FIREBAR® Flat Tubular Heaters

heaters | sensors | controllers

WATLOW®

Better Thermal Solutions...*Faster*

FIREBAR® . . . A SOLUTION TO YOUR HEATER PROBLEMS

For over half a century, people have been using round tubular heating elements for surface heating. The Watlow® FIREBAR® flat tubular heater is an innovative concept that provides a wide array of design improvements.

A SOLUTION TO HEATER POWER AND RESPONSIVENESS PROBLEMS

In oil and other viscous materials, a FIREBAR flat tubular heater operates at a higher watt density than a round tubular heating element without changing the sheath temperature. The FIREBAR heater also enables you to place more wattage into applications at the same watt density without using a longer heating element.

Due to its unique design and geometry, a FIREBAR heater often heats fluids from ambient temperatures faster than round tubular elements, while using the same wattage and lower sheath temperatures.

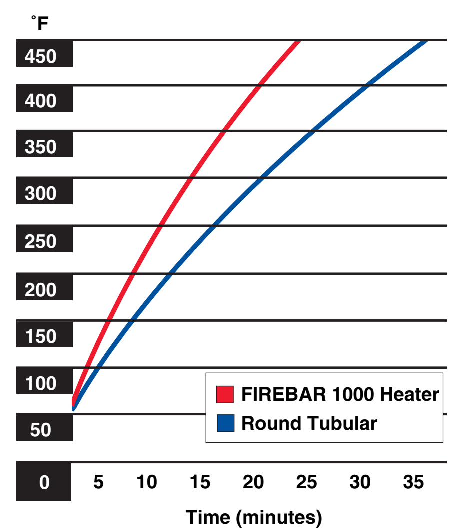
A SOLUTION TO ENERGY EFFICIENCY

FIREBAR flat tubular heater performance in cooking oil instead of a round tubular makes it a perfect choice to combine with Watlow temperature and power controllers for the best solution for energy efficiency. The FIREBAR has been tested in equipment to ASTM F1361. This is the standard test method for the performance of open deep fat fryers.

When direct immersion in liquid is not practical, FIREBAR elements may be clamped to tank walls. FIREBAR's large flat surface area enables it to efficiently transfer heat to the tank walls and into the media. The larger contact area afforded by the FIREBAR design enables the heater to operate at lower coil and sheath temperatures and allows for longer heater life.

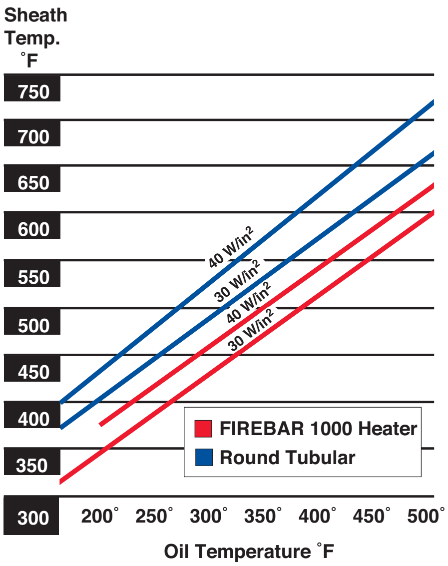
A SOLUTION TO HEATER LIFE PROBLEMS

Reducing watt density or sheath temperature extends the life of any heater. The FIREBAR heater allows you to do either without changing equipment performance.



FIREBAR 1000 Heater Oil Test 30 W/in² (4.6 W/cm²)
Immersed in a light oil (liquid shortening), a 30 W/in² (4.6 W/cm²) FIREBAR heating element heated the oil in the work zone from ambient temperatures faster than a 30 W/in² (4.6 W/cm²) round tubular element. The average sheath temperature of the FIREBAR heater was also 50ºF (10ºC) lower than the round element.

Watlow® and FIREBAR® are registered trademarks of Watlow Electric Manufacturing Company.

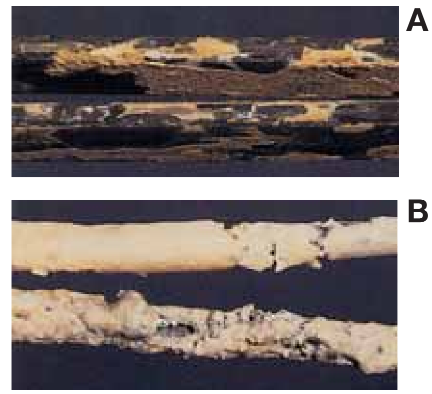


FIREBAR 1000 Heater Oil Test 40 W/in^2 (6.2 W/cm^2)
Tested at different temperatures in light oil, the sheath temperature of a FIREBAR heater is constantly lower than a round tubular element. In fact, the sheath temperature of the FIREBAR heater at a 40 W/in^2 (6.2 W/cm^2) is lower than a 30 W/in^2 (4.6 W/cm^2) round tubular.

A Solution to Heater Scaling and Coking and Fluid Degrading Problems

The thin profile on top of FIREBAR heating elements provides little space for solids to settle. The velocity of fluid flowing past the flat surface of a FIREBAR element also has a "wiping" effect on the surface of the heater. In oil or similar products where coking is a problem, the round tubular heating element's sheath temperature may be too high. FIREBAR heaters provide the benefit of a lower sheath temperature than a round tubular element, without reducing wattage or watt density.

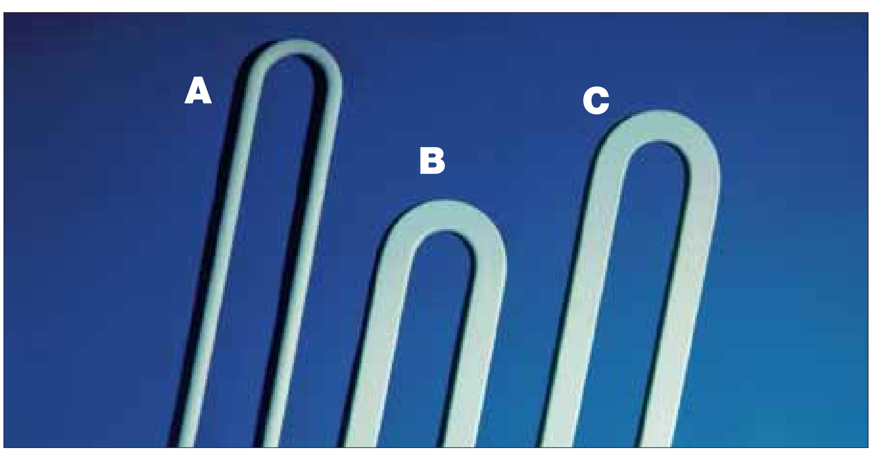
In many applications, scale actually pops off FIREBAR heaters. Because of its geometry, the heater "breathes," breaking many types of scale and deposits off the heater sheath. This breakage usually depends on heater cycles as well as operation time.



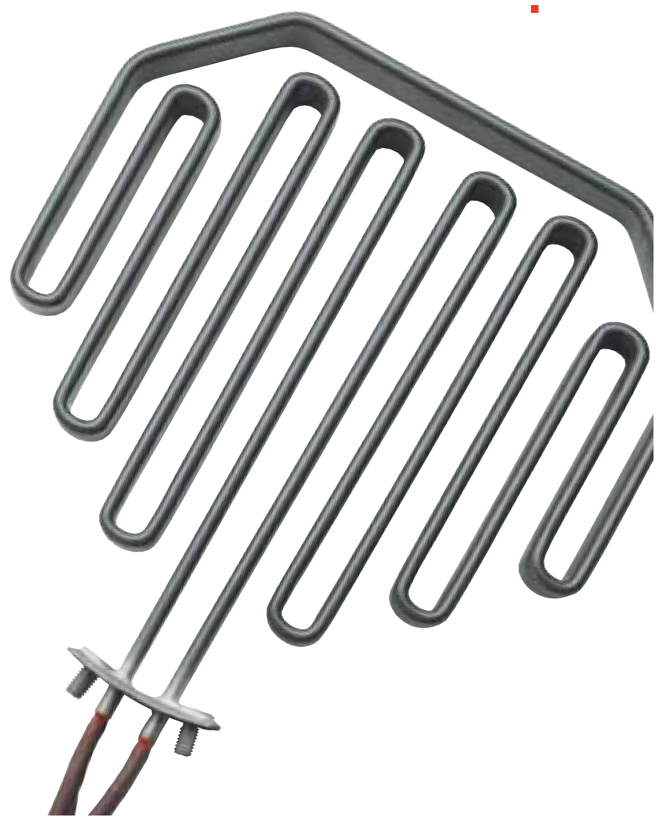
In an accelerated scaling test, researchers operated a 6000 watt FIREBAR heater side-by-side a 6000 watt, 0.315 in. (8 mm) round tubular element in a water heating application. Researchers added dehydrated lime to the water each day to accelerate scaling. Within four days, the scale on the round tubular element (heater B above) was thick enough to cause failure. The scale had built up to a thickness of $1/16$ in. (4.1 mm), completely encompassing the sheath. The FIREBAR heater (heater A above) showed no signs of significant scaling other than small patches less than $1/32$ in. (8.1 mm) thick. The majority of scale was flaking off the heater.

A Solution to Heater Size Problems

Providing the same wattage and watt density, a FIREBAR heater is 41 percent shorter than a 0.430 in. (10.9 mm) diameter round tubular heating element. The FIREBAR heater allows you to add power in equipment designs without needing additional space.

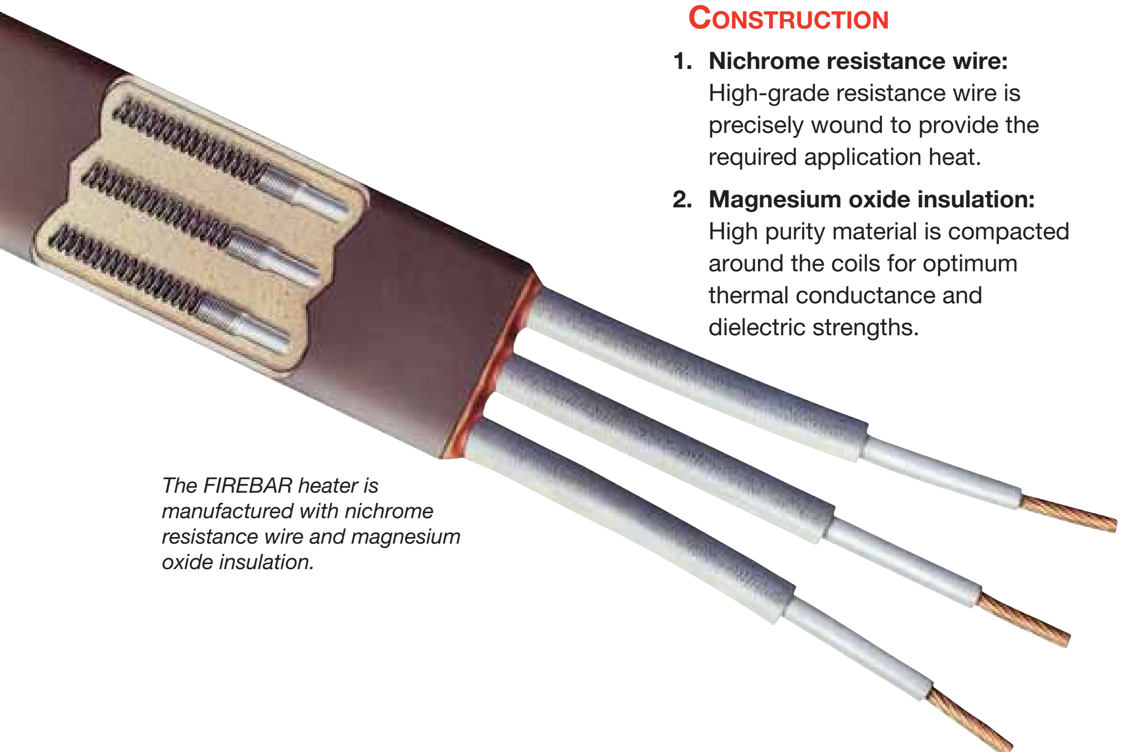


Although it is shorter, the FIREBAR element (heater B) provides the same wattage (800 watts) and watt density 23 W/in^2 (3.5 W/cm^2) as the round tubular element (heater A). An equal length FIREBAR element (heater C) will provide more wattage (1360 watts) at the same watt density, or a lower watt density 13.5 W/in^2 (2.1 W/cm^2) for 800 watts.



Unique Design Features

Watlow's FIREBAR heater is manufactured with three precisely wound resistance wires, arranged side-by-side in a flattened tubular metal sheath and insulated with extremely pure, compacted magnesium oxide (MgO). Flat surface, greater surface area, thin MgO walls and three-coil are all instrumental features provided in the FIREBAR.



The FIREBAR heater is manufactured with nichrome resistance wire and magnesium oxide insulation.

