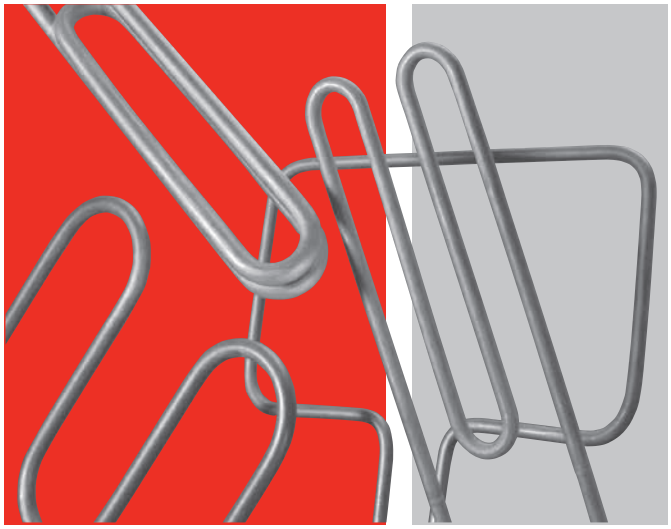
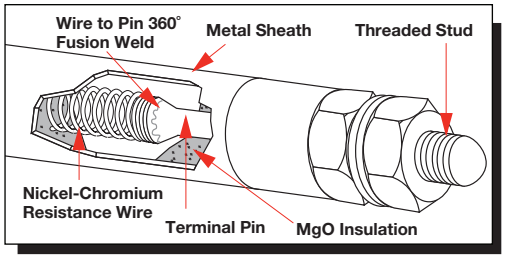
WATROD™ Single/Double-Ended Heaters





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^2 (6.9 W/cm^2)
- 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^2 (18.6 W/cm^2)
- 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

WATROD Single/Double-Ended Heaters

Specifications

Double-Ended

Single-Ended

Applications	Direct immersion Hot runner mold (manifold) Forced air Ovens Radiant Clamp-on		Vacuums Semiconductor		Platens Forced air Deicing antennas Plastic wrap cutting Seal bars				
Watt Density W/in² (W/cm²)	Catalog P/N: Standard:		up to 60 up to 120	(9.3) (18.6)	Catalog P/N: Standard:		up to 20 up to 45	(3.1) (6.9)	
Element Diameters in. (mm) **and Surface Area per Linear** in² (cm²) Diameter Tolerance ± 0.005 in. (0.13 mm)	**Dia.** 0.210 0.260 0.315 0.375 0.430 0.475	**in²** 0.660 0.817 0.990 1.178 1.351 1.492	**Dia. (mm)** (5.33) (6.60) (8.00) (9.53) (10.92) (12.07)	**cm²** (4.26) (5.27) (6.38) (7.60) (8.72) (9.63)	**Dia.** 0.375 0.430 0.475	**in²** 1.178 1.351 1.492	**Dia. (mm)** (9.53) (10.92) (12.07)	**cm²** (7.600) (8.717) (9.626)	
Sheath Materials **Max. Operating** **Temperature**	Standard: 	Alloy 800/840 316 SS Steel 304 SS Alloy 600	1600°F 1200°F 750°F 1200°F 1800°F	(870°C) (650°C) (400°C) (650°C) (980°C)	Standard: 	Alloy 800/840 316 SS 304 SS	1200°F 1200°F 1200°F	(650°C) (650°C) (650°C)	
Sheath Length By Diameter in. (mm)	**Dia.** Standard: 0.210 0.260 0.315 0.375 0.430 0.475	**Sheath Length (in.)** 9 to 130 9 to 270 9 to 270 11 to 360 11 to 360 11 to 275	**Dia. (mm)** (5.33) (6.60) (8.00) (9.53) (10.92) (12.07)	**Sheath Length (mm)** (230 to 3300) (230 to 6858) (230 to 6858) (280 to 9144) (280 to 9144) (280 to 6985)	**Dia.** Standard: 0.375 0.430 0.475	**Sheath Length (in.)** 11 to 125 11 to 106 11 to 125	**Dia. (mm)** (9.53) (10.92) (12.07)	**Sheath Length (mm)** (280 to 3175) (280 to 2690) (280 to 3175)	
Min. No-Heat Length in. (mm)	**Sheath Length** 11 to 20 21 to 50 51 to 80 81 to 110 111 to 140 141 to 170 171 to 200 201 & up	**No-Heat Length** 1 1 1/4 1 1/2 1 5/8 1 3/4 2 2 1/4 2 1/2	**Sheath Length** (280 to 510) (535 to 1270) (1295 to 2030) (2055 to 2795) (2820 to 3555) (3580 to 4320) (4345 to 5080) (5105 & up)	**No-Heat Length** (25) (32) (38) (42) (44) (51) (57) (64)	**Sheath Length** 11 to 20 21 to 50 51 to 80 81 to 110 111 to 125	**No-Heat Length** 1 1/2 1 3/4 2 1/8 2 3/8 2 5/8	**Sheath Length** (280 to 5100) (533 to 1270) (1295 to 2030) (2055 to 2795) (2820 to 3175)	**No-Heat Length** (38) (44) (54) (60) (67)	**½ in. (13 mm) No-heat length on all blunt ends**
Max. Voltage/Amperage By Dia. in. (mm)	**Dia.** 0.260 (6.6) 0.315 (8.0) 0.375 (9.53) 0.430 (10.92) 0.475 (12.07)	**Volts** 250VAC 480VAC 480VAC 600VAC 600VAC	**Amperes** 15 30 30 40 40		**Dia.** 0.375 (9.53) 0.430 (10.92) 0.475 (12.07)	**Volts** 480VAC 480VAC 480VAC	**Ampere** 30 30 30		

