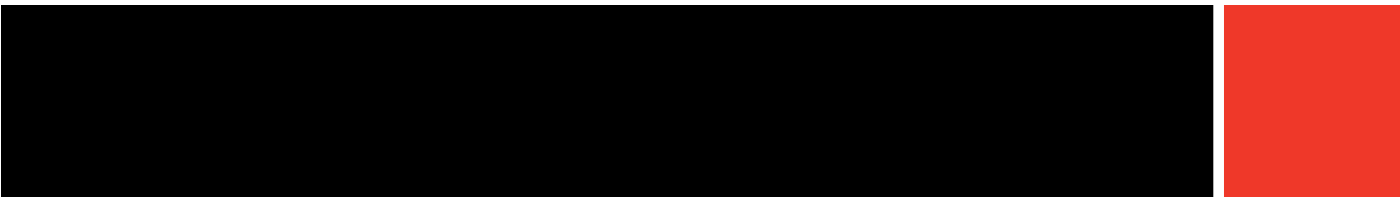


# Tubular Heaters

Tubular Heaters	Sheath Materials	Max. Operating Temperatures		Typical Max. Watt Densities		Page
		°F	°C	W/in <sup>2</sup>	W/cm <sup>2</sup>	
<b>WATROD™</b> Single-Ended Double-Ended	Alloy 800/840	1600	870	45	6.9	<b>61</b>
	Stainless steel	1200	650	60	9.3	
	Steel	750	400	45	6.9	
	Alloy 600	1800	982	45	6.9	
<b>High-Temperature</b>	Alloy 600	1800	982	45	6.9	<b>87</b>
<b>MULTICOIL™</b>	Alloy 800	1400	760	45	6.9	<b>89</b>
	304 stainless steel	1200	650	45	6.9	
	316 stainless steel	1200	650	45	6.9	
<b>Milled Groove</b>	304 stainless steel	1200	650	60	9.3	<b>91</b>
	Alloy 800	1600	870	60	9.3	
<b>FIREBAR®</b> Single-Ended Double-Ended	Alloy 800	1400	760	60	9.3	<b>93</b>
	304 stainless steel	1200	650	60	9.3	
<b>FINBAR™</b> Single-Ended	304 stainless steel	1200	650	50	7.7	<b>112</b>



Tubular Heaters



# Tubular Heaters

## WATROD™ Single/Double-Ended Heaters

Available in single- or double-ended termination styles, the versatile and economical WATROD™ tubular heating element from Watlow® lends itself to virtually the entire range of immersion and air heating applications.

The single-ended WATROD tubular design has both terminals at one end. The opposite end is sealed. Flexible lead wires are 12 in. (305 mm) crimp connected to the terminal pin and have silicone-impregnated fiberglass oversleeves.

The double-ended WATROD, with its round cross-sectional geometry, is highly adaptable for bending—especially when bending is performed in the field. Watlow's double-ended MULTICOIL™ tubular elements offer various combinations of resistor coils and thermocouples inside one sheath. They have the ability to sense the heater's internal temperature accurately every time, or offer three-phase capability in one element.

Both single- and double-ended WATRODs share many construction features delivering long life—the resistance wire is centered in the heater sheath and electrically insulated with compacted, high-grade magnesium oxide for superior heating performance.

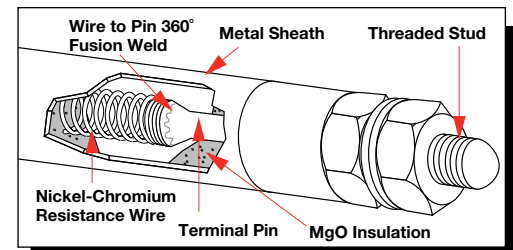
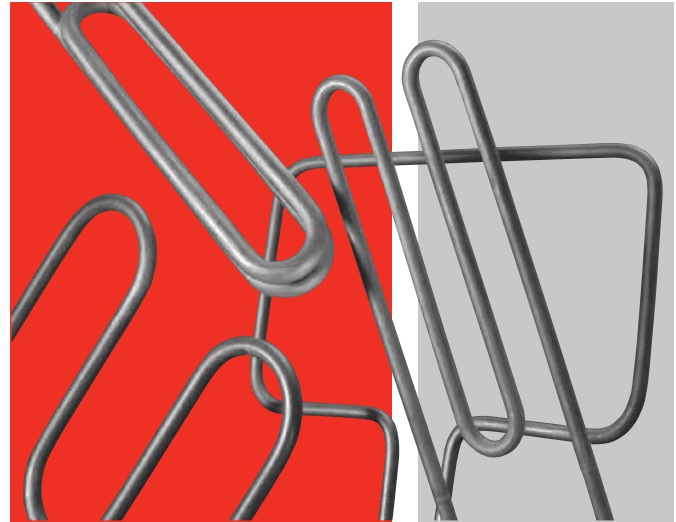
WATROD heating elements have a variety of mounting and termination options making them highly popular among industrial customers.

### Single-Ended WATROD Performance Capabilities

- Watt densities up to 45 W/in<sup>2</sup> (6.9 W/cm<sup>2</sup>)
- UL® and CSA component recognition up to 240VAC
- Alloy 800/840 and stainless steel sheath temperatures up to 1200°F (650°C)

### Double-Ended WATROD Performance Capabilities

- Watt densities up to 120 W/in<sup>2</sup> (18.6 W/cm<sup>2</sup>)
- UL® and CSA component recognition up to 600VAC
- Alloy 800/840 sheath temperatures up to 1600°F (870°C)
- Stainless steel sheath temperatures up to 1200°F (650°C)
- Steel sheath temperatures up to 750°F (400°C)
- Alloy 800 sheath temperatures up to 1800°F (982°C)



### Features and Benefits

#### Precision wound nickel-chromium resistance wire

- Distributes heat evenly to the sheath for optimum heater performance

#### Silicone resin seals

- Protects against moisture contamination and is rated to 221°F (105°C)

#### MgO insulation filled sheath

- Maximizes dielectric strength, heat transfer and life

#### Standard sheath materials

- Steel, 304 and 316 stainless steel, alloy 800/840 and alloy 600

#### 53 standard bend formations

- Allows forming the heating element to the application. Spirals, compound bends and multi-axis and multi-plane configurations

#### Stainless steel studs

- Fusion welded to terminal pins for mechanical strength

**Popular termination, mounting and moisture seal options available**

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Specifications

#### Double-Ended



#### Single-Ended



<b>Applications</b>	Direct immersion Hot runner mold (manifold) Forced air Ovens Radiant Clamp-on	Vacuums Semiconductor	Platens Forced air Deicing antennas Plastic wrap cutting Seal bars
<b>Watt Density</b> W/in <sup>2</sup> (W/cm <sup>2</sup> )	Catalog P/N: Standard:	up to 60 (9.3) up to 120 (18.6)	Catalog P/N: Standard:
<b>Element Diameters</b> in. (mm) <b>and Surface Area per Linear</b> in <sup>2</sup> (cm <sup>2</sup> ) Diameter Tolerance ± 0.005 in. (0.13 mm)	<b>Dia.</b> 0.210 0.260 0.315 0.375 0.430 0.475	<b>in<sup>2</sup></b> 0.660 0.817 0.990 1.178 1.351 1.492	<b>Dia. (mm)</b> (5.33) (6.60) (8.00) (9.53) (10.92) (12.07)
<b>Sheath Materials</b> <b>Max. Operating Temperature</b>	Standard: 316 SS Steel 304 SS Alloy 600	Alloy 800/840 1600°F (870°C) 1200°F (650°C) 750°F (400°C) 1200°F (650°C) 1800°F (980°C)	Standard: Alloy 800/840 316 SS 304 SS 1200°F (650°C) 1200°F (650°C) 1200°F (650°C)
<b>Sheath Length By Diameter</b> in. (mm)	<b>Dia.</b> Standard: 0.210 0.260 0.315 0.375 0.430 0.475	<b>Sheath Length (in.)</b> 9 to 130 9 to 270 9 to 270 11 to 360 11 to 360 11 to 275	<b>Sheath Length (mm)</b> (5.33) (230 to 3300) (6.60) (230 to 6858) (8.00) (230 to 6858) (9.53) (280 to 9144) (10.92) (280 to 9144) (12.07) (280 to 6985)
<b>Min. No-Heat Length</b> in. (mm)	<b>Sheath Length</b> 11 to 20 21 to 50 51 to 80 81 to 110 111 to 140 141 to 170 171 to 200 201 & up	<b>No-Heat Length</b> 1 1 <sup>1</sup> / <sub>4</sub> 1 <sup>1</sup> / <sub>2</sub> 1 <sup>5</sup> / <sub>8</sub> 1 <sup>3</sup> / <sub>4</sub> 2 2 <sup>1</sup> / <sub>4</sub> 2 <sup>1</sup> / <sub>2</sub>	<b>Sheath Length</b> (280 to 510) (535 to 1270) (1295 to 2030) (2055 to 2795) (2820 to 3555) (3580 to 4320) (4345 to 5080) (5105 & up)
<b>Max. Voltage/Amperage</b> <b>By Dia.</b> in. (mm)	<b>Dia.</b> 0.260 (6.6) 0.315 (8.0) 0.375 (9.53) 0.430 (10.92) 0.475 (12.07)	<b>Volts</b> 250VAC 480VAC 480VAC 600VAC 600VAC	<b>Amperes</b> 15 30 30 40 40
	<b>Dia.</b> 0.375 (9.53) 0.430 (10.92) 0.475 (12.07)	<b>Volts</b> 480VAC 480VAC 480VAC	<b>Ampere</b> 30 30 30

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Specifications (Continued)

#### Double-Ended



#### Single-Ended



Ohms Per Heated Inch By Dia. in.	Double-Ended			Single-Ended		
	Dia.	Min.	Max.	Dia.	Min.	Max.
0.210	0.130Ω	14Ω		0.375	0.150Ω	25Ω
0.260	0.080Ω	16Ω		0.430	0.150Ω	24Ω
0.315	0.050Ω	25Ω		0.475	0.150Ω	22Ω
0.375	0.030Ω	20Ω				
0.430	0.030Ω	25Ω				
0.475	0.035Ω	25Ω				
<b>Terminations</b>	Standard: Threaded stud Screw lug (plate) Quick connect (spade) Flexible lead wires			Standard: Flexible lead wires Rubber overmolds		
<b>Seals</b>	Standard: Silicone resin 221°F (105°C) Ceramic base 2800°F (1535°C) Ceramic-to-metal 482°F (250°C) Silicone rubber (RTV) 392°F (200°C) Silicone resin 392°F (200°C) Epoxy resin 194/356°F (90/180°C)			Standard: Silicone resin 221°F (105°C) Silicone rubber (RTV) 500°F (260°C) Epoxy resin 194/356°F (90/180°C)		
<b>Mounting Options</b>	Threaded bulkheads Mounting brackets Locator washers Mounting collars			Threaded bulkhead Locator washers Mounting collars		
<b>Surface Finish Options</b>	Oxide anneal Bright anneal Passivation			Oxide anneal Bright anneal Passivation		
<b>Agency Recognition</b>	UL® Component to 480VAC (File # E52951/E56488) CSA Component to 600VAC (File # 31388)			UL® Component to 240VAC (File # E52951) CSA Component to 240VAC (File # 31388) ①		

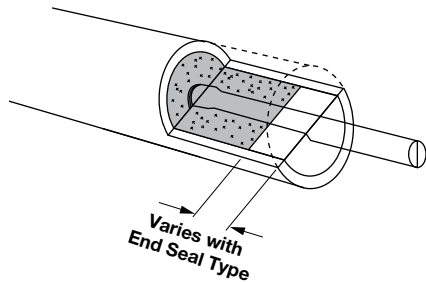
① Not applicable to 0.375 inch diameter single-ended WATROD.

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Options

#### Moisture Resistant Seals



WATROD's MgO insulating material is hygroscopic. To control the rate of moisture entering the heater, an appropriate moisture seal must be used. Choosing the correct seal is important to the life and performance of the heater. All materials have varying rates of gas vapor transmission. Be sure the maximum continuous use temperature is not exceeded at the seal location. Most end seals are applied with a small cavity in the end of the heater. The seal will also help prevent arcing at the terminal ends

#### Zoned Heaters

Single zone heaters are only available.

#### External Finishes

##### 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 food and beverage markets.

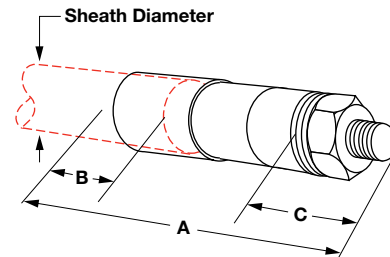
To order, specify **bright annealing**.

##### Passivation

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

To order, specify **passivation**.

#### Ceramic-to-Metal End-Seal



Ceramic-to-metal end-seals with threaded stud terminations provide an air-tight seal for continuous terminal temperatures up to 500°F (260°C). Watlow does not recommend this seal if terminations are exposed to temperatures exceeding 500°F (260°C).

Sheath Diameter in. (mm)	A in. (mm)	B in. (mm)	C in. (mm)	Thread Size
0.260 (6.6)	1 11/16 (42.9)	1/2 (13)	13/32 (10.32)	#8-32
0.315 (8.0)	1 7/8 (47.6)	1/2 (13)	13/32 (10.32)	#10-32
0.430 (10.9)	2 1/8 (54.0)	1/2 (13)	13/32 (10.32)	#1/4-28

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

*Options (Continued)*

### End-Seal Options

End-Seal	Part Number	Color	UL® Recognition	Max. Cont. Use Temperature	Typical or General Usage/Application
Standard Epoxy	<b>EC</b>	Cream	Yes	194°F (90°C)	Long term stable insulation resistance
Intermediate Epoxy	<b>EB</b>	Gray	Yes	356°F (180°C)	Long term stable insulation resistance
High-Temp. Epoxy	<b>HTE</b>	Amber	No	450°F (232°C)	Long term stable insulation resistance
Silicone Resin	<b>SR</b>	Clear	Yes	221°F (105°C)	General usage on tubular products - porous
Silicone Fluid	<b>SF</b>	Clear	No	392°F (200°C)	Moisture resistance of the MgO, or high temperature ceramic seal (storage only) - porous
Lavacone	<b>LC</b>	Dark Brown	Yes	221°F (105°C)	Porous seal for the FIREBAR
Silicone Rubber RTV	<b>RTV</b>	Red-Orange	Yes	392°F (200°C)	General usage on FIREBAR applications - porous
High-Temperature Ceramic	<b>HTC</b>	White	Yes	2800°F (1538°C)	Very high-temperature applications - for extremely low vapor transmission rate

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Terminations

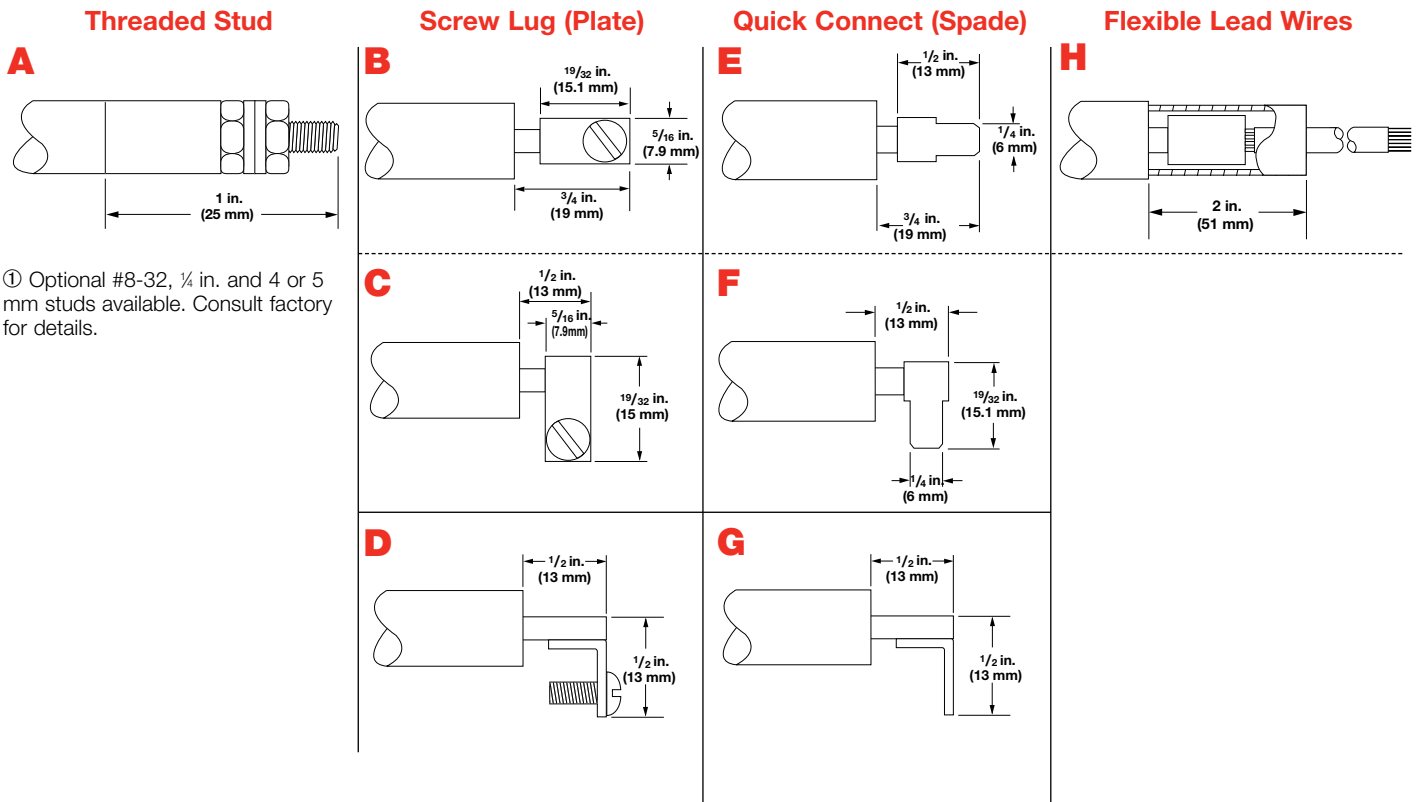
Double-ended WATROD elements are available with a variety of terminations. Single-ended WATROD elements are available with only flexible lead wires.

The following table and illustrations detail the terminations available with double- or single-ended WATRODs—for each available sheath diameter.

Flexible lead wires are 12 in. (305 mm), Sil-A-Blend™ 390°F (200°C) unless otherwise specified. Insulation options include TGGT 480°F (250°C) plus other temperature ratings. Contact your Watlow representative.

Overmolds are available for flexible lead wires only. Available in silicone rubber 390°F (200°C) and neoprene 212°F (90°C). Contact your Watlow representative.

WATROD Element	Sheath Diameter in. (mm)		Threaded Stud ①	Screw Lug (Plate)				Quick Connect (Spade)			Flexible Lead Wires
			A	B	C	D	E	F	G	H	
Double-Ended	0.260	(6.6)	#6-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.315	(8.0)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.335	(8.5)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.375	(9.5)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.430	(10.9)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.475	(12.1)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Single-Ended	0.490	(12.5)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.375	(9.53)	No	No	No	No	No	No	No	No	Yes
	0.430	(10.9)	No	No	No	No	No	No	No	No	Yes
	0.475	(12.1)	No	No	No	No	No	No	No	No	Yes
	0.490	(12.5)	No	No	No	No	No	No	No	No	Yes





# Tubular Heaters

## WATROD Single/Double-Ended Heaters

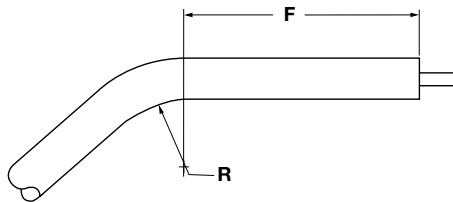
### Bend Formations

#### Double-Ended WATROD Bend Formations

Double-ended WATROD heating elements can be formed into spirals, compounds, multi-axis and multi-planes from 36 common bend configurations. Custom bending with tighter tolerances can be made to meet specific application needs.

Formation is limited by the minimum bend radius (R) and the straight length (F) required beyond the bend. In order to locate the end of a heated length within a bend, the radius must be 3 in. (76 mm) or larger. Additionally, overall length tolerance (T) must be included in one or more of the straight lengths.

Minimum radius for various sheath diameters and lengths are shown in the *Bend Formations* chart below. Illustrated on pages 67 to 76 are the 51 common bend configurations available on both stock and made-to-order WATROD heating elements.



WATROD Length Tolerance (T)			
Sheath Length		Length Tolerance	
in.	(mm)	in.	(mm)
11-50	(280-1270)	±1/8	(±3)
51-110	(1295-2795)	±3/16	(±5)
111-170	(2820-4320)	±1/4	(±6)
171-200	(4345-5080)	±3/8	(±10)
201 & up	(5105 & up)	±1/2	(±13)

#### Single-Ended WATROD Bend Formations

Watlow does not recommend field bending single-ended WATROD elements. Formation is limited by the minimum radius of a bend (R) and the straight length (F) beyond the bend. The radius must be 3 in. (75 mm) or more for the heated length's end to be inside a bend.

