD 810D) 3 g's, any axis, 11-200Hz
Dimensions	19 mm L x 87 mm D (3.4 in. L x 0.75 in. D)
Weight	130 g (4.5 oz)

Nominal Optical Specifications

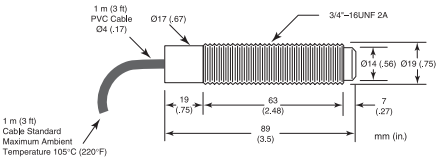


D:S is the optical resolution expressed as a ratio of the distance to the resolution spot divided by the diameter of the spot

Optical resolution for the CI is 4:1.

Nominal spot size based on 90 percent energy

General Dimensions



*Accessories/Options**

Sensing head comes with a 0.9 m (3 ft) cable, two mounting nuts, and an operator's manual

- GP monitor provides display, and 4-20 mA output
- Air-/water-cooled housing*
- High temperature cables (standard with air-/water-cooled housing)
- Adjustable or fixed mounting bracket
- Air purge collar
- Longer cables 3 m, (10 ft)*

*Must be specified at time of order

Temperature Sensors

Problem Solvers

Watlow Solutions To Common Temperature Sensing Problems

Temperature sensing is a vital part of process using a thermal loop. Sensing product temperatures can eliminate problems, reduce costly down time and waste. Check the list below to see if your temperature sensing can be improved.

Contact Sensor Problem	Contact Sensor Solution
High process temperature causing premature sensor failure	• Use a mineral insulated thermocouple assembly
Sensor response too slow for changing temperatures	• Use a lower mass, 3.2 mm (0.125 in.) O.D. thermocouple assembly
Unable to reuse sensor removed from a compression fitting	• Use a thermocouple assembly with an adjustable compression fitting
Fiberglass insulation absorbing moisture or susceptible to contamination	• Use Teflon® insulated lead wire where temperature conditions permit
Process requires greater sensor accuracy than possible with thermocouples	• Use RTD sensors
Connector screws loosen during use	• Use a sensor with a molded-on connector
Sensor lead wires subject to high temperatures or contamination	• Use mineral insulated, metal-sheath cable
Application requires a custom sensor	• Made-to-order sensors, including; ANSI Types B, C*, E, J, K, N, R, S and T; DIN or JIS calibrated RTDs; positive or negative temperature coefficient thermistors

* Not an ANSI symbol

Teflon® is a registered trademark of E.I. duPonte de Nemours and Company.

Case History

Grommet Style Thermocouple Replaces Thermostat, Improves Thermal Performance

Problem:

The extrusion coating and laminating industry demands dies that allow for accurate temperature control and fast adjustment to reduce or eliminate the extruded edge beads, thus providing for material savings associated with traditional overcoat in the process.

A Watlow customer manufactured several sizes of laminating machines that included heated shoe or platen dies. The dies were heated with cartridge heaters and the overall temperature was controlled with a cartridge style thermostat. The heater and thermostat were installed in parallel 15.9 mm (0.625 in.) diameter holes located at the ends of the platen.

The manufacturer wanted to achieve more precise platen temperature control. This necessitated replacing the thermostat with a solid state temperature controller and thermocouple temperature sensor.

Solution:

Watlow furnished a stock, ANSI Type J "grommet" thermocouple to replace the cartridge thermostat. The grommet thermocouple easily mounted with a small screw in the hole formerly used by the cartridge thermostat.

The grommet thermocouple offered easy access for retrofit and allowed continuous use of the existing cast platens. This thermocouple became the universal sensor for several styles of laminating machines.

Power Controllers

DIN-A-MITE® Family

COMPLIES WITH EUROPEAN EMC DIRECTIVE
EN 61326 (1997-98) and EN 50178
Available on Request...
Consult Your Watlow Representative

For complete information on DIN-A-MITE® power controllers reference pages 183 to 193.

Made in the United States of America, Watlow's DIN-A-MITE® family of solid state power controllers provide SCR control, heatsink, wiring and touch-safe exterior in one package. By designing the DIN-A-MITE as a total power controller unit, the need to prep wires for terminals, find the right heatsink and determine adequate terminations is eliminated. It's a complete package you can install with Control Confidence®.

Performance Capabilities

Four DIN-A-MITE styles meet most power controller needs with ratings from 18 to 100 amps with voltages from 120 to 600V~(ac).

Features and Benefits

DIN-rail or sub-panel mounting

- Simple, fast installation

No mercury

- Environmentally safe product

Compact size

- Reduced panel space; less cost

Touch-safe exterior

Increased safety for installer/user

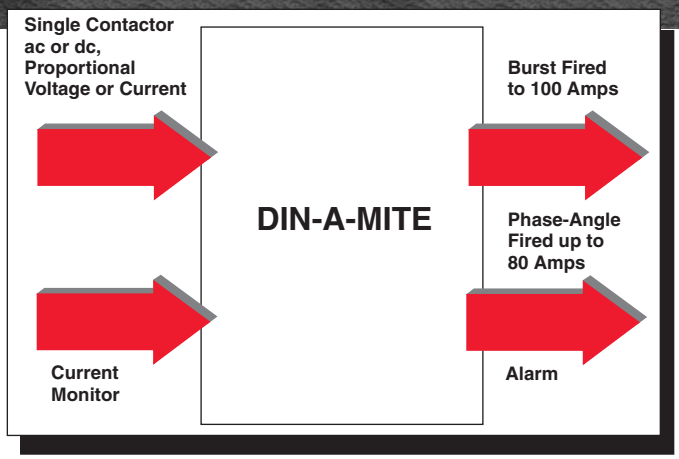
Easy Installation

Installation is simple and fast; saving time and money. All you have to do is strip wires and make connections.

- Sub-panel or DIN-rail mounting
- No drilling and tapping necessary
- Same footprint as comparably rated MDRs

Agency Approvals

- UL® 508 Listed and C-UL®
- UL® 50, UL1604, and CE



Achieve Optimum Temperature Control With Variable Time Base Control

Variable time base control meets the rapid switching demands of PID temperature control to deliver more accurate process control. It also increases heater life by reducing temperature over- and undershoot.

Low Electrical Noise

Burst firing switches ac current at zero cross (zero potential) to produce minimal RFI and EMI electric noise (radio frequency interference/electromagnetic interference). This low electrical noise quality helps prevent interference with sensor circuits and particularly sensitive equipment in your system.

Rugged, Back-to-Back SCR Design Insures Long Term Reliability

With solid state components, there's no limit on the number of switching cycles the DIN-A-MITE can perform. The four DIN-A-MITE styles meet most application requirements by tolerating harsh industrial environments, electrical spikes and dissipating less power. When properly applied, the DIN-A-MITE will outlast all other types of non-electronic power controllers.

UL® and C-UL® are registered trademarks of the Underwriter's Laboratories, Inc.

Power Controllers

DIN-A-MITE® Family

	DIN-A-MITE Style A	DIN-A-MITE Style B	DIN-A-MITE Style C	DIN-A-MITE Style D
1-Phase①	Up to 25 amps @ 600V~(ac)	Up to 40 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Up to 100 amps @ 600V~(ac)
3-Phase, 2-leg①	No	Up to 33 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Gang 2 units
3-Phase, 3-leg①	No	Up to 22 amps @ 600V~(ac)	Up to 70 amps @ 600V~(ac)	Gang 3 units
V~(ac) & V⎓(dc) - Burst Fire Contactor Input	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)	24, 120 & 240V~(ac) 4.5-32V⎓(dc)
Multizone V~(ac) & V⎓(dc) Input	No	Yes	Yes	No
4-20mA⎓(dc) Input - Variable Time Base Output	Yes	Yes	Yes	Yes
Phase-Angle Fire Output②	No	No	Yes 1-phase only	No
Manual Control Via Potentiometer Input, or 0-5, 1-5 or 0-10V⎓(dc) Linear Voltage Input	No	No	Yes	No
Shorted SCR Alarm	No	Yes	Yes	Yes
Open Heater Alarm	No	No	Yes With "S" input only	Yes
Load Current Monitor CT	No	No	No	Yes
On Board Semiconductor Fusing	No	No	No	Yes
DIN-rail Mount	Yes	Yes	Yes	No
Sub-Panel Mount	Yes	Yes	Yes	Yes
Cabinet Thru-Wall Heatsink Mount UL® 50 and UL® 1604	No	No	Yes	No
Electrically Touch-Safe Package	Yes	Yes	Yes	Yes
Back-to-Back SCR Design	Yes	Yes	Yes	Yes
UL® 508 Listed/C-UL®/CE w/filter	Yes	Yes	Yes②	Yes
Dimensions	95 X 45 X 98 mm (3.7 H X 1.8 W X 3.9 in. D)	95 X 80 X 124 mm (3.7 H X 3.1 W X 4.9 in. D)	150 X 80 X 146 mm (6.0 H X 3.1 W③ X 5.7 in. D)	185 X 65 X 240 mm (7.25 H X 2.5 W X 9.4 in.D)
Controller Weight: kg (lbs)	0.32 (0.71)	0.68 (1.5)	1.18 (2.6)	2.95 (6.5)
Controller Weight w/fan: kg (lbs)	N/A	N/A	1.45 (3.2)	N/A

① Refer to curves on page 186 for your specific application ratings.
② Phase-angle fire is not CE approved.
③ Will fit within the width dimension of most comparable MDRs.

Power Controllers

E-SAFE® RELAY

The E-SAFE® mercury-free relay from Watlow provides reliable and accurate power switching for plastics processing applications.

This relay can exceed the performance of typical mercury relays while fitting within the same footprint. The E-SAFE RELAY bridges the gap between mercury displacement relays (MDRs) and solid state relays (SSRs) by providing superior power switching in a non-mercury solution at a lower cost. This mercury-free relay also provides longer contact life and higher performance than typical mechanical relays used in equipment.

The E-SAFE RELAY eliminates mercury, reduces arcing and electrical noise and provides processors with an excellent solution for equipment power switching. The absence of mercury in the E-SAFE RELAY reduces toxic metal hazards in processing environments.

Performance Capabilities

- Up to 40 amps
- 240 V~(ac)

Features and Benefits

High current transient suppression

- High reliability
- Extended contact life
- Low electrical noise
- Outperforms mechanical contactors

Compact size

- Fits footprint of definite purpose relays and most 30 to 50 amp mercury relays
- Easily retrofittable

Environmentally safer than mercury contactors

- Eliminates toxic waste (mercury) from the application environment and disposal from failed mercury contactors

Agency approvals

- UL® 508 listed and C-UL®

Specifications

- Output rating: from 20A to 40A maximum resistive load at -30 to 55°C (-22 to 130°F)
- Maximum power switching voltage: 208/240V~(ac), three pole
- Coil voltage: 24V~(ac), 120V~(ac) and 220V~(ac)
- Maximum operating ambient temperature: 55°C (130°F)
- Maximum cycle rate: 30 cycles per minute

Control Mode

- Zero cross switching output
- Form A outputs, without arcing
- Cycle rate: 30 cycles per minute, maximum

Input Command Signal

- 24V~(ac) (+10 / -15 percent), 120V~(ac) (+10 / -10 percent) 220V~(ac) (+10 / -15 percent)
- 50/60Hz, less than 9VA

Note: Do not place an R/C snubber (filter) on the E-SAFE RELAY input command signal.

Output Rating

- 20A to 40A max. per pole into a resistive load
- 208/240V~(ac), 50/60Hz, each pole
- Three pole

Operating Life

- 1,000,000 switching cycles at max. rating

Weight/Dimensions

- Weight: 0.560 kg (1.25 lbs.)
- 96.0 mm (3.78 in.) high x 82.3 mm (3.24 in.) wide x 90.2 mm (3.55 in.) deep

Terminals

- Controller input: Compression, accept #22 to 10 (0.2 to 6 mm^2) AWG wire. Torque to 7 in.-lbs (0.8 Nm) max.
- Output: Compression, accept #14 to 6 (2.5 to 16 mm^2) AWG wire. Torque to 35 in.-lbs max. (3.95 Nm)

Power Controllers

E-SAFE RELAY

Specifications Cont.

Operating Environment

- Operating temperature up to -30 to 55°C (-22 to 130°F)
- 5 to 85 percent RH, non-condensing
- Shipping and storage temperature -40 to 85°C (-40 to 185°F)

Mounting

- Definite purpose relay and MDR mounting footprint

Agency Approvals

- UL® 508 listed, C-UL® approved, File #E213822

Ordering Information

To order, complete the code number on the right with the information below.

E S _ - _ _ _ - _

E-SAFE RELAY = Hybrid zero cross contactor

Amperage

20 = 20 amp
40 = 30 amp

Number of Poles

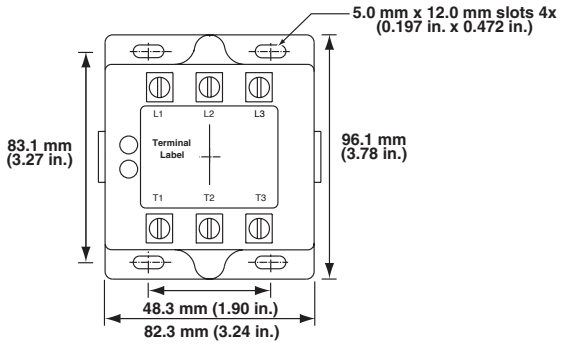
3 = Three pole

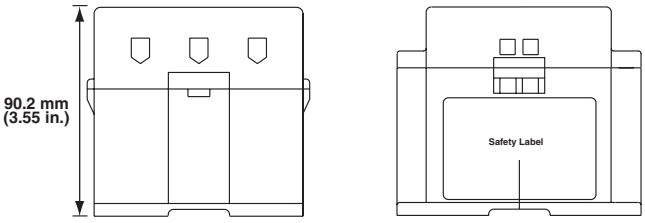
Control Voltage

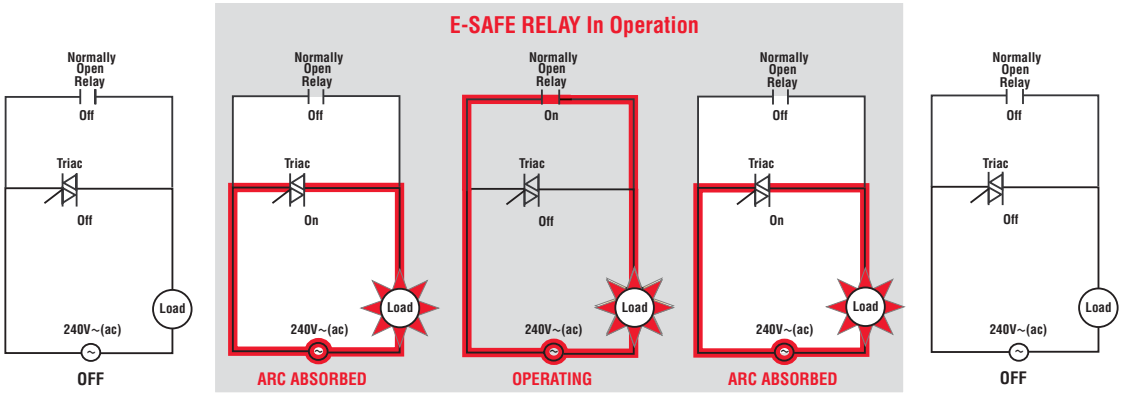
024-AC = 24V~(ac)
120-AC = 120V~(ac)
220-AC = 220V~(ac)

Label Options

00 = Standard product







Power Controllers

SERIES CZR

The SERIES CZR solid state contactor provides a low-cost, highly compact and versatile solid state option for controlling electric heat. With DIN-rail and back panel mounting standard on every controller, the CZR allows for simple and quick installation.

The extensive capabilities of the SERIES CZR include single-phase, 18 to 50 amp zero-cross and random switching up to 600V~(ac) (see output rating curve). The unique integrated design removes the guesswork associated with selecting a proper heatsink and precise terminations for the application.

SERIES CZR contactors are available in V≂(ac/dc) input contactor versions. All configurations are model number dependent and factory selectable.

The SERIES CZR is reliably backed by a two-year warranty from Watlow.

Performance Capabilities

- Output 18 to 50 amps
- Output voltage up to 660V~(ac)

Features and Benefits

DIN-rail or standard panel mount

- Versatile, quick and low-cost installation

Compact size

- Reduces panel space; less cost

Touch-safe terminals

- Increase safety for installer and operator

Mercury-free

- Environmentally safe

Faster switching with solid state

- Saves energy and extends heater life

Agency Approvals

- UL® recognized, CSA certified, VDE and CE

Back-to-back SCR design

- Rugged design

Specifications

Control Mode

- Zero-cross or random fired contactor output

Operator Interface

- Command signal input
- Input signal indication LED

Input Command Signal

- Input Type DC1
  - Turn on voltage 4V⎓(dc) max., turn off voltage 1V⎓(dc) min.
  - Input current: dc typically 10mA @ 4V⎓(dc),13mA @ 32V⎓(dc)
- Input Type AC1
  - 90 to 140Vrms, must turn on at 90V~(ac), must turn off at 10V~(ac)
  - Input current: 15mA typical @120V~(ac)
- Input Type AC2
  - 18 to 36V~(ac) input, must turn on at 18V~(ac), must turn off at 10V~(ac)
  - Input current: 10mA typical @ 24V~(ac)

Output Voltage

- 24 volt; 24V~(ac) min. to 280V~(ac) max.
- 480 volt; 48V~(ac) min. to 530V~(ac) max.
- 600 volt; 48V~(ac) min. to 660V~(ac) max. (not available on 18 amp version)
- Off state leakage 1mA at 25°C (77°F) max. for 600V~(ac) models; 10mA at 25°C (77°F) max. for 24 through 480V~(ac) models
- Holding current: 250mA max.

Output Amperage

- See output rating curve. Ratings are into a resistive heater load

Output Amperage Rating

Model	18	24	34
Maximum Surge Current 16.6 mSec	625	250	625
Maximum I^2t for fusing	1,620	260	1,620

Model	42	50
Maximum Surge Current 16.6 mSec	1,000	1,000
Maximum I^2t for fusing	4,150	6,000

Power Controllers

SERIES CZR

Specifications Cont.

Agency Approvals

- Class II construction
- UL® 508 recognition, File #E73741 and CSA File LR 700195
- 73/23/EEC CE Low Voltage Directive
- VDE 0805, registration number 126921
  - License number 136037 for 18 amp models
  - License number 130515 for 24 to 50 amp models

Output Terminals

- Compression type
- For 18 amp models:
  - Maximum wire size 3.0 mm (10 AWG), torque to 0.6 Nm (5.3 in. lbs)
- For 24 to 50 amp models:
  - Maximum wire size 16.0 mm (6 AWG stranded) torque to 1.5-1.7 Nm (13-15 in. lbs)

Operating Environment

- Up to 80°C (176°F). See output rating curves for your application.
- 0 to 90 percent RH, non-condensing
- Insulation only tested to 3,000 meters
- Units are suitable for “Pollution degree 2”
- Cycle time should be less than three seconds

Mounting

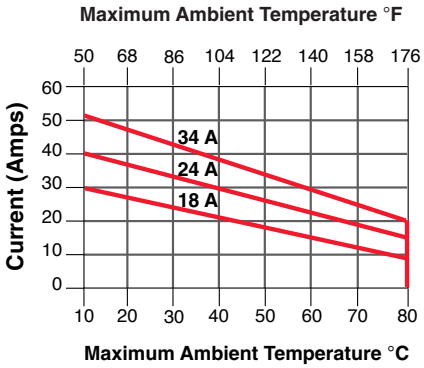
Options include DIN-rail or standard back panel mounting.

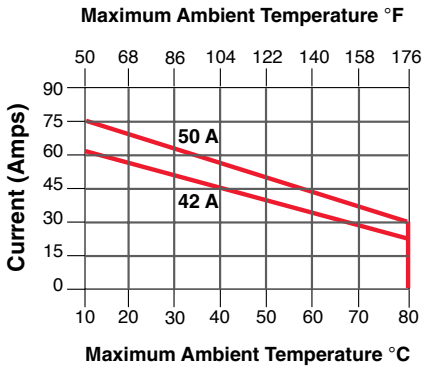
- The DIN-rail specification: DIN EN 50022, 35 mm x 7.5 mm (1.37 x 0.3 in.)
- Minimum clipping distance: 34.8 mm (1.37 in.)
- Maximum clipping distance: 35.3 mm (1.39 in.)
- Mount cooling fins vertical

Weight/Dimensions

- 260 g (9.2 oz)
- 24 to 50 amp models: 100 mm (3.95 in.) high x 45 mm (1.75 in.) wide x 109 mm (4.3 in.) deep
- 18 amp models: 100 mm (3.95 in.) high x 22.6 mm (0.89 in.) wide x 99 mm (3.9 in.) deep

Output Rating Curves





Ordering Information

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

C ___ - A ___ V - ___ 0

Control Mode

R = Random
Z = Zero-cross

Output Amperage

18 = 18 amp (not available with 600V output)
24 = 24 amp
34 = 34 amp
42 = 42 amp
50 = 50 amp

Output Voltage

24 = 24 to 280V~(ac)
48 = 48 to 530V~(ac)
60 = 60 to 660V~(ac) (not available with 18A model)

Input Type (Contactor)

DC1 = 4 to 32V⎓(dc)
AC1 = 90 to 140V~(ac)
AC2 = 18 to 36V~(ac)

Note: Do not use the AC1 and AC2 input type models with temperature control outputs that include an AC snubber filter. This could cause the CZR to stay full on.

Power Controllers

Solid State Relays (SSRs)

Lower cost and longer heater life is the main advantage provided by Watlow solid state relays (SSRs). A unique loop-powered firing card permits a very fast time proportional cycle rate of less than one-tenth of a second that allows using higher watt density heating elements and/or increasing heater life. In addition, temperature control accuracy is optimized with this fast cycle card.

Watlow SSRs can be ordered with all the components necessary for hassle-free mounting, including heatsinks, thermal foil and bevel washers along with semiconductor fuses.