Construction

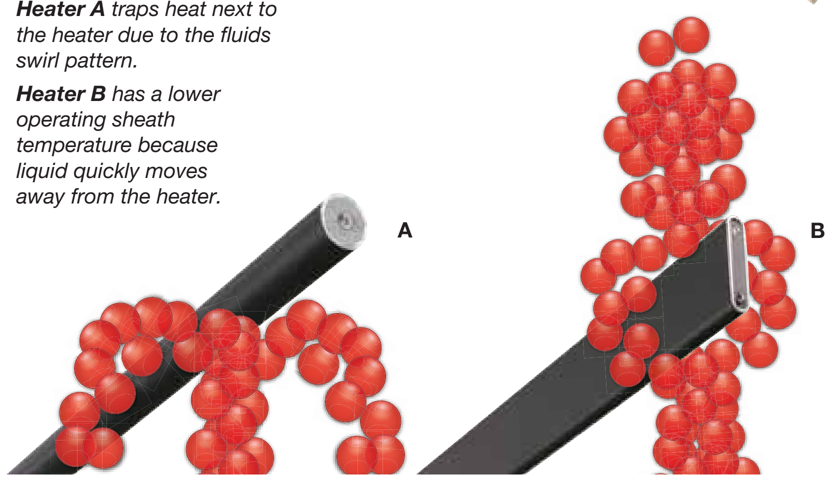
1. **Nichrome resistance wire:** High-grade resistance wire is precisely wound to provide the required application heat.
2. **Magnesium oxide insulation:** High purity material is compacted around the coils for optimum thermal conductance and dielectric strengths.
3. **Welded wire-to-pin connections:** 360˚ fusion weld is used to insure the electrical integrity of the heater.
4. **Sheath material:** Incoloy® and 304 stainless steel are available. 304 stainless steel 1200˚F (650˚C) is the maximum sheath temperature. Incoloy® maximum is 1400˚F (760˚C).
5. **Lead wire termination:** Ranging from 194˚F to 482˚F (90˚C to 250˚C) construction. A standard lavacone seal protects against moisture and contaminants, while providing excellent dielectric strength for operations up to and including 480VAC. Silicone rubber or epoxy resin seals, which are recommended for oil and water heating applications, are also available.

Three Different Features Allow the FIREBAR Heater to Operate at a Lower Sheath Temperature than an Equally Powered Round Tubular Element

1. **Flat surface geometry:** Because of its design and geometry, flat tubular heaters will heat viscous fluids from ambient temperature faster than round tubular elements with the same wattage and at a lower sheath temperature. The benefit of this shape is the enhanced flow of liquid past the surface of the heating element. The round tubular has a much more erratic flow pattern. The currents swirl around and trap heat next to the sheath due to the round shape.

__Heater A__ traps heat next to the heater due to the fluids swirl pattern.

__Heater B__ has a lower operating sheath temperature because liquid quickly moves away from the heater.



Incoloy® is a registered trademark of the Special Metals Corporation.

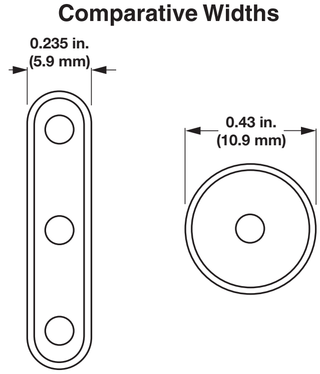
The flow pattern around the flat tubular heater is streamlined; the flat surface has less restriction on the liquid as it moves up and past the heater sides. This efficient and faster flow pattern permits the liquid to move heat away from the sheath very quickly; resulting in the flat tubular heater's lower operating sheath temperature.

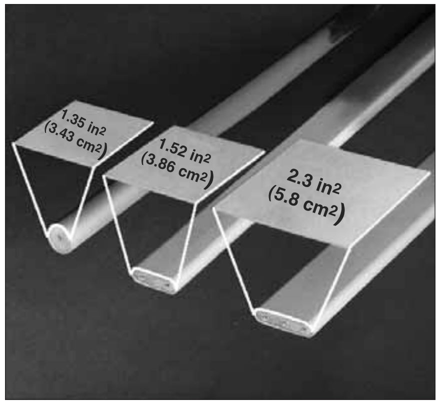
2. **Greater "buoyancy force":** Natural convection phenomena depends partially upon the ratio of a buoyant force to the viscous force of the heated fluid. This buoyant force, or flow of liquid up and across the heater surface, is primarily determined by the size of the boundary layer of the heater (the sides of the heater).

   The boundary layer of a FIREBAR heater is 1 in. (25.4 mm), compared to the 0.43 in. (10.9 mm) boundary layer of a typical diameter round tubular element. Depending on the material being heated, this creates a buoyancy force up to 10 times greater than a round tubular element.

3. **Smaller dimension normal to the flow:** The thin, 0.235 in. (5.9 mm) dimension of the FIREBAR heater normal to flow reduces the drag force on liquid flowing past the heater. Typical commercial round tubular elements have a 0.43 in. (10.9 mm) dimension normal to flow.

Comparative Widths





The 70 Percent Greater Surface Area of a FIREBAR Heater Allows You to Reduce Watt Density From a Round Tubular Element of the Same Length

The surface area per inch of length of a FIREBAR heater is 2.3 in^2/in. (5.8 cm^2/cm), while it is 1.52 in^2/in. (3.86 cm^2/cm) for a 0.43 in. (10.9 mm) diameter round tubular element. This surface area design improvement is the key to lowering watt density for the same length heater and reducing the heater size while maintaining the same watt density.

Thin MgO Walls Remove Heat Out From the FIREBAR Heater Faster

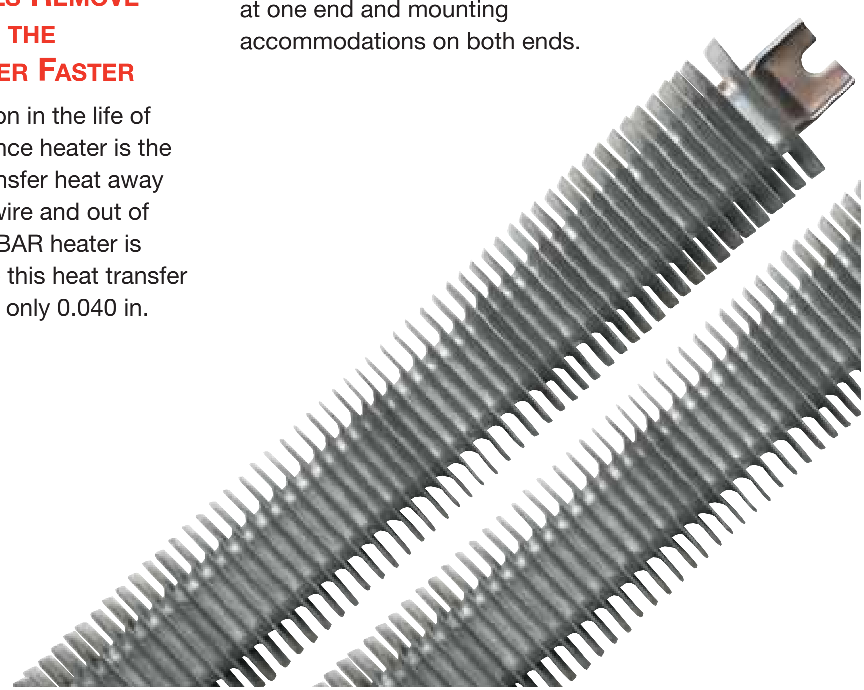
A critical consideration in the life of any electrical resistance heater is the heater's ability to transfer heat away from the resistance wire and out of the heater. The FIREBAR heater is designed to enhance this heat transfer by having MgO walls only 0.040 in. (1.02 mm) thick.

The FIREBAR 625 (5/8 inch) Design Option Provides Increased Surface Area and Longer Life

The lower profile design of the FIREBAR 625 heater provides 13 percent greater surface area and wattage than an equal length, commonly used round tubular heater, reducing watt density and leading to longer heater life.

FINBAR Is a Special Version of the FIREBAR 1000, Designed to Increase Surface Area and Improve Heat Transfer in Air Applications

Composed of aluminized steel fins press fitted to 1 in. (25.4 mm), single-ended FIREBAR elements, the FINBAR offers an increased surface area of approximately 16 in^2 (40.6 cm^2) for every 1 in. (25.4 mm) of element length. This unique design maximizes heat transfer in air applications and allows FINBAR to fit in tight spaces without sacrificing power making it ideal for forced air ducts, dryers, incubators and ovens. Installation is simplified by terminations exiting at one end and mounting accommodations on both ends.



Improving Your Equipment Design

The FIREBAR heater provides more than just a menu of immersion heating design improvements. Here are a variety of other benefits you can put to use.

Using a FIREBAR Heating Element Can Give Your Equipment the Edge Over Your Competition

The multiple performance, flexibility and convenience options the FIREBAR heater provides allow you to improve equipment design in so many different ways. You can make equipment:

- More efficient
- Easier to assemble, install and maintain
- Less expensive
- Lasts longer
- More productive
- More compact

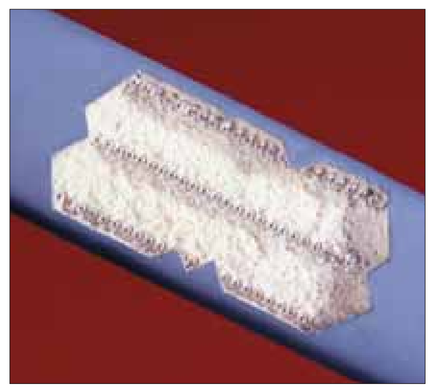
Maintenance is Minimal and Easy with FIREBAR Heaters

FIREBAR heaters require less cleaning maintenance than round tubular heaters because of diminished scaling and coking. If periodic cleaning is required, the flat sides of a FIREBAR heater are easier to clean, and you will probably have fewer elements to clean.

The Three-Coil Design of a FIREBAR Heater Provides Voltage and Heat Output Variety

By using a special center resistance wire coil, Watlow can build FIREBAR heaters so they can be wired 240VAC or 208VAC with the same kilowatt output. If three-heat capability is needed, operate the center coil only for “low” heat, the two outside coils only for “medium” heat or all three coils for “high” heat.

FIREBAR heaters can also be designed with a built-in thermocouple in place of the center coil.



For 240VAC, 10kW wiring, only the outside coils of a FIREBAR would be wired, each coil providing 5kW. For 208VAC, 10kW wiring, all three coils would be wired; the outside coils providing 3.75kW each and the different resistance center coil 2.5kW.

Self-Supporting FIREBAR Heaters Often Make Supporting Metal Brackets Unnecessary

FIREBAR heaters are rigid enough to withstand the turbulence in immersion applications that severely warp unsupported round tubular elements.

FIREBAR Heaters Offer the Versatility of Numerous Mounting Options

Mounting options for FIREBAR heaters include mounting brackets, threaded bulkheads and water-tight double leg threaded fittings. For air heating, stainless steel mounting brackets are commonly used. For liquid heating, 0.236 in. (6 mm) thick steel or stainless steel brackets are brazed or welded liquid-tight to an element.

Threaded bulkheads have a stainless steel bushing with flange on the heater sheath to provide rigid, leak-proof mounting through tank walls. Water-tight double leg threaded fittings use 1⅝ in. (41.27 mm)-10 UNC stainless steel with flange on the heater sheath to provide leak-proof mounting. This double leg fitting allows both heater legs to pass through the same opening.

FIREBAR'S Single-Ended Termination Option Facilitates Application

For simplified wiring and installation, FIREBAR elements are also available in single-ended termination. A slotted end further eases installations in clamp-on applications.

A Single FIREBAR Heater Can Be Wired Three-Phase

Three-phase wiring can simplify your heater installation. By offering three-phase capability, FIREBAR heaters provide a lower amperage solution while delivering the full power needed in a compact heater package. Previously three separate heaters were required for the same job. Because only one element is required, installation time and overall costs are reduced.

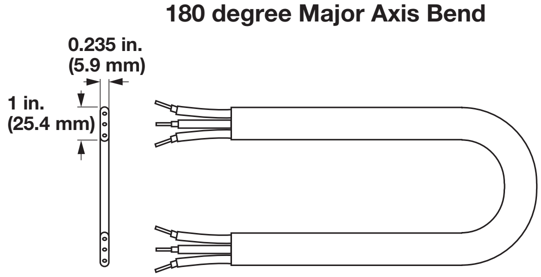
FIREBAR Heating Elements Can Be Configured Into a Wide Variety of Shapes to Meet Virtually Any Application

They can be bent on either the major or minor axis, depending on your element design needs.

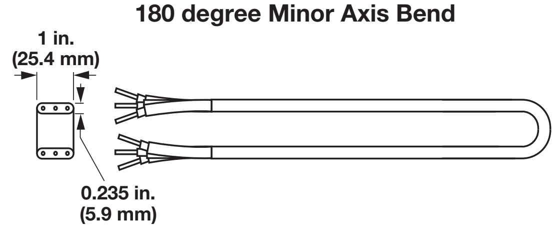
FIREBAR Heating Elements Carry Agency Recognition

UL®, and CSA component recognition, CE (Declaration of Conformity) available on request.

1 in. (25.4 mm) FIREBAR
180 degree Major Axis Bend



1 in. (25.4 mm) FIREBAR
180 degree Minor Axis Bend



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

FIREBAR® Single/Double-Ended Heaters

FIREBAR® heating elements provide added heating performance over standard round tubular heating elements—especially for immersion applications in petroleum based liquids requiring high kilowatts.

The FIREBAR's unique flat surface geometry packs more power in shorter elements and assemblies, along with a host of other performance improvements. These include:

- Minimizing coking and fluid degrading
- Enhancing the flow of fluid past the element's surface to carry heat from the sheath
- Improving heat transfer with a significantly larger boundary layer allowing much more liquid to flow up and across the sheath's surface

FIREBAR elements are available in single- and double-ended constructions with one inch or 5/8 inch heights. These two configuration variables make it possible to use FIREBAR elements instead of round tubular elements in virtually all applications.

FINBAR™ is a special version of the one inch, single-ended FIREBAR. FINBAR is specially modified with fins to further increase surface area for air and gas heating applications. Details are contained in the *FINBAR* section, starting on page 103.