Additionally, the overall length tolerance (T) must be provided for in one or more of the specified lengths.

The four common bend configurations available for standard and made-to-order single-ended WATROD elements are Figures 1, 6, 22 and 28.

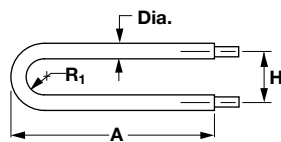
To order a common bend formation, specify the **bend figure number**, dimensions and critical tolerances.

WATROD Minimum Radius					
Sheath Diameter	Field Bend R <sup>①</sup>		Factory R <sup>①</sup>		F <sup>②</sup> Dimension
	in.	(mm)	in.	(mm)	
0.260	(6.6)	3/4 (19.0)	3/8 (9.5)	1/2 (13.0)	1/2 (13.0)
0.315	(8.0)	3/4 (19.0)	1/2 (13.0)	1/2 (13.0)	1/2 (13.0)
0.375	(9.52)	1 (25.0)	1/2 (13.0)	1/2 (13.0)	1/2 (13.0)
0.430	(10.92)	1 (25.0)	1/2 (13.0)	3/4 (19.0)	3/4 (19.0)
0.475	(12.07)	1 (25.0)	5/8 (15.9)	1 (25.0)	1 (25.0)
0.490	(12.45)	1 (25.0)	5/8 (15.9)	1 (25.0)	1 (25.0)

① R is the inside radius of a bend.

② F is the distance from the sheath's end to the start of the first bend.

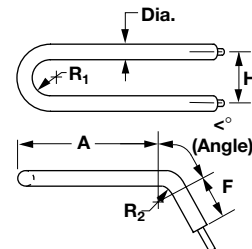
Figure 1



$$SL = 2A + 1.14R_1 - 0.43 \text{ Dia.}$$

(For pricing, use 1 bend)

Figure 2



$$SL = 2A + 2F + 1.14R_1 + 0.0175 (<^\circ)$$

$$(2R_2 + \text{Dia.}) - 0.43 \text{ Dia.}$$

(For pricing, use 3 bends)

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Bend Formations (Continued)

Figure 3

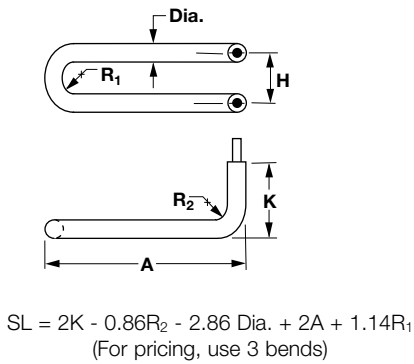


Figure 4

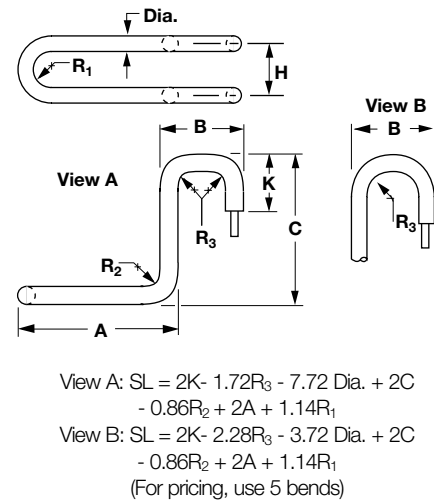


Figure 5

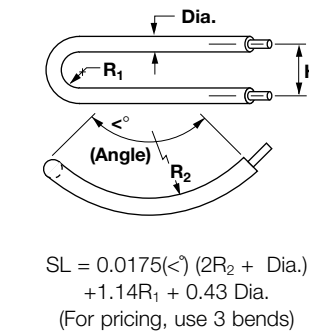


Figure 6

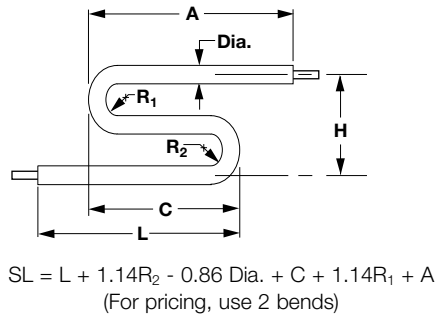


Figure 7

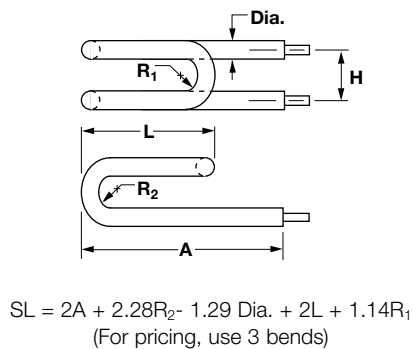


Figure 8

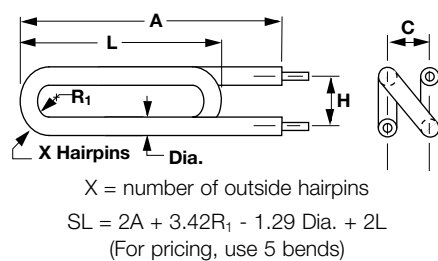
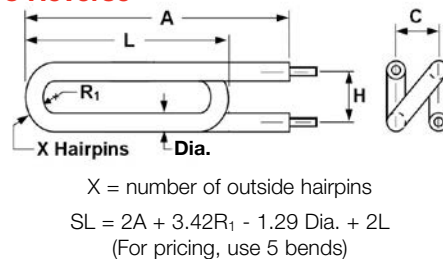


Figure 8 Reverse



# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Bend Formations (Continued)

Figure 9

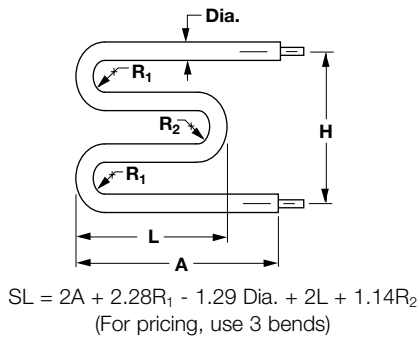


Figure 10

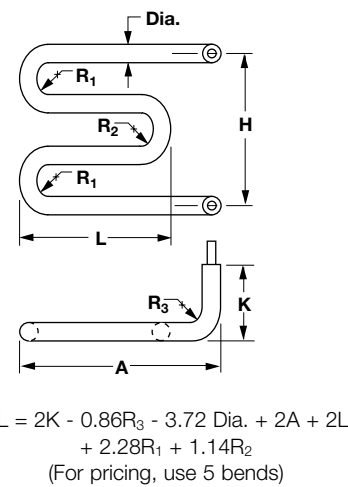


Figure 11

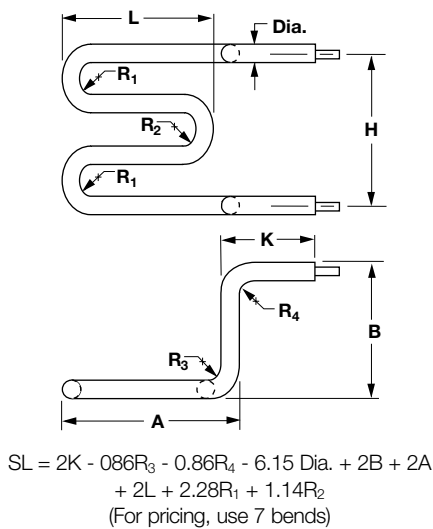


Figure 12

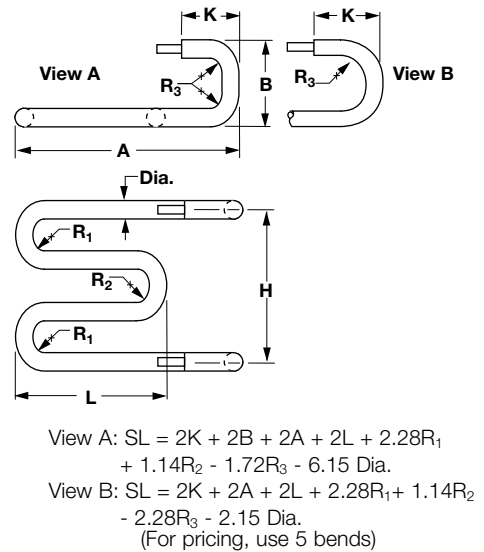


Figure 13

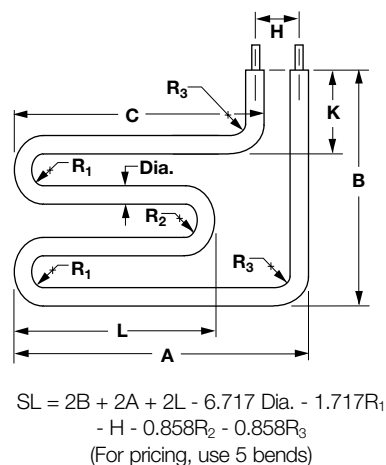
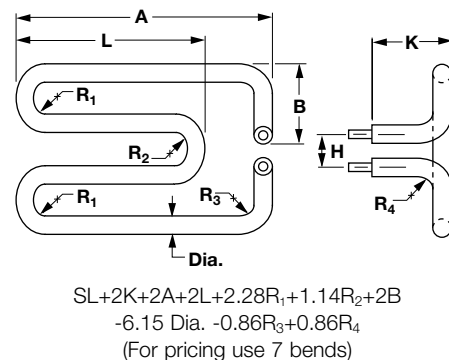


Figure 14

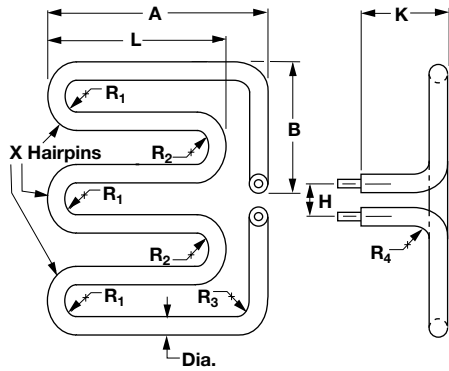


# Tubular Heaters

## WATROD Single/Double-Ended Heaters

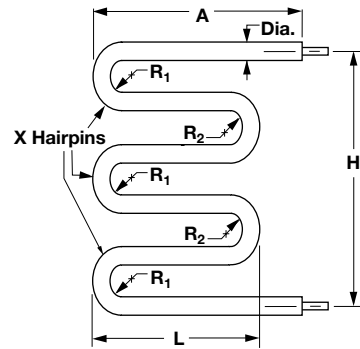
### Bend Formations (Continued)

Figure 15



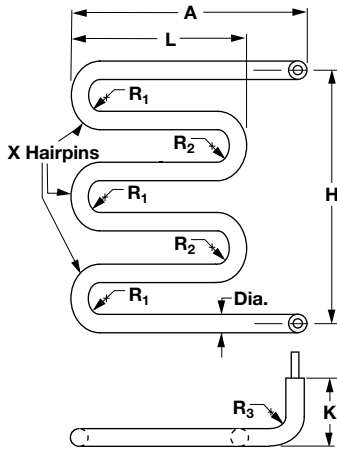
X = number of outside hairpins  
 $SL = 2K + 2A + 2K(X - 1) + 2B - 0.86R_3 - 0.86R_4 + 1.14R_1(X) + 1.14R_2(X - 1) - 4.86 \text{ Dia.} - (2X - 1) 0.43 \text{ Dia.}$   
 (For pricing, use 9 bends if X = 3 hairpins)

Figure 16



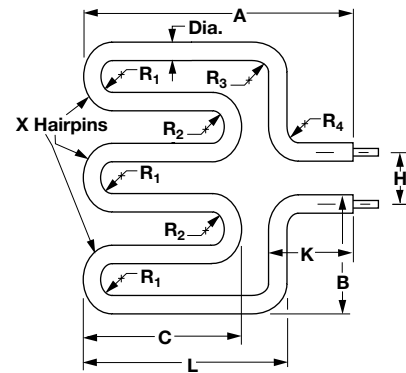
X = number of outside hairpins  
 $SL = 2A + 0.43 \text{ Dia.} (1 - 2X) + 2L(X - 1) + 1.14R_1 + 1.14R_2(X - 1)$   
 (For pricing, use 5 bends if X = 3 hairpins)

Figure 17



X = number of outside hairpins  
 $SL = 1.14R_2X - 0.88 \text{ Dia.} X - 1.14R_2 - 2 \text{ Dia.} + 1.14R_1 X - 0.86R_3 + 2L X - 2L + 2A + 2K$   
 (For pricing, use 7 bends if X = 3 hairpins)

Figure 18



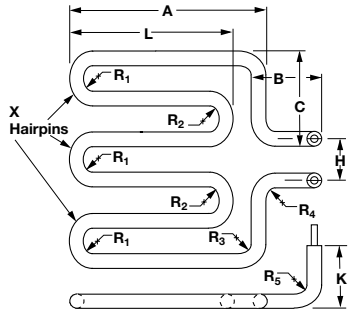
X = number of outside hairpins  
 $SL = 2L + 2K + 2B + 2C(X - 1) - 0.86R_3 - 0.86R_4 - 4.86 \text{ Dia.} + 1.14R_1(X) + 1.14R_2(X - 1) - (2X - 1) 0.43 \text{ Dia.}$   
 (For pricing, use 9 bends if X = 3 hairpins)

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

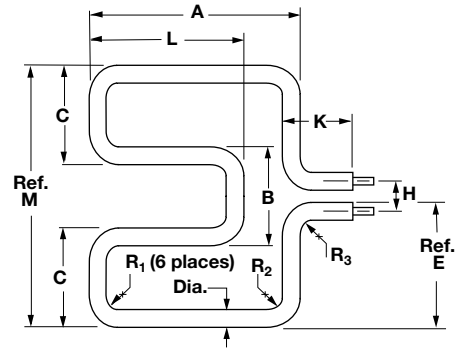
### Bend Formations (Continued)

Figure 19



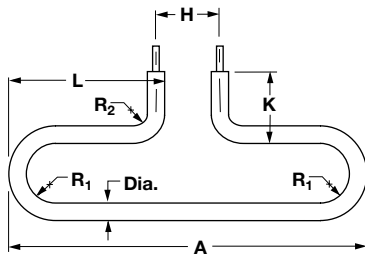
X = number of outside hairpins  
 $SL = 2K + 2A + 2B + 2C + 2L(X - 1) + 1.14R_1(X) + 1.14R_2(X - 1) - 0.86R_3 - 0.86R_4 - 0.86R_5 - 7.29 \text{ Dia.} - (2X - 1) 0.43 \text{ Dia.}$   
 (For pricing, use 11 bends if X = 3 hairpins)

Figure 20



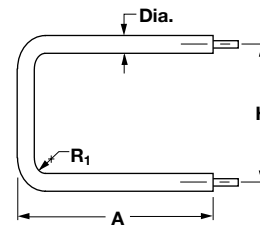
$SL = 2K + 2C + B + 2A + 2L - 2.58R_1 - 0.86R_2 - 0.86R_3 - 12.15 \text{ Dia.}$   
 (For pricing, use 10 bends)

Figure 21



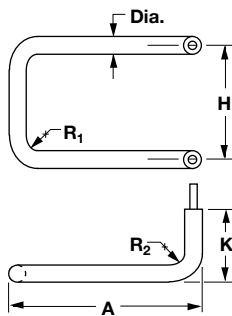
$SL = 2A + 2K - H - 2.28R_1 - 0.86R_2 - 3.29 \text{ Dia.}$   
 (For pricing, use 4 bends)

Figure 22



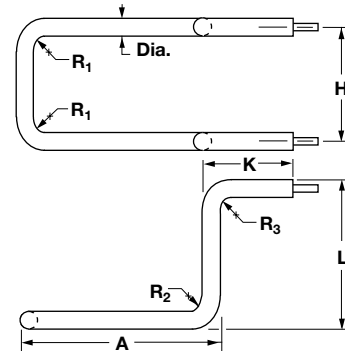
$SL = 2A - 0.86R_1 - 1.43 \text{ Dia.} + H$   
 (For pricing, use 2 bends)

Figure 23



$SL = 2K - 0.86R_2 - 3.86 \text{ Dia.} + 2A - 0.86R_1 + H$   
 (For pricing, use 4 bends)

Figure 24



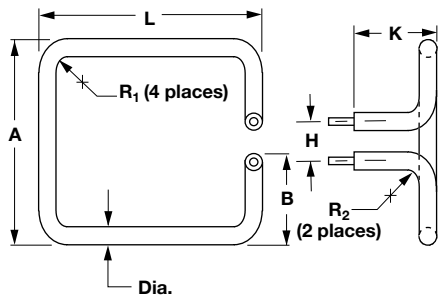
$SL = 2K + 2L + H - 0.86R_1 - 0.86R_2 - 0.86R_3 - 7.29 \text{ Dia.}$   
 (For pricing, use 6 bends)

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Bend Formations (Continued)

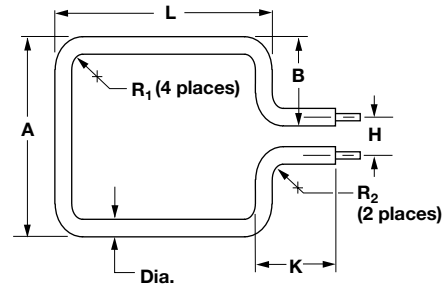
Figure 25



$$SL = 2K + 2A + 2L - H - 1.72R_1 - 0.86R_2 - 6.92 \text{ Dia.}$$

(For pricing, use 6 bends)

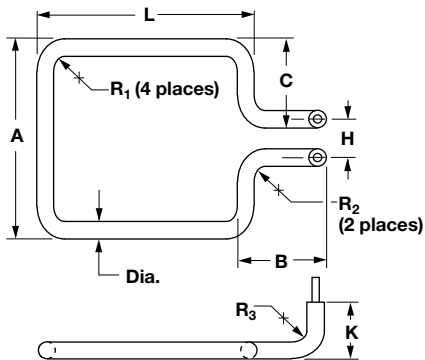
Figure 26



$$SL = 2K + 2A + 2L - H - 1.72R_1 - 0.86R_2 - 6.29 \text{ Dia.}$$

(For pricing, use 6 bends)

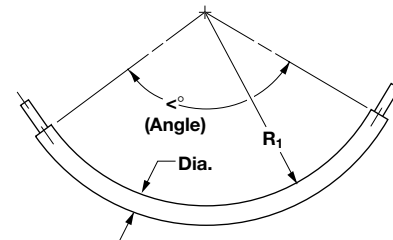
Figure 27



$$SL = 2K + 2A + 2L + 2B - H - 1.72R_1 - 1.72R_2 - 8.72 \text{ Dia.}$$

(For pricing, use 8 bends)

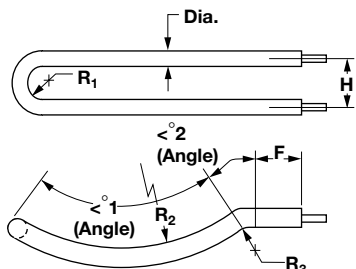
Figure 28



$$SL = 0.0175 \angle^\circ (R_1 + 0.5 \text{ Dia.})$$

(For pricing, use 1 bend)

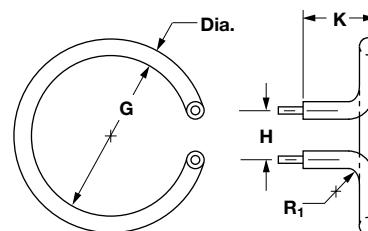
Figure 29



$$SL = 0.0175 \angle^1 (2R_2 + \text{Dia.}) + 2F + 1.14R_1 + 0.0175 \angle^2 (2R_3 + \text{Dia.}) - 0.43 \text{ Dia.}$$

(For pricing, use 5 bends)

Figure 30



$$SL = (G + \text{Dia.}) 3.14 + 1.14R_1 + 2K + 3.28 \text{ Dia.} - H$$

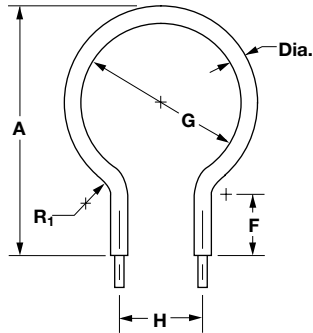
(For pricing, use 4 bends)

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Bend Formations (Continued)

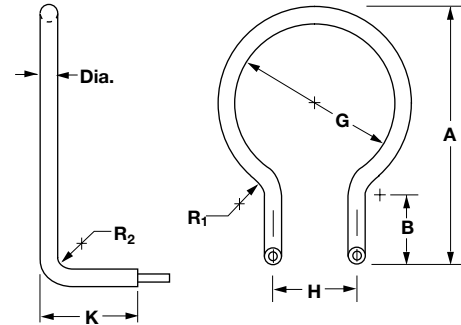
Figure 31



$$SL = (G + \text{Dia.}) 3.14 + 1.14R_1 + 2F + 3.71 \text{ Dia.} - H$$

(For pricing, use 4 bends)