Performance Capabilities

- Burst firing, 10 to 75 amps
- Operating environment -25 to 50°C (-13 to 122°F) with proper heatsink
- Can switch up to 575V~(ac)

Features and Benefits

Fast cycle card

- Heater life is increased, temperature control is optimized and higher watt density heaters can be used

Zero cross firing[1]

- Minimal electrical noise

Back-to-back SCR design

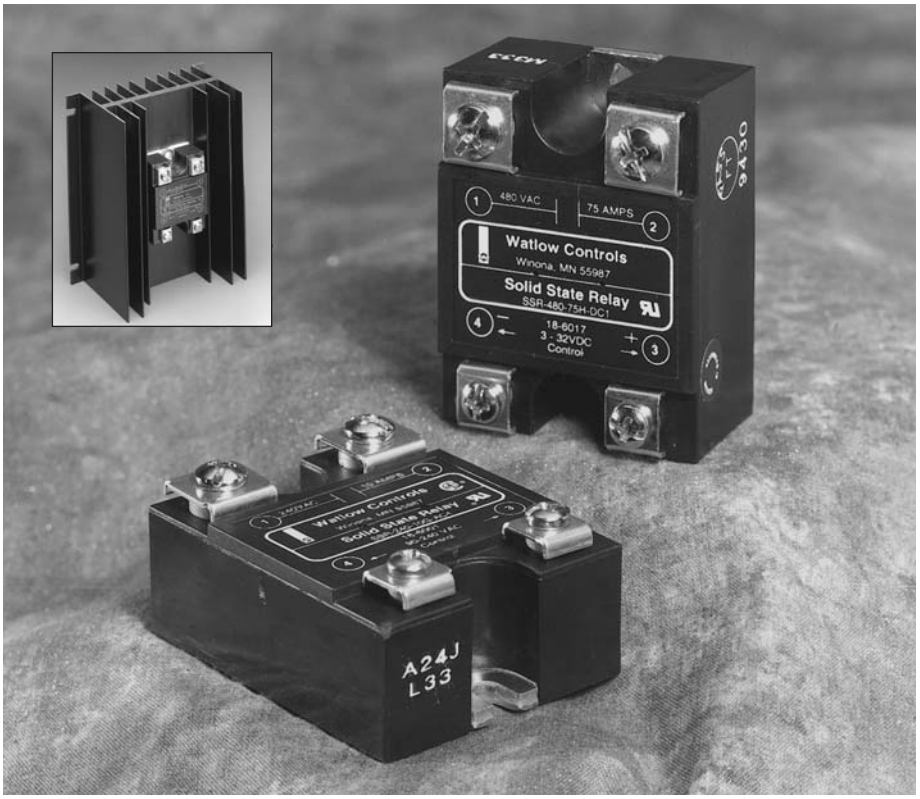
- Will withstand harsh or hostile environments

UL® recognized, CSA certified, VDE licensed

- For applications requiring agency approval

Applications

- Thermoforming equipment
- Injection molding equipment
- Extruders
- Blow molding equipment
- Packaging equipment



Specifications

Standard to all SSRs:

Agency Approvals

- UL® 873, File #E151484, E73741
- CSA #LR700195
- VDE 0805 EN60950, File #90995ÜG
- CE 60950

Dielectric Strength

- 4000 Volts RMS

DC Control Input

Voltage range

- 3-32V⎓(dc), model no. dependent
- 4-32V⎓(dc), model no. dependent

Input current

- 4mA @ 5V⎓(dc)

Turn on voltage

- 3V⎓(dc) minimum

Turn off voltage

- 1V⎓(dc) maximum

AC Control Input

Voltage range

- 90-280V~(ac)

Input current

- 2mA max. @ 120V~(ac)

Turn on voltage

- 90V~(ac) minimum

Turn off voltage

- 10V~(ac) maximum

Output (Maximum)

Forward voltage drop

- 1.5V~(ac) typically

Minimum holding current

- 50mA~(ac)

Turn on-off time

- 8.3ms

Storage Temperature

- -40 to 85°C (-40 to 185°F)

SSR Weight

- 0.090 kg (0.21 lb)

Shipping Weight

- 0.045 kg (1.0 lb)

[1] Not available on random fired models.

Solid State Relays (SSRs)

Ordering Information — Order by selecting the code number from the specifications table below.

Code Number	Output Current (Amps)	Output Voltage	Input Control Voltage	Off State Leakage	One Cycle Surge Current Amps	A^2 Sec. I^2t For Fuse	Thermal Resistance	Frequency Range	Output Voltage Range	PIV Rating
SSR-240-10A-DC1	10	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-DC1	25	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-DC1	40	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-DC1	50	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-DC1	75	120/240V~(ac)	3-32V⎓(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-10A-AC1	10	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-AC1	25	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-AC1	40	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-AC1	50	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-AC1	75	120/240V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-25A-DC1	25	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-DC1	50	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-DC1	75	480V~(ac)	4-32V⎓(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-25A-AC1	25	480V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-AC1	50	480V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-AC1	75	480V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-DC1	25	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-DC1	50	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-DC1	75	600V~(ac)	4-32V⎓(dc) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-AC1	25	600V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-AC1	50	600V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-AC1	75	600V~(ac)	90-280V~(ac) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-240-10A-RND	10	240V~(ac)	4-32V⎓(dc) Random	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-50A-RND	50	480V~(ac)	4-32V⎓(dc) Random	10mA	625	1620	0.63°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-480-75A-RND	75	480V~(ac)	4-32V⎓(dc) Random	10mA	1000	4150	0.31°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-100-20A-DC1	20	100V⎓(dc)	3-32V⎓(dc)	0.3mA	NA	NA	1.06°C/W	N/A	0-100V⎓(dc)	N/A

Availability

Stock: Same day shipment

Power Controllers

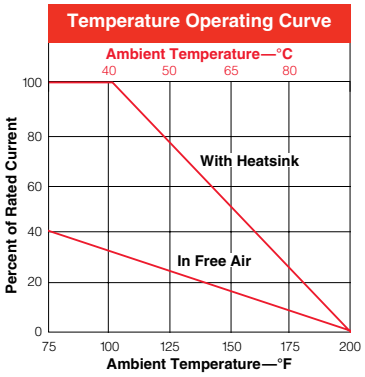
Solid State Relays (SSRs)

Application Hints

Thermal Transfer

A thermal foil is provided with each solid state relay for mounting on the base of the relay to improve heat transfer. In addition, two bevel washers are supplied to provide the proper pressure for the transfer of heat. Use two #8-32 screws, 15.8 mm (0.625 in.) long to secure the relay to the heatsink. See the derating curve, Temperature Operating Curve, for operation without heatsinks.

Note: This rating curve applies only to 10 and 25 amp SSRs. 40 through 75 amp SSRs should not exceed a seven amp load without using a heatsink.



Replacing Contactors or MDRs

Improvements in heater life and control accuracy can be anticipated with solid state relays operated with rapid cycle times as compared to slower operating electromechanical relays or even mercury displacement relays in some applications. When replacing these types of relays with the SSR, it is important to consider two aspects:

1. Heat

Solid state devices require a small voltage to turn on, which is consumed as heat (1.5 watts/amp). This heat must be removed from the device, and is usually accomplished by mounting the relay on heatsinks.

2. Failure Mode

Solid state devices should last for many years when properly protected with voltage and RC suppressors mounted on appropriate heatsinks, and when fused against the high currents caused by electrical shorts.

However, if the unit fails, the most probable condition will be a short. Both mechanical relays mentioned above also have a good probability of failing short. In all cases where uncontrolled full power can cause damage, it is recommended that a high limit temperature controller and contactor be used for protection.

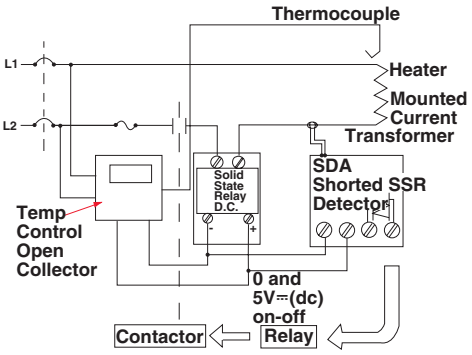
System Diagrams

Shorted SSR Alarm—SDA

The most prevalent concern when using solid state relays is the possibility of a relay failing in a shorted condition. With this in mind, Watlow has designed a cost effective "Shorted SSR Alarm" SDA.

The device monitors the output (current through the heater) and activates a triac (alarm) if there is no command signal from the temperature controller.
The triac can be wired to a bell, or to a normally closed latching relay to remove power to the heater.

Single-Phase—SDA



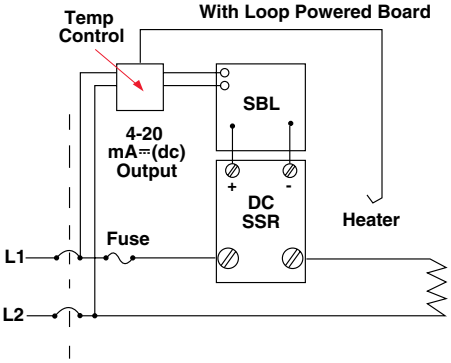
Single-Phase—SBL

4-20mA loop powered firing card for direct mounting on a dc solid state relay. Can be used in three-phase mode with two dc input solid state relays.

Single-Phase—AT and BT

Requires external power switching transformer. Consult factory for part number and voltage required.

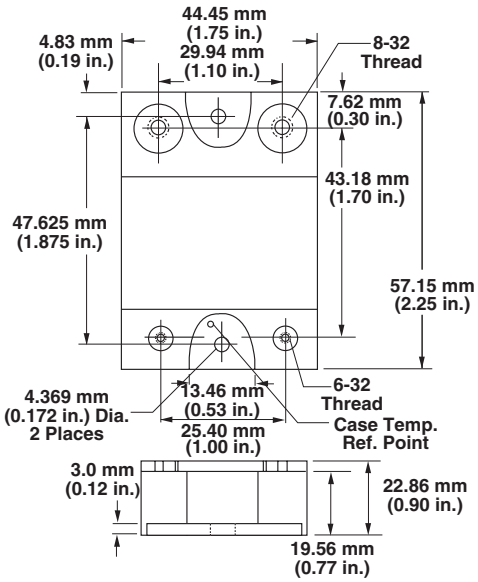
SSR Card	Description	Code No.
SBL	Burst firing 4-20mA only loop powered card for dc input relays only	08-5399
SDA	Shorted SSR alarm for dc input relays only	08-5386
AT	Single-phase, phase-angle firing	08-5422
BT	Single-phase variable time base, single cycle, burst firing transformer power. 4-20mA input	08-5406



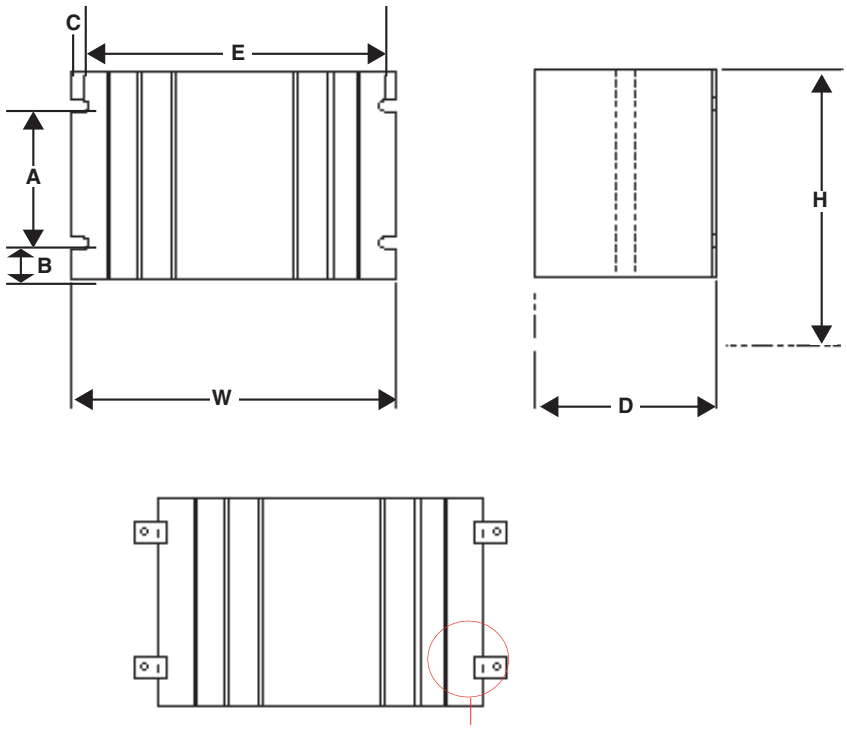
Solid State Relays (SSRs)

Dimensions

Solid State Relay



Heatsinks



Note: The 50 amp 1-phase width mounting dimension has four mounting clips instead of the ½ round cutouts.

Heatsinks – 1-Phase

Amps	Maximum Overall Dimensions						Mounting Dimensions								Fan Cooled	Code Number
	Height (H)		Width (W)		Depth (D)		A		B		C		E			
	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)	mm	(in.)		
10	100	(4.00)	115	(4.50)	25	(1.03)	75	(3.00)	12	(0.50)	4	(0.15)	105	(4.20)	No	**HS-10**
25	75	(3.00)	120	(4.75)	65	(2.60)	115	(2.00)	12	(0.50)	4	(0.15)	115	(4.45)	No	**HS-25**
40	140	(5.50)	120	(4.75)	65	(2.60)	115	(4.50)	12	(0.50)	4	(0.15)	115	(4.45)	No	**HS-40**
50	230	(9.00)	125	(5.00)	90	(3.50)	115	(7.00)	N/A	N/A	N/A	N/A	115	(5.90)	No	**HS-50**
75	190	(7.50)	125	(5.00)	140	(5.50)	175	(7.00)	25	(1.00)	4	(0.15)	120	(4.70)	Yes[2]	**HS-75-1**
75	190	(7.50)	125	(5.00)	140	(5.50)	175	(7.00)	25	(1.00)	4	(0.15)	120	(4.70)	Yes[3]	**HS-75-2**

[2] Heatsink includes fan; requires customer to supply and wire 120V~(ac) to the fan.
[3] Heatsink includes fan; requires customer to supply and wire 240V~(ac) to the fan.

Power Controllers

Problem Solvers

Watlow Solutions To Common Power Controller Problems

Power controller replacement intervals can be lengthened or problems eliminated by using the optimum power controller for the application. Check the list below to see if Watlow power controllers can improve your process.

Problem	Power Controller Solution
Premature heater failure	• Stabilize heater element temperature and reduce thermal stress by using a solid state power control along with a PID temperature controller to reduce the temperature control cycle time
Excessive contactor failure	• Replace electromechanical contactors with solid state relays. Use E-SAFE® RELAY for long cycle times, solid state relays for short cycle times and PID control
Wasted power	• Reduce temperature overshoot and power consumption by smoothing out temperature/heating cycles with solid state power control and PID temperature control
Unsafe panel wiring	• The DIN-A-MITE® power controllers, when properly wired are totally safe from finger and palm electrical shock
Environmental concerns about mercury	• Replace with solid state power controller or E-SAFE RELAY. The DIN-A-MITE has the same footprint as many MDRs
Excessive EMI causing problems in control circuits	• Correct wire routing for minimum EMI pick-up; change from electromechanical and mercury relays, and/or phase-angle fired solid state devices to zero cross (burst firing) solid state power control

Case History

E-SAFE® RELAY Delivers Lower Costs and Increased Productivity

Problem:

A plastics former utilized mechanical relays (contactors) in the power control circuits of their large thermal forming machine. The relays had to be replaced every 250,000 cycles and each change required a two hour shutdown of the production line. The manufacturer also had to dispose of the environmentally hazardous mercury from the failed contactors.

Solution:

To avoid these frequent shutdowns, Watlow E-SAFE® RELAYs were installed. E-SAFE RELAYs were priced lower than the contactors, while also offering longer life. The E-SAFE RELAY provided high performance in a non-mercury offering and eliminated the toxic waste from failed mercury contactors.

After millions of cycles of operation, the customer informed Watlow that the E-SAFE RELAYs were still performing like new and had saved them thousands of dollars in replacement costs. In addition, had they continued to use the contactors, they would have experienced 24 production shutdowns and 48 hours of lost production time.

For complete information on FIREROD cartridge heaters reference pages 70 to 119.

Heaters

FIREROD® Cartridge Family

Watlow's family of cartridge heaters provides superior heat transfer; uniform temperatures and resistance to oxidation and corrosion even at high temperatures.

Watlow's cartridge heaters are available in high, medium and low-watt density units. The wattage distribution can be configured to yield a uniform heat profile and the overall superior construction allows for rapid heat dissipation into the former heater.

Performance Capabilities— FIREROD Cartridge and Metric Version

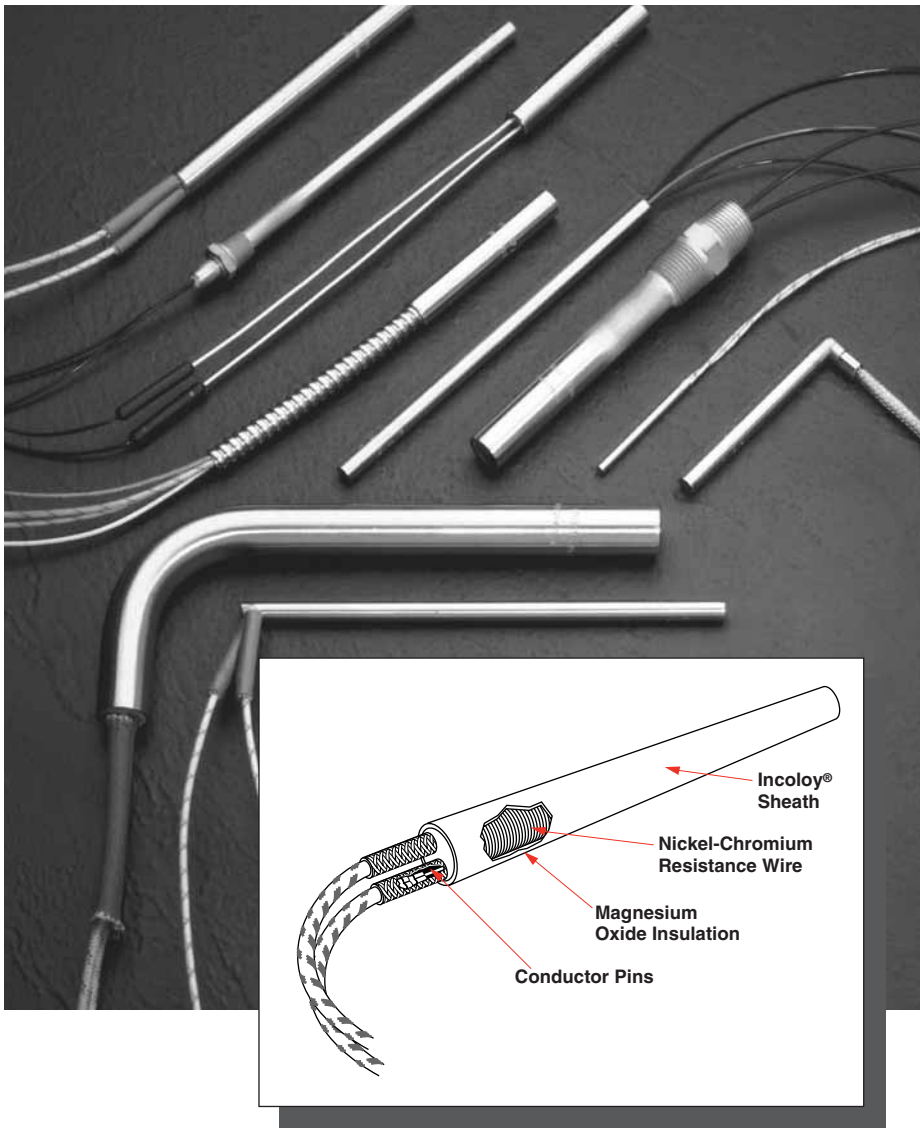
- Temperatures to 760°C (1400°F) on Incoloy® sheath
- Temperatures up to 540°C (1000°F) on optional stainless steel sheath
- Watt densities to 62 W/cm² (400 W/in²)

Performance Capabilities— Metric EB Cartridge

- Part temperatures to 600°C (1100°F)
- Maximum watt density to 30 W/cm² (190 W/in²)
- Maximum voltage to 480V~(ac)

Features and Benefits

- **Nickel-chromium resistance wire,** precisely wound and centered assures even, efficient heat distribution to the sheath.
- **Conductor pins** metallurgically bonded to the resistance wire ensure trouble-free electrical continuity. (The EB version features crimp-connected pins).
- **Magnesium oxide insulation of specific grain and purity,** swaged to the proper density, results in high dielectric strength and contributes to faster heat-up.



- **Incoloy® sheath** resists oxidation and corrosion from many chemicals, heat and atmospheres.
- **Minimal spacing between the element wire and sheath** results in lower internal temperature, giving you the ability to design with fewer or smaller heaters that operate at higher watt densities.
- **UL® and CSA approved flexible stranded wires,** with silicone-fiberglass oversleeve, insulate the wires to temperatures of 250°C (480°F).
- **VDE component recognition** to 230V~(ac) according to VDE 0721 part 1/3.78 and part 2/3.78 Section E in connection with VDE 0720 part 1/11.74.
- **Patented Lead Adapter (LA) method** allows same day shipment on more than 150,000 configurations of stock FIREROD heaters and lead combinations.

Applications

- Extrusion dies
- Formers

Incoloy® is a registered trademark of Special Metals Corporation.
UL® is a registered trademark of Underwriter's Laboratories, Inc.

Quick Ship

- *Same day shipment on all stock heaters with post terminals or Type B leads.*

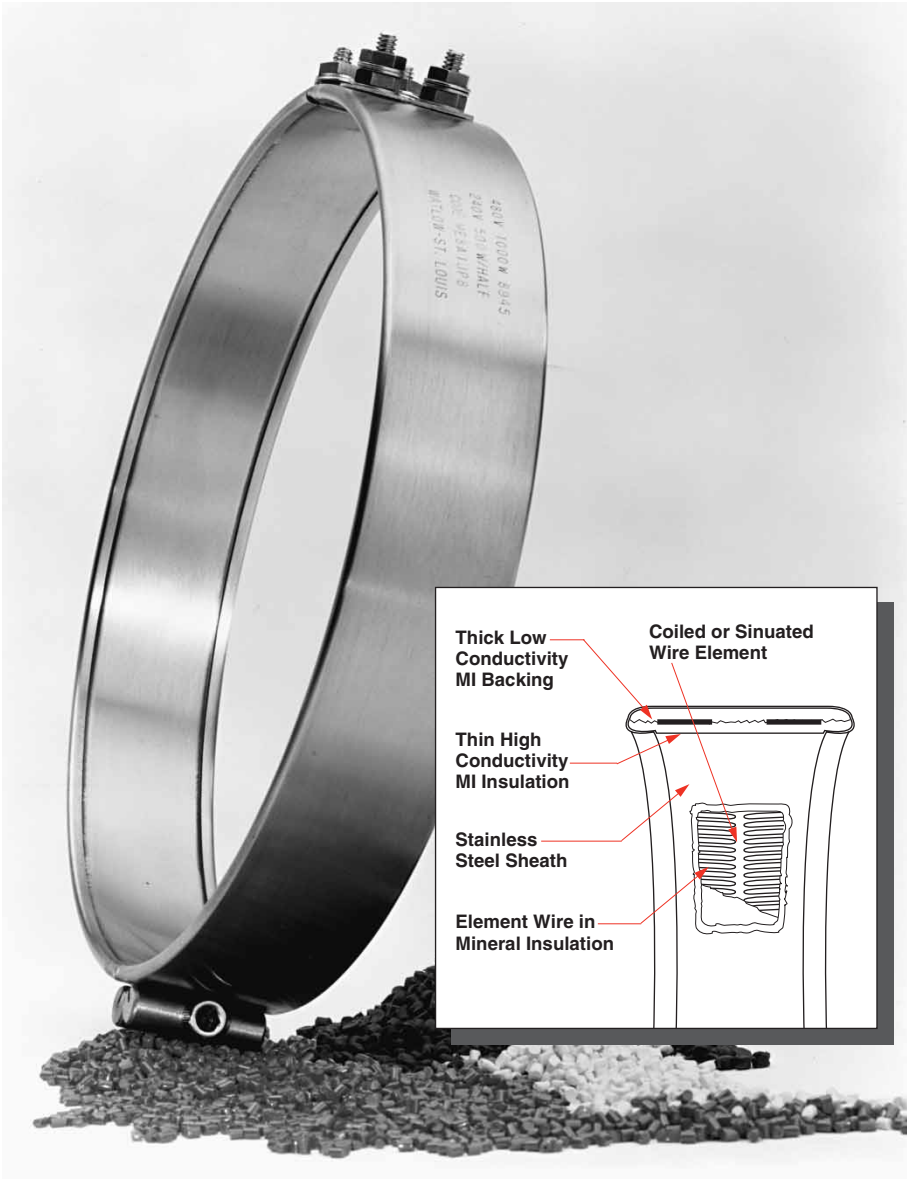
For complete information on MI Band heaters reference pages 18 to 27.