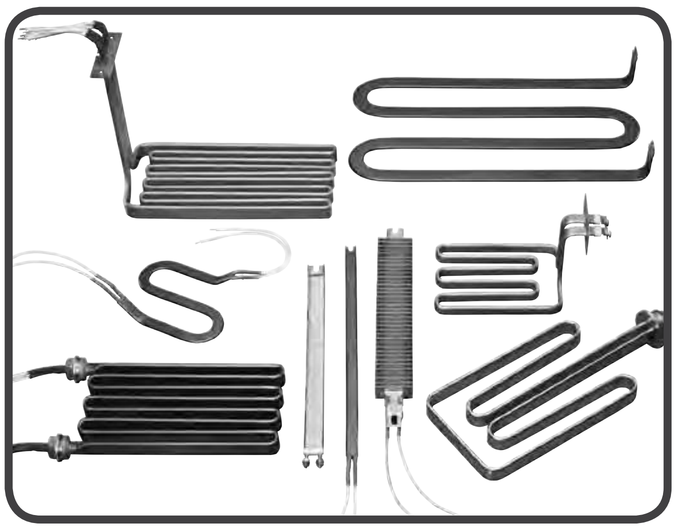
Double-Ended Performance Capabilities

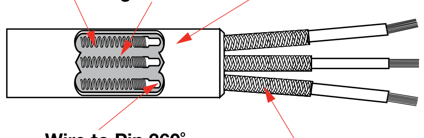
One Inch

- Watt densities up to 120 W/in² (18.6 W/cm²)
- Alloy 800 sheath temperatures up to 1400°F (760°C)
- 304 stainless steel sheath temperatures up to 1200°F (650°C)
- Voltages up to 240VAC
- Amperages up to 48 amperes per heater or 16 amperes per coil

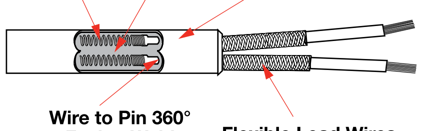
5/8 Inch

- Watt densities up to 90 W/in² (13.9 W/cm²)
- Alloy 840 sheath temperatures up to 1400°F (760°C)
- Voltages up to 240VAC
- Amperages up to 32 amperes per heater or 16 amperes per coil





One Inch Double-Ended FIREBAR Element and Lead Configurations



5/8 Inch Double-Ended FIREBAR Element and Lead Configurations

Single-Ended Performance Capabilities

One Inch

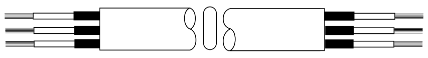
- Watt densities up to 60 W/in² (9.3 W/cm²)
- Alloy 800 sheath temperatures up to 1400°F (760°C)
- 304 stainless steel sheath temperatures up to 1200°F (650°C)
- Voltages up to 240VAC
- Amperages up to 48 amperes per heater or 16 amperes per coil

5/8 Inch

- Watt densities up to 80 W/in² (12.4 W/cm²)
- Alloy 840 sheath temperatures up to 1400°F (760°C)
- Voltages up to 240VAC
- Amperages up to 16 amperes per heater

FIREBAR Double-Ended Heaters

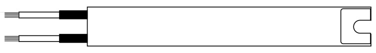
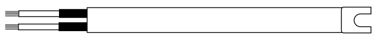
Specifications

	One Inch FIREBAR 	⅝ Inch FIREBAR 
Applications	Direct immersion; water, oils, etc. Clamp-on; hoppers, griddles Forced air heating (Also see FINBAR, page 103) Radiant heating	Direct immersion; water, oils, etc. Clamp-on; hoppers, griddles Forced air heating Radiant heating
Watt Density W/in² (W/cm²)	Standard: up to 90 (13.9) Made-to-Order (M-t-O): up to 120 (18.6)	Standard: up to 90 (13.9) Made-to-Order (M-t-O) up to 90 (13.9)
Surface Area Per Linear In. (cm)	2.3 in² (14.8 cm²)	1.52 in² (9.80 cm²)
Cross Section Height ± 0.015/0.010 in. (0.381/0.254 mm) Thickness ± 0.005/0.001 in. (0.127/0.025 mm)	 1.010 (25.7) 0.235 (5.9)	 0.650 (16.5) 0.235 (5.9)
Sheath Material—Max. Operating temperature	Standard: Alloy 800 1400°F (760°C) M-t-O: Alloy 800 1400°F (760°C) 304 SS 1200°F (650°C)	Standard: Alloy 840 1400°F (760°C) M-t-O: Alloy 840 1400°F (760°C) 304 SS 1200°F (650°C)
Sheath Length in. (mm)	Standard: 15 to 114 (381 to 2896) M-t-O: 11 to 180 (280 to 4572)	Standard: 15 to 51 (381 to 1295) M-t-O: 11 to 115 (280 to 2920)
Straightness Tolerance Major axis in./ft (cm/m): Minor axis in./ft (cm/m):	 0.062 (0.52) 0.062 (0.52)	 0.062 (0.52) 0.062 (0.52)
No-Heat Length	1 in. min., 12 in. max. (25/305 mm)	1 in. min., 12 in. max. (25/305 mm)
Max. Voltage—Amperage **Max. Hipotential** **Max. Current Leakage Per Coil (cold)** **Max. Amperage Per Coil** **Phase(s)** **Resistance Coils**	240VAC—48A 1480VAC 3mA 16A 1-ph parallel/series, 3-ph delta/wye 3 or 2	240VAC—32A 1480VAC 3mA 16A 1-ph parallel/series 2
Ohms/In./Unit① **Ohms/In./Coil①**	0.270Ω min.—2.833Ω max. 0.080Ω min.—8.500Ω max. per coil	0.040Ω min.—4.250Ω max. 0.080Ω min.—8.500Ω max. per coil
Terminations	Flexible lead wires Quick connect (spade) Screw lug (plate) Threaded stud	Flexible lead wires Quick connect (spade) Screw lug (plate) Threaded stud
Seals	Standard: Lavacone 221°F (105°C) M-t-O: Ceramic base 2800°F (1535°C) Silicone rubber 392°F (200°C) Lavacone 221°F (105°C) Epoxy resin 266/356°F (130/180°C)	Standard: Lavacone 221°F (105°C) M-t-O: Ceramic base 2800°F (1535°C) Silicone rubber 392°F (200°C) Lavacone 221°F (105°C) Epoxy resin 266/356°F (130/180°C)
Min. Axis Bending Radius in. (mm) (Do not field bend)	Major: 1 (25) Minor: ½ (13) 90° bend Minor: 5⁄32 (4) 180° bend	Major: ¾ (19) Minor: ½ (13) 90° bend Minor: 5⁄32 (4) 180° bend
Mounting Options	Brackets (Type 1, 2 and 3) Threaded bulkhead or fitting	Brackets (Type 1, 2 and 3) Threaded bulkhead or fitting
Surface Finish Options	Bright anneal, passivation	Bright anneal, passivation
Agency Recognition	UL® component recognition to 240VAC (File # E52951) CSA component recognition to 240VAC (File # 31388)	UL® component recognition to 240VAC (File # E52951) CSA component recognition to 240VAC (File # 31388)

① Resistance values valid for three coil 1 in. (25 mm) FIREBAR only.

FIREBAR Single-Ended Heaters

Specifications *(Continued)*

	One Inch Single-Ended FIREBAR 	⅝ Inch Single-Ended FIREBAR 
Applications	Clamp-on; hoppers, griddles Forced or convection air heating (Also see FINBAR, page 103)	Clamp-on; hoppers, griddles Forced or convection air heating
Watt Density W/in² (W/cm²)	Standard: up to 40 (6.2) M-t-O: up to 60 (9.3)	Standard: up to 20 (3.1) M-t-O: up to 60 (12.4)
Surface Area Per Linear In. (cm)	2.3 in² (14.8 cm²)	1.52 in² (9.80 cm²)
Cross Section Height ± 0.015/0.010 in. (0.381/0.254 mm) Thickness ± 0.005/0.001 in. (0.127/0.025 mm)	 1.010 (25.7) 0.235 (5.9)	 0.650 (16.5) 0.235 (5.9)
Sheath Material—Max. Operating temperature	Standard: 304 SS 1200°F (650°C) M-t-O: Alloy 800 1400°F (760°C) 304 SS 1200°F (650°C)	Standard: Alloy 840 1400°F (760°C) M-t-O: Alloy 840 1400°F (760°C) 304 SS 1200°F (650°C)
Sheath Length in. (mm)	Standard: 11 to 46¼ (280 to 1175) M-t-O: 11 to 120 (280 to 3048)	Standard: 11½ to 52 (280 to 1321) M-t-O: 11 to 116 (280 to 2946)
Straightness Tolerance Major axis in./foot (cm/m): Minor axis in./foot (cm/m):	 0.062 (0.52) 0.062 (0.52)	 0.062 (0.52) 0.062 (0.52)
No-Heat Length Top cold end Bottom (blunt end) cold end	 1 in. min., 12 in. max. (25/305 mm) 1 ph- 0.5 min., 2 in. max. (13/51 mm) 3 ph- 0.75 min., 2 in. max. (19/51 mm)	 1 in. min., 12 in. max. (25/305 mm) Only available at 1.25 in. N/A
Max. Voltage—Amperage **Max. Hipotential** **Max. Current Leakage (cold)** **Max. Amperage Per Coil** **Phase(s)** **Resistance Coils**	240VAC—48A 1480VAC 3mA 16A 1-ph, 3-ph wye 3 or 1	240VAC—16A 1480VAC 3mA 16A 1-ph 1
Ohms/In./Unit	0.200Ω min.—14.00Ω max. ①	0.200Ω min.—14.00Ω max. ①
Terminations	Flexible lead wires Threaded stud Quick connect (spade) Screw lug (plate)	Flexible lead wires Quick connect (spade) Screw lug (plate)
Seals	Standard: Lavacone 221°F (105°C) M-t-O: Ceramic base 2800°F (1535°C) Silicone rubber 392°F (200°C) Lavacone 221°F (105°C) Epoxy resin 266/356°F (130/180°C)	Standard: Lavacone 221°F (105°C) M-t-O: Ceramic base 2800°F (1535°C) Silicone rubber 392°F (200°C) Lavacone 221°F (105°C) Epoxy resin 266/356°F (130/180°C)
Min. Axis Bending Radius in. (mm) (Do not field bend)	Major: 1 (25) Minor: ½ (13) 90° bend Minor: 5⁄32 (4) 180° bend	Major: ¾ (19) Minor: ½ (13) 90° bend Minor: 5⁄32 (4) 180° bend
Mounting Options	Bracket (Type 2) Threaded bulkhead	Bracket (Type 2) Threaded bulkhead
Surface Finish Options	Bright anneal	Bright anneal
Optional Internal Thermocouple	—	—
Single-end Configuration	Standard: Slotted M-t-O: Slotted, sealed or welded	Standard: Slotted M-t-O: Slotted, sealed or welded
Agency Recognition	UL® component recognition to 240VAC (File # E52951) CSA component recognition to 240VAC (File # 31388)	UL® component recognition to 240VAC (File # E52951) CSA component recognition to 240VAC (File # 31388)

① Based on 1-phase, single voltage heater.

FIREBAR Single/Double-Ended Heaters

Features and Benefits

One Inch Features and Benefits

Double-Ended

Streamline, 0.235 x 1.010 in. (5.9 x 25.6 mm) normal to flow dimension
- Reduces drag

70 percent greater surface area per linear inch compared to a 0.430 in. (11 mm) diameter round tubular heater
- Reduces watt density or packs more kilowatts in smaller bundles

Compacted MgO insulation
- Maximizes thermal conductivity and dielectric strength

Nickel-chromium resistance wires
- Precision wound

0.040 in. (1 mm) thick MgO walls
- Transfers heat more efficiently away from the resistance wire to the sheath and media—conducts heat out of the element faster

Three resistance coil design
- Configurable to either one- or three-phase power, readily adapts to a variety of electrical sources and wattage outputs

Lavacone seals
- Provides protection against humid storage conditions, moisture retardant to 221°F (105°C)

Single-Ended

Single-ended termination
- Simplifies wiring and installation

Streamline, 0.235 x 1.010 in. (5.9 x 25.6 mm) normal to flow dimension
- Reduces drag

70 percent greater surface area per linear inch
- Reduces watt density from that of the 0.430 in. (11 mm) diameter round tubular

Slotted end
- Provides installation ease in clamp-on applications

Lavacone seals
- Provides protection against humid storage conditions, moisture retardant to 221°F (105°C)

5/8 inch Features and Benefits

Double-Ended

Special sheath dimensions, 0.235 x 0.650 in. (5.9 x 16.5 mm)
- Results in a lower profile heater

10 percent greater surface area per linear inch
- Reduces watt density from that of the 0.430 in. (11 mm) diameter round tubular heater

0.040 in. (1 mm) thick MgO walls
- Transfers heat efficiently away from the resistance wire to the heated media—conducts heat out of the element faster

Lavacone seals
- Provides protection against humid storage conditions, moisture retardant to 221°F (105°C)

Single-Ended

Single-ended termination
- Simplifies wiring and installation

Special sheath dimensions, 0.235 x 0.650 in. (5.9 x 16.5 mm)
- Results in a lower profile heater for more wattage in a smaller package

Slotted end
- Provides installation ease in clamp-on applications

Lavacone seals
- Provides protection against humid storage conditions, moisture retardant to 221°F (105°C)

FIREBAR Single/Double-Ended Heaters

Performance Features

FIREBAR's flat tubular element geometry produces performance features and benefits not possible with traditional round tubular technology. The following describes how and why the FIREBAR is functionally superior for many applications—especially those requiring large wattage with low watt density.

By using the FIREBAR element it will:

- Lower the element's watt density
- Reduce element size and keep the same watt density
- Increase element life by reducing sheath temperature

Flat Shape Produces Lower Sheath Temperature

The FIREBAR element operates at a lower sheath temperature than a round tubular element of equal watt density because of three factors.

1. Flat Surface Geometry

FIREBAR's flat, vertical geometry is streamline. The liquid's flow past the heating element's surface is not impaired by back eddies inherent in the round tubular shape. The FIREBAR's streamline shape results in fluids flowing more freely with more heat carried away from the sheath.

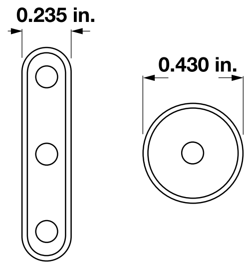
2. Normal to the Flow

The element's width (thickness) of both 1 inch and 5/8 inch FIREBAR elements is just 0.235 in. (5.9 mm). Compared to a 0.430 in. (11 mm) round tubular element, this relative thinness further reduces drag on liquids or gases flowing past the heater.