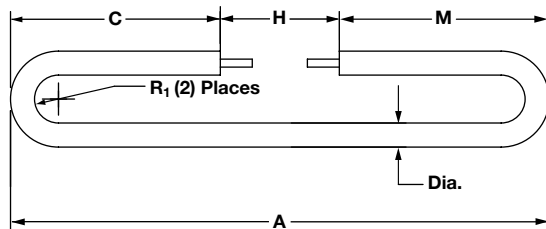
Figure 32



$$SL = (G + \text{Dia.}) 3.14 + 1.14R_1 + 2B + 1.14R_2 + 2K + 3.28 \text{ Dia.} - H$$

(For pricing, use 6 bends)

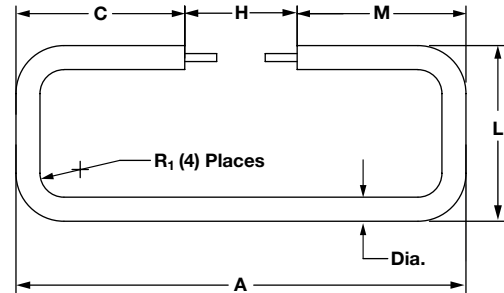
Figure 37



$$SL = (2A - H) + 2\pi R_1 - 2R_1$$

(For pricing, use 2 bends)

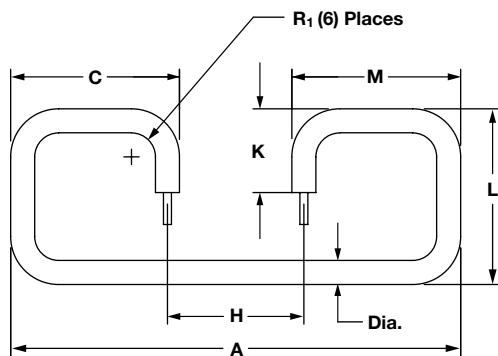
Figure 38



$$SL = (2A - H) + 2L + 2\pi R_1 - 4R_1$$

(For pricing, use 4 bends)

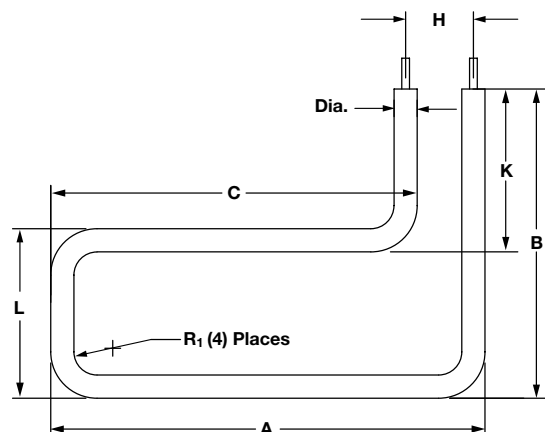
Figure 39



$$SL = (2A - H) + 2L + 2K + 3\pi R_1 - 6R_1$$

(For pricing, use 6 bends)

Figure 40



$$SL = (2A - H) + 2B + 2\pi R_1 - 4R_1$$

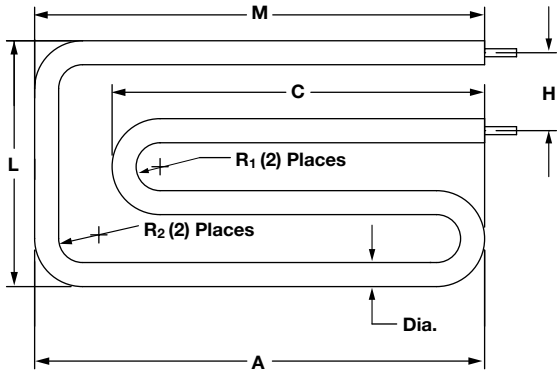
(For pricing, use 4 bends)

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Bend Formations (Continued)

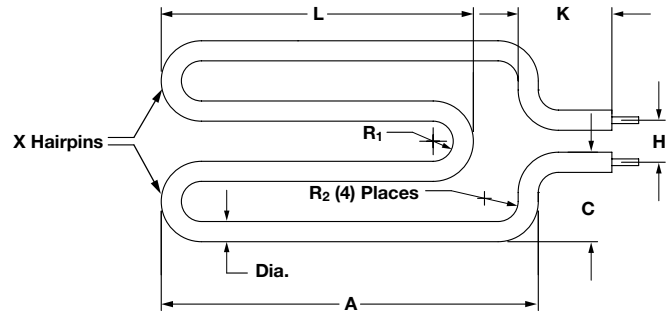
Figure 41



$$SL = 2A + 2C + L - H + 2\pi R_1 + \pi R_2 - 2R_1 - 2R_2$$

(For pricing, use 4 bends)

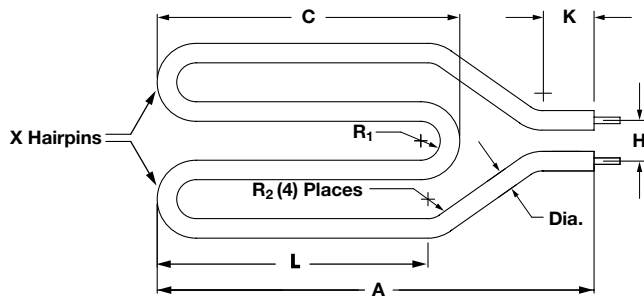
Figure 42



$$SL = 2A + (\#)L + 2K + 2C + 2\pi R_2 + (\# \text{ of } R_1) \pi R_1 - (\# \text{ of } R_1) R_1$$

(For pricing, use 7 bends if X = 2)

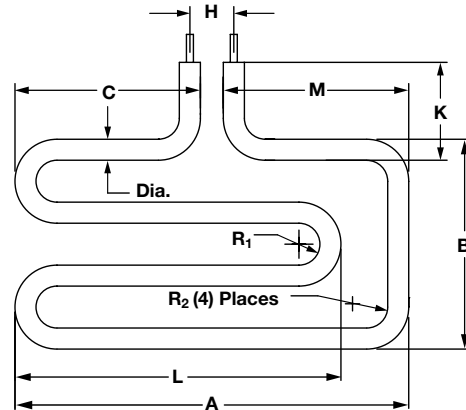
Figure 43



$$SL = 2A + (\#)C + (\# \text{ of } R_1) \pi + 2\pi R_2 - (\# \text{ of } R_1) R_1 - 4R_2$$

(For pricing, use 7 bends if X = 2)

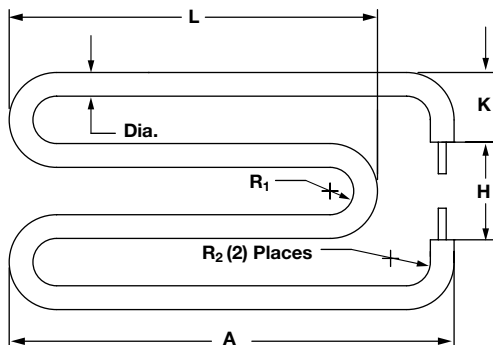
Figure 44



$$SL = 2A + 2L + B + 2K + 2\pi R_2 + 3\pi R_1 - 4R_2 - 3R_1$$

(For pricing, use 7 bends)

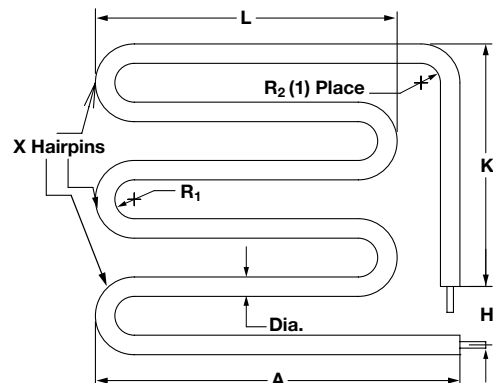
Figure 45



$$SL = 2A + 2L + 2K + 3\pi R_1 + \pi R_2 - 3R_1 - 2R_2$$

(For pricing, use 5 bends)

Figure 46



$$SL = 2A + (\#)L + K + (\# \text{ of } R_1) \pi + \frac{\pi R_2}{2} - (\# \text{ of } R_1) R_1 - R_2$$

(For pricing, use 6 bends if X = 3)



# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Bend Formations (Continued)

Figure 47

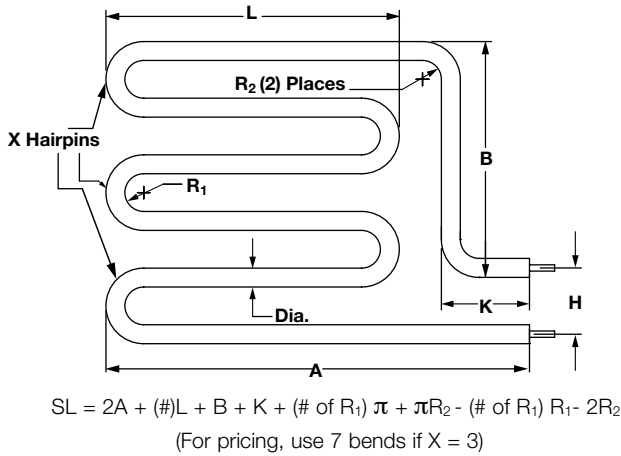


Figure 48

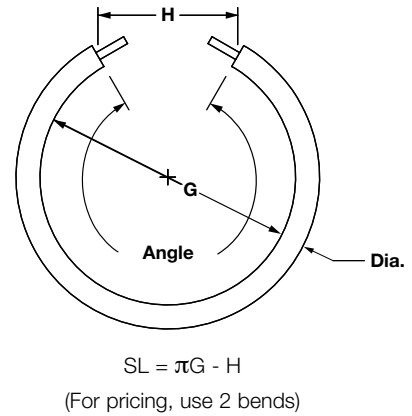


Figure 49

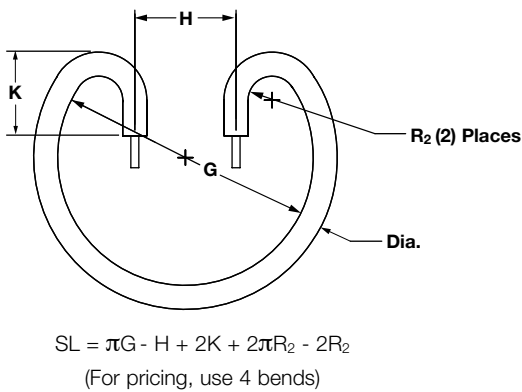


Figure 50

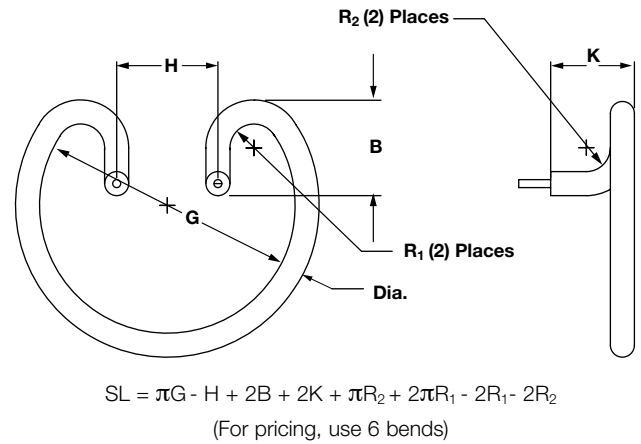


Figure 51

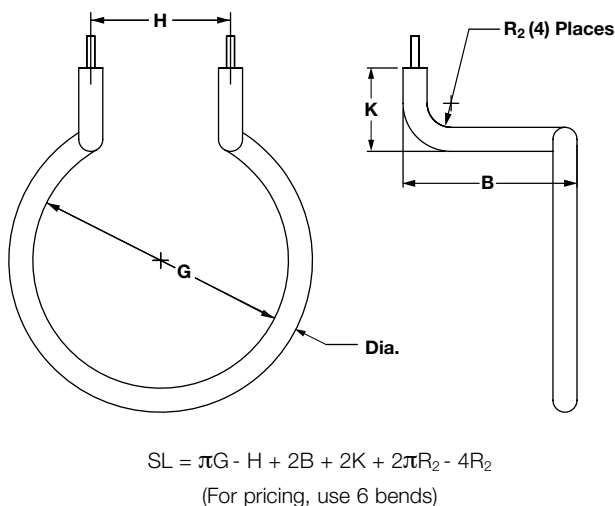
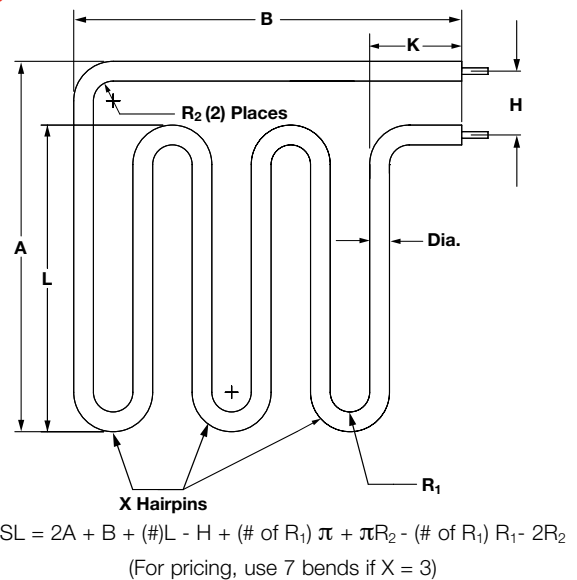


Figure 52

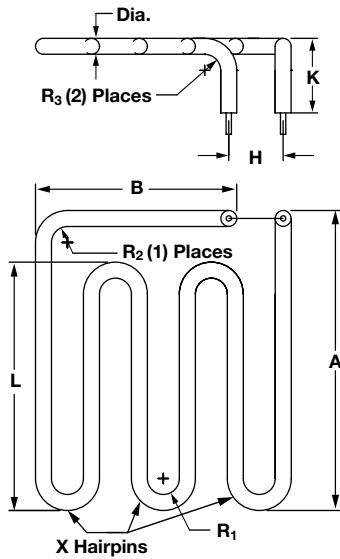


# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Bend Formations (Continued)

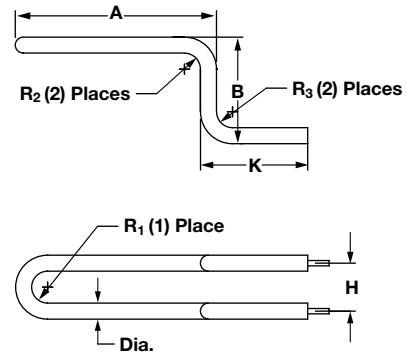
Figure 53



$$SL = 2A + (\#)L + B + 2K + (\# \text{ of } R_1)\pi + 2\left(\frac{\pi R_3}{2}\right) - (\# \text{ of } R_1)R_1 - 2R_3 - R_2$$

(For pricing, use 8 bends if X = 3)

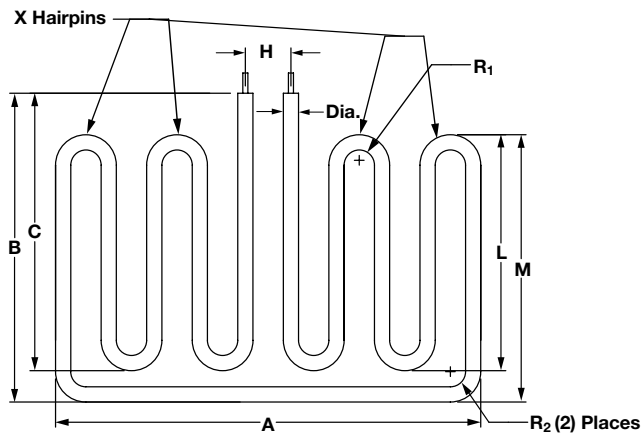
Figure 54



$$SL = 2A + 2B + 2K + \pi R_1 + 2\pi R_2 - R_1 - 4R_2$$

(For pricing, use 5 bends)

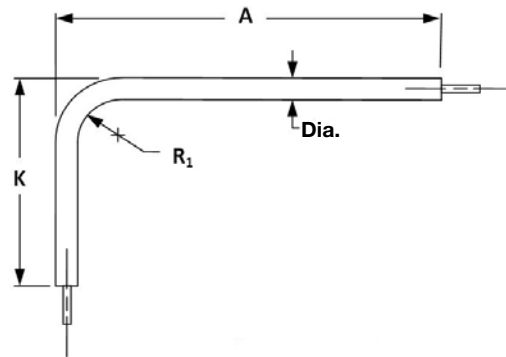
Figure 55



$$SL = A + 2C + 2M + (\#)L + (\# \text{ of } R_1)\pi + \pi R_2 - (\# \text{ of } R_1)R_1 - 2R_2$$

(For pricing, use 10 bends if X = 4)

Figure 56



$$SL = A + K - 0.86R_1$$

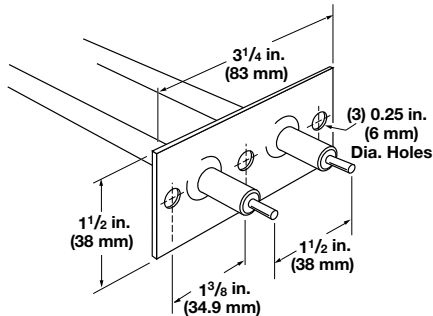
(For pricing, use 1 bend)

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Mounting Methods

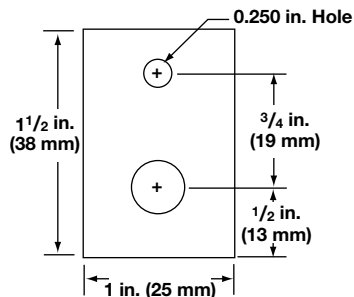
#### Brackets



A 0.065 in. (1.7 mm) thick stainless steel bracket provides element mounting in non-pressurized applications. Attached to the heater sheath, these brackets are not suited for liquid-tight mountings. The bracket is located 1/2 in. (13 mm) from the sheath's end, unless otherwise specified.

To order, specify **mounting bracket**.

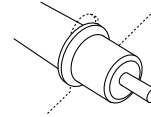
#### Single Leg Bracket



A 1 1/2 in. (38 mm) x 1 in. (25 mm) wide x 16 gauge stainless steel bracket with one element hole and one mounting hole 1/2 in. (13 mm) from end.

To order, specify **single leg bracket**.

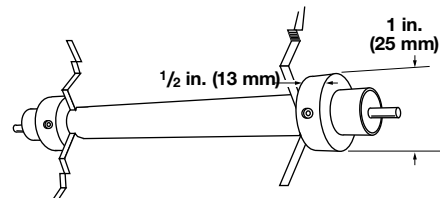
#### Locator Washers



Stainless steel locator washers retain the heated area of the sheath in the work zone, while allowing for expansion and contraction during cycling.

To order, specify **locator washer**, along with dimension from the heater's end.

#### Mounting Collars



Plated steel mounting collars secure the heater sheath with set screws to serve as adjustable stops for through-the-wall mounting. Collars are shipped in bulk.

To order, specify **mounting collars**.

# Tubular Heaters

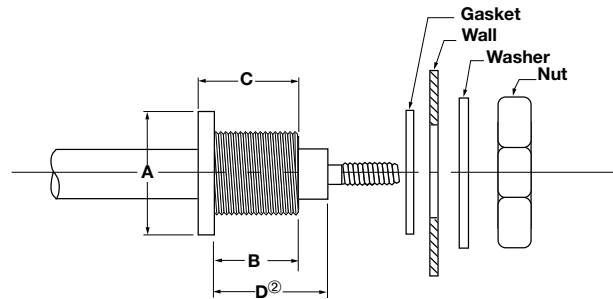
## WATROD Single/Double-Ended Heaters

### Mounting Methods (Continued)

#### Threaded Bulkheads

A threaded bushing with flange on the heater sheath provides rigid, leak-proof mounting through the walls of tanks. A gasket, plated steel washer and hex nut are included. The threaded end of the bushing is flush with the sheath's end unless otherwise specified. Threaded bulkheads are available in brass, steel or stainless steel as indicated in the table.

To order, specify **threaded bulkheads** and the specifications from the table.



#### Threaded Bulkhead Specifications

Element Diameter in. (mm)	Material	Thread Size	A ① Flange Size/Style		B Threaded Length		C Overall Length	
			in.	(mm)	in.	(mm)	in.	(mm)
0.260 (6.6)	Brass	1/2 - 20 UNF	3/4	Round (19.0)	5/8	(15.9)	3/4	(19.0)
0.260 (6.6)	SS	1/2 - 20 UNF	3/4	Round (19.0)	5/8	(15.9)	3/4	(19.0)
0.315 (8.0)	Brass	1/2 - 20 UNF	3/4	Round (19.0)	5/8	(15.9)	3/4	(19.0)
0.315 (8.0)	Steel	1/2 - 20 UNF	3/4	Hex (19.0)	3/4	(19.0)	15/16	(23.8)
0.315 (8.0)	SS	1/2 - 20 UNF	3/4	Round (19.0)	3/4	(19.0)	27/32	(21.4)
0.375 (9.5)	Brass	1/2 - 20 UNF	3/4	Round (19.0)	5/8	(15.9)	3/4	(19.0)
0.375 (9.5)	Steel	1/2 - 20 UNF	3/4	Hex (19.0)	3/4	(19.0)	15/16	(23.8)
0.375 (9.5)	SS	1/2 - 20 UNF	3/4	Round (19.0)	3/4	(19.0)	27/32	(21.4)
0.430 (10.9)	Brass	5/8 - 18 UNF	7/8	Hex (22.2)	3/4	(19.0)	15/16	(23.8)
0.430 (10.9)	Steel	5/8 - 18 UNF	7/8	Round (22.2)	3/4	(19.0)	15/16	(23.8)
0.430 (10.9)	SS	5/8 - 18 UNF	1	Round (25.0)	3/4	(19.0)	15/16	(23.8)
0.475 (12.1)	Brass	5/8 - 18 UNF	7/8	Round (22.2)	3/4	(19.0)	15/16	(23.8)
0.475 (12.1)	Steel	5/8 - 18 UNF	1	Round (25.0)	1	(25.0)	1 1/8	(28.6)
0.475 (12.1)	SS	5/8 - 18 UNF	1	Round (25.0)	3/4	(19.0)	15/16	(23.8)

① Designates the dimension across flats for hex flange style and outside diameter for round flange style.