Heaters

MI Band

The MI Band is a high performance heater. Its performance and name are derived from Watlow's exclusive mineral insulation—a material that has much higher thermal conductivity than the mica and hard ceramic insulators used in conventional heaters.

A thin layer of the "high" thermal conductive MI material is used to electrically insulate the element wire from the inside diameter of the heater sheath. A thicker, "low" thermal conductivity layer backs up the element wire, directing the heat inward towards the part that is being heated. The result is more efficient heat transfer...a performance solution that lowers element wire temperatures and increases heater life.



Performance Capabilities

- Heater operating temperatures to 760°C (1400°F)
- Watt densities to 35.6 W/cm^2 (230 W/in^2) available on small diameter bands
- Watt densities to 15.5 W/cm^2 (100 W/in^2) available on large diameter bands

Features and Benefits

- **Operating temperatures to 760°C (1400°F)** make it possible to safely melt even the newest resins, like Peek™, Teflon®, Ultem® and Zytel®.
- **Higher watt densities than any other band heater** contribute to faster heat-up and through-put to increase productivity.
- **High thermal conductivity of MI and low mass construction** give almost instant response to temperature control. This performance solution eliminates thermal lag and temperature overshoot associated with ceramic knuckle heaters.
- **Stainless steel cover as well as side fold design** resist contamination by overflow of plastic or other free-flowing materials. Side folds turn to the inside diameter rather than the outside diameter.
- **Permanently attached clamp bars** eliminate cumbersome clamping straps, which makes installation easier.

Applications

- Barrels
- Dies

Teflon® and Zytel® are registered trademarks of E.I. du Pont de Nemours & Company.

Ultem® is a registered trademark of General Electric.

Peek™ is a trademark of Victrex plc.

Heaters

MI Band

Applications and Technical Data

The Physical Limitations of Variations table below shows the availability of widths, inside diameters and terminations for Watlow's MI Band heaters. To make sure the available terminations will meet your application needs, refer to the illustrations of termination types on page 22.

If you need to exceed the limitations shown, contact your Watlow sales engineer or authorized distributor.

Physical Limitations of Variations

Widths mm (in.)	I.D. Available—mm (in.)						Available Terminations
	1 pc. Construction		Expandable		2 pc. Construction		
	Minimum mm (in.)	Maximum mm (in.)	Minimum mm (in.)	Maximum mm (in.)	Minimum mm (in.)	Maximum mm (in.)	
25.4 (1)	25.4 (1)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	255.6 (14)	All
34.9 (1.375)	25.4 (1)	76.2 (3)	76.2 (3)	152.4 (6)	76.2 (3)	152.4 (6)	All
38.1 (1.5)	25.4 (1)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All
50.8 (2)	31.8 (1.25)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All
63.5 (2.25)	31.8 (1.25)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All
76.2 (3)	31.8 (1.25)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All
88.9 (3.5)	44.5 (1.75)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All - Except 90° "B" Leads
101.6 (4)	50.8 (2)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All
114.3 (4.5)	57.2 (2.25)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All
127.0 (5)	63.5 (2.5)	355.6 (14)	76.2 (3)	355.6 (14)	76.2 (3)	711.2 (28)	All - Except 90° "B" Leads
139.7 (5.5)	69.85 (2.75)	355.6 (14)	76.2 (3)	355.6 (14)	101.6 (4)	711.2 (28)	Post Terminals, SLE
152.4 (6)	76.2 (3)	355.6 (14)	76.2 (3)	355.6 (14)	101.6 (4)	711.2 (28)	All
177.8 (7)	N/A	N/A	101.6 (4)	355.6 (14)	N/A	N/A	Post Terminals

General Limitations:

- Maximum width of 25 mm (1 in.) diameter heater is 38 mm (1.5 in.) wide
- Maximum heater width = 3x heater diameter
- Minimum I.D. for Type B, C, E and H leads = 25 mm (1 in.)
- Minimum I.D. for Type B—90 degree leads = 28 mm (1.125 in.)
- Maximum lead amps: 8.5A per pair
- Maximum amps (post terminals): 30A per pair

Standard Gaps:

- ≤ 76.2 mm (3 in.) = 3 mm (0.125 in.) nominal
- 76.2 mm (3 in.) ≤ 152.4 mm (6 in.) = 3 mm (0.25 in.) nominal ± 3 mm (0.125 in.)
- 152.4 mm (6 in.) ≤ 355.6 mm (14 in.) = 9.52 mm (0.375 in.) nominal ± 3 mm (0.125 in.)
- > 355.6 mm (14 in.) = 12.7 mm (0.5 in.) nominal ± 6.3 mm (0.25 in.)

MI Band

Applications and Technical Data

Calculating Watt Density

Watt density is the amount of wattage per square inch of heated area. To determine watt density, divide the total wattage by the heated area.

$$\text{Watt Density} = \frac{\text{Total Watts}}{\text{Heated Area}}$$

To apply this equation we must define the term "heated area."

Heated area is the total contact surface of the heater less areas of no heat that are found around terminals, mounting holes, etc.

Heated Area =
Total Contact Area - No-Heat Area

To calculate the heated area:

1. Locate the **no-heat factor** from the chart below that corresponds to the type of heater being considered.
2. To use the formula below, insert the no heat factors, diameter and width (in inches).

Heated Area =
(3.14 x Diameter - No-Heat Factor) x Width

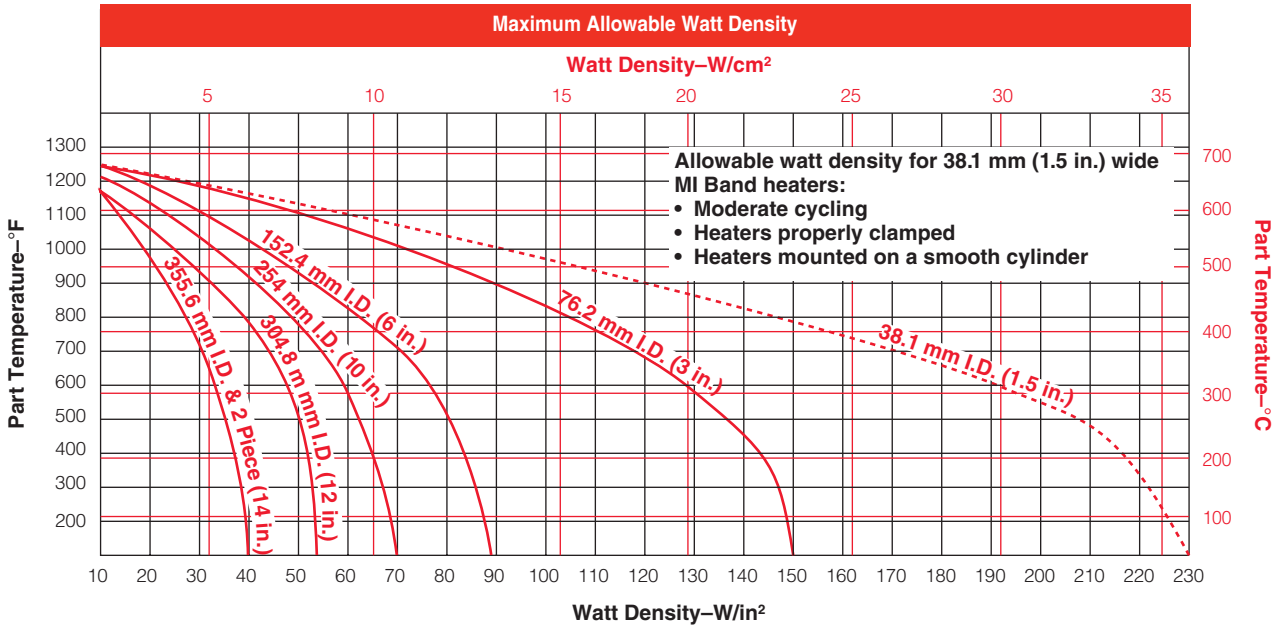
Type	Factor (in.)
1 pc. lead unit Type B, C, H, E or 90°B	(1.37)
1 pc. post terminal	(1.60)
2 pc. expandable post term	(3.18)
2 pc. expandable lead unit	(3.00)

Maximum Allowable Watt Density

The following derating factors apply to the Maximum Allowable Watt Density chart, which are shown in both metric and inch base for convenience. Please review these factors and the chart to determine the correct watt density curve for your application.

Derating Factors:

- For units over 51 mm (2 in.) in width, multiply watt density by 0.8.
- In applications where unusual operating conditions are present, such as irregular mounting surfaces, contact the Watlow factory in St. Louis, Missouri, for watt density limitations.
- For two-piece units used in vertical applications, refer to Clamping Matrix Application Guide, page 21.
- For applications where insulating blankets are used, multiply W/cm² (W/in²) by 0.75.



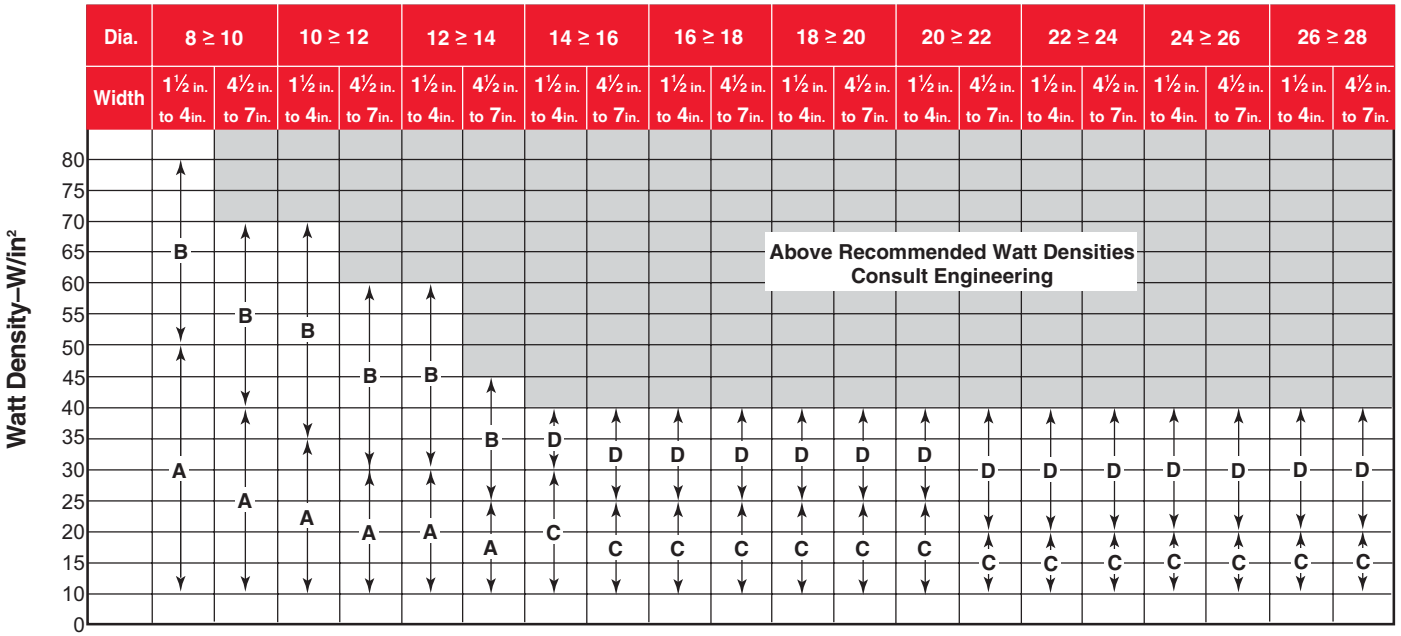
Heaters

MI Band

Applications and Technical Data

- Review Watt Density chart on page 366 to ensure that the application does not exceed the maximum watt density at operating temperature after applying derating factors.
- Locate clamping guideline for unit diameter, width and watt density.
- Description of guideline letters are at lower left of page.
- **Note:** Upward arrows are up to and not including specified watt density. Downward arrows are greater than or equal to specified watt density.

MI Barrel Clamping Matrix Application Guide



A	=	Standard clamping, expandable or one piece construction
B	=	Spring clamps, expandable or one piece construction
C	=	Spring clamps, at one gap, welded barrel nuts at other gap
D	=	Spring clamps, spring clamps at both gaps

Width	Clamp Points at Each Gap
≥ 127 mm (5 in.)	3
≥ 76.2 mm (3 in.)	2
< 76.2 mm (3 in.)	1

MI Installation Procedures - For Standard Product

1. Install heaters over a clean surface.
2. After installing the unit, begin to tighten the clamp screw. The standard clamping screw is 6.35 mm-508 x 31.75 mm (0.25 in.-20 x 1.25 in.), nickel plated allen head cap screw. Begin tightening the clamp bars. If the clamp bars appear not to have seated, tap the clamp bars with a small hammer to insure the bars are well seated in the angle formed by the 60 degree bent tab and the heater.
3. If the bar has multiple screws, alternately tighten the screws at 10 lb in. as you would the lug nuts on a car wheel to insure even loading.
4. Torque all screws to approximately 80 lb in. (9-N-M).
5. When installing terminal lugs, torque the top nuts to 15-20 lb in. or 2.26 N meters.

Heaters

The RAYMAX® Family

Watlow's diverse RAYMAX® heater line allows you to solve virtually any application that requires radiant heat. Our capabilities cover a wide range of needs, from contamination-resistant surfaces, to fast responding high temperature panels, to replaceable tubular elements.

Applying radiant heaters can be complicated. Watlow's engineering staff has the level of training and expertise required to help meet your application requirements, providing a high degree of technical support such as conducting testing for your application at our facility, calculating your watt density and temperature requirements and recommending system components such as sensors and controllers. With our experience in a wide range of industries, chances are Watlow has already helped someone handle a radiant heating application like yours.

Features and Benefits

- **The full RAYMAX line** offers a variety of styles and capabilities to match the ideal temperature and watt density requirements of your application.
- **Engineering and application support** from Watlow makes your projects run more smoothly.
- **Custom designs** can be quickly adapted for particular needs such as special wattage zoning.
- **Watlow sensors and controllers** are completely compatible with RAYMAX heaters for a single source thermal system that is reliable and designed just for your application.

Applications

- Blow molding
- Thermoforming
- Shrink packaging
- Laminating

Caution: *Fire Hazard*

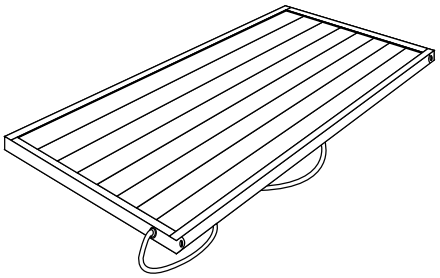
Radiant heaters must not be operated in the presence of flammable vapors, gases or combustible materials without proper ventilation and safety precautions. Radiant heaters must be properly wired and controlled to comply with all applicable electrical codes.

Heaters

The RAYMAX Family

Panel Variations

Low Profile

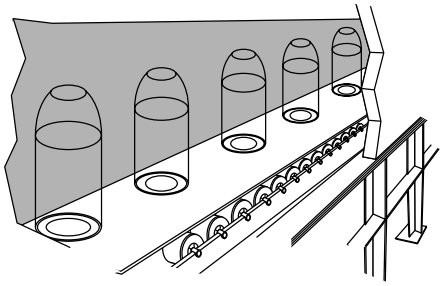


This design may be required where mounting space is limited, for example, when converting existing equipment or designs to radiant panels.

Available options may vary from the standard units when you specify a low profile design. Consult Watlow for further information.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Zoning



Watt densities can be varied across the entire width of RAYMAX heaters. If desired, each zone can have an individually controlled power supply.

Zoning can be very valuable when part of the product requires more heat, or when you must compensate for heat losses at the edges. By separately turning off part of the heated width, you can adjust for various widths of material.

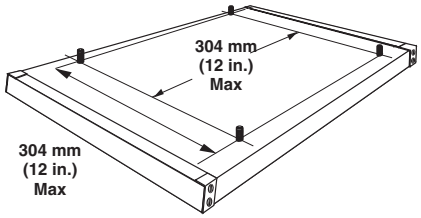
Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

The RAYMAX Family

Mounting Accessories

Application note: Allow for some thermal expansion of the heater case during operation. An expansion of up to one percent can occur when the case reaches its normal maximum limit of 595°C (1100°F). If your equipment has mounting screws to connect to the slots in the mounting legs, allow for a small amount of extra length. If you are using mounting holes to interface with the mounting studs on the back of the RAYMAX case, make sure your holes are oversized. Also, use washers and avoid overtightening.

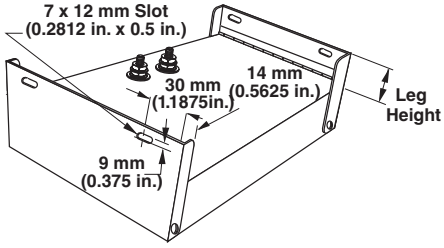
Mounting Studs



Standard M6 X 40 (0.25 X 20 X 1.5 in.) steel studs are welded to the case. For best support, studs should be approximately located on 304 mm (12 in.) centers. Consult Watlow for exact locations on specific heaters.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Mounting Legs



Mounting legs are extensions of the steel end caps with mounting slots for bolting directly to field support members. There is no extra charge for legs; they can be supplied in half inch increments from 12.5 mm (0.5 in.) to 76 mm (3 in.). No slots are provided in legs less than 25 mm (1 in.) long.

For panels over 610 mm (24 in.) long, mounting studs are recommended for the best panel support.

Available with RAYMAX 1120, 1220 and 2030.

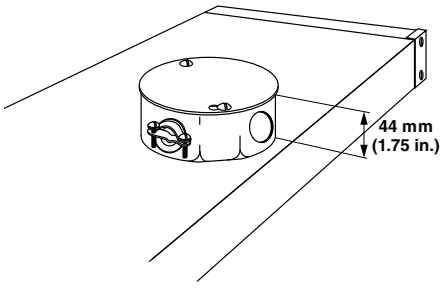
Terminal Accessories

Special Terminal Locations

If the standard terminal locations shown will not meet your needs special locations can be designed.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Terminal Box

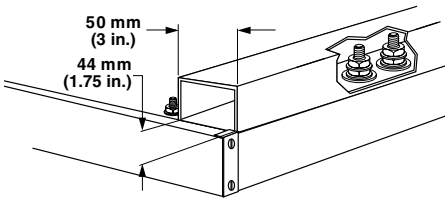


To protect electrical connections, a standard NEMA terminal box is available. The standard size is 102 x 102 x 41 mm (4 x 4 x 1.625 in.) with knockouts for 12.5 mm (0.5 in.) conduit. Other NEMA sizes are also available.

Care should be taken to use lead wire capable of withstanding the ambient temperatures.

Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Wiring Raceway



Custom designed to your specific requirements, a steel raceway provides electrical and physical protection for all terminal connections. This can be particularly useful for multi-zone panels.

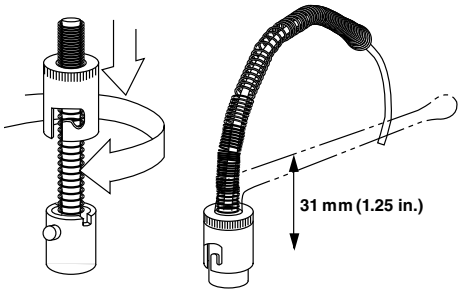
Available with RAYMAX 1010, 1120, 1220, 1330 and 2030.

Heaters

The RAYMAX Family

Temperature Control

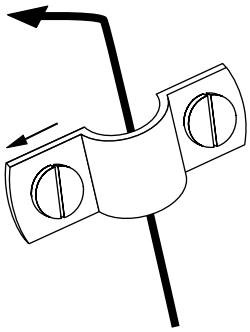
Thermowells



A thermowell allows you to use a thermocouple with a bayonet fitting to monitor heater temperature. The thermowell is located on the back of the panel to allow easy access for thermocouple replacement. Spring tension holds the tip of the thermocouple in contact for close control of the heater temperature. Thermocouple not included.

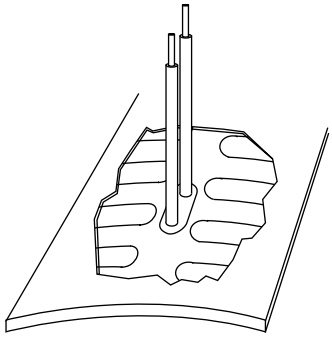
Available with RAYMAX 1010, 1120 and 1330.

Thermocouple Clamps



A thermocouple mounting clamp can be provided on the end of the heater case. The clamp is suitable for use with 3.175 mm (0.125 in.) and 6.35 mm (0.25 in.) O.D. sheath thermocouples, which should be bent 90 degrees so that the sensing tip is just above and lightly touching the hot face at an element location. **Available with RAYMAX 1220 and 2030.**

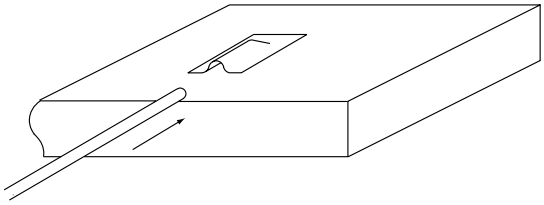
Welded Thermocouple



A thermocouple junction is welded to the emitting surface to provide optimum temperature sensing accuracy and responsiveness. This option permits the actual radiating face temperature to be precisely monitored and controlled.

Available with RAYMAX 1010, 1120 and 1330.

Thermocouple Pocket



A thermocouple pocket is welded to the emitting surface. The pocket accepts a 1.6 mm (0.063 in.) diameter thermocouple (not included). This option provides accurate temperature sensing and easy thermocouple replacement.

Available with RAYMAX 1010, 1120 and 1330.

Case History

Power Controllers Prove High Reliability for High Ambient Application

Problem:

Dairy Blowmolding Specialists was experiencing failures in their single and three-phase SCR relays from another supplier. Watlow wanted to understand the reason for the failure before sampling a solution, so Watlow offered to assist in diagnosing the problem.