3. Buoyancy Force

The FIREBAR element's boundary layer, or vertical side, is greater than virtually all round tubular elements. This is 1.010 and 0.650 in. (25.6 and 16.5 mm) for the one inch and 5/8 in. FIREBARs respectively, compared to a 0.430 in. (11 mm) diameter on a round tubular element. The FIREBAR element's increased height, relative to flow, increases the buoyancy force in viscous liquids. This buoyancy force can be as much as 10 times greater depending on the FIREBAR element and liquid used.

Comparative Widths



Watt Density and Surface Area Advantages

The surface area per linear inch of a 1 in. FIREBAR is 70 percent greater than the 0.430 in. (11 mm) diameter round tubular element. The 5/8 in. FIREBAR is nearly 10 percent greater.

Element Type	Surface Area Per Linear Inch (cm) in^2	(cm^2)
1 in. FIREBAR	2.30 in^2	(5.84 cm^2)
5/8 in. FIREBAR	1.52 in^2	(3.86 cm^2)
0.430 in. Round	1.35 in^2	(3.43 cm^2)

Flat vs. Round Geometry Comparisons

The unique flat surface geometry of the FIREBAR element offers more versatility in solving heater problems than the conventional round tubular element. The following comparisons show how the FIREBAR element consistently outperforms round tubular heaters. FIREBAR elements can:

- Reduce coking and fluid degrading
- Increase heater power within application space parameters
- Provide superior heat transfer in clamp-on applications resulting from greater surface area contact
- Lower watt density

Reducing watt density or sheath temperature extends life. The FIREBAR element allows you to do either, without sacrificing equipment performance … as is proven by the accompanying *Heater Oil Test, Air Flow and Watt Density vs. Sheath Temperature* graphs.

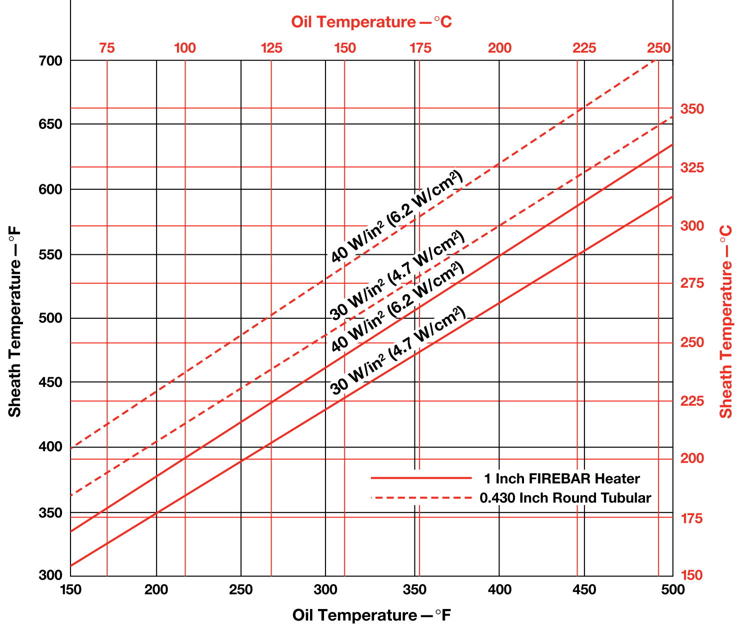
FIREBAR Single/Double-Ended Heaters

Technical Data

The *FIREBAR Heater Oil Test* graph compares sheath temperatures of 40 W/in² (6.7 W/cm²) flat and round tubular elements. The FIREBAR element consistently operates at a lower sheath temperature than the round tubular element, even when light oils are tested at different temperatures. This reduces the chance that coking and fluid degradation will occur.

In fact, the FIREBAR element's sheath temperature at 40 W/in² (6.7 W/cm²) is lower than a 30 W/in² (4.6 W/cm²) round tubular element.

FIREBAR Heater Oil Test



Heater Size and Power

The *Heater Size Comparison* chart shows, at the same wattage and watt density, the FIREBAR element is 38 percent shorter than a 0.430 in. (11 mm) round tubular element. The FIREBAR element requires less space in application and equipment designs.

Heater Size Comparison

Element	Heated Length in.	(mm)	Wattage	W/in²	(W/cm²)
1 in. FIREBAR Element	19⁷/₈	(504.8)	1000	23	(3.6)
0.430 in. Round Tubular Element	32¹/₄	(819.0)	1000	23	(3.6)

The *Heater Power Comparison* chart demonstrates equal watt density, element length and increased total wattage for the FIREBAR element. The power in the FIREBAR element is 70 percent greater.

Heater Power Comparison

Element	Heated Length in.	(mm)	Wattage	W/in²	(W/cm²)
1 in. FIREBAR Element	32¹/₄	(819.0)	1700	23	(3.6)
0.430 in. Round Tubular Element	32¹/₄	(819.0)	1000	23	(3.6)

FIREBAR Single/Double-Ended Heaters

Technical Data *(Continued)*

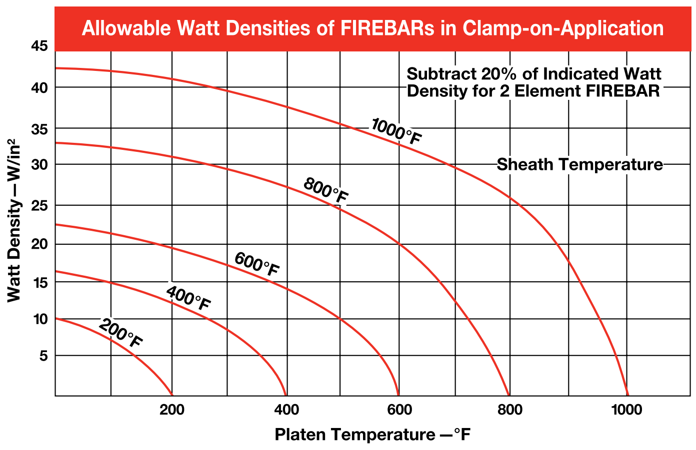
Clamp-On Applications

Direct immersion in the liquid may not always be practical. In these instances the FIREBAR element can be clamped to a tank wall. Heat from the FIREBAR is conducted to the tank wall and into the media.

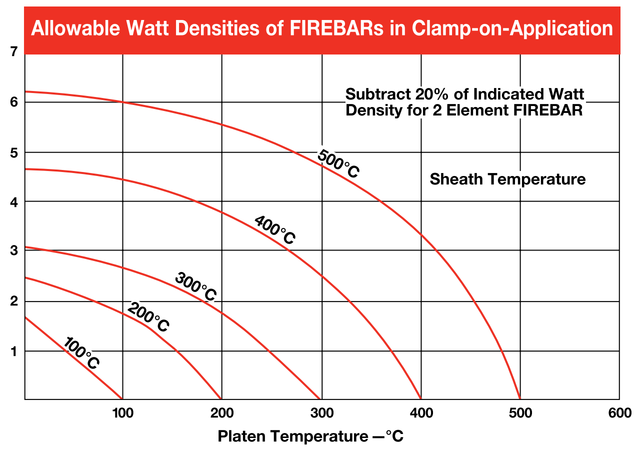
FIREBAR elements are also economical platen heaters. The *Platen Heating* graph shows FIREBAR's large, flat surface area allowing it to operate at twice the watt density of round tubular elements … without sacrificing heater life.

Clamps should be placed approximately 6 in. (150 mm) apart and torqued down with 60 in.-lbs (6.8 Newton meters).

Platen Heating (˚F)

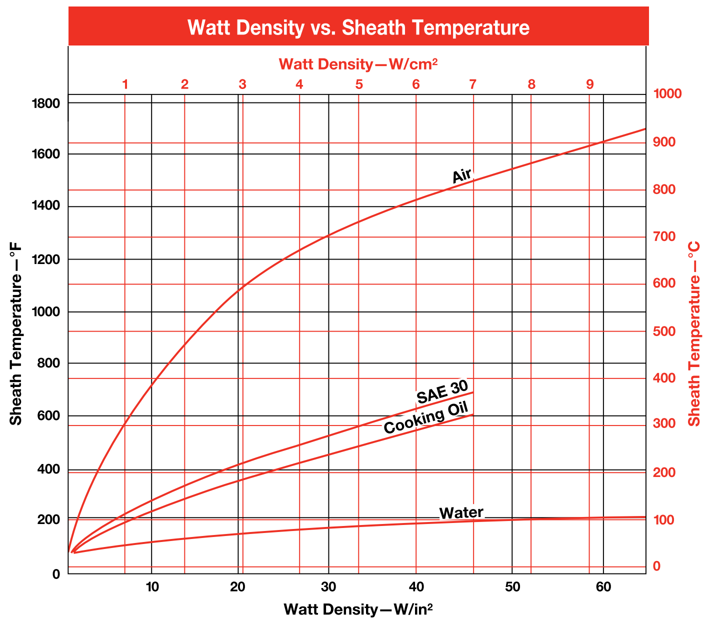


Platen Heating (˚C)



Watt Density vs. Sheath Temperature

The *Watt Density vs. Sheath Temperature* graph features sheath temperature curves for commonly heated substances. A FIREBAR element's watt density will result in the sheath temperature shown at the intersecting point of its vertical watt density line and substance curve.



FIREBAR Single/Double-Ended Heaters

Technical Data *(Continued)*

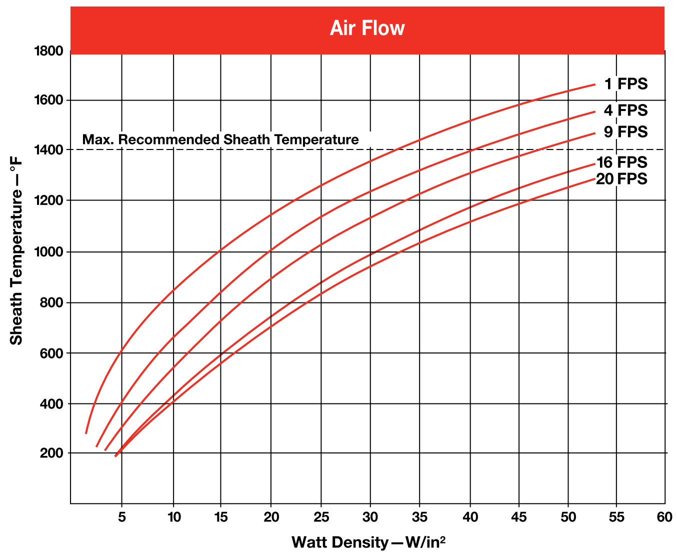
Air Heating

The Air *Flow/Watt Density/Sheath Temperature* graph shows the relationship between air flow, watt density and sheath temperature. Keep in mind that lower sheath temperature yields longer heater life.

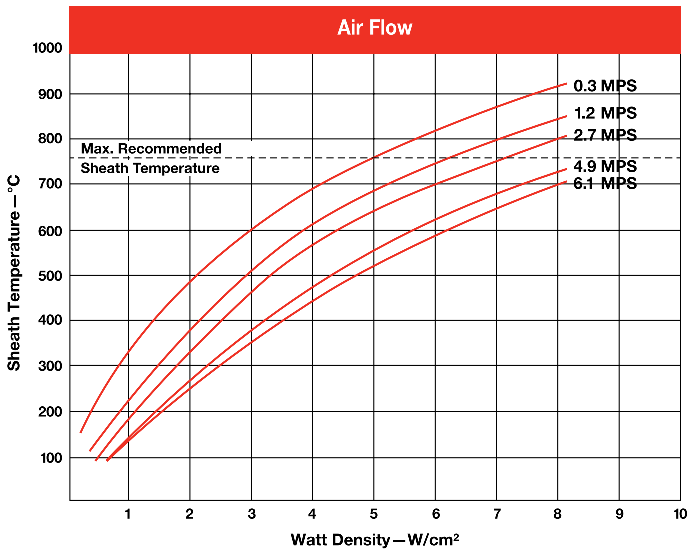
To use the *Air Flow* graph, determine the air flow in feet per second (or meters per second). Then follow the curve to find the recommended sheath temperature and watt density.

Air Flow Normal to Sheath Geometry

Air Flow/Watt Density/Sheath Temperature (°F)



Air Flow/Watt Density/Sheath Temperature (°C)



Moisture Resistant Seals

A lavacone seal is provided to prevent moisture and contaminants from entering the heater. Upon request, optional silicone rubber (RTV) and epoxy resin seals may be ordered.

Silicone Rubber (RTV) Seal

Silicone rubber RTV seals are 1/8 in. (3.2 mm) moisture barriers surrounding the terminal pins at the end of the sheath. Silicone rubber is effective to 392°F (200°C).

Epoxy Resin Seal

Epoxy resin seals are 1/8 in. (3.2 mm) moisture barriers surrounding the terminal pins at the end of the sheath. Epoxy resin is effective to 194°F (90°C) or 356°F (180°C), and recommended for water heating applications.

Application Hints

- Choose a FIREBAR heating element instead of an assembly when the application requires lower wattages or smaller system packages.
- Keep terminations clean, dry and tight.
- Extend the heated section completely into the media being heated at all times to maximize heat transfer and heater life.
- Do not locate the end of the heated length within a bend, unless the radius is 3 in. (76 mm) or larger.
- Ensure termination temperatures do not exceed 392°F (200°C) or the maximum temperature rating of the end seal, whichever is lower.

FIREBAR Single/Double-Ended Heaters

Technical Data *(Continued)*

All FIREBAR heaters are available with a variety of termination options. Contact your Watlow representative for availability.