② Equal to "B" dimension unless otherwise specified.

# Tubular Heaters



## Extended Capabilities For WATROD Single/Double-Ended Heaters

### Options

#### Terminal Enclosures

General purpose terminal enclosures, without thermostats, are standard on all screw plug immersion heaters. To meet specific application requirements, Watlow offers the following optional terminal enclosures:

- General purpose with single or double pole thermostat
- Moisture-resistant or corrosion resistant—available with optional single or double pole thermostat
- Explosion-resistant class 1, groups B, C and D explosion resistant—available with optional single or double-pole thermostat.
- Explosion and moisture-resistant combination—available with optional single- or double-pole thermostat

#### Zoned Heaters

Multiple zone heaters with up to (5) zones are available.

#### Features and Benefits

##### Standard sheath materials

- Optional materials available which include titanium, alloy 20, Hastelloy C276, 321 SS and alloy 400

### Specifications

Double-Ended



Single-Ended

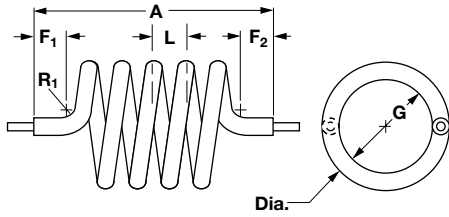


Element Diameters in. (mm) and Surface Area per Linear in <sup>2</sup> (cm <sup>2</sup> ) Diameter Tolerance ± 0.005 in. (0.13 mm)	Double-Ended		Single-Ended	
	Dia. in. mm	in <sup>2</sup> cm <sup>2</sup>	Dia. (mm)	cm <sup>2</sup>
	0.490	1.539	(12.45)	(9.93)
<b>Sheath Materials</b>	Extended: Alloy 400 Titanium		Contact Watlow Contact Watlow	
<b>Max. Operating Temperature</b>			Extended: Alloy 600 1800°F (980°C) Steel 750°F (400°C)	
Sheath Length By Diameter in. (mm)	Dia.	Sheath Length (in.)	Dia. (mm)	Sheath Length (mm)
	Extended: 0.490	11 to 265	(12.45)	(280 to 6731)
Max. Voltage/Amperage By Dia. in. (mm)	Dia.	Volts	Ampere	
	0.490 (12.45)	600VAC	40	
Ohms Per Heated Inch By Dia.	Dia.	Min.	Max.	
	0.490	0.035Ω	21Ω	
	Dia.	Min.	Max.	
	0.490	0.150Ω	24Ω	

## Extended Capabilities For WATROD Single/Double-Ended Heaters

### Bend Formations

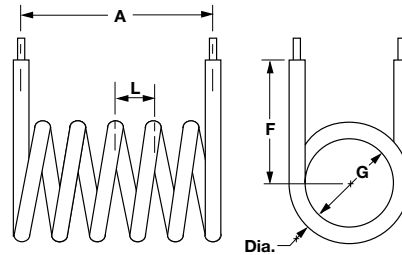
**Figure 33**



$$SL = [(G + \text{Dia.}) (3.14) (\text{Number of } 360^\circ\text{'s}) + F_1 + F_2]$$

(For pricing, contact Watlow)

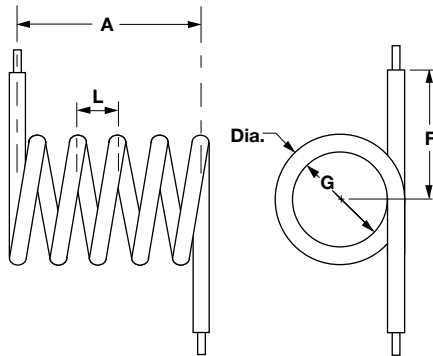
**Figure 34**



$$SL = [(G + \text{Dia.}) (3.14) (\text{Number of } 360^\circ\text{'s}) + 2F]$$

(For pricing, contact Watlow)

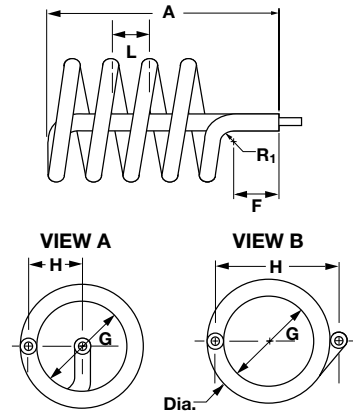
**Figure 35**



$$SL = [(G + \text{Dia.}) (3.14) (\text{Number of } 360^\circ\text{'s}) + 2F]$$

(For pricing, contact Watlow)

**Figure 36**



$$SL = [(G + \text{Dia.}) (3.14) (\text{Number of } 360^\circ\text{'s}) + (G \div 2) + A + F]$$

(For pricing, contact Watlow)

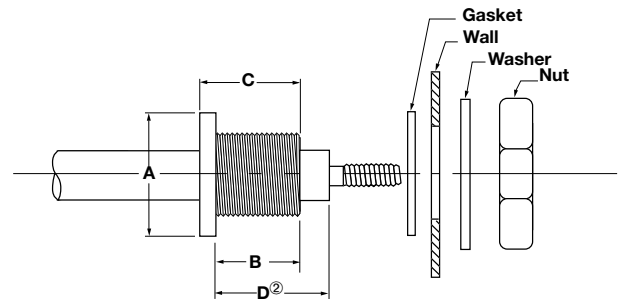
## Extended Capabilities For WATROD Single/Double-Ended Heaters

### Mounting Methods

#### Threaded Bulkheads

A threaded bushing with flange on the heater sheath provides rigid, leak-proof mounting through the walls of tanks. A gasket, plated steel washer and hex nut are included. The threaded end of the bushing is flush with the sheath's end unless otherwise specified. Threaded bulkheads are available in brass, steel or stainless steel as indicated in the table.

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#### Threaded Bulkhead Specifications

Element Diameter		Material	Thread Size	A ① Flange Size/Style		B Threaded Length		C Overall Length	
in.	(mm)			in.	(mm)	in.	(mm)	in.	(mm)
0.260	(6.6)	Steel	1/2 - 20 UNF	3/4 Hex	(19.0)	5/8	(15.9)	3/4	(19.0)
0.430	(10.9)	Titanium	5/8 - 18 UNF	1 Round	(25.0)	3/4	(19.0)	15/16	(23.8)
0.490	(12.5)	Brass	3/4 - 16 UNF	1 Round	(25.0)	3/4	(19.0)	1	(25.0)
0.490	(12.5)	Steel	3/4 - 16 UNF	1 Hex	(25.0)	3/4	(19.0)	1	(25.0)
0.490	(12.5)	SS	3/4 - 16 UNF	1 Round	(25.0)	3/4	(19.0)	1	(25.0)

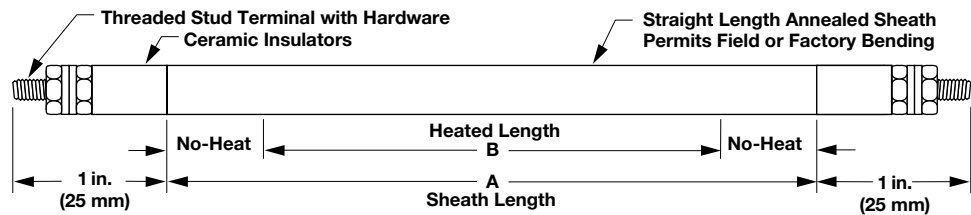
① Designates the dimension across flats for hex flange style and outside diameter for round flange style.

② Equal to "B" dimension unless otherwise specified.

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Double-Ended WATROD



WATROD Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number			Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	480VAC	lbs	(kg)

#### Applications: Medium-Weight, Non-Circulating Oil, Heat-Transfer Oil

<b>15 W/in<sup>2</sup></b> <b>0.475 in. Dia.</b> <b>Steel</b> <b>(2.3 W/cm<sup>2</sup>)</b> <b>(12 mm)</b>	29 <sup>7</sup> / <sub>8</sub>	(758.8)	22 <sup>3</sup> / <sub>8</sub>	(568.4)	500		<b>RGSS29R10S</b>		1.0	(0.5)
	38 <sup>3</sup> / <sub>8</sub>	(974.7)	29 <sup>7</sup> / <sub>8</sub>	(758.8)	667		<b>RGSS38G10S</b>	<b>RGSS38G11S</b>	1.3	(0.6)
	44 <sup>3</sup> / <sub>4</sub>	(1137.0)	37 <sup>1</sup> / <sub>4</sub>	(946.0)	833		<b>RGSS44G10S</b>	<b>RGSS44G11S</b>	1.7	(0.8)
	53 <sup>3</sup> / <sub>8</sub>	(1355.7)	44 <sup>3</sup> / <sub>4</sub>	(1137.0)	1000		<b>RGSS53G10S</b>	<b>RGSS53G11S</b>	1.9	(0.9)
	68 <sup>3</sup> / <sub>8</sub>	(1736.7)	59 <sup>5</sup> / <sub>8</sub>	(1514.4)	1333		<b>RGSS68G10S</b>	<b>RGSS68G11S</b>	2.1	(1.0)
	83 <sup>3</sup> / <sub>8</sub>	(2117.7)	74 <sup>1</sup> / <sub>2</sub>	(1892.0)	1667		<b>RGSS83G10S</b>	<b>RGSS83G11S</b>	2.5	(1.1)
	98 <sup>3</sup> / <sub>8</sub>	(2498.7)	89 <sup>1</sup> / <sub>2</sub>	(2273.0)	2000		<b>RGSS98G10S</b>	<b>RGSS98G11S</b>	3.0	(1.4)
	120 <sup>3</sup> / <sub>8</sub>	(3057.5)	111 <sup>7</sup> / <sub>8</sub>	(2841.6)	2500		<b>RGSS120G10S</b> ①	<b>RGSS120G11S</b> ①	3.9	(1.8)
142 <sup>7</sup> / <sub>8</sub>	(3629.1)	134 <sup>1</sup> / <sub>4</sub>	(3410.0)	3000		<b>RGSS142R10S</b> ①	<b>RGSS142R11S</b> ①	4.1	(1.9)	

#### Application: Air Heating

<b>20 W/in<sup>2</sup></b> <b>0.430 in. Dia.</b> <b>Alloy 840</b> <b>(3.1 W/cm<sup>2</sup>)</b> <b>(10.9 mm)</b>	48 <sup>3</sup> / <sub>4</sub>	(1238.0)	38 <sup>3</sup> / <sub>4</sub>	(984.0)	1000		<b>RCN48N10S</b>	<b>RCN48N11S</b>	1.0	(0.5)
	58 <sup>3</sup> / <sub>4</sub>	(1492.0)	48 <sup>3</sup> / <sub>4</sub>	(1238.0)	1250		<b>RCN58N10S</b>	<b>RCN58N11S</b>	1.1	(0.5)
	73 <sup>3</sup> / <sub>4</sub>	(1873.0)	63 <sup>3</sup> / <sub>4</sub>	(1619.0)	1667			<b>RCN73N11S</b>	1.4	(0.7)
	91 <sup>3</sup> / <sub>4</sub>	(2330.0)	81 <sup>3</sup> / <sub>4</sub>	(2076.0)	2083			<b>RCN91N11S</b>	1.7	(0.8)

#### Applications: Caustic Solutions, Air Heating

<b>23 W/in<sup>2</sup></b> <b>0.315 in. Dia.</b> <b>Alloy 800</b> <b>(3.6 W/cm<sup>2</sup>)</b> <b>(8 mm)</b>	29	(737.0)	22	(559.0)	500	<b>RBN291S</b>			0.4	(0.2)
	40	(1016.0)	33	(839.0)	750	<b>RBN401S</b>			0.5	(0.3)
	51	(1296.0)	44	(1118.0)	1000	<b>RBN511S</b>			0.7	(0.4)
<b>23 W/in<sup>2</sup></b> <b>0.475 in. Dia.</b> <b>Alloy 800</b> <b>(3.6 W/cm<sup>2</sup>)</b> <b>(12 mm)</b>	39	(991.0)	27	(686.0)	1000	<b>RGNA391S</b>	<b>RGNA3910S</b>	<b>RGNA3911S</b>	1.2	(0.6)
	54	(1372.0)	42	(1067.0)	1500		<b>RGNA5410S</b>	<b>RGNA5411S</b>	1.6	(0.8)
	69	(1753.0)	57	(1448.0)	2000		<b>RGNA6910S</b>	<b>RGNA6911S</b>	2.1	(1.0)
	84	(2134.0)	72	(1829.0)	2500		<b>RGNA8410S</b>	<b>RGNA8411S</b>	2.5	(1.2)
	99	(2515.0)	87	(2210.0)	3000		<b>RGNA9910S</b>	<b>RGNA9911S</b>	3.0	(1.4)
	106	(2692.0)	94	(2388.0)	2778			<b>RGNA10611S</b> ①	3.2	(1.5)
	132	(3353.0)	120	(3048.0)	4167		<b>RGNA13210S</b> ①	<b>RGNA13211S</b> ①	4.0	(1.8)
157	(3988.0)	145	(3683.0)	5000		<b>RGNA15710S</b> ①	<b>RGNA15711S</b> ①	4.7	(2.2)	

#### Applications: Light Oils, Greases, Heat-Transfer Oils

<b>23 W/in<sup>2</sup></b> <b>0.315 in. Dia.</b> <b>Steel</b> <b>(3.6 W/cm<sup>2</sup>)</b> <b>(8 mm)</b>	16	(406.0)	12	(305.0)	250	<b>RBS161S</b>	<b>RBS1610S</b>		0.2	(0.1)
	18	(457.0)	14	(356.0)	250	<b>RBS181S</b>			0.3	(0.2)
	21	(533.0)	17	(432.0)	350	<b>RBS211S</b>	<b>RBS2110S</b>		0.3	(0.2)
	23 <sup>3</sup> / <sub>8</sub>	(593.7)	19 <sup>3</sup> / <sub>8</sub>	(492.1)	375	<b>RBS23G1S</b>			0.3	(0.2)
	28 <sup>7</sup> / <sub>8</sub>	(733.4)	24 <sup>7</sup> / <sub>8</sub>	(631.8)	500	<b>RBS28R1S</b>			0.4	(0.2)
	29	(737.0)	24	(610.0)	500	<b>RBS291S</b>	<b>RBS2910S</b>		0.4	(0.2)
	42	(1067.0)	37	(940.0)	750	<b>RBS421S</b>	<b>RBS4210S</b>		0.6	(0.3)
	54	(1372.0)	49	(1245.0)	1000	<b>RBS541S</b>	<b>RBS5410S</b>		0.7	(0.4)
	77	(1956.0)	72	(1829.0)	1500	<b>RBS771S</b>	<b>RBS7710S</b>		1.0	(0.5)

CONTINUED

**RAPID SHIP**

Truck Shipment only

• Next day shipment up to 15 pieces

• ① - Manufacturing lead times



# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Double-Ended WATROD (Continued)

WATROD Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number			Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	480VAC	lbs	(kg)
<b>23 W/in<sup>2</sup></b> <b>0.475 in. Dia.</b> <b>Steel</b> <b>(3.6 W/cm<sup>2</sup>)</b> <b>(12 mm)</b>	23	(584)	14	(356)	500	<b>RGS231S</b>	<b>RGS2310S</b>		0.7	(0.4)
	31	(787)	22	(559)	750	<b>RGS311S</b>	<b>RGS3110S</b>		1.0	(0.5)
	39	(991)	27	(686)	1000	<b>RGS391S</b>	<b>RGS3910S</b>	<b>RGS3911S</b>	1.2	(0.6)
	45	(1143)	36	(914)	1250	<b>RGS451S</b>	<b>RGS4510S</b>		1.4	(0.7)
	54	(1372)	42	(1067)	1500	<b>RGS541S</b>	<b>RGS5410S</b>	<b>RGS5411S</b>	1.6	(0.8)
	69	(1753)	57	(1448)	2000	<b>RGS691S</b>	<b>RGS6910S</b>	<b>RGS6911S</b>	2.1	(1.0)
	84	(2134)	72	(1829)	2500	<b>RGS841S</b>	<b>RGS8410S</b>	<b>RGS8411S</b>	2.5	(1.2)
	99	(2515)	87	(2210)	3000		<b>RGS9910S</b>	<b>RGS9911S</b>	3.0	(1.4)
	106	(2692)	90	(2286)	2778			<b>RGS10611S</b> ①	3.2	(1.5)
	132	(3353)	120	(3048)	4167		<b>RGS13210S</b> ①	<b>RGS13211S</b> ①	4.0	(1.8)
	144	(3658)	128	(3251)	3889			<b>RGS14411S</b> ①	4.3	(2.0)
	157	(3988)	145	(3683)	5000		<b>RGS15710S</b> ①	<b>RGS15711S</b> ①	4.7	(2.2)

### Applications: Light Oils, Greases, Heat-Transfer Oils

### Application: Air Heating

<b>30 W/in<sup>2</sup></b> <b>0.260 in. Dia.</b> <b>Alloy 840</b> <b>(4.7 W/cm<sup>2</sup>)</b> <b>(6.6 mm)</b>	20	(508)	15	(381)	400		<b>RAN2010S</b>		0.2	(0.1)	
	25	(635)	20	(508)	500		<b>RAN2510S</b>		0.3	(0.2)	
	30	(762)	25	(635)	600		<b>RAN3010S</b>		0.3	(0.2)	
	35	(889)	30	(762)	800		<b>RAN3510S</b>		0.4	(0.2)	
	40	(1016)	35	(889)	900		<b>RAN4010S</b>		0.4	(0.2)	
	45	(1143)	40	(1016)	1000		<b>RAN4510S</b>		0.5	(0.3)	
	50	(1270)	45	(1143)	1200		<b>RAN5010S</b>		0.5	(0.3)	
	55	(1397)	50	(1270)	1200		<b>RAN5510S</b>		0.6	(0.3)	
	60	(1524)	55	(1397)	1400		<b>RAN6010S</b>		0.6	(0.3)	
	65	(1651)	60	(1524)	1600		<b>RAN6510S</b>		0.7	(0.4)	
	70	(1778)	65	(1651)	1800		<b>RAN7010S</b>		0.7	(0.4)	
	75	(1905)	70	(1778)	1800		<b>RAN7510S</b>		0.8	(0.4)	
	80	(2032)	75	(1905)	2000		<b>RAN8010S</b>		0.8	(0.4)	
	<b>30 W/in<sup>2</sup></b> <b>0.315 in. Dia.</b> <b>Alloy 840</b> <b>(4.7 W/cm<sup>2</sup>)</b> <b>(8 mm)</b>	15	(381)	10	(254)	300		<b>RBN1510S</b>		0.2	(0.1)
		20	(508)	15	(381)	400		<b>RBN2010S</b>		0.3	(0.2)
25		(635)	20	(508)	600		<b>RBN2510S</b>		0.4	(0.2)	
30		(762)	25	(635)	800		<b>RBN3010S</b>		0.4	(0.2)	
35		(889)	30	(762)	900		<b>RBN3510S</b>		0.5	(0.3)	
40		(1016)	35	(889)	1000		<b>RBN4010S</b>		0.5	(0.3)	
45		(1143)	40	(1016)	1200		<b>RBN4510S</b>		0.6	(0.3)	
50		(1270)	45	(1143)	1400		<b>RBN5010S</b>		0.7	(0.4)	
55		(1397)	50	(1270)	1600		<b>RBN5510S</b>		0.7	(0.4)	
60		(1524)	55	(1397)	1800		<b>RBN6010S</b>		0.8	(0.4)	
65		(1651)	60	(1524)	1800		<b>RBN6510S</b>		0.8	(0.4)	
70		(1778)	65	(1651)	2000		<b>RBN7010S</b>		0.9	(0.5)	
75		(1905)	70	(1778)	2200		<b>RBN7510S</b>		1.0	(0.5)	
80		(2032)	75	(1905)	2400		<b>RBN8010S</b>		1.0	(0.5)	
90		(2286)	85	(2159)	2600		<b>RBN9010S</b>		1.2	(0.6)	
100	(2540)	95	(2413)	3000		<b>RBN10010S</b>		1.3	(0.6)		