After evaluating a failed unit, it was established that although Dairy Blowmolding Specialists had taken steps to keep the ambient temperature in the enclosure below the competitor's rating, the unit had failed due to overtemperature

Solution:

Watlow sampled a 22 mm (0.86 in.) SERIES CZR for their single-phase application. The extra space provided by the controller's small footprint, in addition to the superior internal heat transfer, ensured the SERIES CZR's chance for survival. Dairy Blowmolding Specialists purchased Watlow's DIN-A-MITE® B for their three-phase application.

Both power controllers are stock items and were available to ship the same day.

Dairy Blowmolding Specialists and Watlow are pleased with the results. Both power controllers are perfect fits for the application and have proven to be reliable. Six months after installation there are zero failures.

Capabilities

System Integration

Watlow has the manufacturing capability to design and fabricate complete thermal heating systems for process industries.

Watlow's application engineers work hand in hand with our customer's technical staff, insuring that detailed system proposals provide a clear technical description of the product, as well as costing options. This close communication continues with precise approval drawings for customer review and confirmation, before production is started. Manufacturing schedules and in-plant production or final review visits by our customers are available based on each customer's preference. Complete, technical installation and maintenance (I&M) instructions, as-built drawing packets and component specification sheets are provided to support setup of the system once it is shipped. On-site, factory training or start-up assistance can be provided, when needed. Follow-up service after commissioning is provided by local Watlow sales engineers.

Watlow has the distinct advantage of being the only designer of electric thermal systems to actually manufacture all of the major components in the thermal system. Watlow's vast technical knowledge and experience is combined with these individual components to produce the most effective thermal solution for each unique need.

Modular dual circuit heat/cool DI water system fully enclosed in cabinet with caster wheels.

Technical Specifications

Standards and Certifications

Thermal systems from Watlow are made of components that have all passed the same high standards of quality control testing. Watlow's process engineers and technicians are trained for specialized system design and construction and are the experts in the application of Watlow product lines.

Prior to manufacturing, designs for all projects are submitted for customer approval. This process ensures you of an exacting custom design along with complying to local and international technical standards. Watlow can build assemblies to fit the following standards and certifications:

- ASME - American Society of Mechanical Engineers
- ANSI - American National Standard Institute
- API - American Petroleum Institute
- AWS - American Welding Society
- ASTM - American Society for Testing and Materials
- TEMA - Tubular Exchanger Manufacturers Association
- ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
- SSPC - Steel Structures Painting Council
- US MIL STDS
- UL® - Underwriter's Laboratories
- FM - Factory Mutual
- NEMA - National Electrical Manufacturers Association
- NFPA - National Fire Protection Association

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

Capabilities

System Integration

- NEC - National Electric Code
- CSA - Canadian Standards Association
- CE - European Union Mark of Conformance
- CENELEC - European Committee for Electrotechnical Standardization
- PED - European Union Pressure Equipment Directive
- BASEEFA - British Approval Service for Electrical Equipment in Flammable Atmospheres
- IEC - International Electrotechnical Commission
- JIC - Joint Industrial Council
- SEMI-S2 - Semiconductor Equipment and Materials Institute

Testing and Services

Watlow can provide special testing and services for a variety of needs. These include:

- Radiography
- Charpy impact testing
- Die penetrant testing
- Hydrostatic pressure testing
- Ultrasonic thickness testing
- Magnetic particle testing
- MTRs (Material Test Reports)
- ASME calculations
- Earthquake, stress or vibration calculations
- PE stamp documents (Professional Engineer)
- Helium leak testing
- Tensile testing
- PMI (Positive Material Identification) testing
- Post-weld heat treating
- Chemical passivation
- Electropolishing
- Microscopic analysis
- Brinell hardness testing
- Special metal coatings from thermal spray to galvanizing

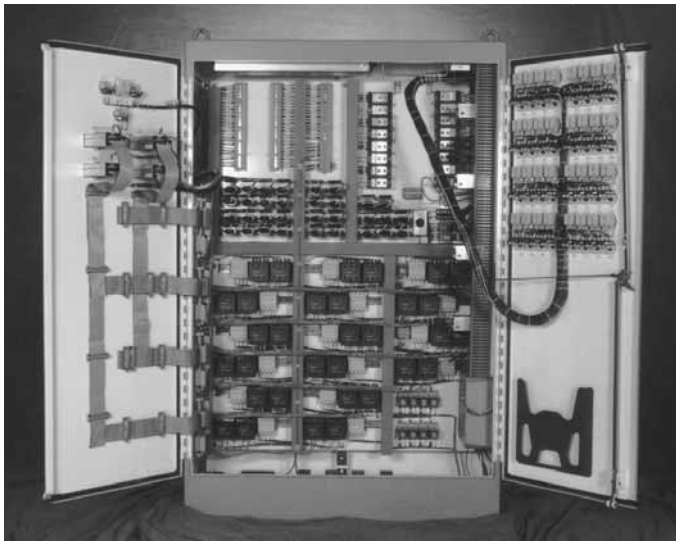
Summary of Product Capabilities and Services

Watlow builds any system to suit your needs. We design and fabricate specialty systems to simulate unique industry needs. Some of the capabilities available to build a Watlow process system include:

- Complete fabrication of low alloy carbon steel through alloy 800, alloy 600, alloy 20 and all exotic metals
- Fabrication of special parts of with CNC machining, lathes, mills, plasma cutting and laser cutting
- ASME Section IX welder and weld procedure qualifications, ASME “U,” “S” and “R” stamps
- Electrical control panel design and assembly. UL® listed and CE certified panels available
- Full interconnection of various system components prior to shipment to minimize field installation difficulties
- Design and fabrication of larger systems - heater sizes from single element, 20 watt assemblies to 600 plus elements, 1016 mm (40 in.) flanges, to multi-vessel stacked systems to 2.5 megawatt
- Standard vessel fabrication up to 1524 mm (60 in.) diameter and wall thickness from schedule five to specialty plate rolled vessels over 25.4 mm (1 in.) thick with lengths up to 20 feet, larger sizes can also be provided
- Ability to integrate valves, pumps, flow switches, strainers, expansion joints, expansion tanks, level glass, level switches, blowers, compressors, differential pressure switches and all fluid flow components as required
- Specialize in high pressure and high temperature design including pressures to 4500 psi and gas heating from cryogenic -226°C to 982°C (-375°F to 1800°F)
- Heater systems designed with best heater for application. Low end temperatures using silicone rubber heaters to ultra-high temperature using ceramic fiber heaters
- Skid-mounting designing and fabrication
- Piping design and fabrication
- Fabrication of heating and control systems for all hazardous and non-hazardous locations. CSA and CENELEC certified enclosures to 1270 mm (50 in.) flange
- Special cleaning procedures including passivation and electropolishing
- Special finishing, blasting and painting of complete thermal systems
- Special packaging and crating for domestic and export systems
- Able to ship F.O.B. factory, F.O.B. U.S. port, ex-factory, C&F destination, CIF destination
- Can coordinate all Freight Forwarder shipping issues to insure smooth and timely export
- Complete I&M packages, drawings, nameplates in English or other international languages as required
- On-site technical reviews, training, commissioning, service by factory engineers and local representatives

Capabilities

System Integration

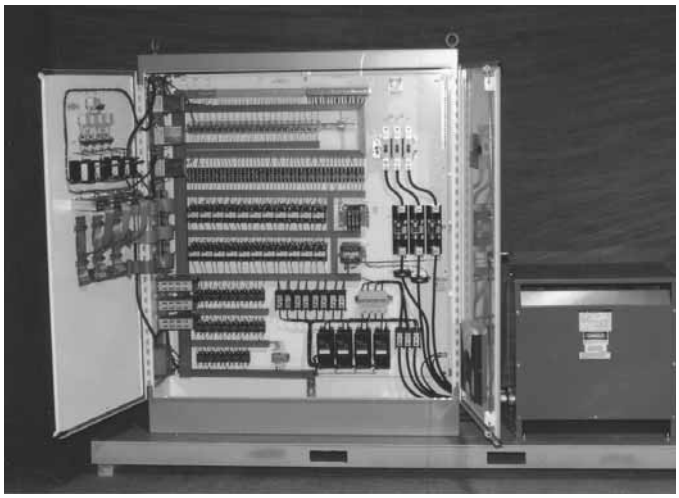


Multi-Zone Control Panel

- Four Watlow 32MLS controllers
- 128 total control loops
  - Four loops per zone
  - Two process and two alarm outputs
- Emergency stop pushbutton
- Interior lighting
- NEMA 12 fan cooled cabinet

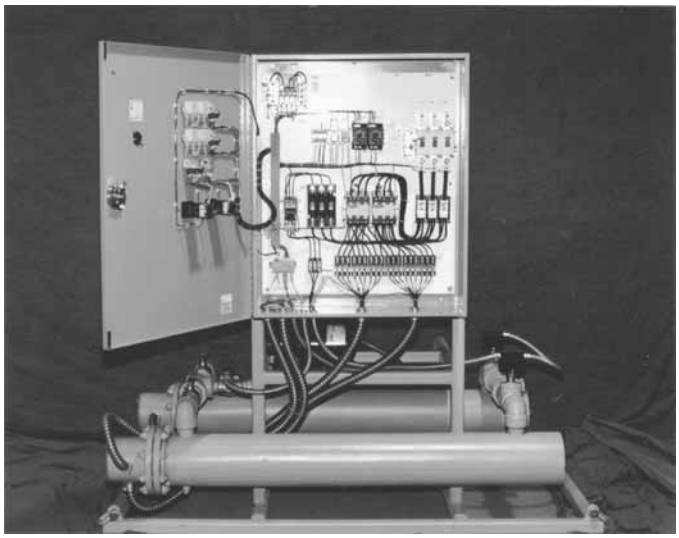
Each zone contains

- On-off selector switch with pilot light
- Watlow DIN-A-MITE® for power switching
- Capacitors and resistors for Torodial heater coil



22 Zone Control System

- 75 kVA, 480V x 240V step-down transformer
- Four C-Style DIN-A-MITE SCR power switching devices
- Three Watlow MLS332 multi-loop controllers
- Four Watlow SERIES 988 temperature controllers with remote set point
- NEMA 12 skid-mounted cabinet
- Main disconnect switch
- 22 safety contactors
- 22 sets of load fusing
- Watt transducer



Water Heating System

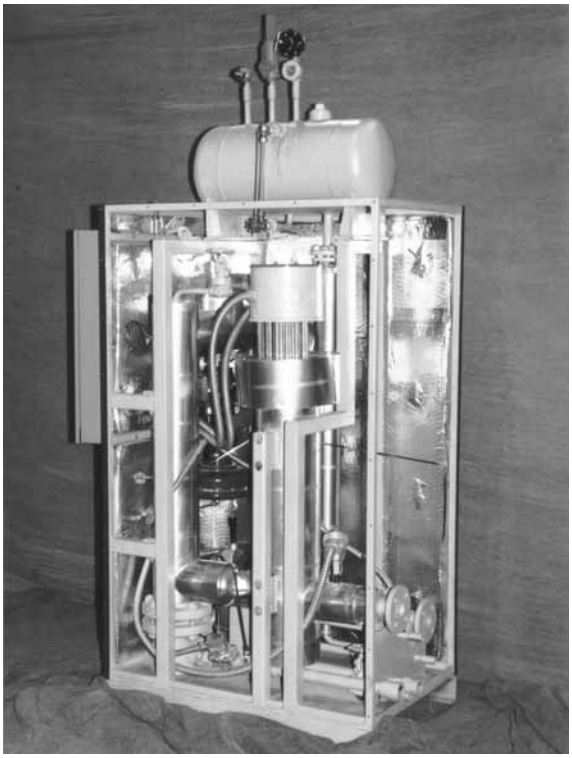
- Two 50kW heaters piped in parallel
- 60 gpm pump
- Solenoid valve
- Isolation valve
- Flow switches
- High limit thermocouples

Completely interconnected to control system consisting of:

- Watlow SERIES 965s
- Watlow SERIES 92s
- Main disconnect
- Mechanical contactors for power switching

Capabilities

System Integration



High Temperature 399°C (750°F) Hot Oil System

- 20kW, 480V, 3PH
- Watlow circulation heater
- 30 gpm high temperature “canned” sealess pump
- Water cooled heat exchanger
- Cooling water pressure switch and solenoid valve
- High temperature three way control valve
- Expansion tank with sight level gauge
- Pressure relief and back pressure purge valves
- Watlow SERIES 988 process temperature controller
- Watlow SERIES 988 mixing valve temperature controller
- Watlow SERIES 92 high limit temperature controller
- Manual disconnect
- Watlow DIN-A-MITE power controller
- NEMA 12 control cabinet
- Framed skid with sealed drip pan
- Insulated skid shroud for low temperature safe touch

Panel-mounted Calorifier Tank

- 400 gallon water calorifier
- Internal epoxy coating on tank
- 40kW, 400V, 3Ph flange immersion heater
- NEMA 4X control panel
- Watlow SERIES 988 process temperature controller
- Watlow SERIES 92 high limit temperature controller
- Two Watlow DIN-A-MITE power controllers with through wall heatsinks
- Drain and vent valves
- Pressure relief valve
- Pressure and temperature indicating gauges

Heaters

Versatile, Standard Cable Heaters

The versatile Watlow cable heater can be formed to a variety of shapes as dictated by its many applications. Cable heaters are small diameter, high performance units, fully annealed and readily bent to a multitude of configurations.

For example, a straight cable heater can snake through a sealing bar in packaging equipment.

Different applications require different construction methods, including one, two, three or four resistance wires; parallel coil or straight wire; drawn or swaged sheaths; with or without internal thermocouples; leads exiting from one or both ends and round, rectangular or square cable sheaths.

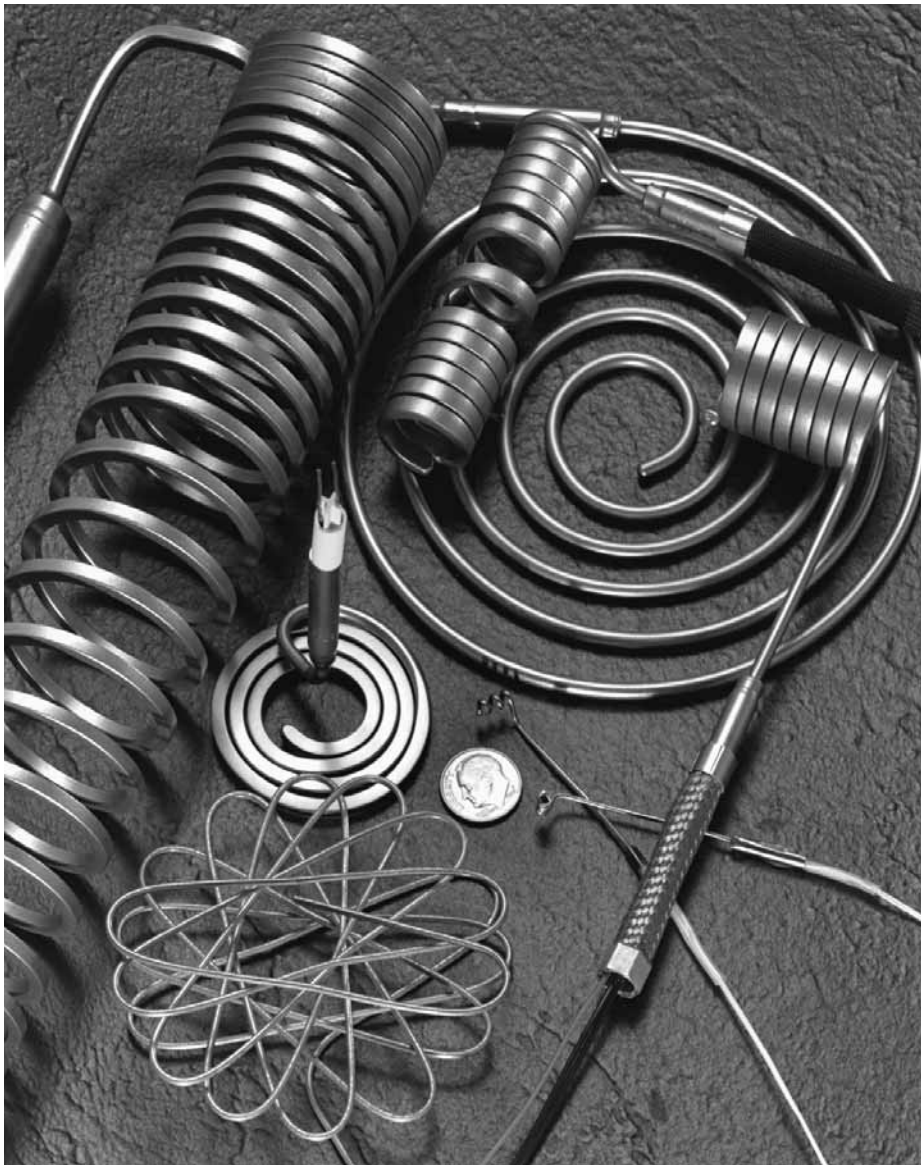
Whatever the packaging application, the Watlow cable heater can be shaped to fit your needs.

Performance Capabilities

- Continuous operating temperatures to 650°C (1200°F) with intermittent operating periods achieving up to 815°C (1500°F). Dependent on type of element wire used.
- Sheath watt densities on the cable to 4.65 W/cm^2 (30 W/in^2), and as high as 11.62 W/cm^2 (75 W/in^2) within factory approved conditions.

Features and Benefits

- **High ductility** allows the heater to be cold-formed into almost any shape.
- **The heater's low mass** allows for quick response to both heating and cooling.
- **Standard 304 stainless steel,** or optional 316L stainless steel or Inconel® 600, provide high temperature corrosion and oxidation resistance along with ideal thermal expansion properties.



- **The heater sheath can be brazed** allowing the permanent attachment of mounted fittings to the heater. Consult factory for additional information.
- **Ranging from 1 mm (0.040 in.) to 5 mm (0.188 in.) diameter,** the cable heater packs a lot of heat into a tiny space. Lengths range from 19 mm (0.75 in.) to over 2134 cm (70 ft.).
- **Internal construction options** allow internal thermocouples and no-heat sections (not available in all sizes).

Applications

- Sealing and cutting bars
- Forming dies and punches
- Laminating and printing presses
- Lidding and cartoning

Inconel® is a registered trademark of Special Metals Corporation.

Custom Cast and IFC

Watlow's cast-in and Interface Fit Construction (IFC) heaters provide an exceptional advantage in design flexibility for the packaging industry. When demanding packaging processes require smaller temperature tolerances and precise, uniform temperature controls to ensure consistent quality, Watlow's cast-in and IFC heaters are an ideal solution.

Cast or pressure fit with pure aluminum, these parts can utilize tubular or cable heaters depending on the application requirement. Cast-in or packaging heaters from Watlow are excellent for applications such as:

- **Lidding via Heat-Seal Platen Heads or Rollers** - The cast-in and IFC heaters can be used to heat-seal cartons by utilizing heated aluminum heads or rollers, which descend to seal lidstock to the container. Watlow's cast-in design also affords a water-resistant construction for wash down in special environments.
- **Bag and Pouch Sealing** – Watlow has provided a wide range of cast-in seal bar assemblies that evenly melt plastics films to seal a variety of bags and pouches.
- **Adhesive Heating and Dispensing** – Custom heater assemblies from Watlow are utilized to melt adhesive pellets and rods in glue pots for cartoning and multi-packing equipment.

Features and Benefits

- **Wide range of shapes and sizes** allows custom parts to meet specific customer needs.
- **Superior thermal transfer between heater and substrate** provides excellent temperature uniformity and improved heater life.
- **Single piece construction** eliminates the need to assemble several components (no brazing required).
- **High operating temperatures** greater than 450°C (842°F).

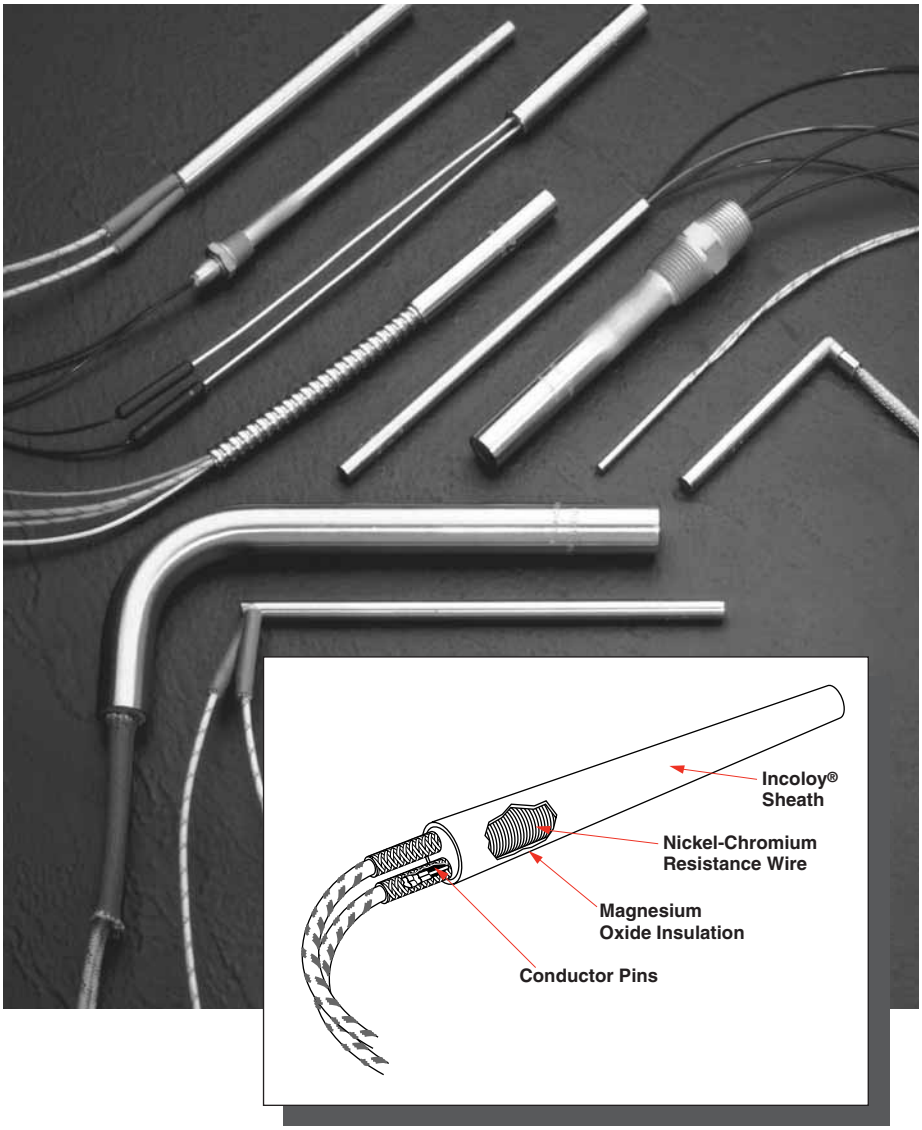
Applications

- Seal bars
- Lidding
- Form, fill and seal
- Cartoning
- Adhesive heating and dispensing
- Die cutting

For complete information on FIREROD cartridge heaters reference pages 70 to 119.

Heaters

FIREROD® Cartridge Family



Watlow's family of cartridge heaters provides superior heat transfer; uniform temperatures and resistance to oxidation and corrosion even at high temperatures.