Terminations

Part Number*	Termination	Phase	Wiring	1 in. FIREBAR Dual-Ended	1 in. FIREBAR S. End/FINBAR	5/8 in. FIREBAR Dual-Ended	5/8 in. FIREBAR Single-Ended
A1	Sil-A-Blend® 200°C lead wire	1	Parallel	Yes	Yes	Yes	Yes
A2	Sil-A-Blend® 200°C lead wire	1	Series	Yes	No	Yes	No
A3	Sil-A-Blend® 200°C lead wire	3	Delta	Yes	No	No	No
A4	Sil-A-Blend® 200°C lead wire	3	Wye	Yes	Yes	No	No
B1	TGGT 250°C lead wire	1	Parallel	Yes	Yes	Yes	Yes
B2	TGGT 250°C lead wire	1	Series	Yes	No	Yes	No
B3	TGGT 250°C lead wire	3	Delta	Yes	No	No	No
B4	TGGT 250°C lead wire	3	Wye	Yes	Yes	No	No
C1	¼ in. quick connect (spade)	1	Parallel	Yes	Yes	Yes	Yes
C2	¼ in. quick connect (spade)	1	Series	Yes	No	No	No
D1	Screw lug (plate) terminal	1	Parallel	Yes	Yes	Yes	Yes
D2	Screw lug (plate) terminal	1	Series	Yes	No	No	No
D3	Screw lug (plate) terminal	3	Delta	Yes	No	No	No
E1	#10-32 stud terminal	1	Parallel	Yes	Yes	Yes	Yes
E2	#10-32 stud terminal	1	Series	Yes	No	No	No
E3	#10-32 stud terminal	3	Delta	Yes	No	No	No

Termination Code Number Legend*

A = Silicone rubber insulation (Sil-A-Blend®) with fiberglass oversleeves Rated to 392°F (200°C)

B = High-temperature TGGT insulation with fiberglass oversleeves Rated to 480°F (250°C)

C = Nickel-plated steel quick connect

D = Nickel-plated steel screw lug with ceramic insulator and plated steel screw

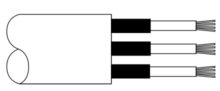
E = #10-32 nickel-plated steel threaded stud with plated steel nuts and washers

Electrical Configuration

1 = 1-phase parallel, 2 = 1-phase series, 3 = 3-phase delta, 4 = 3-phase wye

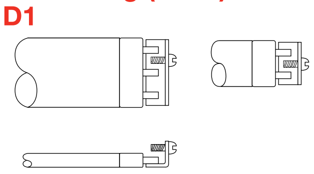
Double-End/Single-End 1 in. FIREBAR

Flexible Lead Wire①
A, B



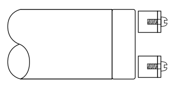
- Double-End 1 in. FIREBAR
- Single-End 1 in. FIREBAR
- FINBAR

Screw Lug (Plate)
D1



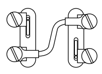
- Double-End 1 & 5/8 in. FIREBAR

Screw Lug (Plate)
D3

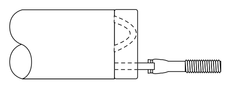


- Double-End 1 in. FIREBAR

3-phase delta wiring example

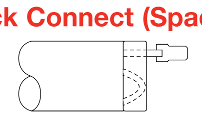


Threaded Stud
E2



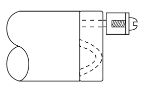
- Double-End 1 in. FIREBAR

Quick Connect (Spade)
C2



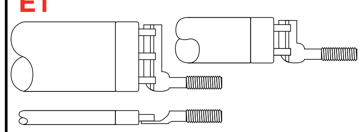
- Double-End 1 in. FIREBAR

Screw Lug (Plate)
D2



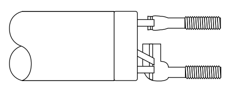
- Double-End 1 in. FIREBAR

Threaded Stud
E1



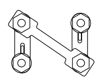
- Double-End 1 & 5/8 in. FIREBAR

Threaded Stud
E3



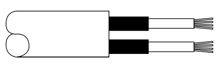
- Double-End 1 in. FIREBAR

3-phase delta wiring example



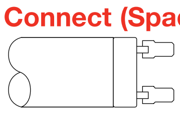
Single-End FIREBAR, Double-End/Single-End FINBAR

Flexible Lead Wire①
A, B



- Single-End 1 in. FIREBAR
- Double-End 5/8 in. FIREBAR
- Single-End 5/8 in. FIREBAR
- FINBAR

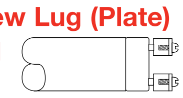
Quick Connect (Spade)
C1



- Single-End 1 FIREBAR
- FINBAR

- Double-End 5/8 in. FIREBAR
- Single-End 5/8 in. FIREBAR

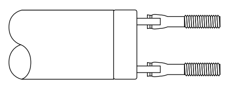
Screw Lug (Plate)
D1



- Single-End 1 in. FIREBAR
- FINBAR

- Double-End 5/8 in. FIREBAR
- Single-End 5/8 in. FIREBAR

Threaded Stud
E1



- Single-End 1 in. FIREBAR
- FINBAR

①Flexible lead wires are 12 in. (305 mm) long unless otherwise specified.

FIREBAR Single/Double-Ended Heaters

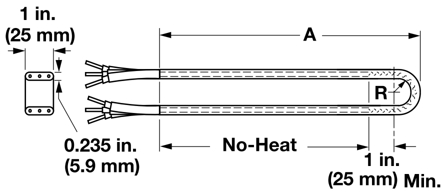
Bending

Major and Minor Axis Bending Parameters

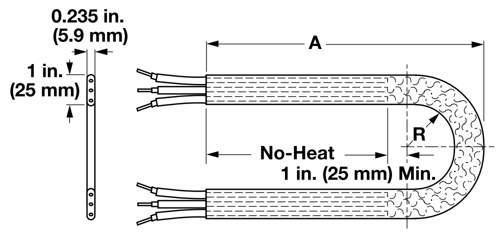
The following illustrations detail the recommended major and minor axis bend parameters for FIREBAR elements. These illustrations show the relationship between the type of bend and the location of heat and no-heat sections. See the next two pages for the 15 common bend formations.

Note: Watlow does not recommend field bending FIREBAR elements. If the element must be bent in the field, please contact your Watlow representative for assistance.

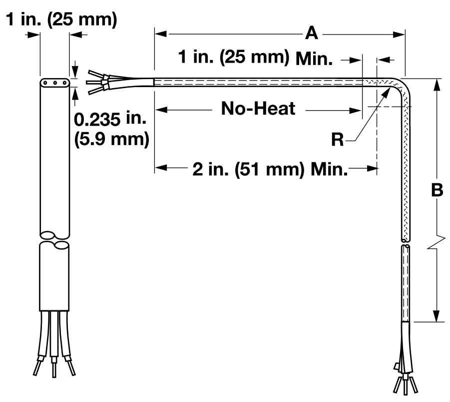
180° Minor Axis Heated Bend



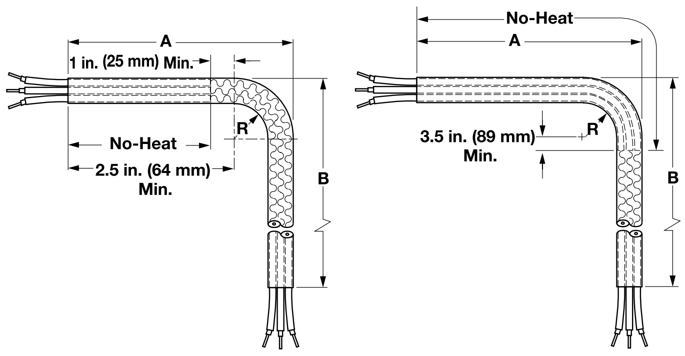
180° Major Axis Heated Bend



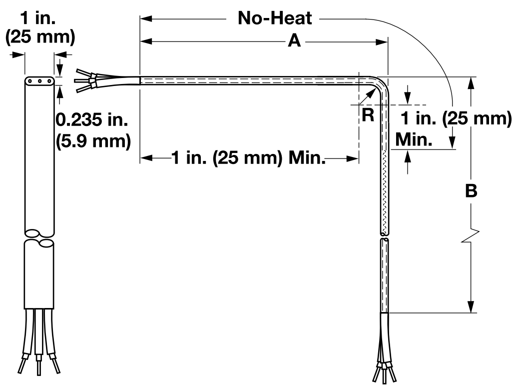
90° Minor Axis Heated Bend



90° Major Axis Heated Bend



90° Minor Axis Un-Heated Bend



180° Major Axis Bends

FIREBAR Size in.	(mm)	Radius in.	(mm)	Arc Length
5/8	(15.9)	3/4	(19.0)	3.125
5/8	(15.9)	1	(25.0)	3.900
5/8	(15.9)	1 1/4	(32.0)	4.620
5/8	(15.9)	1 1/2	(38.0)	5.600
1	(25.0)	1	(25.0)	4.335
1	(25.0)	1 1/4	(32.0)	5.121
1	(25.0)	1 1/2	(38.0)	5.906

FIREBAR Single/Double-Ended Heaters

Bend Formations

FIREBAR elements can be formed into compounds, multi-axis and multi-plane configurations from 15 common bends. Custom bending with tighter tolerances can be made to meet specific application needs.

Formation is limited by bending parameters specified in the illustrations of major and minor axis bends on the previous page. On these illustrations, please note the no-heat end location.

The no-heat end junction must be located a minimum of 1 in. (25 mm) from any bend. If these parameters are not followed, the heater may fail prematurely. Field bending not recommended.

Illustrated below are the common bends that can be ordered for all FIREBAR heating elements.

To order a common bend, specify the **figure number** and **critical dimensions**.

Note: The alpha characters and symbols are used to designate specific dimensions within each illustration.

Minor Axis | Major Axis | Minor Axis | Major Axis

Figure 1A

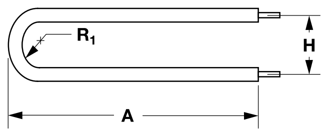


Figure 1B

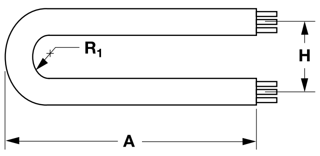


Figure 2A

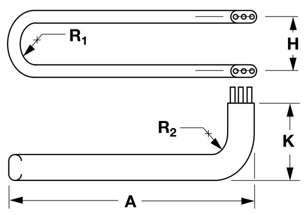


Figure 2B

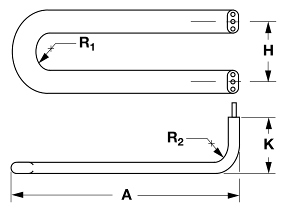


Figure 3A

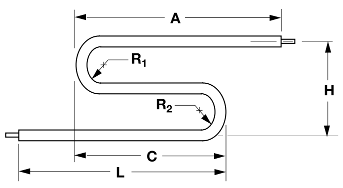


Figure 3B

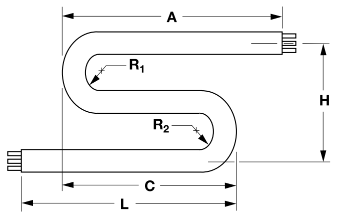


Figure 4A

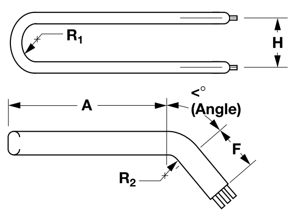


Figure 4B

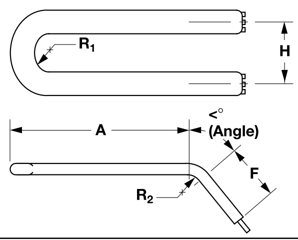


Figure 5A

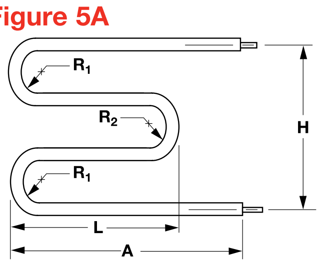


Figure 5B

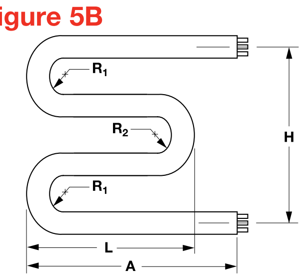


Figure 6A

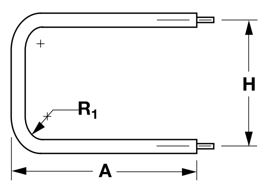


Figure 6B

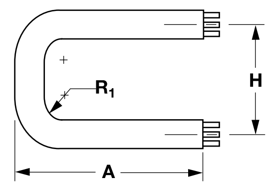


Figure 7A

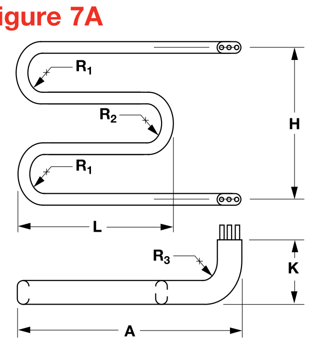


Figure 7B

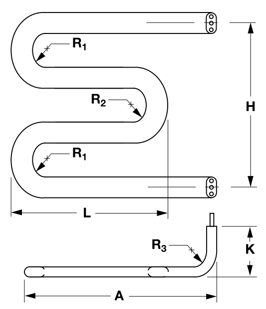


Figure 8A

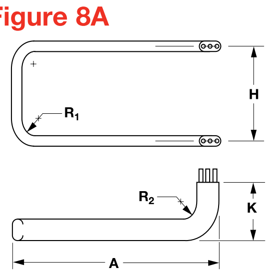
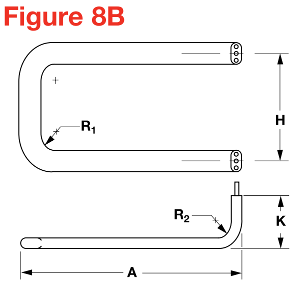


Figure 8B



FIREBAR Single/Double-Ended Heaters

Bend Formation *(Continued)*

Minor Axis	Major Axis	Minor Axis	Major Axis

Figure 9A (Minor Axis)