CONTINUED

**RAPID SHIP**

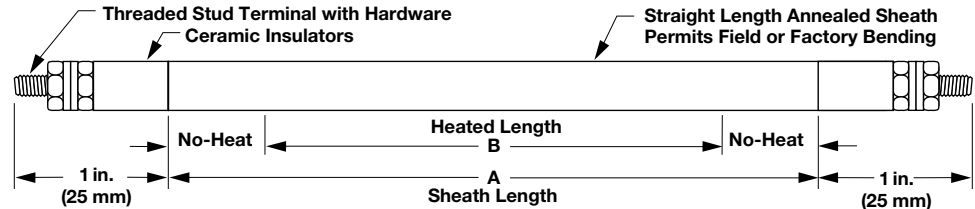
- Next day shipment up to 15 pieces
- ① - Manufacturing lead times

Truck Shipment only

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Double-Ended WATROD (Continued)



WATROD Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number			Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	480VAC	lbs	(kg)

#### Application: Air Heating

<b>30 W/in<sup>2</sup></b> <b>0.430 in. Dia.</b> <b>Alloy 840</b> <b>(4.7 W/cm<sup>2</sup>)</b> <b>(10.9 mm)</b>	15	(381.0)	10	(254.0)	400		<b>RCN1510S</b>		0.3	(0.2)
	20	(508.0)	15	(381.0)	600		<b>RCN2010S</b>		0.4	(0.2)
	25	(635.0)	20	(508.0)	800		<b>RCN2510S</b>		0.5	(0.3)
	30	(762.0)	25	(635.0)	1000		<b>RCN3010S</b>		0.6	(0.3)
	35	(889.0)	30	(762.0)	1200		<b>RCN3510S</b>		0.7	(0.4)
	40	(1016.0)	35	(889.0)	1400		<b>RCN4010S</b>	<b>RCNX48N11S</b>	0.8	(0.4)
	48 <sup>3/4</sup>	(1238.0)	38 <sup>3/4</sup>	(984.0)	1500		<b>RCNX48N10S</b>		1.0	(0.5)
	45	(1143.0)	40	(1016.0)	1600		<b>RCN4510S</b>		0.9	(0.5)
	50	(1270.0)	45	(1143.0)	1800		<b>RCN5010S</b>		1.0	(0.5)
	58 <sup>3/4</sup>	(1492.0)	48 <sup>3/4</sup>	(1238.0)	1917		<b>RCNX58N10S</b>	<b>RCNX58N11S</b>	1.1	(0.5)
	55	(1397.0)	50	(1270.0)	2000		<b>RCN5510S</b>		1.0	(0.5)
	60	(1524.0)	55	(1397.0)	2200		<b>RCN6010S</b>		1.1	(0.5)
	65	(1651.0)	60	(1524.0)	2400		<b>RCN6510S</b>		1.2	(0.6)
	73 <sup>3/4</sup>	(1873.0)	63 <sup>3/4</sup>	(1619.0)	2500			<b>RCNX73N11S</b>	1.4	(0.7)
	70	(1778.0)	65	(1651.0)	2600		<b>RCN7010S</b>		1.3	(0.6)
	75	(1905.0)	70	(1778.0)	2800		<b>RCN7510S</b>		1.4	(0.7)
80	(2032.0)	75	(1905.0)	3000		<b>RCN8010S</b>		1.5	(0.7)	
91 <sup>3/4</sup>	(2331.0)	81 <sup>3/4</sup>	(2077.0)	3167			<b>RCNX91N11S</b>	1.7	(0.8)	
90	(2286.0)	85	(2159.0)	3500		<b>RCN9010S</b>		1.7	(0.8)	
100	(2540.0)	95	(2413.0)	4000		<b>RCN10010S</b> ①		1.9	(0.9)	
110	(2794.0)	105	(2667.0)	4500		<b>RCN11010S</b> ①		2.1	(1.0)	
120	(3048.0)	115	(2921.0)	5000		<b>RCN12010S</b> ①		2.3	(1.1)	

#### Application: Radiant Heating

<b>40 W/in<sup>2</sup></b> <b>0.375 in. Dia.</b> <b>Alloy 800</b> <b>(6.2 W/cm<sup>2</sup>)</b> <b>(9.5 mm)</b>	10 <sup>1/4</sup>	(260.0)	7 <sup>1/4</sup>	(184.0)	400	<b>RDN10E1S</b>			0.2	(0.1)
	16 <sup>5/8</sup>	(422.1)	13 <sup>5/8</sup>	(346.1)	650	<b>RDN16L1S</b>			0.3	(0.2)
	21 <sup>1/16</sup>	(535.0)	16 <sup>13/16</sup>	(427.0)	800	<b>RDN21B1S</b>	<b>RDN21B10S</b>		0.4	(0.2)
	27 <sup>1/8</sup>	(689.0)	22 <sup>7/8</sup>	(581.0)	1100	<b>RDN27C1S</b>	<b>RDN27C10S</b>		0.5	(0.3)
	32 <sup>1/8</sup>	(816.0)	27 <sup>7/8</sup>	(708.0)	1300		<b>RDN32C10S</b>	<b>RDN32C11S</b>	0.6	(0.3)
	42 <sup>7/8</sup>	(1089.0)	38 <sup>5/8</sup>	(981.1)	1800		<b>RDN42R10S</b>	<b>RDN42R11S</b>	0.8	(0.4)
	57 <sup>1/2</sup>	(1461.0)	53 <sup>1/4</sup>	(1353.0)	2500		<b>RDN57J10S</b>	<b>RDN57J11S</b>	1.1	(0.5)
	69 <sup>1/4</sup>	(1759.0)	65	(1651.0)	3000		<b>RDN69E10S</b>	<b>RDN69E11S</b>	1.3	(0.6)
	81 <sup>1/4</sup>	(2064.0)	77	(1956.0)	3600		<b>RDN81E10S</b>	<b>RDN81E11S</b>	1.6	(0.8)
	109 <sup>1/4</sup>	(2775.0)	105	(2667.0)	4000		<b>RDN109E10S</b> ①		2.1	(1.0)
	134 <sup>1/2</sup>	(3416.0)	127 <sup>3/4</sup>	(3245.0)	5000		<b>RDN134J10S</b> ①		2.6	(1.2)
	153 <sup>3/8</sup>	(3895.7)	145 <sup>7/8</sup>	(3705.2)	5500		<b>RDN153R10S</b> ①		2.9	(1.4)
	179 <sup>1/4</sup>	(4553.0)	171 <sup>1/4</sup>	(4350.0)	6500		<b>RDN179E10S</b> ①		3.4	(1.6)

CONTINUED

**RAPID SHIP**

Truck Shipment only

• Next day shipment up to 15 pieces

• ① - Manufacturing lead times

# Tubular Heaters

## WATROD Single/Double-Ended Heaters

### Double-Ended WATROD (Continued)

#### Special 208VAC and 277VAC Voltages

WATROD Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number		Est. Net Wt.	
	in.	(mm)	in.	(mm)		208VAC	277VAC	lbs	(kg)

#### Application: Radiant Heating

40 W/in <sup>2</sup> 0.375 in. Dia. Alloy 800	21 <sup>1</sup> / <sub>16</sub>	(535)	16 <sup>13</sup> / <sub>16</sub>	(427)	800	RDN21B2S <sup>①</sup>	RDN21B4S <sup>①</sup>	0.4	(0.2)
	27 <sup>1</sup> / <sub>8</sub>	(689)	22 <sup>7</sup> / <sub>8</sub>	(581)	1100	RDN27C2S <sup>①</sup>	RDN27C4S <sup>①</sup>	0.5	(0.3)
	42 <sup>7</sup> / <sub>8</sub>	(1089)	38 <sup>5</sup> / <sub>8</sub>	(981)	1800	RDN42R2S <sup>①</sup>	RDN42R4S <sup>①</sup>	0.8	(0.4)
(6.2 W/cm <sup>2</sup> ) (9.5 mm)	57 <sup>1</sup> / <sub>2</sub>	(1461)	53 <sup>1</sup> / <sub>4</sub>	(1353)	2500	RDN57J2S <sup>①</sup>	RDN57J4S <sup>①</sup>	1.1	(0.5)
	69 <sup>1</sup> / <sub>4</sub>	(1759)	65	(1651)	3000	RDN69E2S <sup>①</sup>	RDN69E4S <sup>①</sup>	1.3	(0.6)
	81 <sup>1</sup> / <sub>4</sub>	(2064)	77	(1956)	3600	RDN81E2S <sup>①</sup>	RDN81E4S <sup>①</sup>	1.6	(0.8)

WATROD Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number			Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	480VAC	lbs	(kg)

#### Application: Process Water

48 W/in <sup>2</sup> 0.475 in. Dia. Alloy 800 (7.4 W/cm <sup>2</sup> ) (12 mm)	23	(584)	14	(356)	1000	RGN231S	RGN2310S	RGN2311S	0.7	(0.4)
	30	(762)	21	(533)	1500	RGN301S	RGN3010S	RGN3011S	0.9	(0.5)
	39	(991)	27	(686)	2000	RGN391S	RGN3910S	RGN3911S	1.2	(0.6)
	44	(1118)	35	(889)	2500	RGN441S	RGN4410S	RGN4411S	1.3	(0.6)
	54	(1372)	42	(1067)	3000		RGN5410S	RGN5411S	1.6	(0.8)
	69	(1753)	57	(1448)	4000		RGN6910S	RGN6911S	2.1	(1.0)
	84	(2134)	72	(1829)	5000		RGN8410S	RGN8411S	2.5	(1.2)
	92	(2337)	76	(1930)	5556			RGN9211S	2.8	(1.3)
	99	(2515)	87	(2210)	6000		RGN9910S	RGN9911S	3.0	(1.4)
	149	(3785)	133	(3378)	9722			RGN14911S <sup>①</sup>	4.5	(2.1)

#### Application: Hot Runner Molds (Manifolds)

60 W/in <sup>2</sup> 0.315 in. Dia. 316 SS (9.3 W/cm <sup>2</sup> ) (8 mm)	35	(889)	25	(635)	1500		RBR3510S		0.2	(0.1)
	44	(1118)	34	(864)	2000		RBR4410S		0.3	(0.2)
	52	(1321)	42	(1067)	2500		RBR5210S		0.3	(0.2)
	60	(1524)	50	(1270)	3000		RBR6010S		0.4	(0.2)
	69	(1753)	59	(1499)	3500		RBR6910S		0.4	(0.2)
	77	(1956)	67	(1702)	4000		RBR7710S		0.5	(0.3)
	85	(2159)	75	(1905)	4500		RBR8510S		0.6	(0.3)

#### Applications: Deionized Water, Demineralized Water

60 W/in <sup>2</sup> 0.475 in. Dia. 316 SS (9.3 W/cm <sup>2</sup> ) (12 mm)	20	(508)	11	(279)	1000	RGR201S	RGR2010S	RGR2011S	0.6	(0.3)
	26	(660)	17	(432)	1500	RGR261S	RGR2610S	RGR2611S	0.8	(0.4)
	34	(864)	22	(559)	2000		RGR3410S	RGR3411S	1.0	(0.5)
	40	(1016)	28	(711)	2500		RGR4010S	RGR4011S	1.2	(0.6)
	47	(1194)	31	(787)	2778			RGR4711S	1.4	(0.7)
	46	(1168)	34	(864)	3000		RGR4610S	RGR4611S	1.4	(0.7)
	57	(1448)	45	(1143)	4000		RGR5710S	RGR5711S	1.7	(0.8)
	68	(1727)	56	(1422)	5000		RGR6810S	RGR6811S	2.1	(1.0)
	79	(2007)	67	(1702)	6000		RGR7910S	RGR7911S	2.4	(1.1)
	105	(2667)	93	(2362)	8333			RGR10511S <sup>①</sup>	3.2	(1.5)

CONTINUED

**RAPID SHIP**

Truck Shipment only

- Next day shipment up to 15 pieces
- ① - Manufacturing lead times

# Tubular Heaters

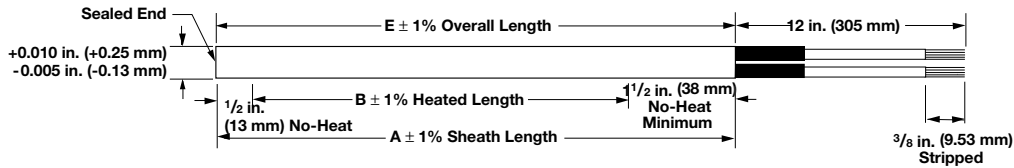
## WATROD Single/Double-Ended Heaters

### Single-Ended WATROD

#### Application Hints

The single-ended WATROD heater's construction limits its usefulness in some applications. The following are some guides to follow when considering a single-ended WATROD.

- When single-ended termination simplifies application wiring.
- The application requires lower wattage or a smaller package.
- Do not locate the end of the heated length within a bend, unless the radius is 3 in. (75 mm) or more. Field bending is not recommended.
- Bending is limited to bend Figures 1, 6, 22 and 28 (see pages 67 to 72 for details).
- Ensure termination temperatures do not exceed 390°F (200°C) or the seal's maximum rating.
- Keep terminations clean, dry and tight.



# Tubular Heaters

## WATROD Double-Ended Heaters

### High-Temperature Tubular Heaters

Watlow manufactures high-temperature tubular heaters to bridge the gap between standard tubular heaters and Watlow MULTICELL™ heaters. This tubular is well suited for process air heating applications in excess of 1300°F (704°C), resulting in a maximum sheath temperature of 1800°F (983°C). Controlled lab testing between the new design and current tubular designs show an increase in life of approximately 50 percent.

The high-temperature tubular consists of an engineered tubing with an outer sheath of alloy 600 and a special internal construction. The outer sheath offers high temperature capabilities, reduced oxidation as well as corrosion resistance.

The tubular offering is available in 0.430 and 0.375 inch diameters that are configurable either as formed tubulars or process heaters. The heaters can also be welded to flanges and plates for mounting purposes. Maximum sheath length available is 275 inches for the 0.430 inch and 0.375 inch diameters. The factory should be contacted for longer sheath lengths.

### Features and Benefits

#### Alloy 600 sheath material and a special internal construction

- Assures high temperature performance and corrosion protection in tough applications

#### 0.430 inch diameters\*

- Allows heater to be configured to existing tubular designs that may be experiencing short life

**\*Note: 0.375 diameters are available in Watlow's extended capabilities, contact your Watlow representative for details.**

#### Dual-ended termination

- Installs into flanges and screw plugs similarly to standard product configurations

#### Bendable in standard formations

- Makes the heater easy to apply in a wide variety of applications



### Typical Applications

- High temperature ovens and furnaces
- Radiant heating
- Drying
- Environmental—VOC abatement
- Process air heating: duct heaters, circulation heaters
- Vacuum applications
- Flue gas cleaning (desulphurization)
- Fluidized beds

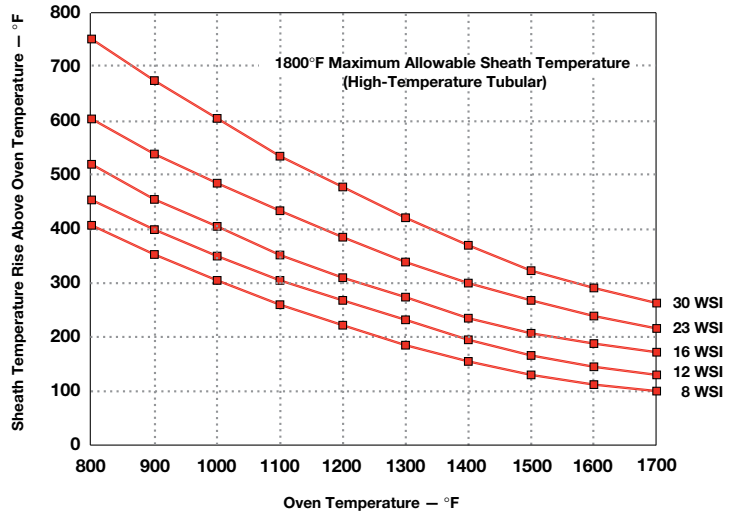
# Tubular Heaters

## WATROD Double-Ended Heaters

### High-Temperature Tubular Heaters

#### Sheath Temperature Versus Oven Temperature at Various Watt Densities

This chart is used to verify the correct watt density for an oven application assuming no air flow. To use the chart, first select the oven process temperature on the X axis, using the chosen watt density read the sheath temperature rise above oven temperature from the Y axis. This number should then be added to oven temperature. If this number is greater than 1800°F (982°C), a lower watt density should be chosen.

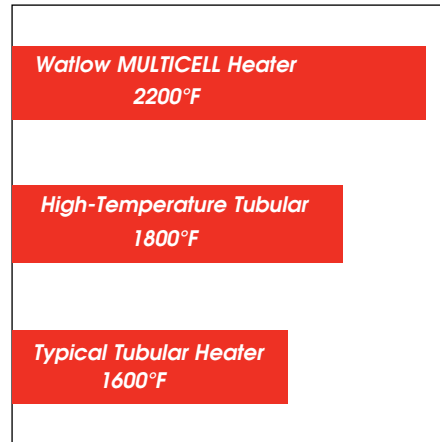


### Heater Life Estimate Service

Watlow now provides an industry first service with the offering of the high-temperature tubular. By providing operating parameters, Watlow provides customers with the estimated life of the heater. To get this information, the following information should be provided:

- Heater voltage
- Heater wattage
- Heater diameter (0.430 or 0.375 in.)
- Heated length
- Bend configuration and dimensions (number of bends and radius)
- Application including process temperature
- Power switching device and cycle time (SCR, etc.)

### High-Temperature Heater Comparisons



\*Assuming normal design practices.

# Tubular Heaters

EXTENDED  
CAPABILITY

## WATROD Single/Double-Ended Heaters

### Extended Capabilities For MULTICOIL™ Tubular Heaters

The tubular element with multiple coils and/or thermocouples inside one sheath from Watlow answers the need for a versatile, innovative tubular heater. Watlow's patented method of packaging a thermocouple inside of a heater with one or more resistance coils, gives the ability to sense a heaters' internal temperature accurately, every time.

Moreover, this is the first tubular heater in the industry with three-phase capability. The three coil, three-phase heater will offer a compact package solution while delivering the full power required in a compact heater package. Previously three separate heaters would have been required to do the same job; therefore Watlow's MULTICOIL™ heater capabilities save money.

### Performance Capabilities

- Watt densities up to 60 W/in<sup>2</sup> (9.3 W/cm<sup>2</sup>)
- Sheath temperatures up to 1600°F (870°C)
- 304 and 316 stainless steel sheath temperatures up to 1200°F (650°C)

### Features and Benefits

#### Three-phase capability

- Results in one element versus three, lower amperage, reduced installation time and lower overall cost

#### Single-ended

- Allows for mounting in a 1/2 inch NPT or 3/4 inch NPT fitting with three-phase capability
- Sensor is not available

#### Multiple coil operations

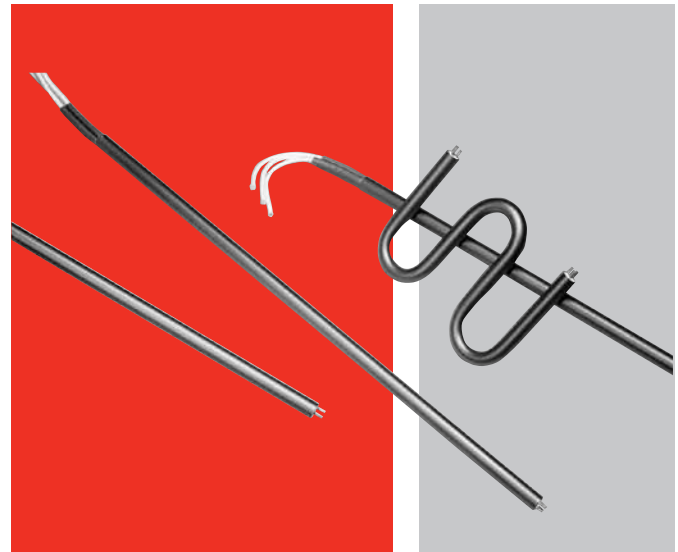
- Reduces inventory by allowing dual voltage capability

#### Versatile forming capabilities

- Forms into many configurations

#### Internal construction with sensor

- Allows space savings because drilling and tapping of flange is unnecessary; plus, the interior thermocouple eliminates contamination buildup around the external sensing tip, reducing the possibility of false readings



### Typical Applications

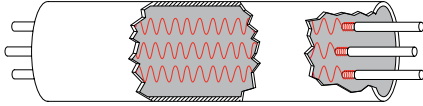
- Foodservice
- Process
- Medical
- Milled groove
- Plastics
- Plating
- Oven heating
- Semiconductor

## WATROD Single/Double-Ended Heaters

### Extended Capabilities For MULTICOIL Tubular Heaters

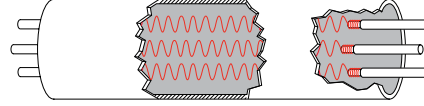
#### Options

##### Option A



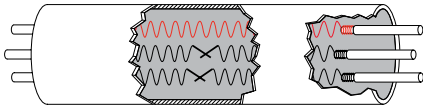
3-phase tubular, 0.475 and 0.490 inch diameter.

##### Option E



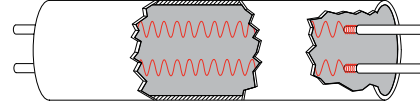
1-phase tubular with three different one phase circuits, 0.475 and 0.490 inch diameter.