Watlow's cartridge heaters are available in high, medium and low-watt density units. The wattage distribution can be configured to yield a uniform heat profile and the overall superior construction allows for rapid heat dissipation into heated parts such as seal bars.

Performance Capabilities—FIREROD Cartridge and Metric Version

- Temperatures to 760°C (1400°F) on Incoloy® sheath
- Temperatures up to 540°C (1000°F) on optional stainless steel sheath
- Watt densities to 62 W/cm^2 (400 W/in^2)

Performance Capabilities—Metric EB Cartridge

- Part temperatures to 600°C (1100°F)
- Maximum watt density to 30 W/cm^2 (190 W/in^2)
- Maximum voltage to 480V~(ac)

Features and Benefits

- **Nickel-chromium resistance wire,** precisely wound and centered assures even, efficient heat distribution to the sheath.
- **Conductor pins** metallurgically bonded to the resistance wire ensure trouble-free electrical continuity. (The EB version features crimp-connected pins).
- **Magnesium oxide insulation of specific grain and purity,** swaged to the proper density, results in high dielectric strength and contributes to faster heat-up.
- **Incoloy® sheath** resists oxidation and corrosion from many chemicals, heat and atmospheres.
- **Minimal spacing between the element wire and sheath** results in lower internal temperature, giving you the ability to design with fewer or smaller heaters that operate at higher watt densities.
- **UL® and CSA approved flexible stranded wires,** with silicone-fiberglass oversleeve, insulate the wires to temperatures of 250°C (480°F).
- **VDE component recognition** to 230V~(ac) according to VDE 0721 part 1/3.78 and part 2/3.78 Section E in connection with VDE 0720 part 1/11.74.
- **Patented Lead Adapter (LA) method** allows same day shipment on more than 150,000 configurations of stock FIREROD heaters and lead combinations.

Applications

- Seal bars
- Form, fill and seal
- Adhesive heating and dispensing
- Hole punching

Incoloy® is a registered trademark of Special Metals Corporation.
UL® is a registered trademark of Underwriter's Laboratories, Inc.

For complete information on thick film heaters reference pages 127 and 143.

Thick Film

The field-proven benefits Watlow's thick film heaters bring injection molders are now being realized by plastics molders for a variety of packaging applications. Watlow's innovative thick film technology allows packaging processors to evenly apply precisely calibrated heat with pinpoint accuracy, at temperatures up to 500°C (925°F). Hot and cold spots are virtually eliminated, allowing for rapid machinery start-up and cycle times, reduced scrap and more consistent package quality.

Thick film heaters offer precise control and the ability to customize the temperature profile. Whether seal bar or die head, the circuitry allows the heater to vary thermal output across the entire surface, helping to control and correct almost any temperature uniformity issue caused by conventional units. Thick film heaters also provide design flexibility. The heater shape can match any form desired, allowing the heater to adapt to unique machine dimensions and geometry.

Whether flat surfaced or cylindrical, Watlow thick film heaters are ideal for a multitude of packaging heater applications. Thick film heaters have been used on the face of seal bars in form, fill and seal machines to make pouches. Customized thick film heaters are also used to seal protective foils or plastic membranes to containers after filling. Cartons can be sealed utilizing a head or roller, heated with thick film, which descends and seals lidstock to the container or product.

Features and Benefits

- **Uniform thermal profile and ability to pattern heater layout** results in even temperature for improved product quality; eliminates hot and cold spots.
- **Low thermal mass** allows quicker heat up and less thermal lag between the heater and the part.
- **Extremely low profile** allows for premium space to be kept at a minimum.
- **Moisture-resistant non-porous glass film construction** eliminates the need for soft starting, minimizes current leakage and ultimately reduces cost by eliminating special need of GFCI protection.

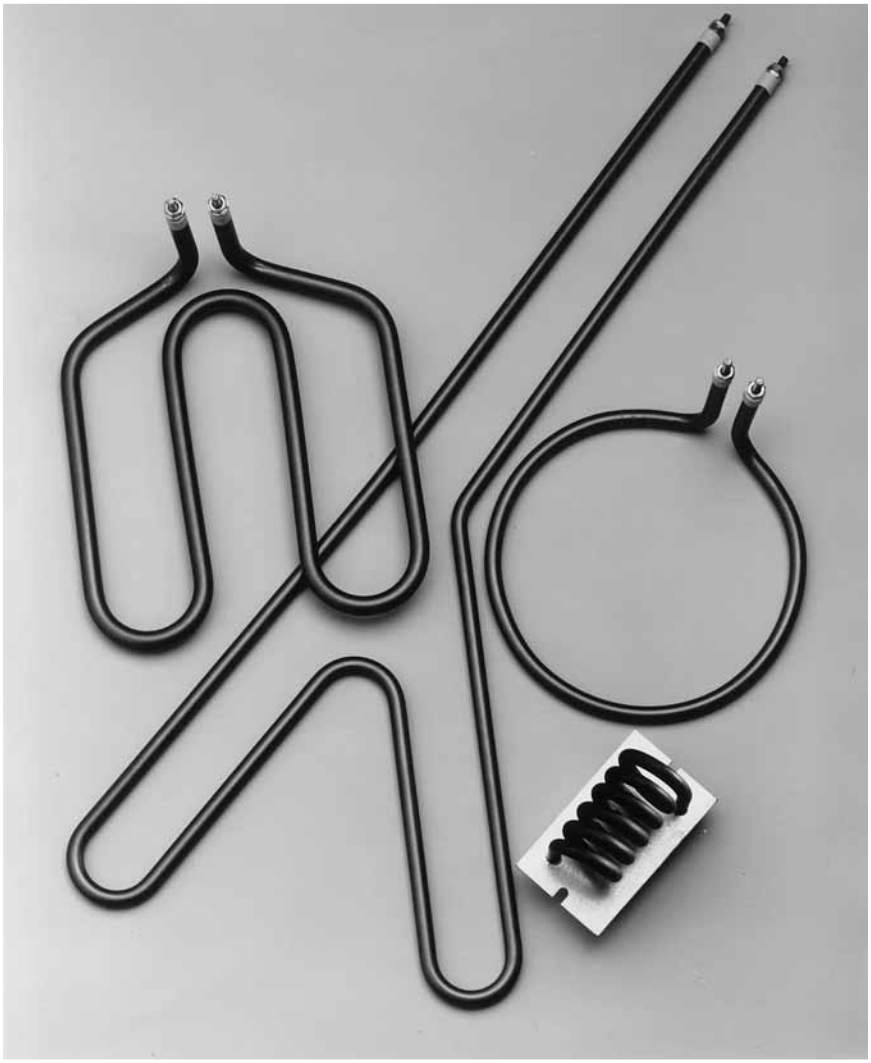
Applications

- Seal bars
- Lidding
- Form, fill and seal
- Cartoning
- Adhesive heating and dispensing
- Die cutting

Heaters

Tubular

Today's packaging applications demand exacting temperature tolerances and precise thermal specifications. Watlow's tubular heating elements are reliable, versatile and flexible, making them ideal for numerous packaging industry requirements. The heaters also provide consistent temperature levels to ensure superior final product quality.



Features and Benefits

- **Precise conformity to customer specifications** ensures easy installation—bending tolerances as low as ± 0.002 inch.
- **Common element diameters** include: 6.6, 8, 8.5, 9.5 and 10.9 mm (0.260, 0.315, 0.335, 0.375 and 0.430 in.) .
- **Incoloy® sheath material** for high temperatures, 304 stainless steel for smaller radius bends.
- **Superior resistance coil design** produces even heating.
- **Threaded stud or lead wire termination** as required.

Applications

- Seal bars
- Shrink tunnels
- Lidding
- Cartoning
- Adhesive heating and dispensing

Heaters

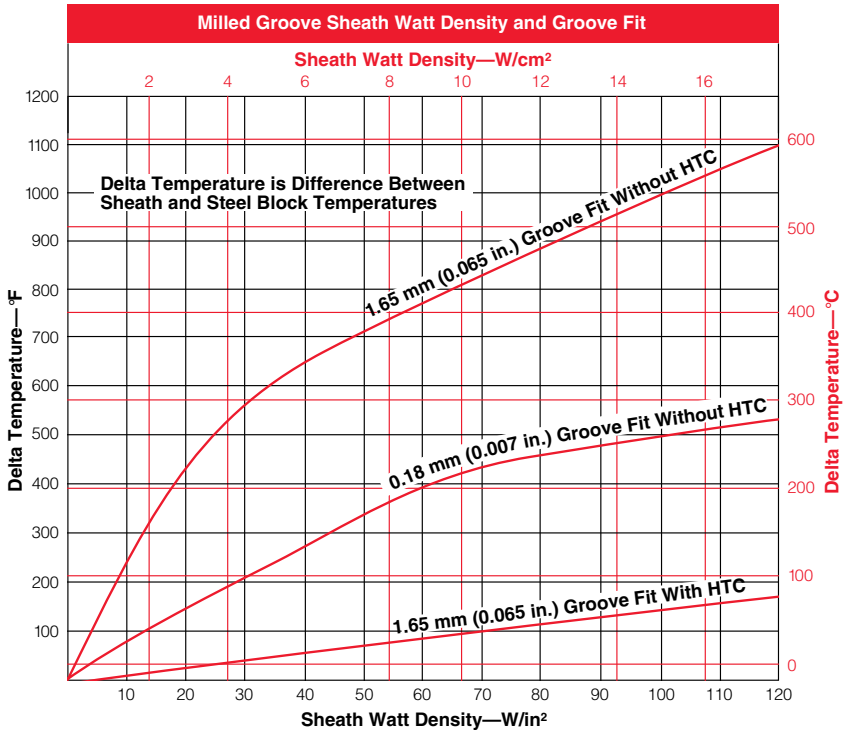
Tubular

Use the Milled Groove Sheath Watt Density and Groove Fit chart to find the recommended watt density or tightest groove fit. Optimum groove fit, without heat transfer cement, can be determined by plotting the intersect point between the required sheath watt density and the Delta temperature (T). If the Delta T is not known, simply subtract the mold temperature from the maximum 540°C (1000°F) sheath temperature. Any combination of watt density and groove fit that results in a Delta T below the recommended maximum will maximize heater life. Conversely, if the Delta T is greater, less heater life can be expected.

How to Order

All milled groove heaters are made-to-order. Due to precision forming requirements, please provide a detailed drawing or CAD disk. Consult your Watlow representative for price and shipment details. To help the ordering process, provide the following information:

- Operating temperature
- Volts/watts
- Sheath diameter and material
- No-heat section
- Electrical terminations
- Bend configurations and dimensions
- Groove cross section dimensions
- Quantity



Replacement Heaters

To order a replacement for an existing milled groove heater, specify original Watlow code number, or provide dimensions of the competitive heater, or the groove dimensions from the manifold.

Heat Transfer Cement (HTC)

Heat transfer cement can maximize heater performance and life by increasing thermal conductivity between the sheath and manifold. The maximum exposure temperature is 675°C (1250F°). Available in one quart cans. To order, specify **code number 148-15-2-1.**

Caution

Heat transfer cement conducts electricity. Avoid contact with terminations, wiring and other sources of electric current.

Heaters

Case Histories

Cable Heater Makes Tamper Proof Packaging Possible

Problem:

An equipment manufacturer produced and applied tamper-resistant seals to various containers, bottles and plastic cups.

Inserting a cartridge heater into a drilled hole failed to produce an even temperature around the sealing head's circumference. A tubular heater was also considered, but dropped when the watt density exceeded the recommended maximum.

Solution:

The problem was solved with a Watlow cable heater. A 1.6 mm (0.062 in.) diameter cable, 130 cm (50 in.) long was wound to a 4.7 mm (0.187 in.) inside diameter by 100 mm (4 in.) long coil. This coil was fitted into a round sealing head with a slot milled along the circumference. Installing the heater in this fashion made a ring-shaped sealing head possible. This configuration drastically reduced the sealing head's mass and provided rapid heat-up and recovery times. Teflon® leads and seals protected the heater against moisture from the frequent washdowns.

Cast-In Aluminum Assembly Reduces Downtime For Food Processor

Problem:

A food processing company utilized a cable heater held in a stainless steel milled groove to seal the lids of yogurt containers. The assembly did not meet the desired specifications for thermal performance, was unreliable and caused significant downtime.

The heaters began to fail within one to four weeks because they could not withstand the regular equipment washdowns required for the application. The customer also had to stock large inventories of replacement components (cable heaters and many stainless steel parts). This situation forced them to search for an alternative solution.

Solution:

Watlow provided a cast-in aluminum heater to fit into a redesigned assembly. The required part had to be small- 101 mm (4 in.), which limited the heater design options.

Watlow delivered the necessary wattage with a short length, parallel coil cable heater.

The heater replaced several stainless steel components, thus lowering the part count. The efficient heat transfer of the cast aluminum assembly improved the thermal performance to the desired customer specifications. Downtime and change out times were also reduced when the customer added a quick disconnect plug.

The benefits realized by the new Watlow design were reduced inventory levels, a more reliable process and less downtime. The more efficient cast-in heater reduced wattage by about 50 percent and still produced reliable seals between the lid and container.

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

Case Histories

Cast-In Aluminum Heaters Provide Cost Savings and Uniform Heating

Problem:

A manufacturer of hot melt glue systems used a machined reservoir with cartridge heaters installed in the bottom of the reservoir. The reservoirs were utilized to melt glue pellets used for gluing boxes.

The manufacturer experienced charred glue in certain areas of the reservoirs due to hot spots. They needed to heat the glue evenly to ensure good flow and prevent hot spots from damaging the adhesive.

Solution:

A cast-in aluminum heated part was designed with a slanted tank mounting that permitted the warmed glue to flow, via gravity, towards the pump. A low watt density cast-in tubular heater was located to eliminate “hot spots” and keep the melt flowing freely.

The Watlow cast-in tubular heater provided the required even heating, long life and cost savings.

Tubular Heaters Help Orange Juice Stay Fresh

Problem:

A manufacturer produced machines that constructed paper tubes used for frozen juice containers. The application required a thermal system flexible enough to heat five to 10 various types of glues in quantities of 5 gallons (19 liters) with different melt temperatures and watt density tolerances.

Solution:

The answer to this application was Watlow’s FIREBAR heater. The heater offered low watt density and wider temperature ranges. The FIREBAR used was a stock product formed to fit a glue pan.

A high-limit temperature controller was used to protect the glue from burning. The FIREBAR heater was also coated with a Teflon® coating to protect it from the glue.

Five advantages made the FIREBAR suitable for this application:

1. The FIREBAR was a stock product that could be shaped to meet the customer’s needs without extensive engineering.
2. The FIREBAR’s low watt densities, maximum surface area provided performance flexibility for the different glues.
3. The FIREBAR provided three individual heating elements, for low, medium and high selectable heat.
4. The FIREBAR could be supplied with a thin Teflon® sheath coating to prevent the glue from sticking.
5. The FIREBAR could be supplied with a mounting bracket.

Heaters

Case Histories

Cartridge and Silicone Rubber Heaters Eliminate Burn-Out In Hot Melt Equipment

Problem:

Hot melt equipment is used for high-speed packaging operations as well as automated product assembly. For example, CB, radio, TV components, cabinets, automotive parts and corrugated cartons are assembled by handgun adhesive applicators. If the hose and gun are not heated, the adhesive would solidify and clog the application system.

In this application, a cartridge heater was frequently burning-out in the dispensing gun due to frequent cycling and poor heat transfer.

Solution:

The adhesive in the melt pot was melted with a Watlow FIREROD® cartridge heater, then pumped through hoses heated with silicone rubber heaters. The liquid glue was ejected onto the part through a dispensing gun heated by another FIREROD heater.

Watlow's FIREROD provided the customer with benefits including high watt density, UL® recognition, superior lead arrangement and trouble-free performance for their hot melt equipment application.

Construction Details Make Tubular Heaters For Skin Packaging A Success

Problem:

The contents of a package are visible, yet protected, when using skin packaging. This system immobilizes the product(s) under plastic film and seals them from contamination.

To do this, a radiant heater bank is energized to soften a plastic film to a pliable, thermoformable state. This plastic film is then applied by:

1. A frame holding the film descending over the product(s)
2. A vacuum drawing the film into tight conformity with the product(s)
3. The film frame being lifted and the packaged product(s) automatically discharging from the machine, which rethreads the film
4. The equipment is then ready for the next packaging cycle

This customer was relying on a competitor's tubular heater, which failed rapidly. The company attributed the failure to excessive moisture in the manufacturing equipment.

Solution:

The Watlow sales representative inspected the failed units and discovered that the problem resulted from spot-welding the resistance wire to the cold pin. The Watlow tubular heater had a 360-degree fusion weld between the resistance wire and cold pin. The customer chose the superior Watlow tubular once he understood the reason for his heater failures.

Watlow tubular elements were mounted onto an aluminum reflector that was rectangular in shape. The products to be packaged were then automatically conveyed under the heater/reflector assembly.

Case History

Thick Film Heaters Provide Fast Thermal Response in Automated Pouching Machines

Problem:

As the world market becomes increasingly conscious of the cost of products and the impact of the product packaging on our environment, consumer product manufacturers have been searching for ways to reduce the volume of containers while lowering their cost to package product like snack foods, cookies, cake mixes, etc. One resulting trend is the replacement of boxes in the supermarket with paper pouch containers. These packages, including some re-sealable types, are becoming very popular and are populating the store shelves in greater numbers every day.

These containers are formed and filled at high speeds right on the production line. Heaters that seal these pouches must be capable of handling a variety of package speeds while minimizing start-up cycles and improving the reliability of the seal between sheets of plastic or silicone impregnated paper.

A customer was having difficulties during their manufacturing process when the product stopped flowing on the production line. The product was lost to large seals between pouches or burned packaging materials. The root cause of the problem was latent heat stored in the bulky heaters typically used in sealing equipment. Due to the speed of the filling process, large amounts of food and other materials could be lost in a very short period of time.

Solution:

The manufacturer needed heaters that could be retrofitted into their current machinery that provided fast thermal response with minimal mass and good thermal uniformity along a 304.8 mm (12 in.) length. Watlow custom-designed a specialty-machined substrate and developed a suitable resistor circuit in three design iterations that suited the customers requirements.

Heater Description:

- 9.35 mm (0.368 in.) thick 430SS thick film heater of rectangular shape roughly 101.6 x 304.8 mm (4 x 12 in.) long. Heated area on both sides.
- 120V design generating 600 total watts of power (300W per side). Circuits were wired in series.
- Operating temperature of up to 148°C (300°F); 67 wsi developed from 60 percent coverage.
- Special silicone over-molded terminations with silicone/fiberglass lead wires.

Notes:

With the fast capability, excellent thermal uniformity and a single source replacement for three components, Thick film heaters were a more cost-effective solution.

Temperature and Power Controllers

Temperature and Power Controller Overview

Watlow offers a broad range of basic and limit, temperature and power controllers to meet the most demanding or intricate packaging application.

The field-proven temperature controllers include the CLS200, PPC-2000, CPC400, MLS300, SERIES F4, SD and PD. These solutions offer performance, reliability and versatility and many include agency approvals, supporting software tools and connectivity options.

Watlow's line of power controllers consists of the DIN-A-MITE® family, E-SAFE® RELAY, SERIES CZR and Solid State Relays (SSRs). These solutions complement the rapid switching required by PID temperature controllers and help deliver optimum system performance and service life. Available in 1-phase and 3-phase/2-leg and 3-leg configurations, Watlow power controllers meet many packaging applications. Random, zero cross or phase-angle fire options match the power controller to the application requirement.

If you have more questions or need additional assistance, please contact your Authorized Watlow Sales Agent.

Applications

- Seal bars
- Lidding
- Form, fill and seal
- Cartoning
- Adhesive heating and dispensing
- Die cutting

Reference Data

Formulas, Conversions and Engineering Constants

The section contains technical references, conversion tables, formulas and other data used in solving heating problems.