WATROD Single/Double-Ended Heaters

Specifications *(Continued)*

Double-Ended

Single-Ended

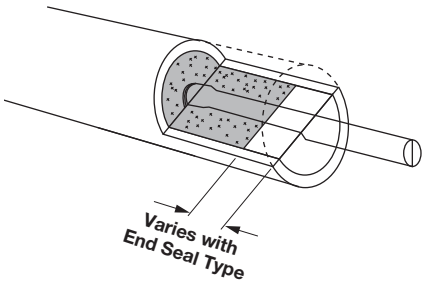
Ohms Per Heated Inch By Dia. in.	**Dia.**	**Min.**	**Max.**		**Dia.**	**Min.**	**Max.**	
	0.210	0.130Ω	14Ω		0.375	0.150Ω	25Ω	
	0.260	0.080Ω	16Ω		0.430	0.150Ω	24Ω	
	0.315	0.050Ω	25Ω		0.475	0.150Ω	22Ω	
	0.375	0.030Ω	20Ω					
	0.430	0.030Ω	25Ω					
	0.475	0.035Ω	25Ω					
Terminations	Standard:	Threaded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

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.

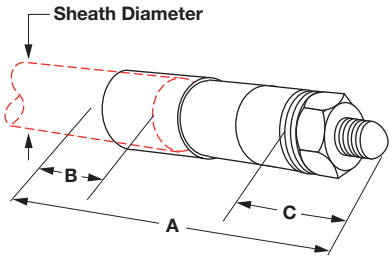
To order, specify **bright annealing**.

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)	#¼-28

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

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.

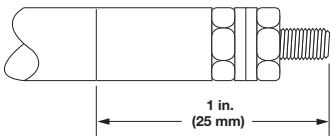
Flexible lead wires are 12 in. (305 mm), Sil-A-Blend™ 390°F (200°C) unless otherwise specified. Insulation options include TGGT 480°F (250°C) plus other temperature ratings. Contact your Watlow representative.