##### Option C



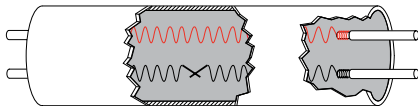
1-phase tubular with one resistance wire and two thermocouples, 0.475 and 0.490 inch diameter.

##### Option F



1-phase tubular with two resistance coils, 0.375, 0.430, 0.475 and 0.490 inch diameter.

##### Option D



1-phase tubular with one resistance coil and one thermocouple, 0.375, 0.430, 0.475 and 0.490 inch diameter.

## Specifications

### Termination Styles

- Lead wires 392°F (200°C) Sil-A-Blend™ or 482°F (250°C) GGS.

### Moisture Seals

Moisture seals are required, options include:

- Epoxy with temperature rating to 356°F (180°C). Typical applications include water/oil immersion.
- Lavacone with temperature rating to 221°F (105°C). Typical application includes air heating.
- High-temperature ceramic rated to 2800°F (1537.8°C).
- Contact your Watlow representative for other moisture seal options.

### Mounting options

- Mounting brackets
- Locator washers
- Mounting collars
- Water-tight bulkheads

### Maximum trim length

- 237 in. (6020 mm), heater designs with trim length greater than 120 in. (3048 mm) must be reviewed with your Watlow representative.

### Sheath materials

- Alloy 600, 800, 840, 304 and 316 stainless steel, contact your Watlow representative for other sheath material options.

### Internal thermocouple options

- Type K is used, contact your Watlow representative for Type J thermocouple options.



## **WATROD Single/Double-Ended Heaters**

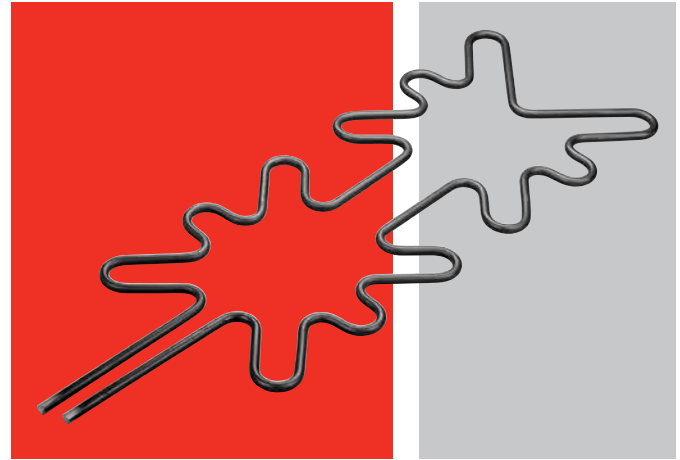
### ***Extended Capabilities For Milled Groove Tubular Heaters***

WATROD milled groove heaters are precision-formed and customized to your hot runner mold application. Even tight radius bends of 0.250 inch maintaining tolerances of  $\pm 0.062$  to  $\pm 0.002$  inch are possible. 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.

Simply send your groove dimensions in a detailed drawing or on CAD file. Depending on the formation requirements, the resulting CAD design will be transferred to either Watlow's CNC bending equipment or a highly skilled bending operator.

A variety of sheath materials are available including alloy 800, 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 the process with efficient heat transfer, but guarantees the heater's fast delivery, too. While Watlow guarantees standard delivery within three to four weeks, tough delivery schedules are Watlow's specialty.



### **Features and Benefits**

#### **Precise conformity to customer specifications**

- Ensures easy installation—bending tolerances as low as  $\pm 0.002$  in.

#### **Common element diameters**

- Includes 0.260, 0.315, 0.375 and 0.430 in. (6.6, 8, 9.5 and 10.9 mm) diameters

#### **Alloy 800 sheath material**

- Corrosion resistant, capable in high-temperature environments

#### **304 stainless steel**

- Excellent pliability, best choice for small bend radii

#### **Superior resistance coil design**

- Produces even heating

#### **Threaded stud or lead wire termination as required**

- Provides robust options for challenging environments

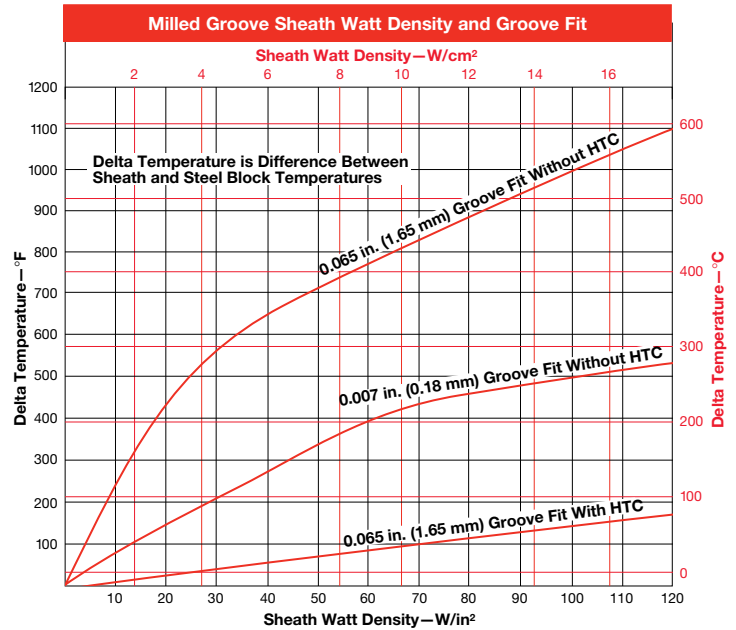
### **Typical Applications**

- Hot runner molds
- Precise heat uniformity

## WATROD Single/Double-Ended Heaters

### Extended Capabilities For Milled Groove Tubular Heaters

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 1000°F (540°C) 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 = 40 to 70 W/in<sup>2</sup> (6.2 to 10.9 W/cm<sup>2</sup>)
- Recommended groove = 0.065 inch (1.65 mm) larger in diameter than sheath diameter and use heat transfer cement.
- Recommended heater sheath diameter = 0.315 in. (8 mm)
- Recommended maximum Delta T = 400°F (205°C)
- Maximum sheath temperature = 1000°F (540°C)
- Recommended sheath material = alloy 800

# Tubular Heaters

## 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  $\frac{5}{8}$  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 112.

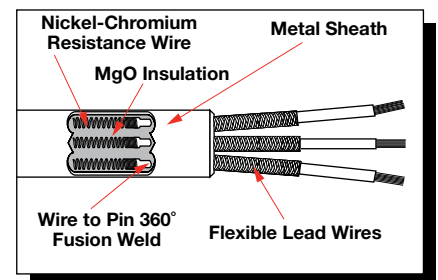
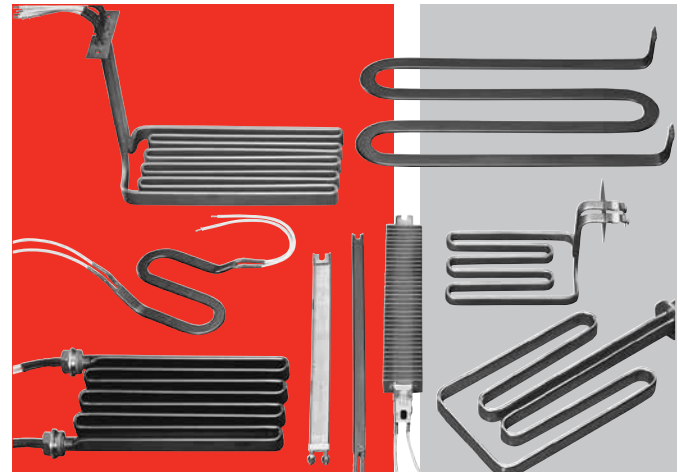
### Double-Ended Performance Capabilities

#### One Inch

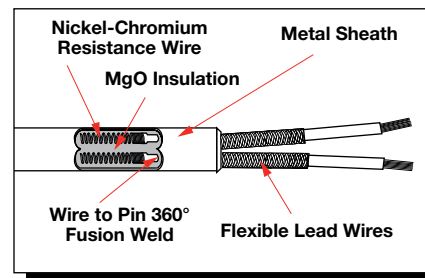
- Watt densities up to 120 W/in<sup>2</sup> (18.6 W/cm<sup>2</sup>)
- Sheath temperatures up to 1400°F (760°C)
- 304 stainless steel sheath temperatures up to 1200°F (650°C)
- Voltages up to 240VAC
- Amperages up to 48 amperes per heater or 16 amperes per coil

#### $\frac{5}{8}$ Inch

- Watt densities up to 90 W/in<sup>2</sup> (13.9 W/cm<sup>2</sup>)
- Alloy 800 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



$\frac{5}{8}$  Inch Double-Ended FIREBAR Element and Lead Configurations

### Single-Ended Performance Capabilities

#### One Inch

- Watt densities up to 60 W/in<sup>2</sup> (9.3 W/cm<sup>2</sup>)
- 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

#### $\frac{5}{8}$ Inch

- Watt densities up to 80 W/in<sup>2</sup> (12.4 W/cm<sup>2</sup>)
- Alloy 800 sheath temperatures up to 1400°F (760°C)
- Voltages up to 240VAC
- Amperages up to 16 amperes per heater

# Tubular Heaters

## FIREBAR Double-Ended Heaters

### Specifications

#### One Inch FIREBAR



#### 5/8 Inch FIREBAR



<b>Applications</b>	Direct immersion; water, oils, etc. Clamp-on; hoppers, griddles Forced air heating (Also see FINBAR, page 112) Radiant heating	Direct immersion; water, oils, etc. Clamp-on; hoppers, griddles Forced air heating Radiant heating
<b>Watt Density</b> W/in <sup>2</sup> (W/cm <sup>2</sup> )	Stock: up to 90 (13.9) Made-to-Order (M-t-O): up to 120 (18.6)	Stock: up to 90 (13.9) Made-to-Order (M-t-O): up to 90 (13.9)
<b>Surface Area Per Linear In. (cm)</b>	2.3 in <sup>2</sup> (14.8 cm <sup>2</sup> )	1.52 in <sup>2</sup> (9.80 cm <sup>2</sup> )
<b>Cross Section</b> 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)
<b>Sheath Material—Max.</b> Operating temperature	Stock: Alloy 800 1400°F (760°C) M-t-O: Alloy 800 1400°F (760°C) 304 SS 1200°F (650°C)	Stock: Alloy 800 1400°F (760°C) M-t-O: Alloy 800 1400°F (760°C) 304 SS 1200°F (650°C)
<b>Sheath Length</b> in. (mm)	Stock: 15 to 114 (381 to 2896) M-t-O: 11 to 180 (280 to 4572)	Stock: 15 to 51 (381 to 1295) M-t-O: 11 to 115 (280 to 2920)
<b>Straightness Tolerance</b> 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)
<b>No-Heat Length</b>	1 in. min., 12 in. max. (25/305 mm)	1 in. min., 12 in. max. (25/305 mm)
<b>Max. Voltage—Amperage</b> <b>Max. Hipotential</b> <b>Max. Current Leakage Per Coil (cold)</b> <b>Max. Amperage Per Coil</b> <b>Phase(s)</b> <b>Resistance Coils</b>	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
<b>Ohms/In./Unit</b> ① <b>Ohms/In./Coil</b> ①	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
<b>Terminations</b>	Flexible lead wires Quick connect (spade) Screw lug (plate) Threaded stud	Flexible lead wires Quick connect (spade) Screw lug (plate) Threaded stud
<b>Seals</b>	Stock: 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)	Stock: 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)
<b>Min. Axis Bending Radius</b> in. (mm) (Do not field bend)	Major: 1 (25) Minor: 1/2 (13) 90° bend Minor: 3/2 (4) 180° bend	Major: 3/4 (19) Minor: 1/2 (13) 90° bend Minor: 3/2 (4) 180° bend
<b>Mounting Options</b>	Brackets (Type 1, 2 and 3) Threaded bulkhead or fitting	Brackets (Type 1, 2 and 3) Threaded bulkhead or fitting
<b>Surface Finish Options</b>	Bright anneal, passivation	Bright anneal, passivation
<b>Agency Recognition</b>	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.

# Tubular Heaters

## FIREBAR Single-Ended Heaters

### Specifications (Continued)

#### One Inch Single-Ended FIREBAR

#### 5/8 Inch Single-Ended FIREBAR



<b>Applications</b>	Clamp-on; hoppers, griddles Forced or convection air heating (Also see FINBAR, page 112)	Clamp-on; hoppers, griddles Forced or convection air heating
<b>Watt Density</b> W/in <sup>2</sup> (W/cm <sup>2</sup> )	Stock: up to 40 (6.2) M-t-O: up to 60 (9.3)	Stock: up to 20 (3.1) M-t-O: up to 60 (12.4)
<b>Surface Area Per Linear In. (cm)</b>	2.3 in <sup>2</sup> (14.8 cm <sup>2</sup> )	1.52 in <sup>2</sup> (9.80 cm <sup>2</sup> )
<b>Cross Section</b> 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)
<b>Sheath Material—Max.</b> Operating temperature	Stock: 304 SS 1200°F (650°C) M-t-O: Alloy 800 1400°F (760°C) 304 SS 1200°F (650°C)	Stock: Alloy 800 1400°F (760°C) M-t-O: Alloy 800 1400°F (760°C) 304 SS 1200°F (650°C)
<b>Sheath Length</b> in. (mm)	Stock: 11 to 46¼ (280 to 1175) M-t-O: 11 to 120 (280 to 3048)	Stock: 11½ to 52 (280 to 1321) M-t-O: 11 to 116 (280 to 2946)
<b>Straightness Tolerance</b> 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)
<b>No-Heat Length</b> 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
<b>Max. Voltage—Amperage</b> <b>Max. Hipotential</b> <b>Max. Current Leakage (cold)</b> <b>Max. Amperage Per Coil</b> <b>Phase(s)</b> <b>Resistance Coils</b>	240VAC—48A 1480VAC 3mA 16A 1-ph, 3-ph wye 3 or 1	240VAC—16A 1480VAC 3mA 16A 1-ph 1
<b>Ohms/In./Unit</b>	0.200Ω min.—14.00Ω max. ①	0.200Ω min.—14.00Ω max. ①
<b>Terminations</b>	Flexible lead wires Threaded stud Quick connect (spade) Screw lug (plate)	Flexible lead wires Quick connect (spade) Screw lug (plate)
<b>Seals</b>	Stock: 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)	Stock: 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)
<b>Min. Axis Bending Radius</b> 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
<b>Mounting Options</b>	Bracket (Type 2) Threaded bulkhead	Bracket (Type 2) Threaded bulkhead
<b>Surface Finish Options</b>	Bright anneal	Bright anneal
<b>Optional Internal Thermocouple</b>	—	—
<b>Single-end Configuration</b>	Stock: Slotted M-t-O: Slotted, sealed or welded	Stock: Slotted M-t-O: Slotted, sealed or welded
<b>Agency Recognition</b>	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.

# Tubular Heaters

## 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)

# Tubular Heaters

## 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:

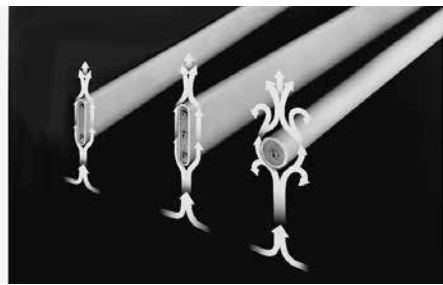
- Lower the element's watt density
- Reduce element size and keep the same watt density
- Increase element life by reducing sheath temperature

#### 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.



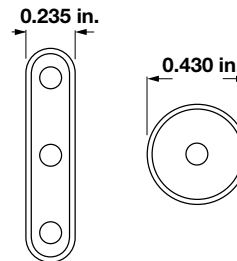
#### 2. Normal to the Flow

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

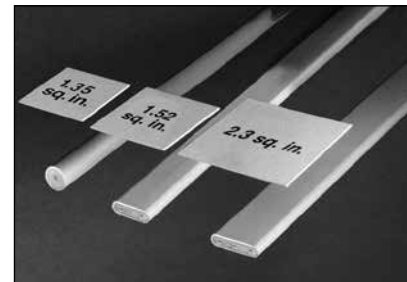
The FIREBAR element's boundary layer, or vertical side, is greater than virtually all round tubular elements. This is 1.010 and 0.650 in. (25.6 and 16.5 mm) for the one inch and 5/8 in. FIREBARs respectively, compared to a 0.430 in. (11 mm) diameter on a round tubular element. The FIREBAR element's increased 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 <sup>2</sup>	cm <sup>2</sup>
1 in. FIREBAR	2.30 in <sup>2</sup>	(5.84 cm <sup>2</sup> )
5/8 in. FIREBAR	1.52 in <sup>2</sup>	(3.86 cm <sup>2</sup> )
0.430 in. Round	1.35 in <sup>2</sup>	(3.43 cm <sup>2</sup> )

#### 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.

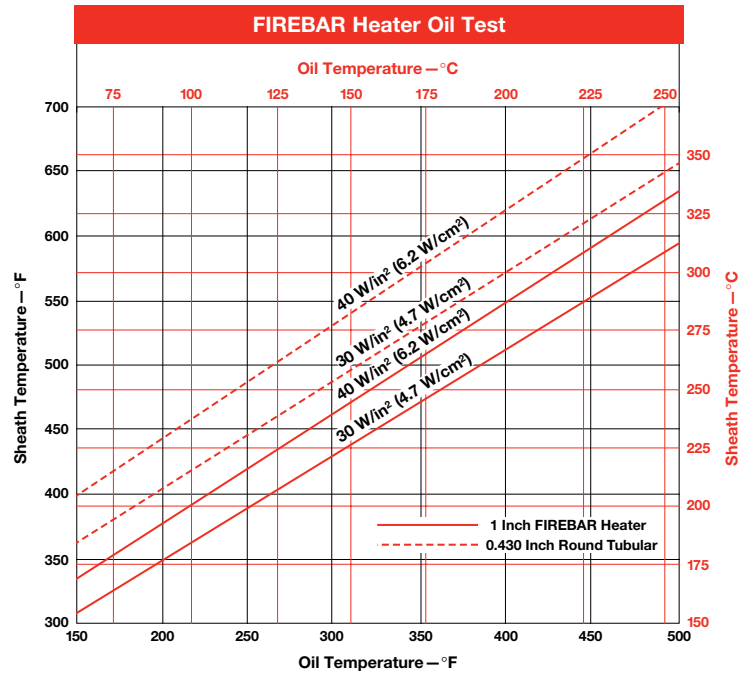
# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

### Technical Data

The *FIREBAR Heater Oil Test* graph compares sheath temperatures of 40 W/in<sup>2</sup> (6.7 W/cm<sup>2</sup>) 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/in<sup>2</sup> (6.7 W/cm<sup>2</sup>) is lower than a 30 W/in<sup>2</sup> (4.6 W/cm<sup>2</sup>) round tubular element.



### 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/in <sup>2</sup>	(W/cm <sup>2</sup> )
1 in. FIREBAR Element	19 <sup>7</sup> / <sub>8</sub> (504.8)	1000	23	(3.6)
0.430 in. Round Tubular Element	32 <sup>1</sup> / <sub>4</sub> (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/in <sup>2</sup>	(W/cm <sup>2</sup> )
1 in. FIREBAR Element	32 <sup>1</sup> / <sub>4</sub> (819.0)	1700	23	(3.6)
0.430 in. Round Tubular Element	32 <sup>1</sup> / <sub>4</sub> (819.0)	1000	23	(3.6)



# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

### Technical Data (Continued)

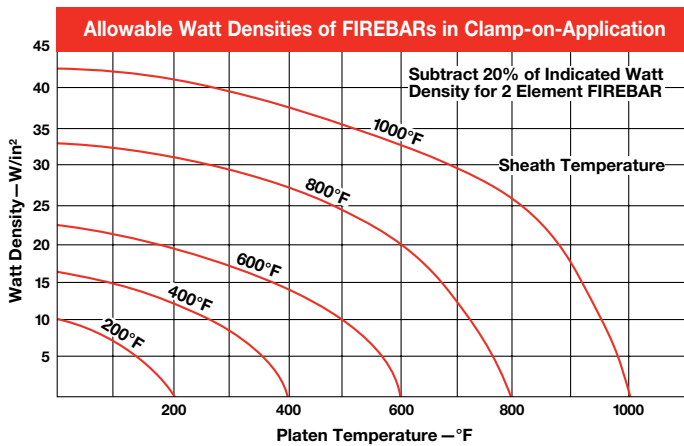
#### Clamp-On Applications

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.

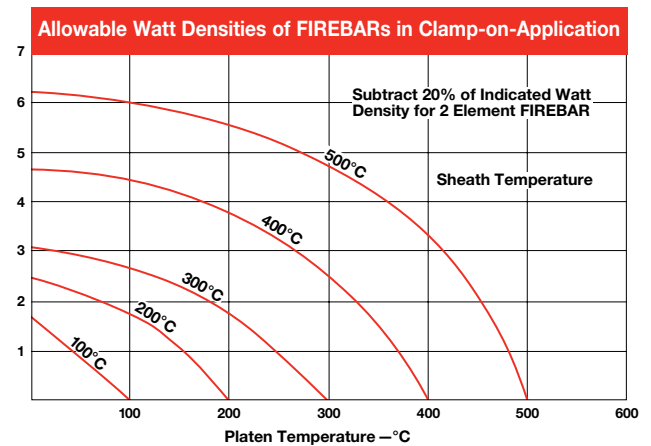
FIREBAR elements are also economical platen heaters. The *Platen Heating* graph shows FIREBAR's large, flat surface area allows it to operate at twice the watt density of round tubular elements ... without sacrificing heater life.