Celsius to Fahrenheit/Fahrenheit to Celsius

to °C	°F/°C	to °F	to °C	°F/°C	to °F	to °C	°F/°C	to °F	to °C	°F°/C	to °F
-184.4	-300	NA	65.6	150	302.0	315.6	600	1112.0	565.6	1050	1922.0
-178.9	-290	NA	71.1	160	320.0	321.1	610	1130.0	571.1	1060	1940.0
-173.3	-280	NA	76.7	170	338.0	326.7	620	1148.0	576.7	1070	1958.0
-167.8	-270	-454.0	82.2	180	356.0	332.2	630	1166.0	582.2	1080	1976.0
-162.2	-260	-436.0	87.8	190	374.0	337.8	640	1184.0	587.8	1090	1994.0
-156.7	-250	-418.0	93.3	200	392.0	343.3	650	1202.0	593.3	1100	2012.0
-151.1	-240	-400.0	98.9	210	410.0	348.9	660	1220.0	598.9	1110	2030.0
-145.6	-230	-382.0	104.4	220	428.0	354.4	670	1238.0	604.4	1120	2048.0
-140.0	-220	-364.0	110.0	230	446.0	360.0	680	1256.0	610.0	1130	2066.0
-134.4	-210	-346.0	115.6	240	464.0	365.6	690	1274.0	615.6	1140	2084.0
-128.9	-200	-328.0	121.1	250	482.0	371.1	700	1292.0	621.1	1150	2102.0
-123.3	-190	-310.0	126.7	260	500.0	376.7	710	1310.0	626.7	1160	2120.0
-117.8	-180	-292.0	132.2	270	518.0	382.2	720	1328.0	632.2	1170	2138.0
-112.2	-170	-274.0	137.8	280	536.0	387.8	730	1346.0	637.8	1180	2156.0
-106.7	-160	-256.0	143.3	290	554.0	393.3	740	1364.0	643.3	1190	2174.0
-101.1	-150	-238.0	148.9	300	572.0	398.9	750	1382.0	648.9	1200	2192.0
-95.6	-140	-220.0	154.4	310	590.0	404.4	760	1400.0	654.4	1210	2210.0
-90.0	-130	-202.0	160.0	320	608.0	410.0	770	1418.0	660.0	1220	2228.0
-84.4	-120	-184.0	165.6	330	626.0	415.6	780	1436.0	665.6	1230	2246.0
-78.9	-110	-166.0	171.1	340	644.0	421.1	790	1454.0	671.1	1240	2264.0
-73.3	-100	-148.0	176.7	350	662.0	426.7	800	1472.0	676.7	1250	2282.0
-67.8	-90	-130.0	182.2	360	680.0	432.2	810	1490.0	682.2	1260	2300.0
-62.2	-80	-112.0	187.8	370	698.0	437.8	820	1508.0	687.8	1270	2318.0
-56.7	-70	-94.0	193.3	380	716.0	443.3	830	1526.0	693.3	1280	2336.0
-51.1	-60	-76.0	198.9	390	734.0	448.9	840	1544.0	698.9	1290	2354.0
-45.6	-50	-58.0	204.4	400	752.0	454.4	850	1562.0	704.4	1300	2372.0
-40.0	-40	-40.0	210.0	410	770.0	460.0	860	1580.0	710.0	1310	2390.0
-34.4	-30	-22.0	215.6	420	788.0	465.6	870	1598.0	715.6	1320	2408.0
-28.9	-20	-4.0	221.1	430	806.0	471.1	880	1616.0	721.1	1330	2426.0
-23.3	-10	14.0	226.7	440	824.0	476.7	890	1634.0	726.7	1340	2444.0
-17.8	0	32.0	232.2	450	842.0	482.2	900	1652.0	732.2	1350	2462.0
-12.2	10	50.0	237.8	460	860.0	487.8	910	1670.0	737.8	1360	2480.0
-6.7	20	68.0	243.3	470	878.0	493.3	920	1688.0	743.3	1370	2498.0
-1.1	30	86.0	248.9	480	896.0	498.9	930	1706.0	748.9	1380	2516.0
4.4	40	104.0	254.4	490	914.0	504.4	940	1724.0	754.4	1390	2534.0

CONTINUED

Formulas, Conversions and Engineering Constants

Continued

to °C	°F/°C	to °F	to °C	°F/°C	to °F	to °C	°F/°C	to °F	to °C	°F°/C	to °F
10.0	50	122.0	260.0	500	932.0	510.0	950	1742.0	760.0	1400	2552.0
15.6	60	140.0	265.6	510	950.0	515.6	960	1760.0	765.6	1410	2570.0
21.1	70	158.0	271.1	520	968.0	521.1	970	1778.0	771.1	1420	2588.0
26.7	80	176.0	276.7	530	986.0	526.7	980	1796.0	776.7	1430	2606.0
32.2	90	194.0	282.2	540	1004.0	532.2	990	1814.0	782.2	1440	2624.0
37.8	100	212.0	287.8	550	1022.0	537.8	1000	1832.0	787.8	1450	2642.0
43.3	110	230.0	293.3	560	1040.0	543.3	1010	1850.0	793.3	1460	2660.0
48.9	120	248.0	298.9	570	1058.0	548.9	1020	1868.0	798.9	1470	2678.0
54.4	130	266.0	304.4	580	1076.0	554.4	1030	1886.0	804.4	1480	2696.0
60.0	140	284.0	310.0	590	1094.0	560.0	1040	1904.0	810.0	1490	2714.0
815.6	1500	2732.0	954.4	1750	3182.0	1093.3	2000	3632.0	1232.2	2250	4082.0
821.1	1510	2750.0	960.0	1760	3200.0	1098.9	2010	3650.0	1237.8	2260	4100.0
826.7	1520	2768.0	965.6	1770	3218.0	1104.4	2020	3668.0	1243.3	2270	4118.0
832.2	1530	2786.0	971.1	1780	3236.0	1110.0	2030	3686.0	1248.9	2280	4136.0
837.8	1540	2804.0	976.7	1790	3254.0	1115.6	2040	3704.0	1254.4	2290	4154.0
843.3	1550	2822.0	982.2	1800	3272.0	1121.1	2050	3722.0	1260.0	2300	4172.0
848.9	1560	2840.0	987.8	1810	3290.0	1126.7	2060	3740.0	1265.6	2310	4190.0
854.4	1570	2858.0	993.3	1820	3308.0	1132.2	2070	3758.0	1271.1	2320	4208.0
860.0	1580	2876.0	998.9	1830	3326.0	1137.8	2080	3776.0	1276.7	2330	4226.0
865.6	1590	2894.0	1004.4	1840	3344.0	1143.3	2090	3794.0	1282.2	2340	4244.0
871.1	1600	2912.0	1010.0	1850	3362.0	1148.9	2100	3812.0	1287.8	2350	4262.0
876.7	1610	2930.0	1015.6	1860	3380.0	1154.4	2110	3830.0	1293.3	2360	4280.0
882.2	1620	2948.0	1021.1	1870	3398.0	1160.0	2120	3848.0	1298.9	2370	4298.0
887.8	1630	2966.0	1026.7	1880	3416.0	1165.6	2130	3866.0	1304.4	2380	4616.0
893.3	1640	2984.0	1032.2	1890	3434.0	1171.1	2140	3884.0	1310.0	2390	4334.0
898.9	1650	3002.0	1037.8	1900	3452.0	1176.7	2150	3902.0	1315.6	2400	4352.0
904.4	1660	3020.0	1043.3	1910	3470.0	1182.2	2160	3920.0	1321.1	2410	4370.0
910.0	1670	3038.0	1048.9	1920	3488.0	1187.8	2170	3938.0	1326.7	2420	4388.0
915.6	1680	3056.0	1054.4	1930	3506.0	1193.3	2180	3956.0	1332.2	2430	4406.0
921.1	1690	3074.0	1060.0	1940	3524.0	1198.9	2190	3974.0	1337.8	2440	4424.0
926.7	1700	3092.0	1065.6	1950	3542.0	1204.4	2200	3992.0	1343.3	2450	4442.0
932.2	1710	3110.0	1071.1	1960	3560.0	1210.0	2210	4010.0	1348.9	2460	4460.0
937.8	1720	3128.0	1076.7	1970	3578.0	1215.6	2220	4028.0	1354.5	2470	4478.0
943.3	1730	3146.0	1082.2	1980	3596.0	1221.1	2230	4046.0	1360.0	2480	4496.0
948.9	1740	3164.0	1087.8	1990	3614.0	1226.7	2240	4064.0	1365.6	2490	4515.0

Reference Data

Formulas, Conversions and Engineering Constants

Temperature Scale	Convert to by...
Fahrenheit	°F = 1.8°C + 32°
Celsius	°C = ⅝ (°F - 32°)
Rankine	°R = 1.8K + 0.6° °R = °F + 460°
Kelvin	K = ⅝ (°R - 0.6°) K = °C + 273°

Note: The Kelvin scale uses no "°" symbol.

Ratings of Listed Heater Voltages Operated on Other Voltages

kW Rating of Heater	120 Volts		240 Volts			480 Volts	
	Output kW of Heater When Operated On:						
	110 Volts	115 Volts	208 Volts	220 Volts	230 Volts	440 Volts	460 Volts
1.0	0.84	0.92	0.75	0.84	0.92	0.84	0.92
2.0	1.69	1.84	1.50	1.69	1.84	1.69	1.84
3.0	2.53	2.76	2.25	2.53	2.76	2.53	2.76
4.0	3.36	3.67	3.00	3.36	3.68	3.36	3.68
4.5	3.78	4.13	3.38	3.78	4.14	3.78	4.14
5.0	4.20	4.59	3.5	4.2	4.6	4.2	4.6
7.5	6.30	6.89	5.6	6.3	6.9	6.3	6.9
10.0			7.5	8.4	9.2	8.4	9.2
12.5			9.4	10.5	11.5	10.5	11.5
15.0			11.3	12.6	13.8	12.6	13.8
20.0			15.0	16.9	18.4	16.9	18.4
25.0			18.8	21.0	23.0	21.0	23.0
50.0			37.6	42.0	46.0	42.0	46.0
75.0			56.3	63.0	69.0	63.0	69.0
100.0			75.1	84.0	92.0	84.0	92.0

Equation:

$$W_{NEW} = W_{RATED} \left(\frac{V_{NEW}}{V_{RATED}} \right)^2$$

Reference Data

Formulas, Conversions and Engineering Constants

Conversion Factors

To Convert To...		Multiply...		By...
Atmospheres	(atm)	Bar		0.9869
Atmospheres	(atm)	Inches Mercury	(in Hg)	0.03342
Atmospheres	(atm)	Pounds/square inch	(psi)	0.06805
Atmospheres	(atm)	Torr		0.001316
Bar		Atmospheres	(atm)	1.0133
Bar		Pounds/square inch	(psi)	0.06895
British Thermal Units	(Btu)	Joules	(J)	0.000948
British Thermal Units	(Btu)	Kilowatt-hours	(kWh)	3412
British Thermal Units	(Btu)	Watt-hours	(Wh)	3.412
British Thermal Units/hour	(Btu/h)	Kilocalories/hour	(kcal/h)	3.969
British Thermal Units/hour	(Btu/h)	Watts	(W)	3.412
British Thermal Units—inches hour-square foot—°F	(Btu—in) (h-ft²—°F)	Watts/meter—°C	(W/m—°C)	6.933
British Thermal Units/pound	(Btu/lb)	Kilojoules/kilogram	(kJ/kg)	0.4299
British Thermal Units/pound—°F	(Btu/lb—°F)	Kilojoules/kilogram—°C	(kJ/kg—°C)	0.2388
Calories	(cal)	Joules	(J)	0.2388
Centimeters	(cm)	Feet	(ft)	30.48
Centimeters	(cm)	Inches	(in)	2.54
Centimeters/second	(cm/s)	Feet/minute	(fpm)	0.508
Cubic centimeters	(cm^3 or cc)	Cubic feet	(ft^3)	28,320
Cubic centimeters	(cm^3 or cc)	Cubic inches	(in^3)	16.39
Cubic centimeters	(cm^3 or cc)	Milliliters	(ml)	1.0
Cubic feet	(ft^3)	Cubic meters	(m^3)	35.32
Cubic feet	(ft^3)	Gallons, U.S.	(gal)	0.1337
Cubic feet	(ft^3)	Liters	(l)	0.03532
Cubic feet/minute	(cfm)	Cubic meters/hour	(m^3/h)	0.5885
Cubic feet/minute	(cfm)	Cubic meters/second	(m^3/s)	2119
Cubic feet/minute	(cfm)	Liters/second	(l/s)	2.119
Cubic inches	(in^3)	Cubic centimeters	(cm^3 or cc)	0.061
Cubic meters	(m^3)	Gallons, U.S.	(gal)	0.003785
Cubic meters	(m^3)	Liters	(l)	0.001
Cubic meters	(m^3)	Cubic feet	(ft^3)	0.02832
Cubic meters/hour	(m^3/h)	Cubic feet/minute	(cfm)	1.699
Cubic meters/hour	(m^3/h)	Gallons/minute	(gpm)	0.2271
Cubic meters/second	(m^3/s)	Cubic feet/minute	(cfm)	0.000472
Feet	(ft)	Centimeters	(cm)	0.03281
Feet	(ft)	Meters	(m)	3.281
Feet/minute	(fpm)	Centimeters/second	(cm/s)	1.969
Feet/minute	(fpm)	Meters/second	(m/s)	196.9
Gallons, Imperial		Gallons, U.S.	(gal)	0.8327

CONTINUED

Reference Data

Formulas, Conversions and Engineering Constants

Continued

Conversion Factors

To Convert To...		Multiply...		By...
Gallons, U.S.	(gal)	Cubic feet	(ft^3)	7.481
Gallons, U.S.	(gal)	Cubic meters	(m^3)	264.2
Gallons, U.S.	(gal)	Gallons, Imperial		1.201
Gallons, U.S.	(gal)	Liters	(l)	0.2642
Gallons/minute	(gpm)	Cubic meters/hour	(m^3/h)	4.403
Gallons/minute	(gpm)	Liters/second	(l/s)	15.85
Grams	(g)	Ounces	(oz)	28.35
Grams	(g)	Pounds	(lb)	453.6
Grams/cubic centimeter	(g/cm^3)	Kilograms/cubic meter	(kg/m^3)	0.001
Grams/cubic centimeter	(g/cm^3)	Pounds/cubic foot	(lb/ft^3)	0.01602
Grams/cubic centimeter	(g/cm^3)	Pounds/cubic inch	(lb/in^3)	27.68
Inches	(in)	Centimeters	(cm)	0.3937
Inches	(in)	Millimeters	(mm)	0.03937
Inches Mercury	(in Hg)	Atmospheres	(atm)	29.92
Inches Mercury	(in Hg)	Torr		25.4
Joules	(J)	British Thermal Units	(Btu)	1055
Joules	(J)	Calories	(cal)	4.187
Joules	(J)	Watt-hours	(Wh)	3600
Joules/second	(J/s)	British Thermal Units/hour	(Btu/h)	0.2931
Joules/second	(J/s)	Watts	(W)	1
Kilocalories/hour	(kcal/h)	Btu/hour	(Btu/h)	0.252
Kilograms	(kg)	Pounds	(lb)	0.4536
Kilograms/cubic meter	(kg/m^3)	Grams/cubic centimeter	(g/cm^3)	1000
Kilograms/cubic meter	(kg/m^3)	Pounds/cubic foot	(lb/ft^3)	16.02
Kilograms/square centimeter	(kg/cm^2)	Pounds/square inch	(psi)	0.07031
Kilojoules	(kJ)	Watt-hours	(Wh)	3.6
Kilojoules/kilogram	(kJ/kg)	British Thermal Units/pound	(Btu/lb)	2.326
Kilojoules/kilogram—°C	(kJ/kg—°C)	British Thermal Units/pound—°F	(Btu/lb—°F)	4.187
Kilometers/hour	(km/h)	Miles/hour	(mph)	1.609
Kilopascals	(kPa)	Pounds/square inch	(psi)	6.895
Kilowatts	(kW)	British Thermal Units/hour	(Btu/h)	0.0002931
Kilowatts	(kW)	Watts	(W)	0.001
Kilowatt-hours	(kWh)	British Thermal Units	(Btu)	0.0002931
Kilowatt-hours	(kWh)	Watt-hours	(Wh)	0.001
Liters	(l)	Cubic Feet	(ft^3)	28.32
Liters	(l)	Cubic Meters	(m^3)	1000
Liters	(l)	Gallons, U.S.	(gal)	3.785
Liters/second	(l/s)	Cubic feet/minute	(cfm)	0.4719
Liters/second	(l/s)	Gallons/minute	(gpm)	0.06309

CONTINUED

Formulas, Conversions and Engineering Constants

Continued

Conversion Factors

To Convert To...		Multiply...		By...
Meters	(m)	Feet	(ft)	0.3048
Meters/second	(m/s)	Feet/minute	(fpm)	0.00508
Miles/hour	(mph)	Kilometers/hour	(km/h)	0.6215
Millimeters	(mm)	Inches	(in)	25.4
Newtons/square meter	(N/m^2)	Pounds/square inch	(psi)	6,895
Ounces	(oz)	Grams	(g)	0.035274
Pounds	(lb)	Grams	(g)	0.002205
Pounds	(lb)	Kilograms	(kg)	2.205
Pounds/cubic foot	(lb/ft^3)	Grams/cubic centimeter	(g/cm^3)	62.43
Pounds/cubic foot	(lb/ft^3)	Kilograms/cubic meter	(kg/m^3)	0.06243
Pounds/cubic inch	(lb/in^3)	Grams/cubic centimeter	(g/cm^3)	0.03613
Pounds/square inch	(psi)	Bar		14.504
Pounds/square inch	(psi)	Kilograms/square centimeter	(kg/cm^2)	14.22
Pounds/square inch	(psi)	Kilopascals	(kPa)	0.145
Pounds/square inch	(psi)	Newtons/square meter	(N/m^2)	0.000145
Square centimeters	(cm^2)	Square feet	(ft^2)	929
Square centimeters	(cm^2)	Square inches	(in^2)	6.452
Square feet	(ft^2)	Square centimeters	(cm^2)	0.001076
Square feet	(ft^2)	Square meters	(m^2)	10.76
Square inches	(in^2)	Square centimeters	(cm^2)	0.155
Square meters	(m^2)	Square feet	(ft^2)	0.0929
Torr		Inches Mercury	(in. Hg)	0.03937
Torr		Pounds/square inch	(psi)	51.71
Watts	(W)	British Thermal Units/hour	(Btu/h)	0.2931
Watts	(W)	Joules/second	(J/s)	1
Watt-hours	(Wh)	British Thermal Units	(Btu)	0.2931
Watt-hours	(Wh)	Joules	(J)	0.0002778
Watt-hours	(Wh)	Kilojoules	(kJ)	0.2778
Watts/meter—°C	(W/m—°C)	$\frac{\text{British Thermal Units—inches}}{\text{hour-square foot—°F}}$	$\frac{\text{(Btu—in)}}{\text{(h-ft}^2\text{—°F)}}$	0.1442
Watts/square centimeter	(W/cm^2)	Watts/square inch	(W/in^2)	0.155
Watts/square inch	(W/in^2)	Watts/square centimeter	(W/cm^2)	6.452

Reference Data

Formulas, Conversions and Engineering Constants

Ohm's Law

Volts

Volts = $\sqrt{\text{Watts} \times \text{Ohms}}$

Volts = $\frac{\text{Watts}}{\text{Amperes}}$

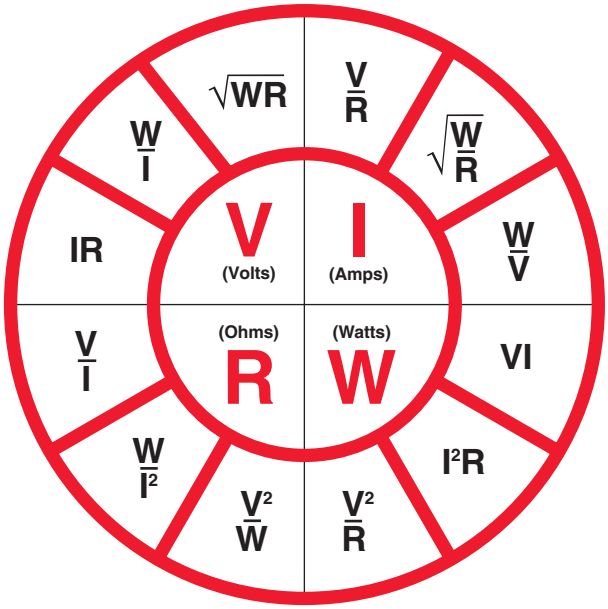
Volts = Amperes x Ohms

Amperes

Amperes = $\frac{\text{Volts}}{\text{Ohms}}$

Amperes = $\frac{\text{Watts}}{\text{Volts}}$

Amperes = $\sqrt{\frac{\text{Watts}}{\text{Ohms}}}$



Ohms

Ohms = $\frac{\text{Volts}}{\text{Amperes}}$

Ohms = $\frac{\text{Volts}^2}{\text{Watts}}$

Ohms = $\frac{\text{Watts}}{\text{Amperes}^2}$

Watts

Watts = $\frac{\text{Volts}^2}{\text{Ohms}}$

Watts = Amperes^2 x Ohms

Watts = Volts x Amperes

Wattage varies directly as ratio of voltages squared

$W_2 = W_1 \times \left(\frac{V_2}{V_1}\right)^2$

3-Phase Amperes = $\frac{\text{Total Watts}}{\text{Volts x 1.732}}$

Reference Data

Formulas, Conversions and Engineering Constants

Typical 3-Phase Wiring Diagrams and Equations for Resistive Heaters

Definitions

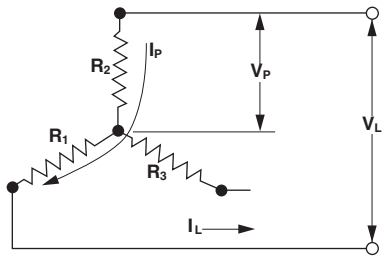
For Both Wye and Delta (Balanced Loads)

V_P = Phase Voltage
V_L = Line Voltage
I_P = Phase Current
I_L = Line Current
R = $R_1 = R_2 = R_3$ = Resistance of each branch
W = Wattage

Wye and Delta Equivalents

$W_{DELTA} = 3\ W_{WYE}$
$W_{ODELTA} = \frac{2}{3}\ W_{DELTA}$
$W_{OWYE} = \frac{1}{2}\ W_{WYE}$

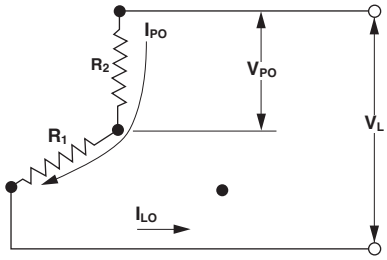
3-Phase Wye (Balanced Load)



Equations For Wye Only

$I_P = I_L$
$V_P = V_L/1.73$
$W_{WYE} = V_L^2/R = 3(V_P^2)/R$
$W_{WYE} = 1.73\ V_L I_L$

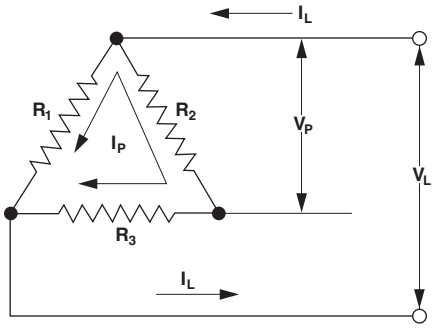
3-Phase Open Wye (No Neutral)



Equations For Open Wye Only
(No Neutral)

$I_{PO} = I_{LO}$
$V_{PO} = V_L/2$
$W_{0WYE} = 1/2\ (V_L^2/R)$
$W_{0WYE} = 2\ (V_{PO}^2/R)$

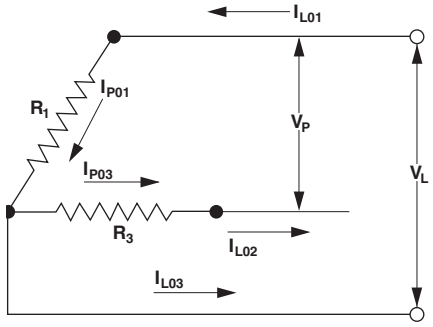
3-Phase Delta (Balanced Load)



Equations For Delta Only

$I_P = I_L/1.73$
$V_P = V_L$
$W_{DELTA} = 3\ (V_L^2)/R$
$W_{DELTA} = 1.73\ V_L I_L$

3-Phase Open Delta



Equations For Open Delta Only

$V_P = V_L$
$I_{PO1} = I_{PO3} = I_{LO2}$
$I_{LO3} = 1.73\ I_{PO1}$
$W_{0DELTA} = 2\ (V_L^2/R)$

Reference Data

Heat Loss Factors and Graphs

Heat Losses at 21°C (70°F) Ambient

How to use the graph for more accurate calculations

Convection curve correction factors:

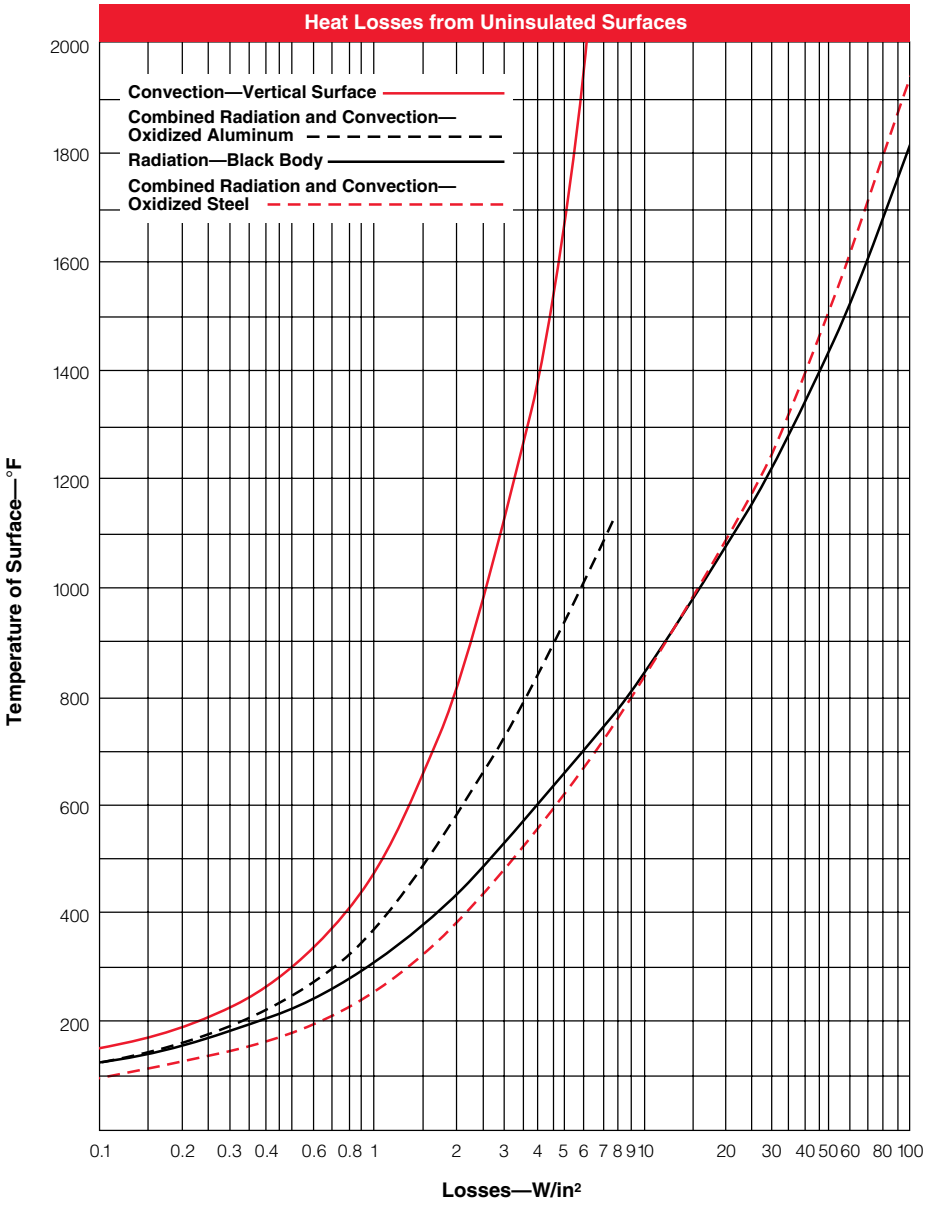
For losses from top surfaces or from horizontal pipes	Multiply convection curve value by 1.29
For side surfaces and vertical pipes	Use convection curve directly
For bottom surfaces	Multiply convection curve value by 0.63

Radiation Curve Correction Factors

The radiation curve shows losses from a perfect blackbody and are not dependent upon position. Commonly used block materials lose less heat by radiation than a blackbody, so correction factors are applied. These corrections are the emissivity (e) values listed to the right:

Total Heat Losses =

Radiation losses (curve value times e)
+ Convection losses (top)
+ Convection losses (sides)
+ Convection losses (bottom)
= Conduction losses
(where applicable)



Reference Data

Heat Loss Factors and Graphs

Helpful Hint: The graphs for losses from **uninsulated** and **insulated** surfaces are hard to read at low temperatures close to ambient. Here are two easy-to-use calculations that are only rule-of-thumb approximations when used within the limits noted.