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
	0.315	(8.0)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.335	(8.5)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.375	(9.5)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.430	(10.9)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.475	(12.1)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	0.490	(12.5)	#10-32	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Single-Ended	0.375	(9.53)	No	No	No	No	No	No	No	Yes
	0.430	(10.9)	No	No	No	No	No	No	No	Yes
	0.475	(12.1)	No	No	No	No	No	No	No	Yes
	0.490	(12.5)	No	No	No	No	No	No	No	Yes

Threaded Stud

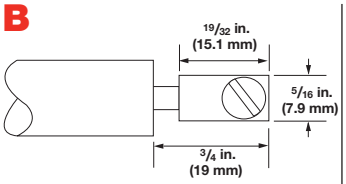
A



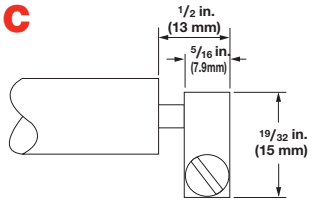
① Optional #8-32, ¼ in. and 4 or 5 mm studs available. Consult factory for details.

Screw Lug (Plate)

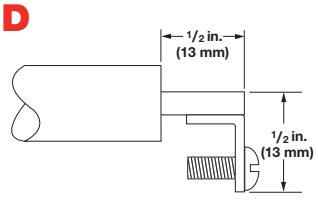
B



C

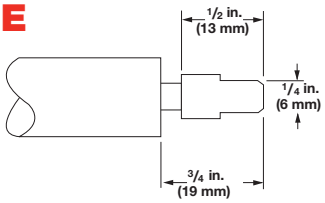


D

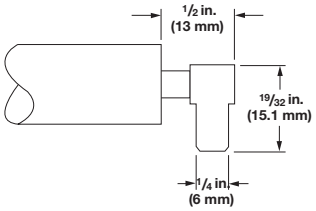


Quick Connect (Spade)

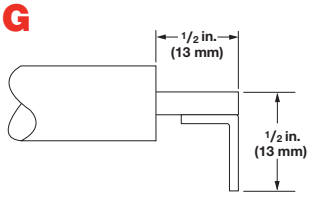
E



F

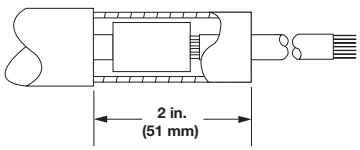


G



Flexible Lead Wires

H



WATROD Single/Double-Ended Heaters

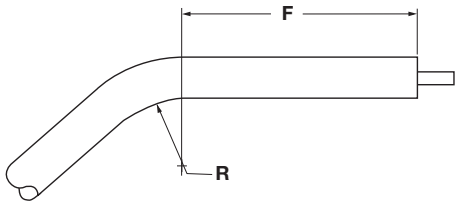
Bend Formations

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.

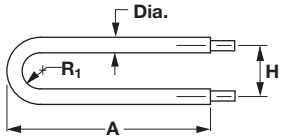
The four common bend configurations available for standard and made-to-order single-ended WATROD elements are Figures 1, 6, 22 and 28.

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

WATROD Minimum Radius							
Sheath Diameter		Field Bend R①		Factory R①		F② Dimension	
in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
0.260	(6.6)	3/4	(19.0)	3/8	(9.5)	1/2	(13.0)
0.315	(8.0)	3/4	(19.0)	1/2	(13.0)	1/2	(13.0)
0.375	(9.52)	1	(25.0)	1/2	(13.0)	1/2	(13.0)
0.430	(10.92)	1	(25.0)	1/2	(13.0)	3/4	(19.0)
0.475	(12.07)	1	(25.0)	5/8	(15.9)	1	(25.0)
0.490	(12.45)	1	(25.0)	5/8	(15.9)	1	(25.0)

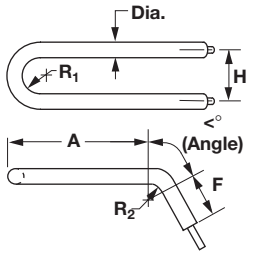
① R is the inside radius of a bend.
② F is the distance from the sheath's end to the start of the first bend.