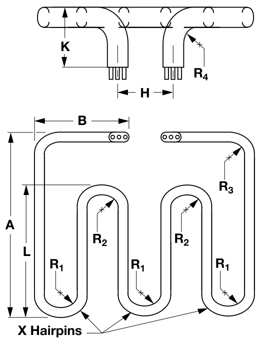


Figure 9B (Major Axis)

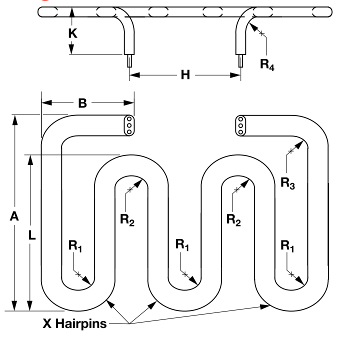
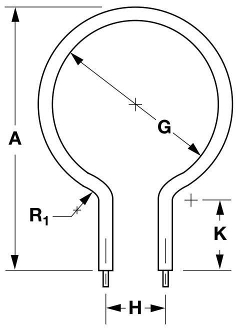
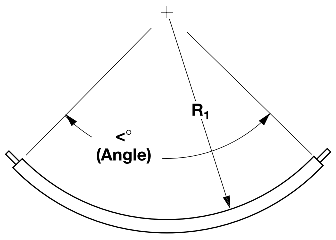


Figure 10A (Minor Axis)



Bend Figure 10B Not Available On Major Axis

Figure 11A



Bend Figure 11B Not Available On Major Axis

Figure 12A

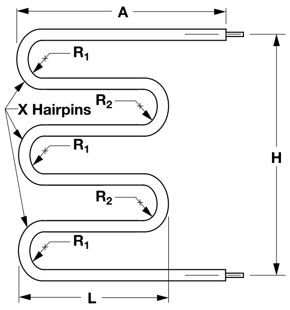


Figure 12B

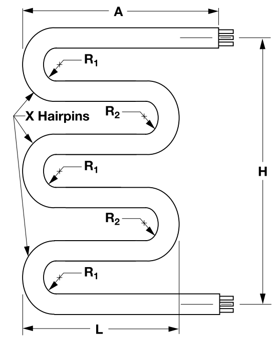


Figure 13A

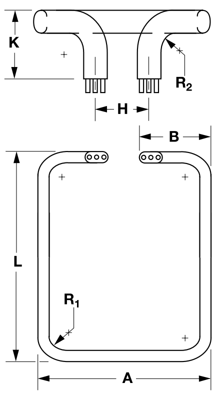


Figure 13B

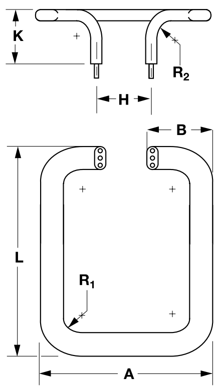


Figure 14A

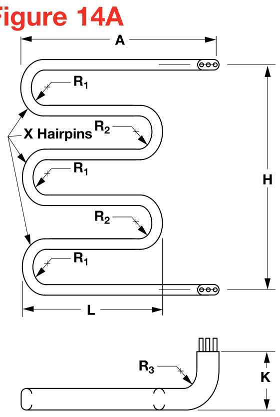


Figure 14B

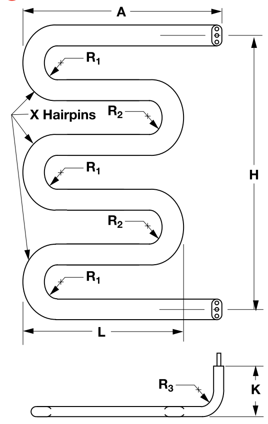


Figure 15A

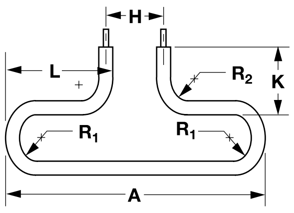
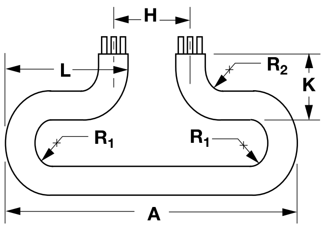


Figure 15B



FIREBAR Single/Double-Ended Heaters

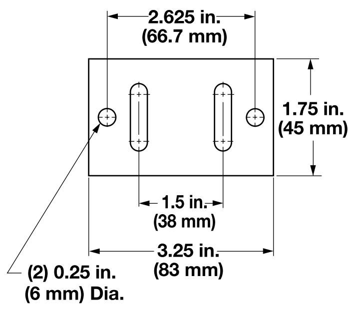
Mounting Brackets

Steel brackets provide element mounting in non-pressurized applications. In air heating applications, an 18-gauge aluminized steel bracket is tack welded to the element. A $^{1}/_{4}$ in. (6 mm) thick steel bracket is brazed or welded liquid-tight to the element for liquid heating. Upon request, stainless steel brackets can be provided. Special sizes also available.

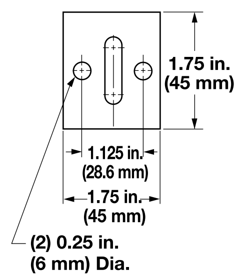
The bracket is located $^{1}/_{2}$ in. (13 mm) from the sheath's end, $^{1}/_{16}$ in. (1.6 mm) if welded. Available on $^{5}/_{8}$ in. (15.9 mm) FIREBAR as **made-to-order** only.

To order, specify **mounting bracket** as well as type, location, material and size.

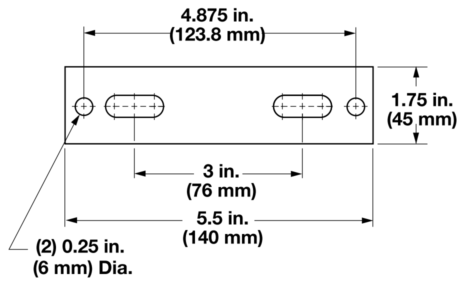
Type 1



Type 2



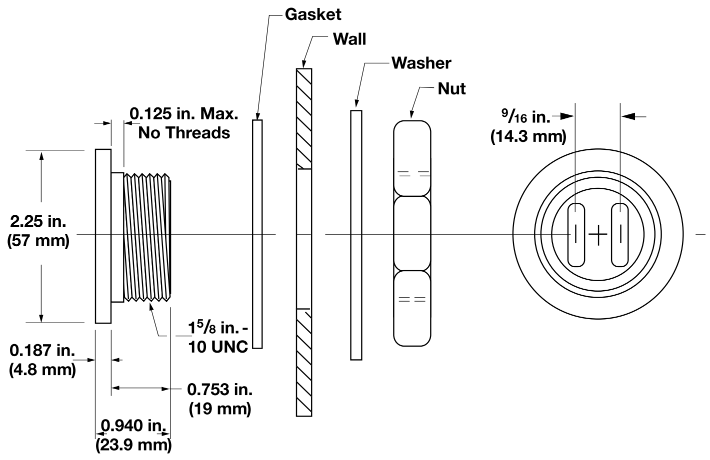
Type 3



Water-Tight Double-Leg Threaded Fitting

A threaded $1^{5}/_{8}$ in.-10 UNC stainless steel fitting with flange on the heater sheath provides rigid, leak-proof mounting through tank walls. This fitting allows both legs of the heater to pass through the same opening. A gasket, plated steel washer and hex nut are included. The threaded end of the bulkhead is mounted flush with the sheath's end, unless otherwise specified. Available on **1 inch FIREBAR only (brazed only, available)**.

To order, specify **water-tight double-leg threaded fitting**.



Surface Finish

Bright Annealing

Bright annealing is a process that produces a smooth, metallic finish. It is a special annealed finish created in a non-oxidizing atmosphere. This finish is popular in the pharmaceutical and foodservice/beverage markets.

To order, specify **bright annealing**.

Passivation

During manufacturing, particles of iron or tool steel may be embedded in the stainless steel or alloy sheath. If not removed, these particles may corrode and produce rust spots. For critical sheath applications, passivation will remove free iron from the sheath.

To order, specify **passivation**.

EXTENDED CAPABILITY

Extended Capabilities for FIREBAR Single/Double-Ended Heaters

Single Leg Threaded Bulkhead

A threaded stainless steel bushing with flange on the heater sheath provides rigid, leak-proof mounting through tank walls. A gasket, plated steel washer and hex nut are included (brazed only, available).

To order, specify **single leg threaded bulkhead**.

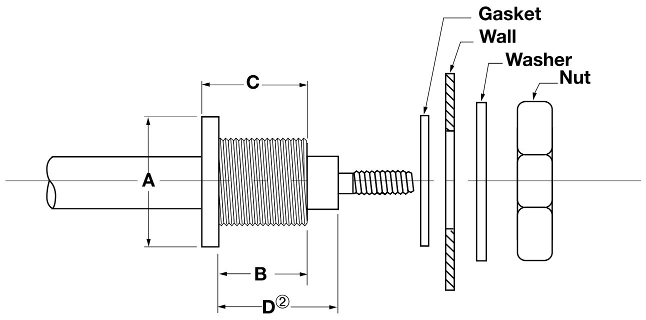


Illustration for 1-inch FIREBAR

Heater Size in.	(mm)	Thread Size
5/8	(15.9)	7/8-14 UNF-2A
1	(25.0)	3/4-16 UNF-2A

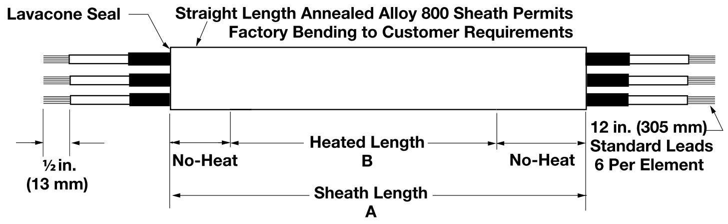
Illustration for ⅝-inch FIREBAR

Options for One-Inch and 5/8-Inch FIREBAR

- Electropolished finish
- Bulkhead, single leg
- Custom formations
- Terminal enclosures (general purpose, moisture resistant, and moisture/corrosion resistant)
- Custom wattage tolerance (±5%)

FIREBAR Single/Double-Ended Heaters

One-Inch, Double-Ended FIREBAR

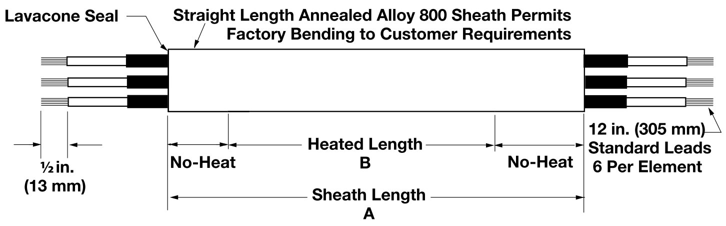


FIREBAR Description	Sheath A Dimension in.	(mm)	Heated B Dimension in.	(mm)	Watts	Part Number 120VAC	Part Number 240VAC	Est. Net Wt. lbs	(kg)
Applications: Asphalt, Paraffin (Solid), Bunker Oil, Clamp-On									
6 W/in^2	35	(889)	25	(635)	310	**FBN351WD**		1.3	(0.6)
Alloy 800	41	(1041)	31	(787)	410	**FBN411WD**		1.5	(0.7)
(1 W/cm^2)	51	(1295)	41	(1041)	530	**FBN511WD**	**FBN5110WD**	1.9	(0.9)
	62	(1574)	52	(1320)	650	**FBN621WD**	**FBN6210WD**	2.3	(1.1)
	72	(1828)	62	(1574)	800	**FBN721WD**	**FBN7210WD**	2.6	(1.2)
	93	(2362)	83	(2108)	1,060	**FBN931WD**	**FBN9310WD**	3.4	(1.6)
	114	(2895)	104	(2641)	1,350	**FBN1141WD**	**FBN11410WD**	4.2	(1.9)
Applications: Griddles, Fuel Oil, Clamp-On									
10 W/in^2	25	(635)	22	(558)	500	**FBN251WL**		0.9	(0.4)
Alloy 800	35	(889)	32	(812)	750	**FBN351WL**	**FBN3510WL**	1.3	(0.6)
(1.6 W/cm^2)	47	(1193)	43	(1092)	1,000	**FBN471WL**	**FBN4710WL**	1.7	(0.8)
	69	(1752)	65	(1651)	1,500	**FBN691WL**	**FBN6910WL**	2.5	(1.2)
	90	(2286)	86	(2184)	2,000	**FBN901WL**	**FBN9010WL**	3.3	(1.5)
Applications: Clamp-On, Medium Weight Oils, Liquid Paraffin, Low-Temperature Ovens 400°F (205°C)									
15 W/in^2 ①	29	(736)	19	(482)	670		**FBN2910WE**	1.1	(0.5)
Alloy 800	34	(863)	24	(609)	830		**FBN3410WE**	1.3	(0.6)
(2.3 W/cm^2)	39	(990)	29	(736)	1,000		**FBN3910WE**	1.4	(0.7)
	48	(1219)	38	(965)	1,330		**FBN4810WE**	1.8	(0.9)
	58	(1473)	48	(1219)	1,670		**FBN5810WE**	2.1	(1.0)
	68	(1727)	58	(1473)	2,000		**FBN6810WE**	2.5	(1.2)
	87	(2209)	77	(1955)	2,670		**FBN8710WE**	3.2	(1.5)
	106	(2692)	96	(2438)	3,330		**FBN10610WE**	3.9	(1.8)
Applications: Radiant, Platens, Dies, Low-Temperature Ovens 300°F (150°C)									
20 W/in^2	15	(381)	11	(279)	500	**FBN151WM**		0.6	(0.3)
Alloy 800	20	(508)	16	(406)	750	**FBN201WM**		0.8	(0.4)
(3.1 W/cm^2)	26	(660)	22	(558)	1,000	**FBN261WM**	**FBN2610WM**	1.0	(0.5)
	36	(914)	32	(812)	1,500	**FBN361WM**	**FBN3610WM**	1.3	(0.6)
	48	(1219)	43	(1092)	2,000	**FBN481WM**	**FBN4810WM**	1.8	(0.9)
	70	(1778)	65	(1651)	3,000		**FBN7010WM**	2.6	(1.2)
	91	(2311)	85	(2159)	4,000		**FBN9110WM**	3.3	(1.5)
Applications: Degreasing Solutions, Heat Transfer Oils									
23 W/in^2	35	(889)	25	(635)	1,250	**FBN351WT**	**FBN3510WT**	1.3	(0.6)
Alloy 800	41	(1041)	31	(787)	1,625	**FBN411WT**	**FBN4110WT**	1.5	(0.7)
(3.6 W/cm^2)	51	(1295)	41	(1041)	2,125	**FBN511WT**	**FBN5110WT**	1.9	(0.9)
	62	(1574)	52	(1320)	2,625	**FBN621WT**	**FBN6210WT**	2.3	(1.1)
	72	(1828)	62	(1574)	3,200	**FBN721WT**	**FBN7210WT**	2.6	(1.2)
	93	(2362)	83	(2108)	4,250	**FBN931WT**	**FBN9310WT**	3.4	(1.6)
	114	(2895)	104	(2641)	5,400	**FBN1141WT**	**FBN11410WT**	4.2	(1.9)