Rule #1: Losses from an **uninsulated** surface (with an emissivity close to 1.0): (This applies only to temperatures between ambient and about 121°C (250°F))

$$\text{Losses } (W/in^2) = \frac{\Delta T\ (°F) \text{ rise above ambient}}{200}$$

Rule #2: Losses from an **insulated** surface: (This insulation is assumed to be one inch thick and have a K-value of about 0.5 Btu-in/hr - ft²-°F. Use only for surfaces less than 427°C (800°F.))

$$\text{Losses } (W/in^2) = \frac{\Delta T\ (°F) \text{ rise above ambient}}{950}$$

Some Material Emissivities/Metals

Material	Specific Heat Btu/lb-°F	Emissivity		
		Polished Surface	Medium Oxide	Heavy Oxide
Blackbody			0.75	1.00
Aluminum	0.24	0.09	0.11	0.22
Brass	0.10	0.04	0.35	0.60
Copper	0.10	0.04	0.03	0.65
Incoloy® 800	0.12	0.20	0.60	0.92
Inconel® 600	0.11	0.20	0.60	0.92
Iron, Cast	0.12	—	0.80	0.85
Lead, solid	0.03	—	0.28	—
Magnesium	0.23	—	—	—
Nickel 200	0.11	—	—	—
Nichrome, 80-20	0.11	—	—	—
Solder, 50-50	0.04	—	—	—
Steel				
mild	0.12	0.10	0.75	0.85
stainless 304	0.11	0.17	0.57	0.85
stainless 430	0.11	0.17	0.57	0.85
Tin	0.056	—	—	—
Zinc	0.10	—	0.25	—

Some Material Emissivities/Non-Metals

Material	Specific Heat Btu/lb-°F	Emissivity
Asbestos	0.25	Most non-metals: 0.90
Asphalt	0.40	
Brickwork	0.22	
Carbon	0.20	
Glass	0.20	
Paper	0.45	
Plastic	0.2-0.5	
Rubber	0.40	
Silicon Carbide	0.20-0.23	
Textiles	—	
Wood, Oak	0.57	

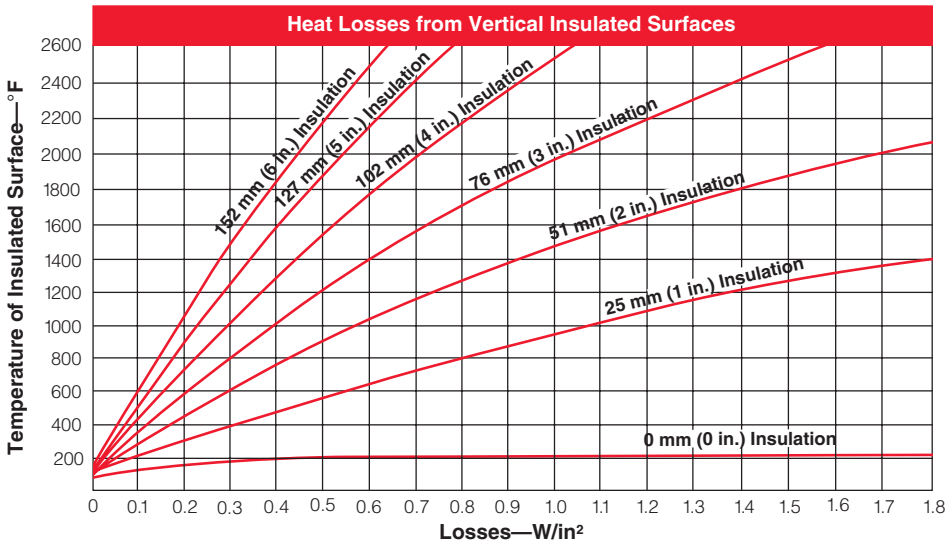
Additional information on emissivities is available from Watlow.

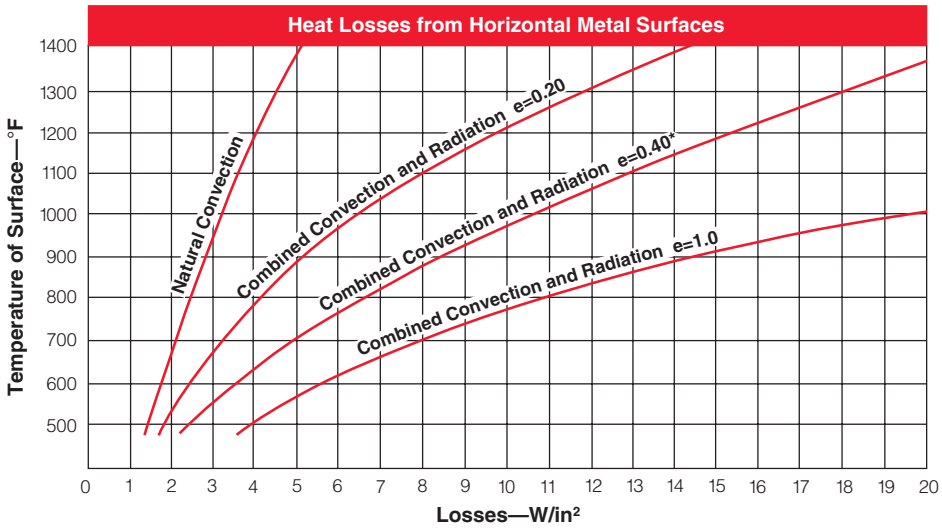
Incoloy® is a registered trademark of Special Metals Corporation.
Inconel® is a registered trademark of Special Metals Corporation.

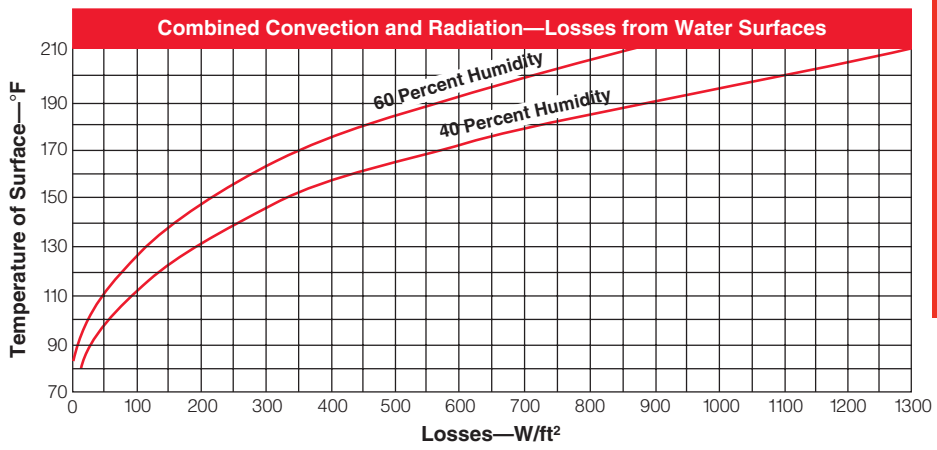
Reference Data

Heat Loss Factors and Graphs

1. Based upon combined natural convection and radiation losses into 21°C (70°F) environment.
2. Insulation characteristics
   k = 0.67 @ 93°C (200°F)
   k = 0.83 @ 537°C (1000°F)
3. For molded ceramic fiber products and packed or tightly packed insulation, losses will be lower than values shown.
   For 2 or 3 inches Insulation multiply by 0.84
   For 4 or 5 inches Insulation multiply by 0.81
   For 6 inches Insulation multiply by 0.79

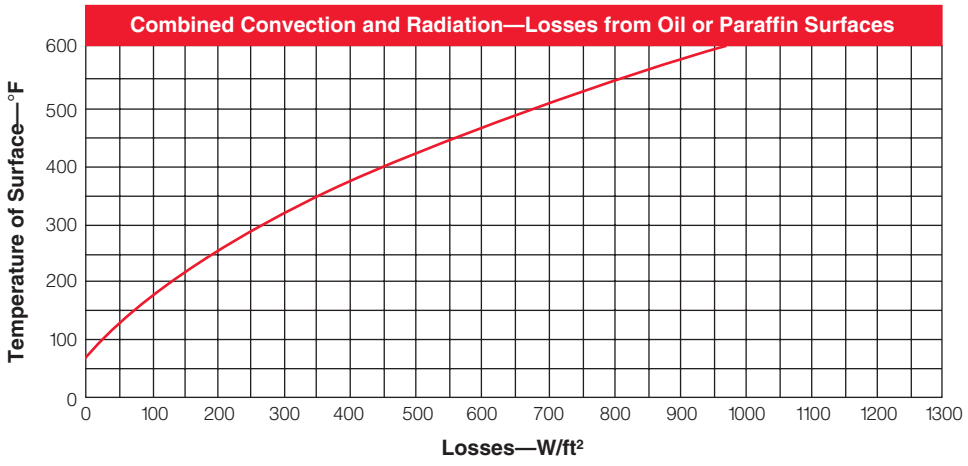


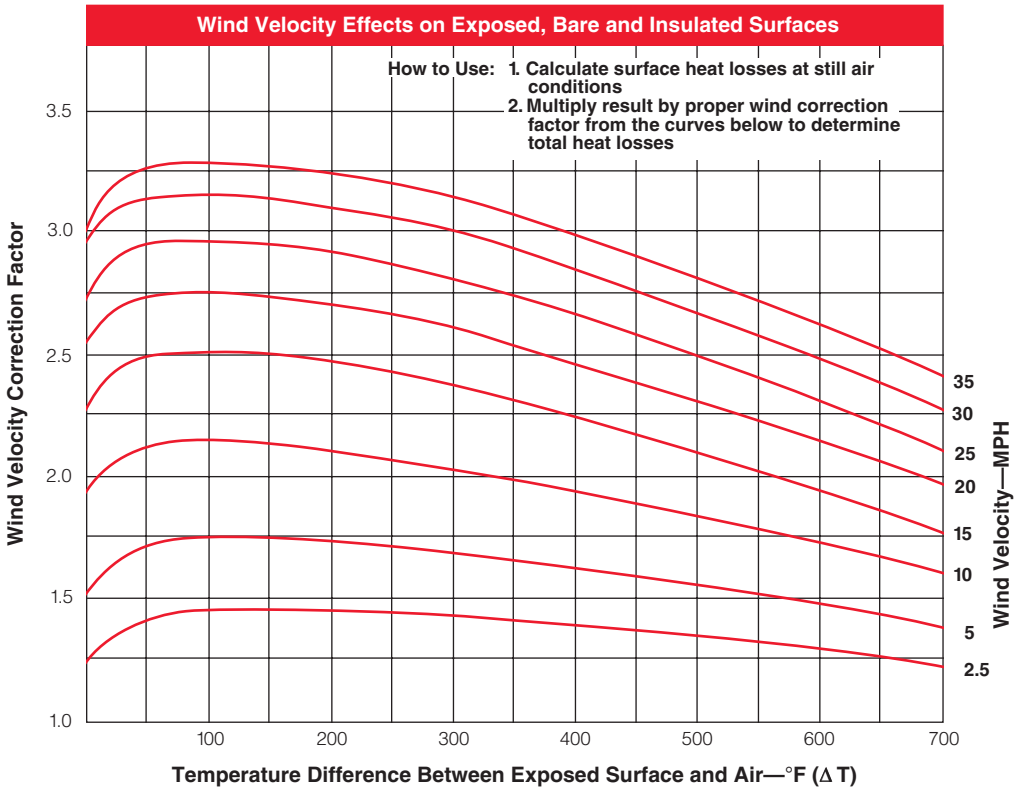




* For losses of molten metal surfaces, use the curve e=0.40.

Heat Loss Factors and Graphs
Continued





Reference Data

Quick Estimates of Wattage Requirements

The following tables can be used to make quick estimates of wattage requirements.

For Steel:

Use table or metric equation.

$$kW = \frac{\text{Kilograms} \times \text{Temperature Rise (°C)}}{5040 \times \text{Heat-up Time (hrs.)}}$$

$$kW = \frac{\text{Pounds} \times \text{Temperature Rise (°F)}}{20{,}000 \times \text{Heat-up Time (hrs.)}}$$

Kilowatt-Hours to Heat Steel*

Amount of Steel (lbs.)	Temperature Rise °F						
	50°	100°	200°	300°	400°	500°	600°
	Kilowatts to Heat in One Hour						
25	0.06	0.12	0.25	.37	0.50	0.65	0.75
50	0.12	0.25	0.50	.75	1.00	1.25	1.50
100	0.25	0.50	1.00	1.50	2.00	2.50	3.00
150	0.37	0.75	1.50	2.25	3.00	3.75	4.50
200	0.50	1.00	2.00	3.00	4.00	5.00	6.00
250	0.65	1.25	2.50	3.75	5.00	6.25	7.50
300	0.75	1.50	3.00	4.50	6.00	7.50	9.00
400	1.00	2.00	4.00	6.00	8.00	10.00	12.00
500	1.25	2.50	5.00	7.50	10.00	12.50	15.00
600	1.50	3.00	6.00	9.00	12.00	15.00	18.00
700	1.75	3.50	7.00	10.50	14.00	17.50	21.00
800	2.00	4.00	8.00	12.00	16.00	20.00	24.00
900	2.25	4.50	9.00	13.50	18.00	22.50	27.00
1000	2.50	5.00	10.00	15.00	20.00	25.00	30.00

* Read across in table from nearest amount in pounds of steel to desired temperature rise column and note kilowatts to heat in one hour. Includes a 40 percent safety factor to compensate for high heat losses and/or low power voltage.

For Oil:

Use equation or table.

$$kW = \frac{\text{Gallons} \times \text{Temperature Rise (°F)}}{800 \times \text{Heat-up time (hrs.)}}$$

OR

$$kW = \frac{\text{Liters} \times \text{Temperature Rise (°C)}}{1680 \times \text{Heat-up time (hrs.)}}$$

1 cu. ft. = 7.49 gallons

Kilowatt-Hours to Heat Oil*

Amount of Oil		Temperature Rise °F					
Cubic Feet	Gallons	50°	100°	200°	300°	400°	500°
0.5	3.74	0.3	0.5	1	2	2	3
1.0	7.48	0.5	1.0	2	3	4	6
2.0	14.96	1.0	1.0	2	4	6	11
3.0	22.25	2.0	3.0	6	9	12	16
4.0	29.9	2.0	4.0	8	12	16	22
5.0	37.4	3.0	4.0	9	15	20	25
10.0	74.8	5.0	9.0	18	29	40	52
15.0	112.5	7.0	14.0	28	44	60	77
20.0	149.6	9.0	18.0	37	58	80	102
25.0	187	11.0	22.0	46	72	100	127
30.0	222.5	13.0	27.0	56	86	120	151
35.0	252	16.0	31.0	65	100	139	176
40.0	299	18.0	36.0	74	115	158	201
45.0	336.5	20.0	40.0	84	129	178	226
50.0	374	22.0	45.0	93	144	197	252
55.0	412	25.0	49.0	102	158	217	276
60.0	449	27.0	54.0	112	172	236	302
65.0	486	29.0	58.0	121	186	255	326
70.0	524	32.0	62.0	130	200	275	350
75.0	562	34.0	67.0	140	215	294	375

* Read across in table from nearest amount in gallons of liquids to desired temperature rise column and note kilowatts to heat in one hour. Add 5 percent for uninsulated tanks.

Reference Data

Quick Estimates of Wattage Requirements
Continued

* Read across in table from nearest amount in gallons of liquid to desired temperature rise column and note kilowatts to heat in one hour.

For Heating Flowing Water:

kW = GPM x Temperature Rise (°F) x 0.16

OR

kW = Liters/min. x Temperature Rise (°C) x 0.076

For Heating Water in Tanks:

Use equation or table.

$$kW = \frac{\text{Gallons} \times \text{Temperature Rise (°F)}}{375 \times \text{Heat-up Time (hrs)}}$$

OR

$$kW = \frac{\text{Liters} \times \text{Temperature Rise (°C)}}{790 \times \text{Heat-up Time (hrs)}}$$

1 cu. ft. = 7.49 gallons

Kilowatt-Hours to Heat Water*

Amount of Liquid		Temperature Rise °F						
ft^3	Gallons	20°	40°	60°	80°	100°	120°	140°
		Kilowatts to Heat in One Hour						
0.66	5	0.3	0.5	0.8	1.1	1.3	1.6	1.9
1.3	10	0.5	1.1	1.6	2.1	2.7	3.2	3.7
2.0	13	0.8	1.6	2.4	3.2	4.0	4.8	5.6
2.7	20	1.1	2.2	3.2	4.3	5.3	6.4	7.5
3.3	25	1.3	2.7	4.0	5.3	6.7	8.0	9.3
4.0	30	1.6	3.2	4.8	6.4	8.0	9.6	12.0
5.3	40	2.1	4.0	6.4	8.5	11.0	13.0	15.0
6.7	50	2.7	5.4	8.0	10.7	13.0	16.0	19.0
8.0	60	3.3	6.4	9.6	12.8	16.0	19.0	22.0
9.4	70	3.7	7.5	11.2	15.0	19.0	22.0	26.0
10.7	80	4.3	8.5	13.0	17.0	21.0	26.0	30.0
12.0	90	5.0	10.0	14.5	19.0	24.0	29.0	34.0
13.4	100	5.5	11.0	16.0	21.0	27.0	32.0	37.0
16.7	125	7.0	13.0	20.0	27.0	33.0	40.0	47.0
20.0	150	8.0	16.0	24.0	32.0	40.0	48.0	56.0
23.4	175	9.0	18.0	28.0	37.0	47.0	56.0	65.0
26.7	200	11.0	21.0	32.0	43.0	53.0	64.0	75.0
33.7	250	13.0	27.0	40.0	53.0	67.0	80.0	93.0
40.0	300	16.0	32.0	47.0	64.0	80.0	96.0	112.0
53.4	400	21.0	43.0	64.0	85.0	107.0	128.0	149.0
66.8	500	27.0	53.0	80.0	107.0	133.0	160.0	187.0

Kilowatt-Hours to Superheat Steam

1. Plot points on lines P, Q and S.

   P represents the inlet temperature (and saturation pressure) of the system.

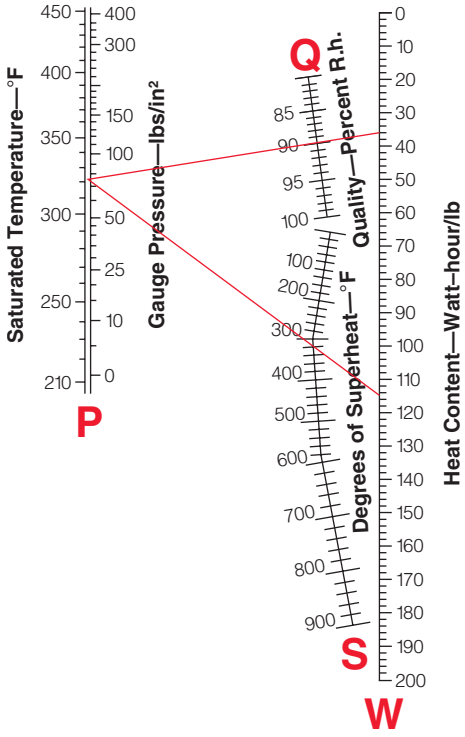
   Q represents the liquid content of the water vapor.

   S indicates the outlet temperature minus the saturated temperature.

   W indicates the heat content of the water vapor.
2. Draw a straight line from P through Q to W. Read W_1.
3. Draw a straight line from P through S to W. Read W_2.
4. Required watts = Weight (lbs.) of steam/hour x (W_2-W_1).

Watt density is critical. Review temperature and velocity prior to heater selection.

Reference is 80 percent quality at 20 psig.