Figure 1



SL = 2A + 1.14R_1 - 0.43 Dia.
(For pricing, use 1 bend)

Figure 2

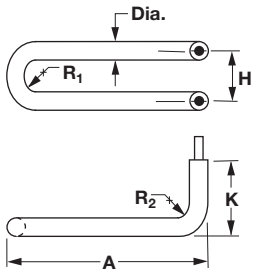


SL = 2A + 2F + 1.14R_1 + 0.0175 (<°)
(2R_2 + Dia.) - 0.43 Dia.
(For pricing, use 3 bends)

WATROD Single/Double-Ended Heaters

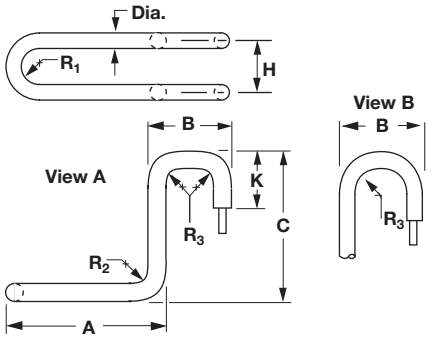
Bend Formations *(Continued)*

Figure 3



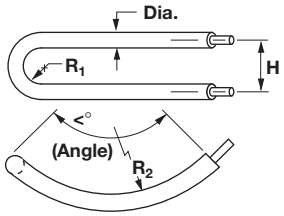
$SL = 2K - 0.86R_2 - 2.86\ Dia. + 2A + 1.14R_1$
(For pricing, use 3 bends)

Figure 4



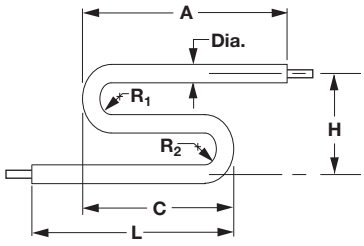
View A: $SL = 2K - 1.72R_3 - 7.72\ Dia. + 2C - 0.86R_2 + 2A + 1.14R_1$
View B: $SL = 2K - 2.28R_3 - 3.72\ Dia. + 2C - 0.86R_2 + 2A + 1.14R_1$
(For pricing, use 5 bends)

Figure 5



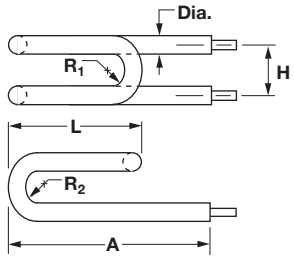
$SL = 0.0175(<^\circ)\ (2R_2 + Dia.) + 1.14R_1 + 0.43\ Dia.$
(For pricing, use 3 bends)

Figure 6



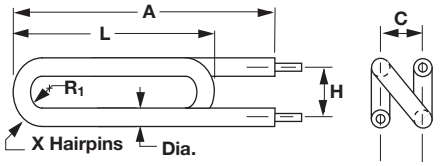
$SL = L + 1.14R_2 - 0.86\ Dia. + C + 1.14R_1 + A$
(For pricing, use 2 bends)

Figure 7



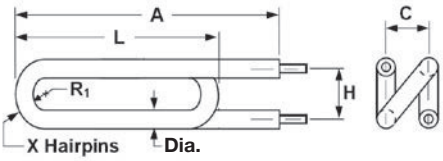
$SL = 2A + 2.28R_2 - 1.29\ Dia. + 2L + 1.14R_1$
(For pricing, use 3 bends)

Figure 8



X = number of outside hairpins
$SL = 2A + 3.42R_1 - 1.29\ Dia. + 2L$
(For pricing, use 5 bends)