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

#### Platen Heating (°F)

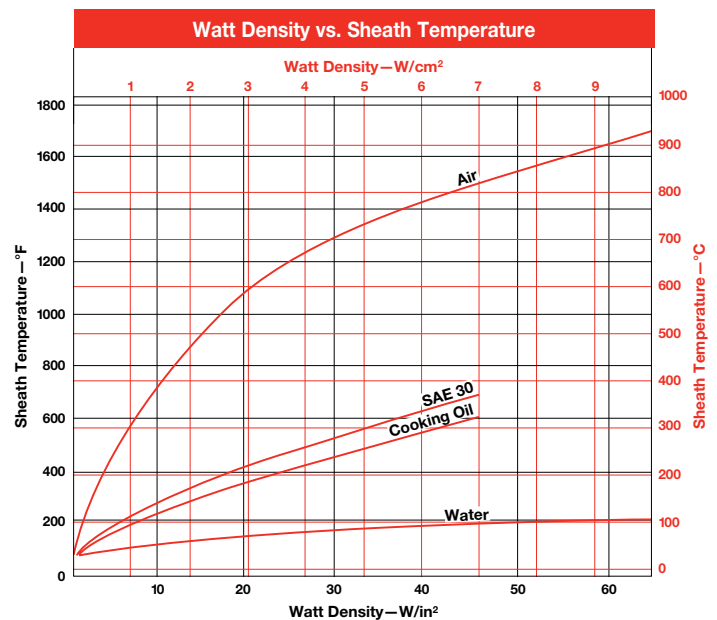


#### Platen Heating (°C)



#### 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.



# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

### Technical Data (Continued)

#### Air Heating

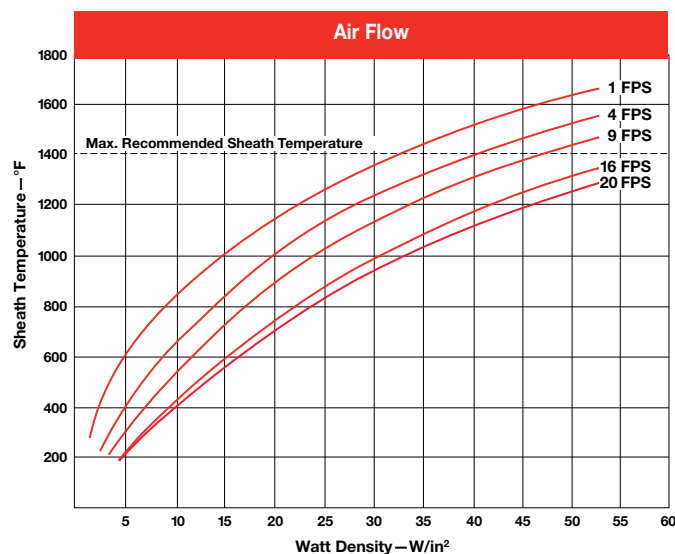
The Air Flow/Watt Density/Sheath Temperature graph shows the relationship between air flow, watt density and sheath temperature. Keep in mind that lower sheath temperature yields longer heater life.

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.

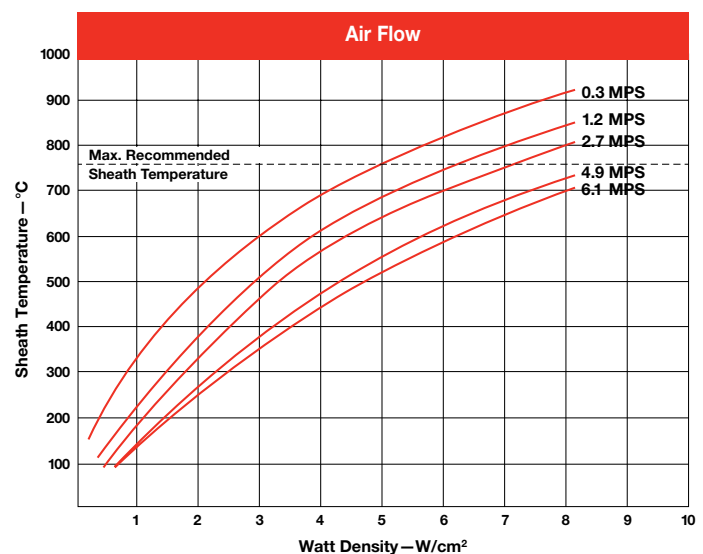


Air Flow Normal to Sheath Geometry

#### 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.

# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

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

### Technical Data (Continued)

#### Terminations

Part Number*	Termination	Phase	Wiring	1 in. FIREBAR		5/8 in. FIREBAR	
				Dual-Ended	S. End/FINBAR	Dual-Ended	Single-Ended
<b>A1</b>	Sil-A-Blend™ 200°C lead wire	1	Parallel	Yes	Yes	Yes	Yes
<b>A2</b>	Sil-A-Blend™ 200°C lead wire	1	Series	Yes	No	Yes	No
<b>A3</b>	Sil-A-Blend™ 200°C lead wire	3	Delta	Yes	No	No	No
<b>A4</b>	Sil-A-Blend™ 200°C lead wire	3	Wye	Yes	Yes	No	No
<b>B1</b>	TGGT 250°C lead wire	1	Parallel	Yes	Yes	Yes	Yes
<b>B2</b>	TGGT 250°C lead wire	1	Series	Yes	No	Yes	No
<b>B3</b>	TGGT 250°C lead wire	3	Delta	Yes	No	No	No
<b>B4</b>	TGGT 250°C lead wire	3	Wye	Yes	Yes	No	No
<b>C1</b>	1/4 in. quick connect (spade)	1	Parallel	Yes	Yes	Yes	Yes
<b>C2</b>	1/4 in. quick connect (spade)	1	Series	Yes	No	No	No
<b>D1</b>	Screw lug (plate) terminal	1	Parallel	Yes	Yes	Yes	Yes
<b>D2</b>	Screw lug (plate) terminal	1	Series	Yes	No	No	No
<b>D3</b>	Screw lug (plate) terminal	3	Delta	Yes	No	No	No
<b>E1</b>	#10-32 stud terminal	1	Parallel	Yes	Yes	Yes	Yes
<b>E2</b>	#10-32 stud terminal	1	Series	Yes	No	No	No
<b>E3</b>	#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<sup>①</sup>

#### Flexible Lead Wire<sup>①</sup>

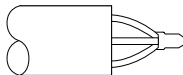
A, B



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

#### Quick Connect (Spade)

C1



- Double-End 1 in. FIREBAR

#### Quick Connect (Spade)

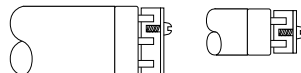
C2



- Double-End 1 in. FIREBAR

#### Screw Lug (Plate)

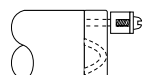
D1



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

#### Screw Lug (Plate)

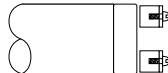
D2



- Double-End 1 in. FIREBAR

#### Screw Lug (Plate)

D3



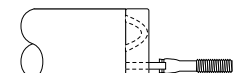
- Double-End 1 in. FIREBAR

3-phase delta wiring example



#### Threaded Stud

E2



- Double-End 1 in. FIREBAR

#### Threaded Stud

E1



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

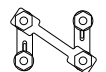
#### Threaded Stud

E3



- Double-End 1 in. FIREBAR

3-phase delta wiring example



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

### Single-End FIREBAR, Double-End FINBAR 1 5/8 in. FIREBAR<sup>①</sup>

#### Flexible Lead Wire<sup>①</sup>

A, B



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

#### Quick Connect (Spade)

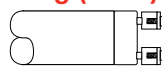
C3



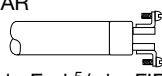
- Single-End 1 FIREBAR
- FINBAR
- Double-End 5/8 in. FIREBAR
- Single-End 5/8 in. FIREBAR

#### Screw Lug (Plate)

D4



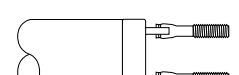
- Single-End 1 in. FIREBAR
- FINBAR



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

#### Threaded Stud

E4



- Single-End 1 in. FIREBAR
- FINBAR

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

# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

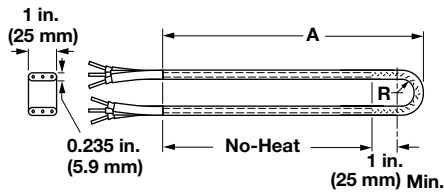
### Bending

#### Major and Minor Axis Bending Parameters

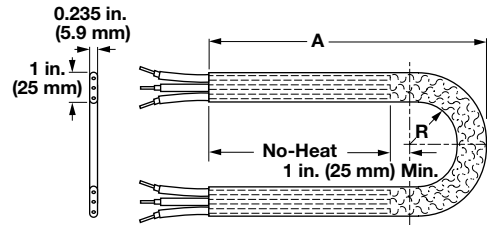
The following illustrations detail the recommended major and minor axis bend parameters for FIREBAR elements. These illustrations show the relationship between the type of bend and the location of heat and no-heat sections. See the next two pages for the 15 common bend formations.

**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.

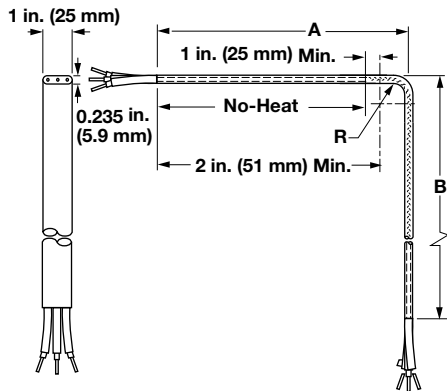
#### 180° Minor Axis Heated Bend



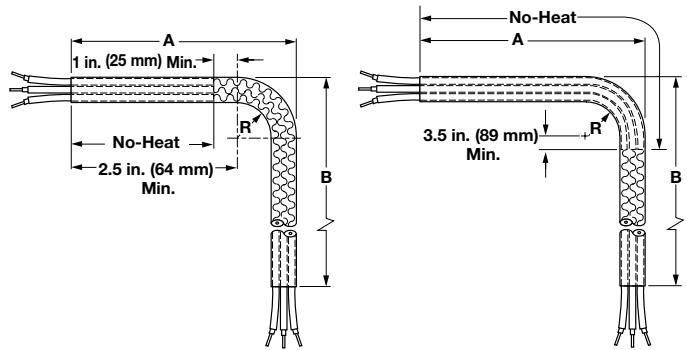
#### 180° Major Axis Heated Bend



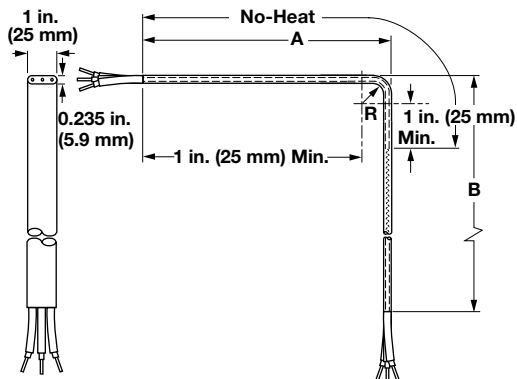
#### 90° Minor Axis Heated Bend



#### 90° Major Axis Heated Bend



#### 90° Minor Axis Un-Heated Bend



#### 180° Major Axis Bends

FIREBAR Size		Radius		Arc Length
in.	(mm)	in.	(mm)	
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

# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

### Bend Formations

FIREBAR elements can be formed into spirals, 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.

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
<b>Figure 1A</b> 	<b>Figure 1B</b> 	<b>Figure 2A</b> 	<b>Figure 2B</b> 
<b>Figure 3A</b> 	<b>Figure 3B</b> 	<b>Figure 4A</b> 	<b>Figure 4B</b> 
<b>Figure 5A</b> 	<b>Figure 5B</b> 	<b>Figure 6A</b> 	<b>Figure 6B</b> 
<b>Figure 7A</b> 	<b>Figure 7B</b> 	<b>Figure 8A</b> 	<b>Figure 8B</b> 

# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

### Bend Formation (Continued)

Minor Axis	Major Axis	Minor Axis	Major Axis
<p><b>Figure 9A</b></p>	<p><b>Figure 9B</b></p>	<p><b>Figure 10A</b></p>	<p>Bend Figure 10B Not Available On Major Axis</p>
<p><b>Figure 11A</b></p>	<p>Bend Figure 11B Not Available On Major Axis</p>	<p><b>Figure 12A</b></p>	<p><b>Figure 12B</b></p>
<p><b>Figure 13A</b></p>	<p><b>Figure 13B</b></p>	<p><b>Figure 14A</b></p>	<p><b>Figure 14B</b></p>
<p><b>Figure 15A</b></p>	<p><b>Figure 15B</b></p>		

# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

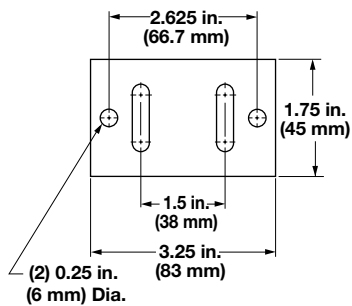
### Mounting Brackets

Steel brackets provide element mounting in non-pressurized applications. In air heating applications, an 18-gauge aluminized steel bracket is press fitted 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.

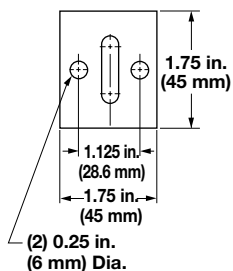
The bracket is located 1/2 in. (13 mm) from the sheath's end, 1/16 in. (1.6 mm) if welded. Available on 5/8 in. (15.9 mm) FIREBAR as **made-to-order** only.

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

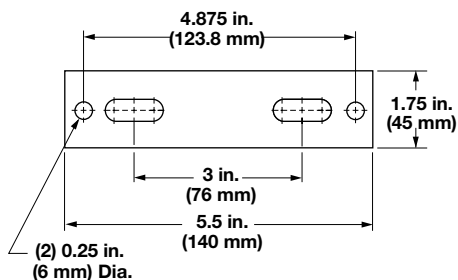
#### Type 1



#### Type 2



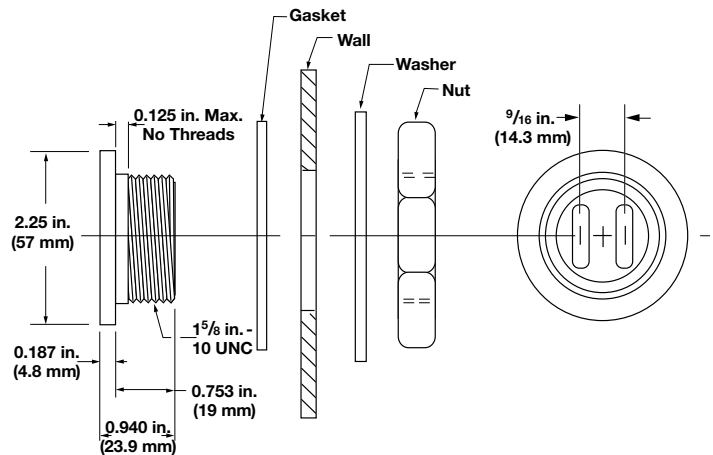
#### Type 3



### 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 Capabilities For FIREBAR Single/Double-Ended Heaters

### Internal Thermocouples

To provide protection against element over-temperature conditions, 1 in. (25 mm) double-ended FIREBAR elements can be ordered with ASTM **Type K** thermocouples. This is accomplished by eliminating the center resistance coil and embedding the thermocouple junction inside the sheath. Thus, thermocouples are available only on two resistance coil, 1 in. (25 mm) FIREBAR elements.

To order, specify:

- **Type K** thermocouple
- Distance the junction is to be located from the element's end
- Lead length

### Thermocouple Types

ASTM Type	Conductor Positive	Characteristics		Recommended Temp. Range °F (°C)
		Negative		
K	Chromel® (Non-magnetic)	Alumel® (Magnetic)		0 to 2000 (-20 to 1100)

① **Type K** thermocouples are rated 32 to 2282°F (0 to 1250°C). Watlow does not recommend exceeding the temperature range shown on this chart.

### Options for 5/8-Inch FIREBAR

- Electropolished finish
- Custom formations
- Cordset
- Termination overmolds (silicone or neoprene)
- Terminal enclosures (general purpose, moisture resistant, moisture/explosion resistant and explosion resistant)
- Internal thermocouple (dual end only, single or dual coil)
- Custom wattage tolerance (±5%)

### Options for One-Inch FIREBAR

- Electropolished finish
- Bulkhead, single leg
- Custom formations
- Cordset
- Termination overmolds (silicone or neoprene)
- Terminal enclosures (general purpose, moisture resistant, moisture/explosion resistant and explosion resistant)
- Internal thermocouple (dual end only, single or dual coil)
- Custom wattage tolerance (±5%)

## Mounting Brackets

### Threaded Bulkheads

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 **threaded bulkheads**.

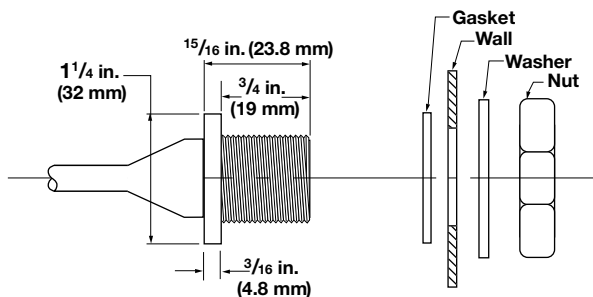


Illustration for 1-inch FIREBAR

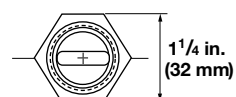


Illustration for 5/8-inch FIREBAR

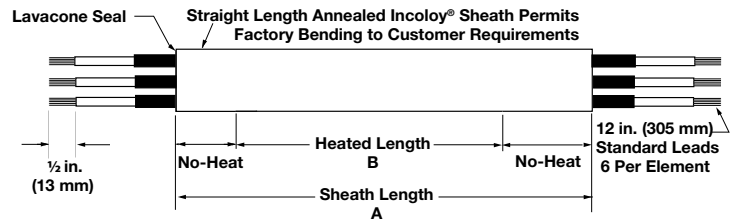
Heater Size in.	Heater Size (mm)	Thread Size
5/8	(15.9)	7/8-14 UNF-2A
1	(25.0)	3/4-16 UNF-2A



# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

### One-Inch, Double-Ended FIREBAR



FIREBAR Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number			Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	480VAC	lbs	(kg)

#### Applications: Asphalt, Paraffin (Solid), Bunker Oil, Clamp-On

6 W/in <sup>2</sup> Alloy 800 (1 W/cm <sup>2</sup> )	35	(889)	25	(635)	310	FBN351WD			1.3	(0.6)
	41	(1041)	31	(787)	410	FBN411WD			1.5	(0.7)
	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 <sup>2</sup> Alloy 800 (1.6 W/cm <sup>2</sup> )	25	(635)	22	(558)	500	FBN251WL			0.9	(0.4)
	35	(889)	32	(812)	750	FBN351WL	FBN3510WL		1.3	(0.6)
	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 <sup>2</sup> ① Alloy 800 (2.3 W/cm <sup>2</sup> )	29	(736)	19	(482)	670		FBN2910WE		1.1	(0.5)
	34	(863)	24	(609)	830		FBN3410WE		1.3	(0.6)
	39	(990)	29	(736)	1,000		FBN3910WE		1.4	(0.7)
	48	(1219)	38	(965)	1,330		FBN4810WE	FBN4811WE	1.8	(0.9)
	58	(1473)	48	(1219)	1,670		FBN5810WE	FBN5811WE	2.1	(1.0)
	68	(1727)	58	(1473)	2,000		FBN6810WE	FBN6811WE	2.5	(1.2)
	87	(2209)	77	(1955)	2,670		FBN8710WE	FBN8711WE	3.2	(1.5)
	106	(2692)	96	(2438)	3,330		FBN10610WE	FBN10611WE	3.9	(1.8)

#### Applications: Radiant, Platens, Dies, Low-Temperature Ovens 300°F (150°C)

20 W/in <sup>2</sup> Alloy 800 (3.1 W/cm <sup>2</sup> )	15	(381)	11	(279)	500	FBN151WM			0.6	(0.3)
	20	(508)	16	(406)	750	FBN201WM			0.8	(0.4)
	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	FBN7011WM	2.6	(1.2)
	91	(2311)	85	(2159)	4,000		FBN9110WM	FBN9111WM	3.3	(1.5)