Reference Data

Quick Estimates of Wattage Requirements
Continued

Kilowatt-Hours to Heat Air

Amt. of Air CFM	Temperature Rise °F										
	50°	100°	150°	200°	250°	300°	350°	400°	450°	500°	600°
100	1.7	3.3	5.0	6.7	8.3	10.0	11.7	13.3	15.0	16.7	20.0
200	3.3	6.7	10.0	13.3	16.7	20.0	23.3	26.7	30.0	33.3	40.0
300	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	60.0
400	6.7	13.3	20.0	26.7	33.3	40.0	46.7	53.3	60.0	66.7	80.0
500	8.3	16.7	25.0	33.3	41.7	50.0	58.3	66.7	75.0	83.3	100.0
600	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	120.0
700	11.7	23.3	35.0	46.7	58.3	70.0	81.7	93.3	105.0	116.7	140.0
800	13.3	26.7	40.0	53.3	66.7	80.0	93.3	106.7	120.0	133.3	160.0
900	15.0	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0	150.0	180.0
1000	16.7	33.3	50.0	66.7	83.3	100.0	116.7	133.3	150.0	166.7	200.0
1100	18.3	36.7	55.0	73.3	91.7	110.0	128.3	146.7	165.0	183.3	220.0
1200	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0	200.0	240.0

Use the maximum anticipated airflow. This equation assumes insulated duct (negligible heat loss). 21°C (70°F) inlet air and 14.7 psia.

For Air:

Use equation or table.

$$kW = \frac{CFM^* \times \text{Temperature Rise (°F)}}{3000}$$

OR

$$kW = \frac{\text{Cubic Meters/Min}^* \times \text{Temperature Rise (°C)}}{47}$$

For Compressed Air:

$$kW = \frac{CFM^{**} \times \text{Density}^{**} \times \text{Temperature Rise (°F)}}{228}$$

OR

$$kW = \frac{\text{Cubic Meters/Min}^{**} \times \text{Temperature Rise (°C)} \times \text{Density (kg/m}^3)^{**}}{57.5}$$

*Measured at normal temperature and pressure.

**Measured at heater system inlet temperature and pressure.

Reference Data

Power Controllers

The discrete output device that acts in response to a deliberate guidance from the temperature controller is the power controller.

There are four common power controllers: electromechanical relays, mercury displacement relays, solid state relays and silicon controlled rectifiers (SCRs). The first one uses magnetic devices to actuate power switching. The latter two use solid state electronics to effect the switching function. The selection of a specific power controller type depends on the method of control being used, system power demands, degree of temperature control (accuracy to set point), the heater type and heater life requirements.

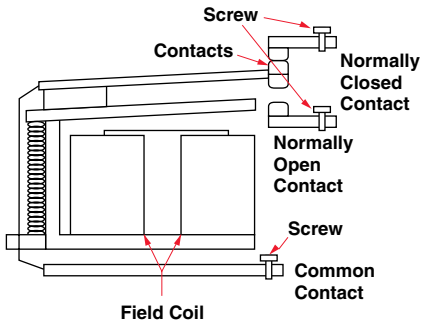
Watlow manufactures a wide range of solid state relays and SCR power controllers in ratings to meet almost all power switching needs. Each is manufactured to the highest standards of reliability and performance. For more information specific to power controller types, models and ratings, see the “Power Controllers” product section of Take Control With Integrated Thermal Control Systems catalog.

Four Basic Types:

The **electromechanical contactor, or relay** is an electrical and mechanical device with moving parts. When power is applied to the relay solenoid, contact closure is created through movement of the relay’s “common” contact.

1. Electromechanical Relay

Because this contactor has moving parts, it is susceptible to vibration or mechanical failure. The closure of the contacts when powered results in contact failure through burning and pitting, which, in fact, is the primary



reason for failure of an electromechanical relay. A general guideline for projecting the life of higher quality mechanical relays is as follows:

1. 100,000 cycles at full rated load
2. 500,000 cycles at ⅔ rated load
3. 1,000,000 cycles at ⅓ rated load

Electromechanical contactors provide a positive circuit break. This is important in many circuits. This contrasts with solid state devices which almost always have a small amount of leakage current flow.

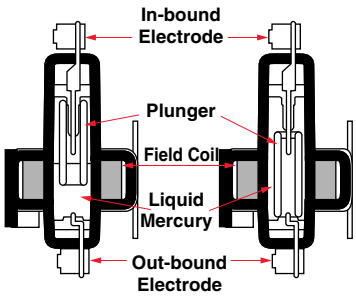
Electromechanical contactors can be mounted in almost any position and are much easier to install and service than many solid state switches. They are offered with normally open and normally closed contacts, with a very slight cost differential for both contacts.

Reference Data

Power Controllers

Four Basic Types
Continued

2. Mercury Displacement Relay (MDR)

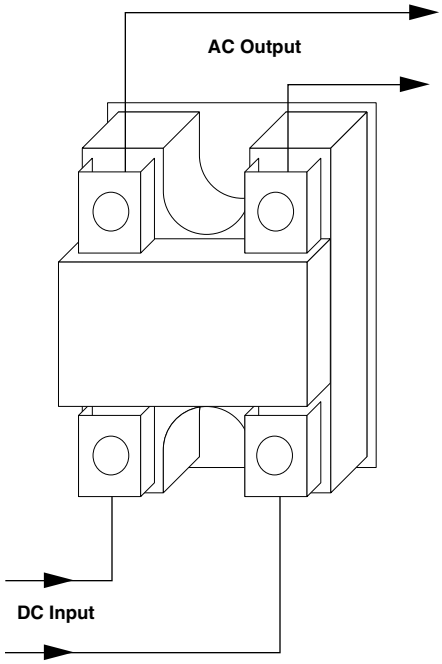


Watlow No Longer Manufactures Mercury Displacement Relays (MDRs)

Because MDRs contain mercury, they should not be placed in normal waste streams (trash barrel). Mercury is listed as a hazardous material and therefore all MDRs are required by law to be recycled and or disposed of properly. To promote the responsible handling of mercury Watlow has provided the following link to an approved recycling facility:

http://www.watlow.com/products/controllers/co_mdr.cfm

3. Solid State Relays



Solid state switching devices have no moving parts and consequently, no mechanical failures. Solid state switches are resistant to shock and vibration. The absence of moving parts also makes them noise-free (they produce no audible sound). The most important factor affecting service life is its ambient operating temperature. Solid state devices are very durable, **if they are operated within tolerable ambient temperatures.** Failure to dissipate the heat generated by any solid state component will quickly destroy it. Location and heatsinking must be adequate.

Watlow solid state relays accept a time proportioned or on-off signal from a controller.

Watlow's solid state relays change state near zero volts, which is burst firing. They are also optically isolated, which means the output circuitry is energized by infrared light striking a photosensitive device. This minimizes electrically generated noise, plus output to input electrical isolation.

Because solid state relays can operate at much faster cycle times than electromechanical relays, they should be employed where extremely tight process control is required.

Disadvantages of solid state relays include the inability to provide a positive circuit break, the initial cost and their failure mode when misapplied or subjected to overrated conditions. The failure modes include burnout of the switch if the system heater shorts out; reduction in switching capabilities as the ambient temperatures rise; and susceptibility to failure caused by line transients and inductive loads.

These failure modes can be eliminated to a great degree by proper fusing of switches for overload conditions, increasing the heat sinking (the overall size) for high ambients, and filtering for the transients and inductive loads. Each of these will increase the cost of the solid state relay.

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Power Controllers

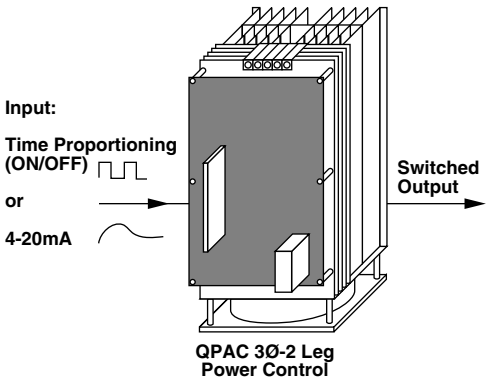
Four Basic Types

Continued

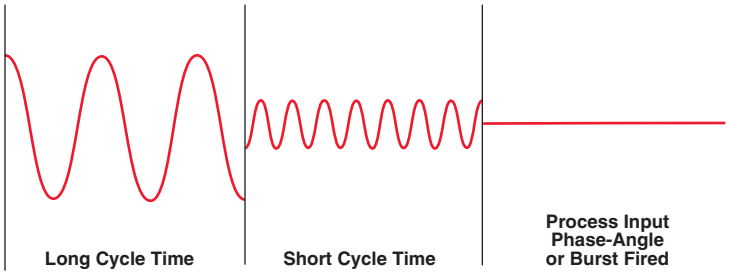
4. SCR (Silicon Controlled Rectifier)

The Watlow SCR (silicon controlled rectifier) is a solid state switching device that can switch up to a 1200 amp load. A correctly chosen SCR can reduce system cost by improving heater life and process controllability.

SCR Power Controller



Reduced Temperature Excursions



Watlow SCR power controllers can accept two types of input signals; time proportioned (or on-off) and process signals (either 4-20mA or 1-5V⎓(dc) from any temperature control. SCRs accepting time proportioned (or on-off) signals are generally called "power contactors." SCRs accepting process signals (4-20mA or 1-5VDC) are generally called "power controllers." They control the power by two methods of firing, phase-angle and variable time base burst firing.

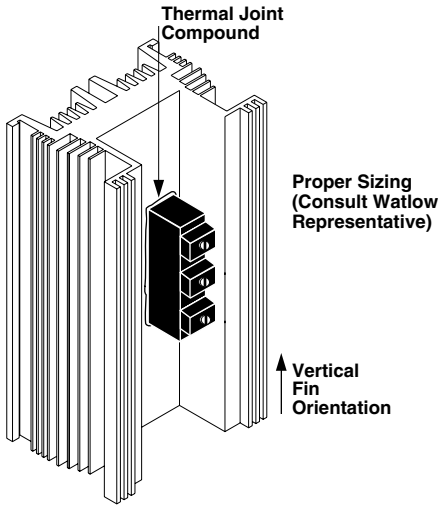
The primary advantages of SCR power controllers are their flexible input options, lack of moving parts, long life, improved controllability and tremendous current handling capability.

A Watlow SCR can improve system performance with increased heater life through the rapid switching an SCR provides.

All SCRs, including Watlow's, require a proper heat sink. Heat is the inevitable by-product of solid state power switching.

The Power Switching Device Comparison Chart details differences among the controllers listed above. The criteria for judging these devices, as well as some basics for understanding SCRs, will follow in this section.

Proper Heat Sinking



- Vertical fin orientation
- Proper size
- Thermal compound between heat sink and solid state device

Reference Data

Power Controllers

Four Basic Types

Continued

4a. DIN-A-MITE® SCR Power Controller

The DIN-A-MITE® Power controller combines SCR control, heat sink, wiring and a touch safe exterior in one complete package. The DIN-A-MITE controller configured with variable time base switches as fast as three ac wave cycles (less than 0.1 seconds). Set point deviation is virtually eliminated, providing the finest control, lowest power consumption and longest heater element life.

Power Output Types:

One pole	Single-phase loads
Two pole	Three-phase ungrounded loads only Two pole multizone for two independent single-phase loads
Three pole	Three-phase grounded Y loads, inside delta Three pole multizone for three independent single-phase loads

Type of Control:

Contactor (C input) is on-off; on when the command signal is present, off when the command signal is absent. The temperature controller does the proportioning. It is available with ac or dc command signal.

Variable time base (V input) is loop powered and requires an analog input (4 to 20 mA only) to set the power. The DIN-A-MITE controller does the proportioning. At 50 percent power the load is on for 3 cycles and off for three cycles. At 25 percent power it is on three cycles and off nine. Cannot use voltage or pot input.

Phase-angle (P input) control is infinitely variable from full off to full on. It varies the turn-on time inside the sine wave. This provides a variable voltage and current control. This option includes soft start, line voltage compensation and will work with a mA signal, a linear voltage signal or a pot input. It will also control the primary of a step down transformer. (This is single-phase only.)

The shorted SCR alarm option uses a current transformer to sense load current and a comparator to look at load current and command signal. If there is command signal and load current, everything is OK. If there is load current but no command signal, the alarm will activate. The alarm output is a 0.25 amp triac that can be used to turn on a relay. The alarm will not work on the phase angle option and also will not work on a three pole DIN-A-MITE with an ungrounded load.

Reference Data

Replacement Controllers

Existing Controller	Suggested New Replacement
SERIES 93	SERIES SD6C
SERIES 94	SERIES SD6L
SERIES 935	SERIES SD31 or SD3C
SERIES 945	SERIES SD_C
SERIES 988LF	SERIES SD_C
SERIES 101	SERIES CV
SERIES 102	SERIES CV
SERIES 103	SERIES CV
SERIES 104	SERIES CV or SERIES CF
SERIES 942	SERIES 96_AA or SERIES SD4R
SERIES 142	SERIES LV or SERIES LF
SERIES 145	SERIES LV
SERIES 146	SERIES LV
SERIES 147	SERIES LV or SERIES LF
SERIES 550	SERIES TM
SERIES 733/734	SERIES N7
MDR	E-SAFE® RELAY

Reference Data

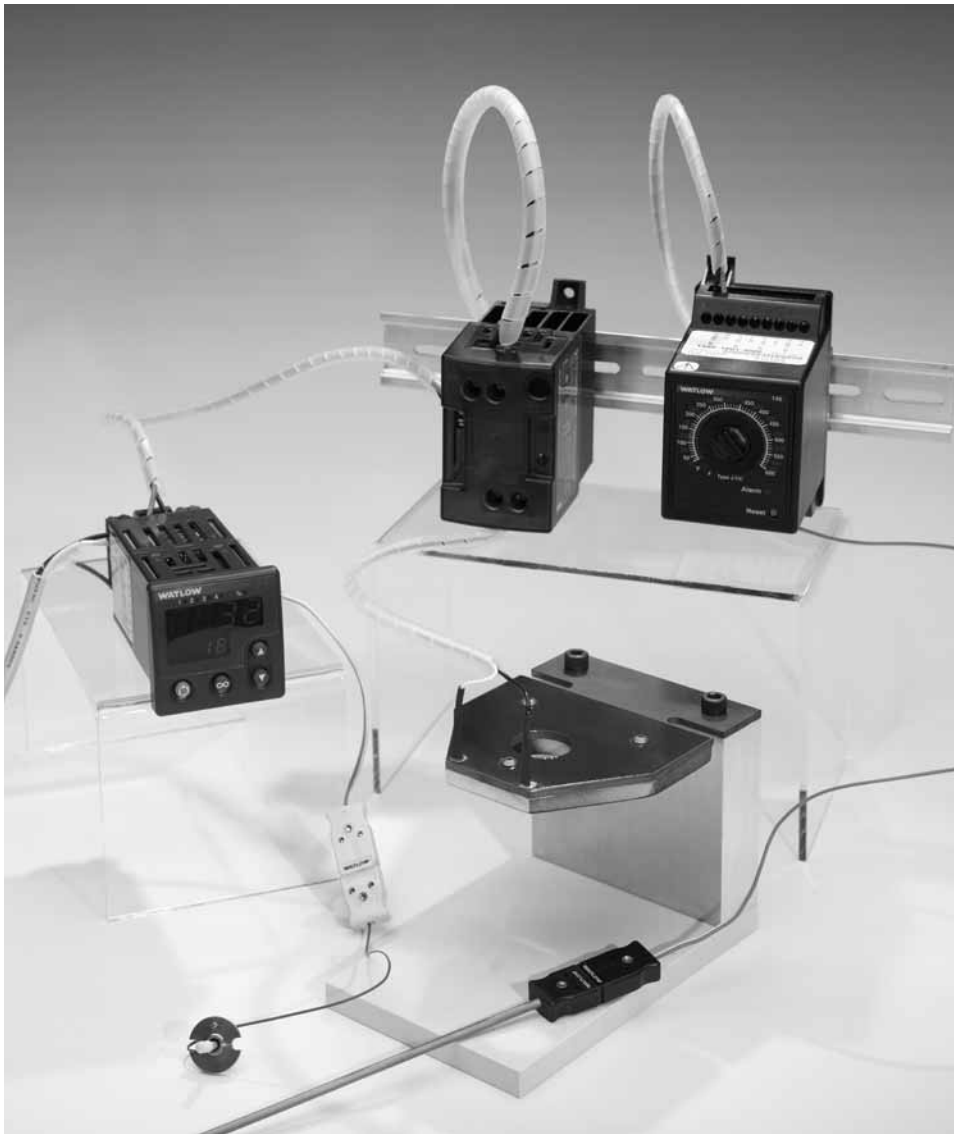
Wiring Practices

This section is devoted to thermal system wiring practices. In this section are general guidelines for successful integration of the different thermal system components—heaters, temperature sensors, temperature controllers and power controllers. This section **is not** a step-by-step, how-to manual. It is your responsibility to be sure your wiring is safe and meets the requirements of applicable agency standards along with national and local electrical codes. If you're unable to determine which method of wiring will best suit your needs, call your nearest Watlow Sales Representative. Their experience with all types of thermal systems makes them an invaluable source for advice. Sales offices are listed on the back cover of this catalog.

System wiring is divided into two main areas—signal wiring and power wiring. Signal wiring deals with input signals (generated by the temperature sensor) and output signals (generated by the temperature controller). Power wiring deals with supply power to the temperature and power controllers and the current that's ultimately delivered to the heating element.

Signal wiring is less straight forward than power wiring. Not only does it have to conform to circuit designs, but must also be installed in such a way as to minimize the negative effects of electrical noise present in any thermal system.

This section will start with wiring sensors to controllers and then wiring power controllers to temperature controllers. It also offers limit control wiring examples which provide a comprehensive system overview.



Wiring Practices for a Successful Control System

Not long ago the majority of industrial thermal systems were controlled by electrical/mechanical devices that were fairly immune to the negative effects of electrical noise. The shortest path for the wire was the best and only path. Noise resistant wiring practices just weren't a concern. With the advent of today's electronic controllers, awareness of techniques to minimize the disrupting effects of electrical "noise" is critical.

Wiring Practices

Electrical Noise

What is Electrical Noise?

It is electrical signals, which produce undesirable effects in the electronic circuits of the control system. The term "electrical noise" originated with AM radios when the extraneous "noise" heard in the speaker was caused by lightning or other sources of electrical arcing. Electrical noise from all sources and its effects on controllers are very difficult to define, let alone give exact rules on how to prevent. Noise sensitivity is a function of more recent electronic controller designs. However, the majority of noise problems stem from crude wiring practices and techniques which allow "coupling" or the transfer of electrical noise into the control circuit.

An outstanding resource for information about wiring guidelines (source for this summary) is the **IEEE Standard No. 518-1982** and is available from IEEE, Inc., 345 East 47th Street, New York, NY 10017; phone number: 800-678-4333.

When is Electrical Noise a Problem?

Symptoms resulting from an electrically noisy environment are difficult to predict. One common symptom is an erratic system, with no evidence of a problem appearing consistently. Even worse, the system may exhibit several different symptoms.

Some other commonplace symptoms of noise-related problems are fluctuating digital indicators, blanked digital indicators, control instability about set point, and outputs turning ON or OFF unexpectedly. Another "red flag" of electrical noise raises when high or low limits trip with no limit fault condition.

Why is Electrical Noise Sensitivity a Problem?

How accurately a controller can differentiate between desired system signals and electrical noise is a good indicator of its sensitivity to noise. In general, high power controllers such as mechanical relays or mercury displacement relays have low noise sensitivity, while low power controllers that use electronic logic, especially those using integrated circuits, are more sensitive to noise. The development of all electronic solid state controllers has improved the accuracy of control and expanded immensely their capabilities, but they are more complex and operate at very low power levels. Electrical noise is more likely to affect them because of their lower operating power levels.

Where Does Electrical Noise Come From?

Our industrial world is full of equipment capable of generating many types of electrical noise. A typical noise source is any piece of equipment that can cause or produce very rapid or large amplitude changes in voltage or current when turned on and off.

Noise Sources:

- Switches and relay contacts operating inductive loads such as motors, coils, solenoids, and relays, etc.
- Thyristors or other semiconductor devices which are not burst fired (randomly-fired or phase angle-fired devices)
- All welding machinery
- Heavy current carrying conductors
- Fluorescent and neon lights
- Thermal voltages between dissimilar metals that influence the low voltage thermocouple input signal
- Chemical voltage produced by electrolyte action between poorly connected leads and interconnect cables
- Thermal noise from increased ambient temperatures around the circuit electronics
- Noise could be introduced if the control circuit includes the option of a mechanical relay output and is used to switch high load currents over two or three amps. This presents a significant source for noise, including inductive noise from the coil and contact arcing, depending on how much power is brought inside the controller.

Thermocouple and Extension Wire Color Codes

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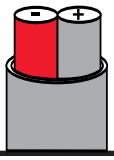
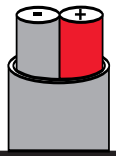
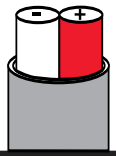
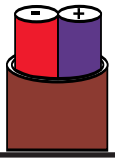
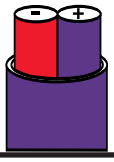
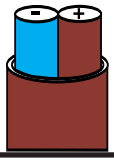
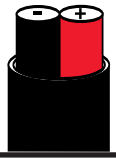
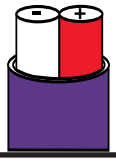
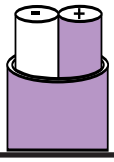
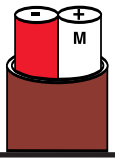
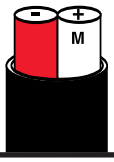
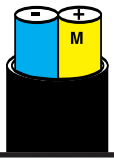
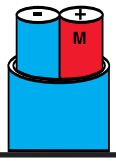
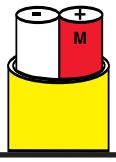
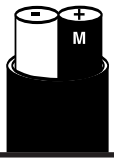
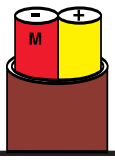
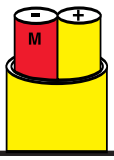
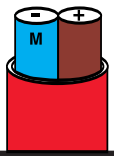
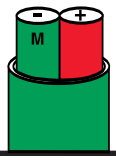
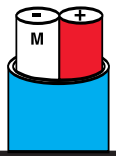
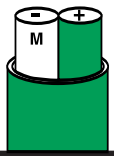
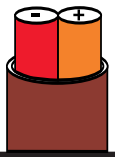
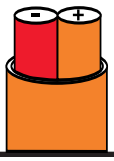
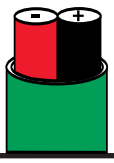
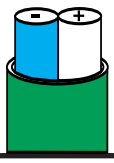
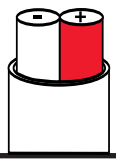
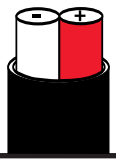
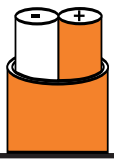
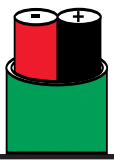
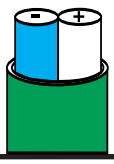
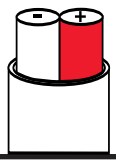
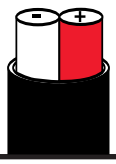
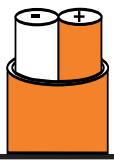
Type B						
Type E						
Type J						
Type K						
Type N						
Type R						
Type S						
Type T