Figure 8 Reverse

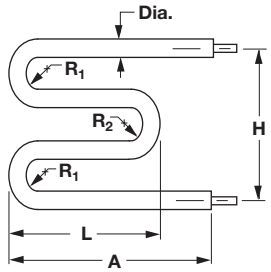


X = number of outside hairpins
$SL = 2A + 3.42R_1 - 1.29\ Dia. + 2L$
(For pricing, use 5 bends)

WATROD Single/Double-Ended Heaters

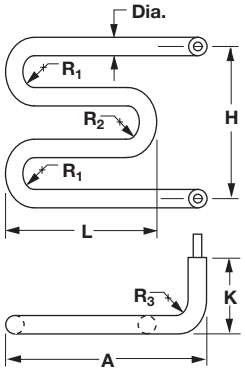
Bend Formations *(Continued)*

Figure 9



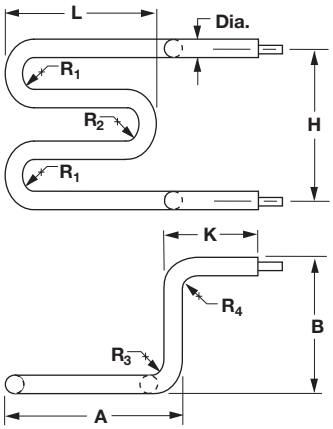
SL = 2A + 2.28R_1 - 1.29 Dia. + 2L + 1.14R_2
(For pricing, use 3 bends)

Figure 10



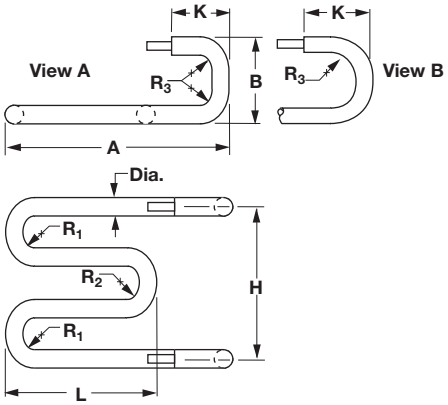
SL = 2K - 0.86R_3 - 3.72 Dia. + 2A + 2L
+ 2.28R_1 + 1.14R_2
(For pricing, use 5 bends)

Figure 11



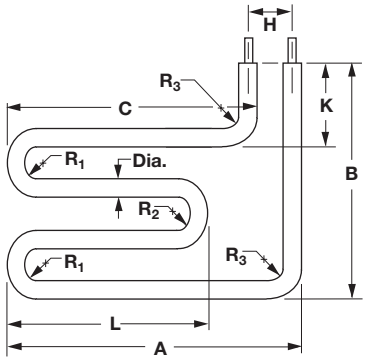
SL = 2K - 086R_3 - 0.86R_4 - 6.15 Dia. + 2B + 2A
+ 2L + 2.28R_1 + 1.14R_2
(For pricing, use 7 bends)

Figure 12



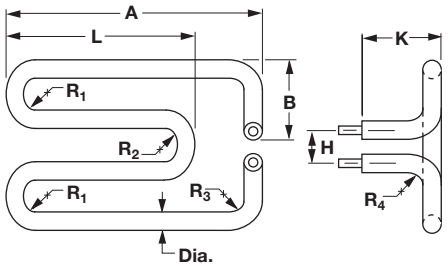
View A: SL = 2K + 2B + 2A + 2L + 2.28R_1
+ 1.14R_2 - 1.72R_3 - 6.15 Dia.
View B: SL = 2K + 2A + 2L + 2.28R_1+ 1.14R_2
- 2.28R_3 - 2.15 Dia.
(For pricing, use 5 bends)

Figure 13



SL = 2B + 2A + 2L - 6.717 Dia. - 1.717R_1
- H - 0.858R_2 - 0.858R_3
(For pricing, use 5 bends)