#### Applications: Degreasing Solutions, Heat Transfer Oils

23 W/in <sup>2</sup> Alloy 800 (3.6 W/cm <sup>2</sup> )	35	(889)	25	(635)	1,250	FBN351WT	FBN3510WT		1.3	(0.6)
	41	(1041)	31	(787)	1,625	FBN411WT	FBN4110WT		1.5	(0.7)
	51	(1295)	41	(1041)	2,125	FBN511WT	FBN5110WT	FBN5111WT	1.9	(0.9)
	62	(1574)	52	(1320)	2,625	FBN621WT	FBN6210WT	FBN6211WT	2.3	(1.1)
	72	(1828)	62	(1574)	3,200	FBN721WT	FBN7210WT	FBN7211WT	2.6	(1.2)
	93	(2362)	83	(2108)	4,250	FBN931WT	FBN9310WT	FBN9311WT	3.4	(1.6)
	114	(2895)	104	(2641)	5,400	FBN1141WT	FBN11410WT	FBN11411WT	4.2	(1.9)

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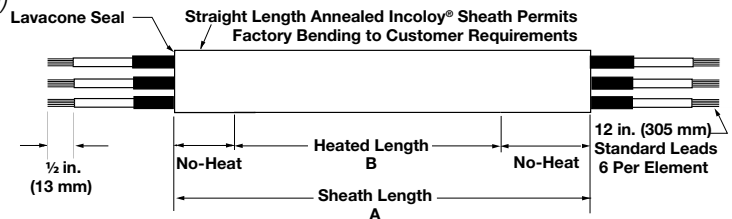
• Manufacturing lead times

Truck Shipment only

# Tubular Heaters

## FIREBAR Single/Double-Ended Heaters

### One-Inch, Double-Ended FIREBAR (Continued)



FIREBAR Description	Sheath A Dimension		Heated B Dimension		Watts	Part Number			Est. Net Wt.	
	in.	(mm)	in.	(mm)		120VAC	240VAC	480VAC	lbs	(kg)

#### Applications: Cooking Oils, Mild Caustic Solution, Ethylene Glycol (100%)

30 W/in <sup>2</sup> Alloy 800 (4.7 W/cm <sup>2</sup> )	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	FBN5011WH	1.8	(0.9)
	64	(1625)	57	(1447)	4000		FBN6410WH	FBN6411WH	2.4	(1.1)
	80	(2032)	72	(1828)	5000		FBN8010WH	FBN8011WH	2.9	(1.4)

#### Applications: Process Water, Ethylene Glycol (50%)

40 W/in <sup>2</sup> Alloy 800 (6.2 W/cm <sup>2</sup> )	25	(635)	22	(558)	2000		FBN2510WK		0.9	(0.4)
	35	(889)	32	(812)	3000		FBN3510WK	FBN3511WK	1.3	(0.6)
	47	(1193)	43	(1092)	4000		FBN4710WK	FBN4711WK	1.7	(0.8)
	69	(1752)	65	(1651)	6000		FBN6910WK	FBN6911WK	2.5	(1.2)
	90	(2286)	86	(2184)	8000		FBN9010WK	FBN9011WK	3.3	(1.5)
45 W/in <sup>2</sup> Alloy 800 (7 W/cm <sup>2</sup> )	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	FBN4811WP	1.8	(0.9)
	58	(1473)	48	(1219)	5000		FBN5810WP	FBN5811WP	2.1	(1.0)
	68	(1727)	58	(1473)	6000		FBN6810WP	FBN6811WP	2.5	(1.2)
	87	(2209)	77	(1955)	8000		FBN8710WP	FBN8711WP	3.2	(1.5)
106	(2692)	96	(2438)	10,000		FBN10610WP	FBN10611WP	3.9	(1.8)	

#### Applications: Clean and Potable Water

80 W/in <sup>2</sup> Alloy 800 (12.4 W/cm <sup>2</sup> )	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	FBN2611WJ	1.0	(0.5)
	36	(914)	32	(812)	6000		FBN3610WJ	FBN3611WJ	1.3	(0.6)
	48	(1219)	43	(1092)	8000		FBN4810WJ	FBN4811WJ	1.8	(0.9)
	70	(1778)	65	(1651)	12,000			FBN7011WJ	2.6	(1.2)
90 W/in <sup>2</sup> Alloy 800 (14 W/cm <sup>2</sup> )	91	(2311)	85	(2159)	16,000			FBN9111WJ	3.3	(1.5)
	35	(889)	25	(635)	5000	FBN351WG	FBN3510WG	FBN3511WG	1.3	(0.6)
	41	(1041)	31	(787)	6500	FBN411WG	FBN4110WG	FBN4111WG	1.5	(0.7)
	51	(1295)	41	(1041)	8500		FBN5110WG	FBN5111WG	1.9	(0.9)
	62	(1574)	52	(1320)	10,500		FBN6210WG	FBN6211WG	2.3	(1.1)
	72	(1828)	62	(1574)	12,750		FBN7210WG	FBN7211WG	2.6	(1.2)
	93	(2362)	83	(2108)	17,000			FBN931WG	3.4	(1.6)
114	(2895)	104	(2641)	21,500			FBN11411WG	3.4	(1.6)	

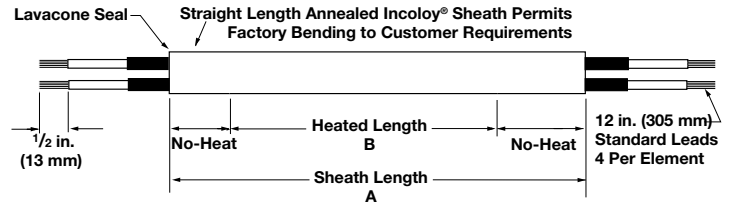
• Manufacturing lead times

■ Truck Shipment only

# Tubular Heaters

## 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	480VAC	lbs	(kg)

#### Applications: Degreasing Fluids, Heat Transfer Oils

<b>23 W/in<sup>2</sup> ①</b> <b>Alloy 800</b> <b>(3.6 W/cm<sup>2</sup>)</b>	19	(483)	11	(279)	375	<b>FAN191WT</b>			0.5	(0.3)
	22	(559)	14	(356)	500	<b>FAN221WT</b>	<b>FAN2210WT</b>		0.5	(0.3)
	26	(660)	18	(457)	625	<b>FAN261WT</b>	<b>FAN2610WT</b>		0.6	(0.3)
	30	(762)	22	(559)	750	<b>FAN301WT</b>	<b>FAN3010WT</b>		0.7	(0.4)
	37	(940)	29	(737)	1000	<b>FAN371WT</b>	<b>FAN3710WT</b>		0.9	(0.5)
	44	(1118)	36	(914)	1250	<b>FAN441WT</b>	<b>FAN4410WT</b>		1.0	(0.5)
	51	(1295)	43	(1092)	1500	<b>FAN511WT</b>	<b>FAN5110WT</b>		1.2	(0.6)

#### Applications: Clean and Potable Water

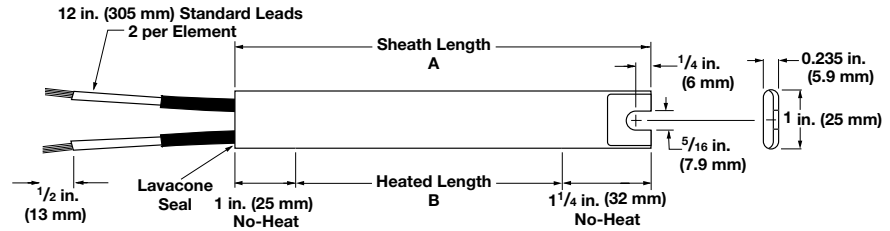
<b>90 W/in<sup>2</sup></b> <b>Alloy 800</b> <b>(14 W/cm<sup>2</sup>)</b>	15	(381)	7	(178)	1000	<b>FAN151WG</b>	<b>FAN1510WG</b>		0.4	(0.2)
	19	(483)	11	(279)	1500	<b>FAN191WG</b>	<b>FAN1910WG</b>	<b>FAN1911WG</b>	0.5	(0.3)
	22	(559)	14	(356)	2000	<b>FAN221WG</b>	<b>FAN2210WG</b>	<b>FAN2211WG</b>	0.5	(0.3)
	26	(660)	18	(457)	2500	<b>FAN261WG</b>	<b>FAN2610WG</b>	<b>FAN2611WG</b>	0.6	(0.3)
	30	(762)	22	(559)	3000	<b>FAN301WG</b>	<b>FAN3010WG</b>	<b>FAN3011WG</b>	0.7	(0.4)
	37	(940)	29	(737)	4000		<b>FAN3710WG</b>	<b>FAN3711WG</b>	0.9	(0.5)
	44	(1118)	36	(914)	5000		<b>FAN4410WG</b>	<b>FAN4411WG</b>	1.0	(0.5)
	51	(1295)	43	(1092)	6000		<b>FAN5110WG</b>	<b>FAN5111WG</b>	1.2	(0.6)

- Manufacturing lead times

# Tubular Heaters

## 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/in <sup>2</sup> 304 SS (3.1 W/cm <sup>2</sup> )	8 <sup>3</sup> / <sub>4</sub>	(222.0)	6 <sup>1</sup> / <sub>2</sub>	(165.0)	300	FSP91WM		0.4	(0.2)
	10 <sup>1</sup> / <sub>4</sub>	(260.0)	7 <sup>1</sup> / <sub>2</sub>	(203.0)	375	FSP101WM		0.4	(0.2)
	12 <sup>1</sup> / <sub>4</sub>	(311.0)	10	(254.0)	450	FSP121WM		0.5	(0.3)
	13 <sup>1</sup> / <sub>2</sub>	(343.0)	11 <sup>1</sup> / <sub>4</sub>	(286.0)	500	FSP141WM		0.5	(0.3)
	16 <sup>1</sup> / <sub>8</sub>	(408.6)	13 <sup>7</sup> / <sub>8</sub>	(352.4)	650	FSP161WM	FSP1610WM	0.6	(0.3)
	17 <sup>3</sup> / <sub>4</sub>	(451.0)	15 <sup>1</sup> / <sub>2</sub>	(393.0)	725	FSP181WM	FSP1810WM	0.7	(0.4)
	19 <sup>1</sup> / <sub>4</sub>	(489.0)	17	(431.0)	800	FSP191WM	FSP1910WM	0.7	(0.4)
	22	(558.0)	19 <sup>3</sup> / <sub>4</sub>	(502.0)	900	FSP221WM	FSP2210WM	0.8	(0.4)
	23 <sup>3</sup> / <sub>4</sub>	(603.0)	21 <sup>1</sup> / <sub>2</sub>	(546.0)	1,000	FSP241WM	FSP2410WM	0.9	(0.4)
	25	(635.0)	22 <sup>3</sup> / <sub>4</sub>	(578.0)	1,050	FSP251WM	FSP2510WM	0.9	(0.4)
	28 <sup>5</sup> / <sub>8</sub>	(727.1)	26 <sup>3</sup> / <sub>8</sub>	(670.0)	1,250	FSP291WM	FSP2910WM	1.1	(0.5)
	31 <sup>5</sup> / <sub>8</sub>	(803.3)	29 <sup>3</sup> / <sub>8</sub>	(746.1)	1,350	FSP321WM	FSP3210WM	1.2	(0.6)
	34 <sup>1</sup> / <sub>8</sub>	(866.8)	31 <sup>7</sup> / <sub>8</sub>	(809.6)	1,500		FSP3410WM	1.3	(0.6)
	36 <sup>7</sup> / <sub>8</sub>	(936.6)	34 <sup>5</sup> / <sub>8</sub>	(879.5)	1,600		FSP3710WM	1.4	(0.7)
	40 <sup>5</sup> / <sub>8</sub>	(1031.9)	38 <sup>3</sup> / <sub>8</sub>	(974.7)	1,800		FSP4110WM	1.5	(0.7)
	46 <sup>1</sup> / <sub>4</sub>	(1175.0)	44	(1117.0)	2,000		FSP4610WM	1.7	(0.8)

#### Applications: Air Heating

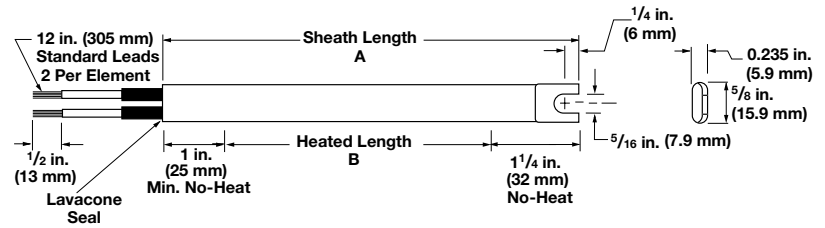
40 W/in <sup>2</sup> 304 SS (6.2 W/cm <sup>2</sup> )	8 <sup>3</sup> / <sub>4</sub>	(222.0)	6 <sup>1</sup> / <sub>2</sub>	(165.0)	600	FSP91WK		0.4	(0.2)
	10 <sup>1</sup> / <sub>4</sub>	(260.0)	7 <sup>1</sup> / <sub>2</sub>	(203.0)	750	FSP101WK		0.4	(0.2)
	12 <sup>1</sup> / <sub>4</sub>	(311.0)	10	(254.0)	900	FSP121WK	FSP1210WK	0.5	(0.3)
	13 <sup>1</sup> / <sub>2</sub>	(343.0)	11 <sup>1</sup> / <sub>4</sub>	(286.0)	1,000	FSP131WK	FSP1310WK	0.5	(0.3)
	16 <sup>1</sup> / <sub>4</sub>	(413.0)	13 <sup>7</sup> / <sub>8</sub>	(352.4)	1,300	FSP161WK	FSP1610WK	0.6	(0.3)
	17 <sup>3</sup> / <sub>4</sub>	(451.0)	15 <sup>1</sup> / <sub>2</sub>	(393.0)	1,450	FSP181WK	FSP1810WK	0.7	(0.4)
	19 <sup>1</sup> / <sub>4</sub>	(489.0)	17	(431.0)	1,600		FSP1910WK	0.7	(0.4)
	22	(558.0)	19 <sup>3</sup> / <sub>4</sub>	(502.0)	1,800		FSP2210WK	0.8	(0.4)
	23 <sup>3</sup> / <sub>4</sub>	(603.0)	21 <sup>1</sup> / <sub>2</sub>	(546.0)	2,000		FSP2410WK	0.9	(0.4)
	25	(635.0)	22 <sup>3</sup> / <sub>4</sub>	(578.0)	2,100		FSP2510WK	0.9	(0.4)
	28 <sup>5</sup> / <sub>8</sub>	(727.1)	26 <sup>3</sup> / <sub>8</sub>	(669.9)	2,500		FSP2910WK	1.1	(0.5)
	31 <sup>5</sup> / <sub>8</sub>	(803.2)	29 <sup>3</sup> / <sub>8</sub>	(746.1)	2,700		FSP3210WK	1.2	(0.6)
	34 <sup>1</sup> / <sub>8</sub>	(866.8)	31 <sup>7</sup> / <sub>8</sub>	(809.6)	3,000		FSP3410WK	1.3	(0.6)
	36 <sup>7</sup> / <sub>8</sub>	(936.6)	34 <sup>5</sup> / <sub>8</sub>	(879.5)	3,200		FSP3710WK	1.4	(0.7)
	40 <sup>5</sup> / <sub>8</sub>	(1031.9)	38 <sup>3</sup> / <sub>8</sub>	(974.7)	3,600		FSP4110WK	1.5	(0.7)
	46 <sup>1</sup> / <sub>4</sub>	(1175.0)	44	(1117.0)	4,000		FSP4610WK	1.7	(0.8)

- Manufacturing lead times

# Tubular Heaters

## 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/in <sup>2</sup>	11 1/2	(292)	8	(203)	250	FSA121WM		0.3	(0.2)
Alloy 800	15 1/2	(394)	12	(304)	375	FSA161WM	FSA1610WM	0.4	(0.2)
(3.1 W/cm <sup>2</sup> )	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)

- Manufacturing lead times

# Tubular Heaters

## 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<sup>2</sup> (7.7 W/cm<sup>2</sup>)
- 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

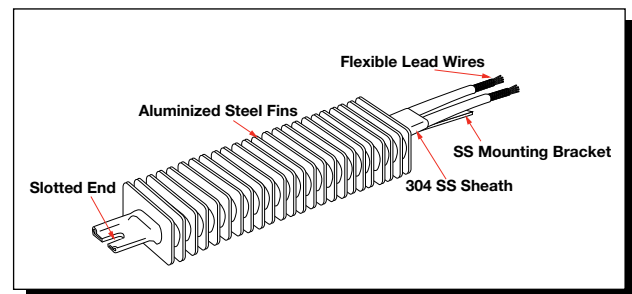
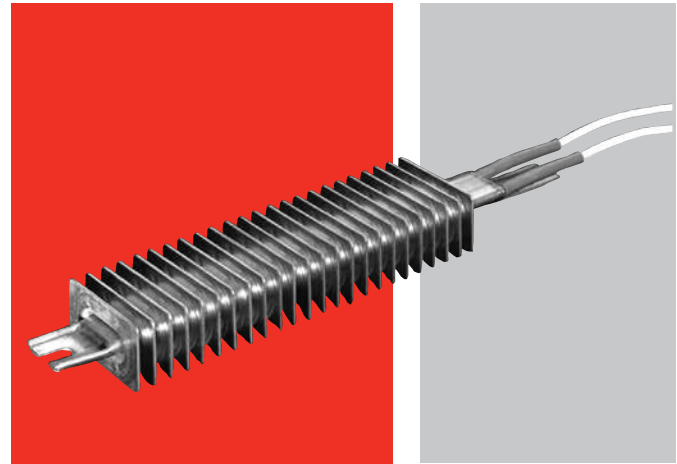
- Allows ease of installation

#### 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<sup>2</sup> (6.2 W/cm<sup>2</sup>)

**Fin Surface Area:** 16 in<sup>2</sup>/linear in. (40.5 cm<sup>2</sup>/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

**Agency Recognition:** Refer to FIREBAR UL®

# Tubular Heaters

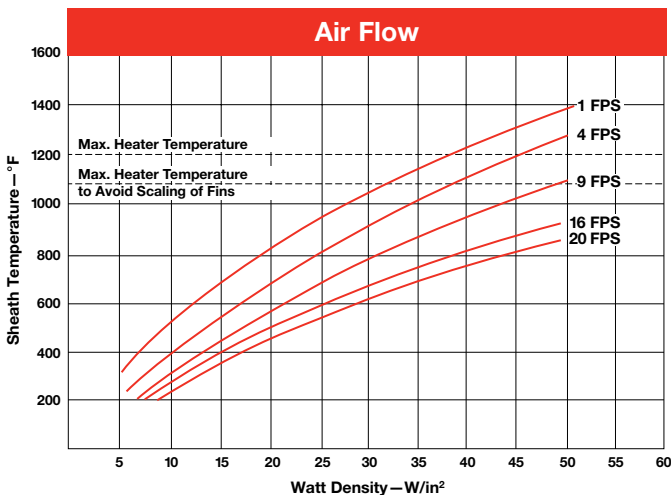
## FINBAR Single-Ended Heaters

### 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**.

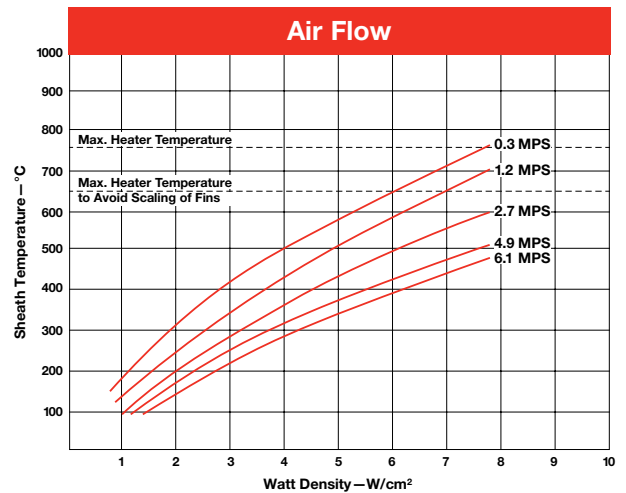
The graphic representation is based on a single-ended FINBAR, various air velocities (at 68°F/20°C inlet temperature) and different watt densities.

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



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 (°C)



### Dual Ended FINBAR

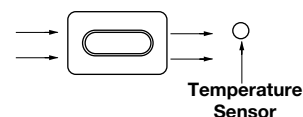
FINBAR elements are typically terminated at one end. Upon request, however, dual-ended FINBAR heaters can be ordered. To order, specify **dual-ended FINBAR** and lead length.

### 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:

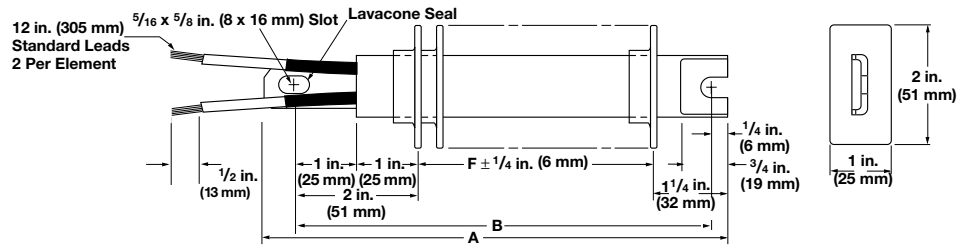
- Air flow over element must be parallel with the flat side.
- Element center line to element center line spacing must be a minimum of 1½ in. (38 mm).



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

# Tubular Heaters

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

• M - Manufacturing lead times