CONTINUED

FIREBAR Single/Double-Ended Heaters

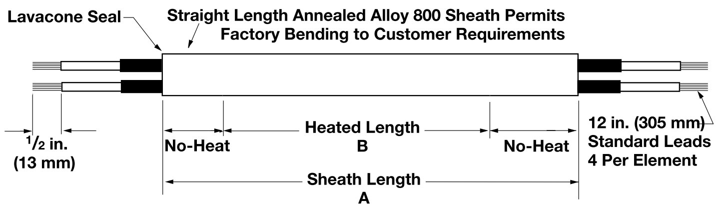
One-Inch, Double-Ended FIREBAR (Continued)



FIREBAR Description	Sheath A Dimension in.	(mm)	Heated B Dimension in.	(mm)	Watts	Part Number 120VAC	240VAC	Est. Net Wt. lbs	(kg)
Applications: Cooking Oils, Mild Caustic Solution, Ethylene Glycol (100%)									
30 W/in² Alloy 800 (4.7 W/cm²)	16	(406)	10	(254)	750	**FBN161WH**		0.6	(0.3)
	20	(508)	14	(355)	1000	**FBN201WH**		0.8	(0.4)
	27	(685)	21	(533)	1500	**FBN271WH**	**FBN2710WH**	1.0	(0.5)
	34	(863)	28	(711)	2000	**FBN341WH**	**FBN3410WH**	1.3	(0.6)
	50	(1270)	43	(1092)	3000		**FBN5010WH**	1.8	(0.9)
	64	(1625)	57	(1447)	4000		**FBN6410WH**	2.4	(1.1)
	80	(2032)	72	(1828)	5000		**FBN8010WH**	2.9	(1.4)
Applications: Process Water, Ethylene Glycol (50%)									
40 W/in² Alloy 800 (6.2 W/cm²)	25	(635)	22	(558)	2000		**FBN2510WK**	0.9	(0.4)
	35	(889)	32	(812)	3000		**FBN3510WK**	1.3	(0.6)
	47	(1193)	43	(1092)	4000		**FBN4710WK**	1.7	(0.8)
	69	(1752)	65	(1651)	6000		**FBN6910WK**	2.5	(1.2)
	90	(2286)	86	(2184)	8000		**FBN9010WK**	3.3	(1.5)
45 W/in² Alloy 800 (7 W/cm²)	29	(736)	19	(482)	2000		**FBN2910WP**	1.1	(0.5)
	34	(863)	24	(609)	2500		**FBN3410WP**	1.3	(0.6)
	39	(990)	29	(736)	3000		**FBN3910WP**	1.4	(0.7)
	48	(1219)	38	(965)	4000		**FBN4810WP**	1.8	(0.9)
	58	(1473)	48	(1219)	5000		**FBN5810WP**	2.1	(1.0)
	68	(1727)	58	(1473)	6000		**FBN6810WP**	2.5	(1.2)
	87	(2209)	77	(1955)	8000		**FBN8710WP**	3.2	(1.5)
	106	(2692)	96	(2438)	10,000		**FBN10610WP**	3.9	(1.8)
Applications: Clean and Potable Water									
80 W/in² Alloy 800 (12.4 W/cm²)	15	(381)	11	(279)	2000		**FBN1510WJ**	0.6	(0.3)
	20	(508)	16	(406)	3000		**FBN2010WJ**	0.8	(0.4)
	26	(660)	22	(558)	4000		**FBN2610WJ**	1.0	(0.5)
	36	(914)	32	(812)	6000		**FBN3610WJ**	1.3	(0.6)
	48	(1219)	43	(1092)	8000		**FBN4810WJ**	1.8	(0.9)
	70	(1778)	65	(1651)	12,000			2.6	(1.2)
	91	(2311)	85	(2159)	16,000			3.3	(1.5)
90 W/in² Alloy 800 (14 W/cm²)	35	(889)	25	(635)	5000	**FBN351WG**	**FBN3510WG**	1.3	(0.6)
	41	(1041)	31	(787)	6500	**FBN411WG**	**FBN4110WG**	1.5	(0.7)
	51	(1295)	41	(1041)	8500		**FBN5110WG**	1.9	(0.9)
	62	(1574)	52	(1320)	10,500		**FBN6210WG**	2.3	(1.1)
	72	(1828)	62	(1574)	12,750		**FBN7210WG**	2.6	(1.2)
	93	(2362)	83	(2108)	17,000			3.4	(1.6)
	114	(2895)	104	(2641)	21,500			3.4	(1.6)

FIREBAR Single/Double-Ended Heaters

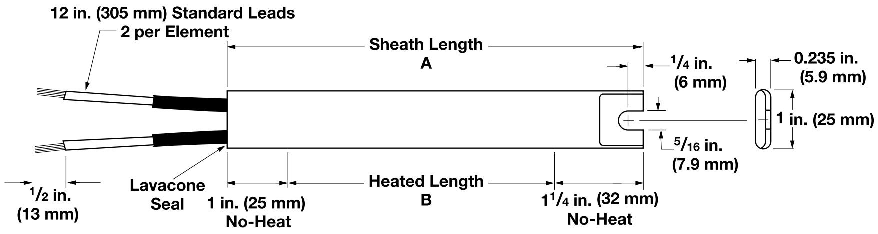
5/8-Inch Double-Ended FIREBAR



FIREBAR Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number		Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	lbs	(kg)
Applications: Degreasing Fluids, Heat Transfer Oils									
23 W/in^2 ①	19	(483)	11	(279)	375	**FAN191WT**		0.5	(0.3)
Alloy 840	22	(559)	14	(356)	500	**FAN221WT**	**FAN2210WT**	0.5	(0.3)
(3.6 W/cm^2)	26	(660)	18	(457)	625	**FAN261WT**	**FAN2610WT**	0.6	(0.3)
	30	(762)	22	(559)	750	**FAN301WT**	**FAN3010WT**	0.7	(0.4)
	37	(940)	29	(737)	1000	**FAN371WT**	**FAN3710WT**	0.9	(0.5)
	44	(1118)	36	(914)	1250	**FAN441WT**	**FAN4410WT**	1.0	(0.5)
	51	(1295)	43	(1092)	1500	**FAN511WT**	**FAN5110WT**	1.2	(0.6)
Applications: Clean and Potable Water									
90 W/in^2	15	(381)	7	(178)	1000	**FAN151WG**	**FAN1510WG**	0.4	(0.2)
Alloy 840	19	(483)	11	(279)	1500	**FAN191WG**	**FAN1910WG**	0.5	(0.3)
(14 W/cm^2)	22	(559)	14	(356)	2000	**FAN221WG**	**FAN2210WG**	0.5	(0.3)
	26	(660)	18	(457)	2500	**FAN261WG**	**FAN2610WG**	0.6	(0.3)
	30	(762)	22	(559)	3000	**FAN301WG**	**FAN3010WG**	0.7	(0.4)
	37	(940)	29	(737)	4000		**FAN3710WG**	0.9	(0.5)
	44	(1118)	36	(914)	5000		**FAN4410WG**	1.0	(0.5)
	51	(1295)	43	(1092)	6000		**FAN5110WG**	1.2	(0.6)

FIREBAR Single/Double-Ended Heaters

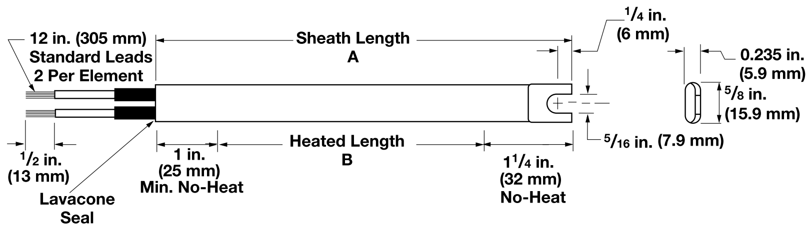
One-Inch, Single-Ended FIREBAR



FIREBAR Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number		Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	lbs	(kg)
Applications: Radiant, Platens, Dies, Low-Temperature Ovens 300°F (150°C)									
20 W/in² 304 SS (3.1 W/cm²)	8 3/4	(222.0)	6 1/2	(165.0)	300	**FSP91WM**		0.4	(0.2)
	10 1/4	(260.0)	7 1/2	(203.0)	375	**FSP101WM**		0.4	(0.2)
	12 1/4	(311.0)	10	(254.0)	450	**FSP121WM**		0.5	(0.3)
	13 1/2	(343.0)	11 1/4	(286.0)	500	**FSP141WM**		0.5	(0.3)
	16 1/8	(408.6)	13 7/8	(352.4)	650	**FSP161WM**	**FSP1610WM**	0.6	(0.3)
	17 3/4	(451.0)	15 1/2	(393.0)	725	**FSP181WM**	**FSP1810WM**	0.7	(0.4)
	19 1/4	(489.0)	17	(431.0)	800	**FSP191WM**	**FSP1910WM**	0.7	(0.4)
	22	(558.0)	19 3/4	(502.0)	900	**FSP221WM**	**FSP2210WM**	0.8	(0.4)
	23 3/4	(603.0)	21 1/2	(546.0)	1,000	**FSP241WM**	**FSP2410WM**	0.9	(0.4)
	25	(635.0)	22 3/4	(578.0)	1,050	**FSP251WM**	**FSP2510WM**	0.9	(0.4)
	28 5/8	(727.1)	26 3/8	(670.0)	1,250	**FSP291WM**	**FSP2910WM**	1.1	(0.5)
	31 5/8	(803.3)	29 3/8	(746.1)	1,350	**FSP321WM**	**FSP3210WM**	1.2	(0.6)
	34 1/8	(866.8)	31 7/8	(809.6)	1,500		**FSP3410WM**	1.3	(0.6)
	36 7/8	(936.6)	34 5/8	(879.5)	1,600		**FSP3710WM**	1.4	(0.7)
	40 5/8	(1031.9)	38 3/8	(974.7)	1,800		**FSP4110WM**	1.5	(0.7)
	46 1/4	(1175.0)	44	(1117.0)	2,000		**FSP4610WM**	1.7	(0.8)
Applications: Air Heating									
40 W/in² 304 SS (6.2 W/cm²)	8 3/4	(222.0)	6 1/2	(165.0)	600	**FSP91WK**		0.4	(0.2)
	10 1/4	(260.0)	7 1/2	(203.0)	750	**FSP101WK**		0.4	(0.2)
	12 1/4	(311.0)	10	(254.0)	900	**FSP121WK**	**FSP1210WK**	0.5	(0.3)
	13 1/2	(343.0)	11 1/4	(286.0)	1,000	**FSP131WK**	**FSP1310WK**	0.5	(0.3)
	16 1/4	(413.0)	13 7/8	(352.4)	1,300	**FSP161WK**	**FSP1610WK**	0.6	(0.3)
	17 3/4	(451.0)	15 1/2	(393.0)	1,450	**FSP181WK**	**FSP1810WK**	0.7	(0.4)
	19 1/4	(489.0)	17	(431.0)	1,600		**FSP1910WK**	0.7	(0.4)
	22	(558.0)	19 3/4	(502.0)	1,800		**FSP2210WK**	0.8	(0.4)
	23 3/4	(603.0)	21 1/2	(546.0)	2,000		**FSP2410WK**	0.9	(0.4)
	25	(635.0)	22 3/4	(578.0)	2,100		**FSP2510WK**	0.9	(0.4)
	28 5/8	(727.1)	26 3/8	(669.9)	2,500		**FSP2910WK**	1.1	(0.5)
	31 5/8	(803.2)	29 3/8	(746.1)	2,700		**FSP3210WK**	1.2	(0.6)
	34 1/8	(866.8)	31 7/8	(809.6)	3,000		**FSP3410WK**	1.3	(0.6)
	36 7/8	(936.6)	34 5/8	(879.5)	3,200		**FSP3710WK**	1.4	(0.7)
	40 5/8	(1031.9)	38 3/8	(974.7)	3,600		**FSP4110WK**	1.5	(0.7)
	46 1/4	(1175.0)	44	(1117.0)	4,000		**FSP4610WK**	1.7	(0.8)

FIREBAR Single/Double-Ended Heaters

5/8-Inch Single-Ended FIREBAR



FIREBAR Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number		Est. Net Weight	
	in.	(mm)	in.	(mm)		120VAC	240VAC	lbs	(kg)
Applications: Radiant, Platens, Dies, Low-Temperature Ovens 300°F (150°C)									
20 W/in²	11 1/2	(292)	8	(203)	250	**FSA121WM**		0.3	(0.2)
Alloy 840	15 1/2	(394)	12	(304)	375	**FSA161WM**	**FSA1610WM**	0.4	(0.2)
(3.1 W/cm²)	19 1/2	(495)	16	(406)	500	**FSA201WM**	**FSA2010WM**	0.5	(0.3)
	28	(711)	24	(609)	750	**FSA281WM**	**FSA2810WM**	0.6	(0.3)
	36	(914)	32	(812)	1,000	**FSA361WM**	**FSA3610WM**	0.8	(0.4)
	52	(1321)	48	(1219)	1,500	**FSA521WM**	**FSA5210WM**	1.2	(0.6)

FINBAR™ Single-Ended Heaters

Composed of aluminized steel fins press fitted to a one-inch single-ended FIREBAR element. The FINBAR™ is designed to improve heat transfer to the air and permits putting more power in tighter spaces—like forced air ducts, dryers, ovens and load bank resistors.

Heat transfer, lower sheath temperature and element life are all maximized by its finned construction. Installation is simplified by terminations exiting at one end and mounting accommodations on both ends.

Performance Capabilities

- Watt densities up to 50 W/in^2 (7.7 W/cm^2)
- 304 stainless steel sheath temperatures up to 1200°F (650°C)
- Voltages up to 480VAC
- Amperages up to 48 amperes per heater or 16 amperes per coil

Features and Benefits

Rugged aluminized steel fins
- Provides an increase in surface area to approximately 16 square inches for every linear inch of element length. Fins press fitted to the heating element improve heat transfer to the air

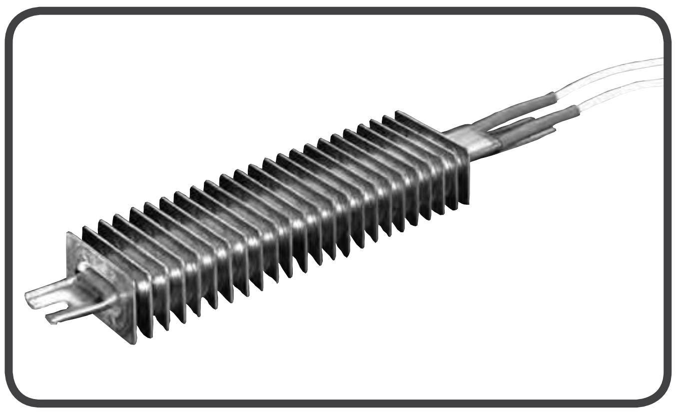
Single-ended termination
- Simplifies wiring and installation

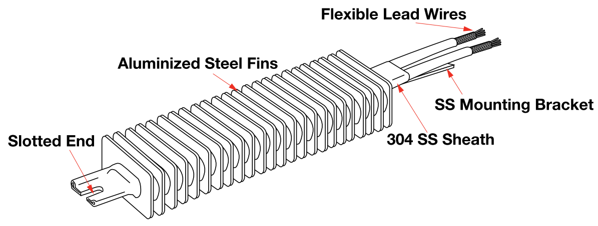
Stainless steel mounting bracket, welded to the terminal end, supplied with a slotted end
- Allows ease of installation

Lavacone seals
- Provides protection against humid storage conditions, moisture retardant to 221°F (105°C)

Typical Applications

- Forced air heating for dryers, ovens, ducts
- Still air heating for ovens, comfort heating
- Incubators
- Ink drying
- Load bank resistors





Construction Features

Watt Density: Up to 40 W/in^2 (6.2 W/cm^2)

Fin Surface Area: 16 in^2/linear in. (40.5 cm^2/linear cm)

Fin Cross Section: 2 x 1 in. (50 x 25 mm)

Maximum Operating Temperature: Sheath material: 304 SS, 1200°F (650°C), fin material; aluminized steel; 1100°F (600°C)

Heater Length: 11 to 120 in. (280 to 3050 mm)

No-Heat Length: 1 in. (25 mm) min., 12 in. (305 mm) max.

Voltages: Up to 240VAC

Phase: 1-phase parallel or 3-phase wye

Resistance Coils: 1 or 3

Terminations: Flexible lead wires, quick connect (spade), screw lug (plate) and threaded stud

Seal Material: Lavacone, rated to 221°F (105°C)

Single-End Configuration: Slotted

FINBAR Single-Ended Heaters

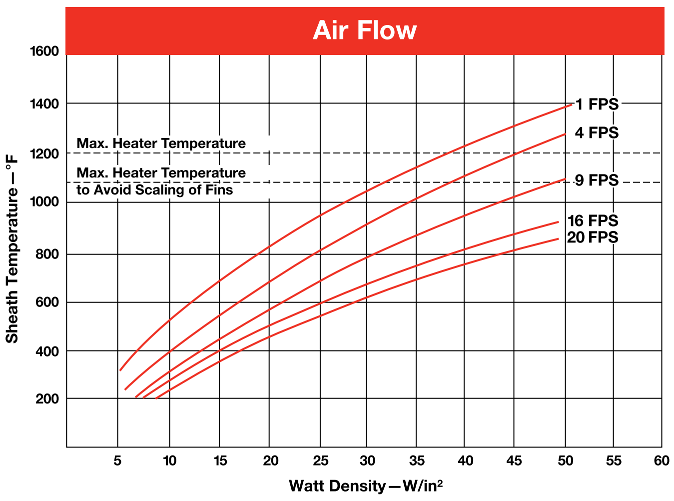
Air Heating

The *Watt Density, Air Flow and Sheath Temperature* graph shows the relationship between watt density, air flow velocity and sheath temperature, along with a recommended temperature to avoid deteriorating the fins. Be aware that **lower sheath temperature yields longer heater life**.

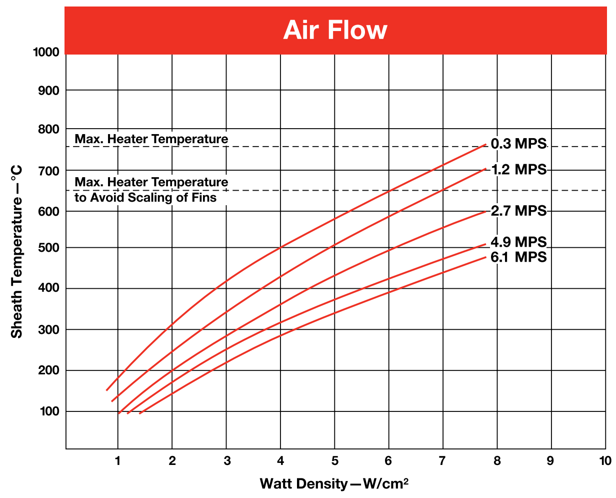
The graphic representation is based on a single-ended FINBAR, various air velocities (at 68°F/20°C inlet temperature) and different watt densities.

To determine, from the graph, the operating temperature of the FINBAR's sheath, identify the air velocity curve that approximates your application in feet per second (meters per second). Then, look at the vertical line that most closely approximates the FINBAR's watt density. From the intersecting point, read over to the temperature column to determine the sheath's operating temperature.

Watt Density, Air Flow and Sheath Temperature (°F)



Watt Density, Air Flow and Sheath Temperature (°C)



Dual Ended FINBAR

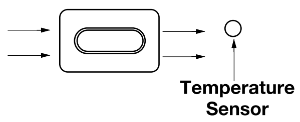
FINBAR elements are typically terminated at one end. Upon request, however, dual-ended FINBAR heaters can be ordered. To order, specify **dual-ended FINBAR** and lead length.

Application Hints

- Avoid deteriorating the fins by not exceeding the recommended maximum fin temperature of 1100°F (600°C).
- Ensure proper air flow to prevent premature heater failure.
- Locate the temperature sensor downstream from heater(s) for process temperature sensing.

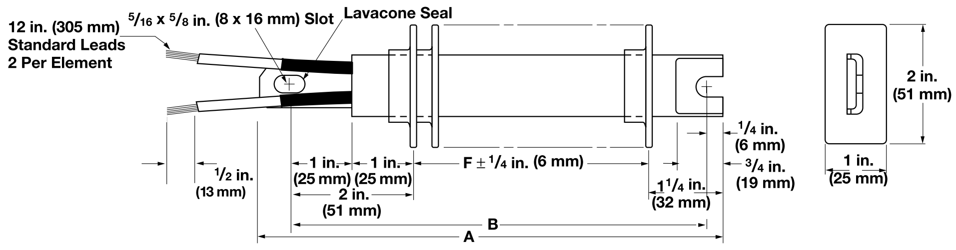
The following mounting parameters are recommended:

- Air flow over element must be parallel with the flat side.
- Element center line to element center line spacing must be a minimum of 1 1/2 in. (38 mm).



Proper air flow relative to the heater's sheath is parallel with the longer cross sectional axis.

FINBAR Single-Ended Heaters



FINBAR Description	Overall A Dimension		Overall F Dimension		Mounting B Dimension		Watts	Part Number		Est. Net Wt.	
	in.	(mm)	in.	(mm)	in.	(mm)		120VAC	240VAC	lbs	(kg)
Application: Forced Air											
20 W/in² 304 SS (3.1 W/cm²)	10 1/4	(260.0)	6 1/2	(158.0)	9 1/2	(241.0)	300	**FSP91WMF**		1.4	(0.7)
	11 3/4	(298.0)	8	(203.0)	11	(279.0)	375	**FSP101WMF**		1.4	(0.7)
	13 3/4	(349.0)	10	(254.0)	13	(330.0)	450	**FSP121WMF**		1.5	(0.7)
	15	(381.0)	11 1/4	(285.0)	14 1/4	(362.0)	500	**FSP141WMF**		1.5	(0.7)
	17 5/8	(447.7)	13 7/8	(352.4)	16 7/8	(428.6)	650	**FSP161WMF**	**FSP1610WMF**	1.6	(0.8)
	19 1/4	(489.0)	15 1/2	(393.0)	18 1/2	(469.0)	725	**FSP181WMF**	**FSP1810WMF**	1.7	(0.8)
	20 3/4	(527.0)	17	(431.0)	20	(508.0)	800	**FSP191WMF**	**FSP1910WMF**	1.7	(0.8)
	23 1/2	(597.0)	19 3/4	(501.0)	22 3/4	(577.0)	900	**FSP221WMF**	**FSP2210WMF**	1.8	(0.9)
	25 1/4	(641.0)	21 1/2	(546.0)	24 1/2	(622.0)	1000	**FSP241WMF**	**FSP2410WMF**	1.9	(0.9)
	26 1/2	(673.0)	22 3/4	(577.0)	25 3/4	(654.0)	1050	**FSP251WMF**	**FSP2510WMF**	1.9	(0.9)
	30 1/8	(765.2)	26 3/8	(669.9)	29 3/8	(746.1)	1250	**FSP291WMF**	**FSP2910WMF**	2.1	(1.0)
	33 1/8	(841.4)	29 3/8	(746.1)	32 3/8	(822.3)	1350	**FSP321WMF**	**FSP3210WMF**	2.2	(1.0)
	35 5/8	(904.9)	31 7/8	(809.6)	34 7/8	(885.8)	1500		**FSP3410WMF**	2.3	(1.1)
	38 3/8	(974.7)	34 5/8	(879.5)	37 5/8	(955.7)	1600		**FSP3710WMF**	2.4	(1.1)
	42 1/8	(1070.0)	38 3/8	(974.7)	41 3/8	(1051.0)	1800		**FSP4110WMF**	2.5	(1.2)
	47 3/4	(1213.0)	44	(1117.0)	47	(1193.0)	2000		**FSP4610WMF**	2.7	(1.3)
40 W/in² 304 SS (6.2 W/cm²)	10 1/4	(260.0)	6 1/2	(158.0)	9 1/2	(241.0)	600	**FSP91WKF**		1.4	(0.7)
	11 3/4	(298.0)	8	(203.0)	11	(279.0)	750	**FSP101WKF**		1.4	(0.7)
	13 3/4	(349.0)	10	(254.0)	13	(330.0)	900	**FSP121WKF**	**FSP1210WKF**	1.5	(0.7)
	15	(381.0)	11 1/4	(285.0)	14 1/4	(362.0)	1000	**FSP131WKF**	**FSP1310WKF**	1.5	(0.7)
	17 5/8	(447.7)	13 7/8	(352.4)	16 7/8	(428.6)	1300	**FSP161WKF**	**FSP1610WKF**	1.6	(0.8)
	19 1/4	(489.0)	15 1/2	(393.0)	18 1/2	(469.0)	1450	**FSP181WKF**	**FSP1810WKF**	1.7	(0.8)
	20 3/4	(527.0)	17	(431.0)	20	(508.0)	1600		**FSP1910WKF**	1.7	(0.8)
	23 1/2	(597.0)	19 3/4	(501.0)	22 3/4	(577.0)	1800		**FSP2210WKF**	1.8	(0.9)
	25 1/4	(641.0)	21 1/2	(546.0)	24 1/2	(622.0)	2000		**FSP2410WKF**	1.9	(0.9)
	26 1/2	(673.0)	22 3/4	(577.0)	25 3/4	(654.0)	2100		**FSP2510WKF**	1.9	(0.9)
	30 1/8	(765.2)	26 3/8	(669.9)	29 3/8	(746.1)	2500		**FSP2910WKF**	2.1	(1.0)
	33 1/8	(841.4)	29 3/8	(746.1)	32 3/8	(822.3)	2700		**FSP3210WKF**	2.2	(1.0)
	35 5/8	(904.9)	31 7/8	(809.6)	34 7/8	(885.8)	3000		**FSP3410WKF**	2.3	(1.1)
	38 3/8	(974.7)	34 5/8	(879.4)	37 5/8	(955.7)	3200		**FSP3710WKF**	2.4	(1.1)
	42 1/8	(1070.0)	38 3/8	(974.7)	41 3/8	(1050.9)	3600		**FSP4110WKF**	2.5	(1.2)
	47 3/4	(1213.0)	44	(1117.0)	47	(1193.0)	4000		**FSP4610WKF**	2.7	(1.3)