Figure 14

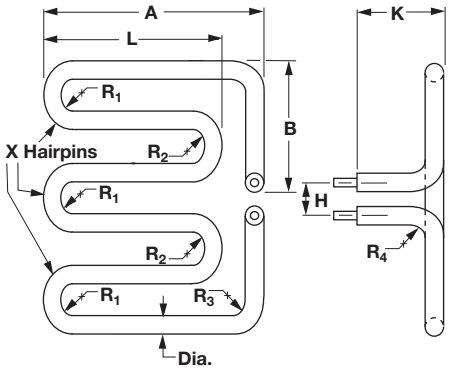


SL+2K+2A+2L+2.28R_1+1.14R_2+2B
-6.15 Dia. -0.86R_3+0.86R_4
(For pricing use 7 bends)

WATROD Single/Double-Ended Heaters

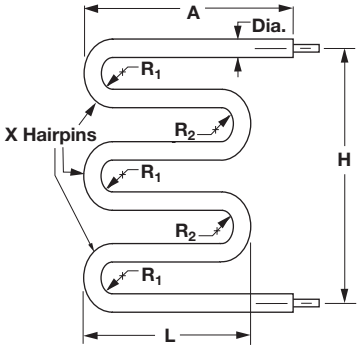
Bend Formations *(Continued)*

Figure 15



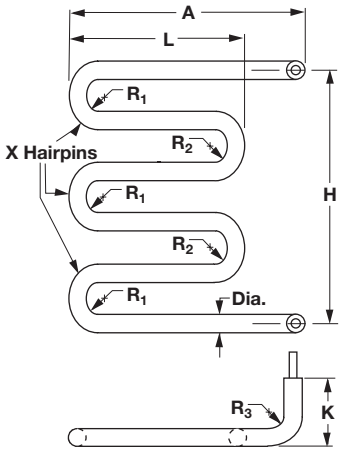
X = number of outside hairpins
SL = 2K + 2A + 2K(X - 1) + 2B - 0.86R_3 - 0.86R_4 + 1.14R_1 (X) + 1.14R_2 (X - 1) - 4.86 Dia. - (2X - 1) 0.43 Dia.
(For pricing, use 9 bends if X = 3 hairpins)

Figure 16



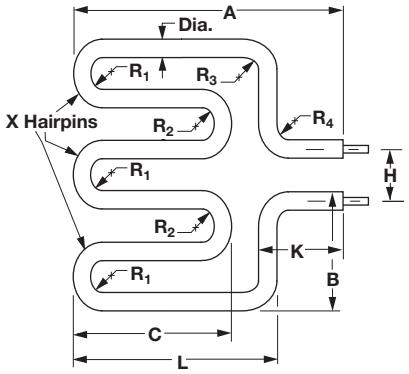
X = number of outside hairpins
SL = 2A + 0.43 Dia. (1 - 2X) + 2L (X - 1) + 1.14R_1 + 1.14R_2 (X - 1)
(For pricing, use 5 bends if X = 3 hairpins)

Figure 17



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

Figure 18

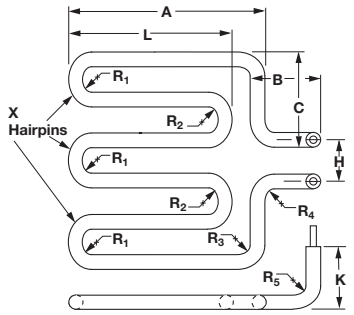


X = number of outside hairpins
SL = 2L + 2K + 2B + 2C (X - 1) - 0.86R_3 - 0.86R_4 - 4.86 Dia. + 1.14R_1 (X) + 1.14R_2 (X - 1) - (2X - 1) 0.43 Dia.
(For pricing, use 9 bends if X = 3 hairpins)

WATROD Single/Double-Ended Heaters

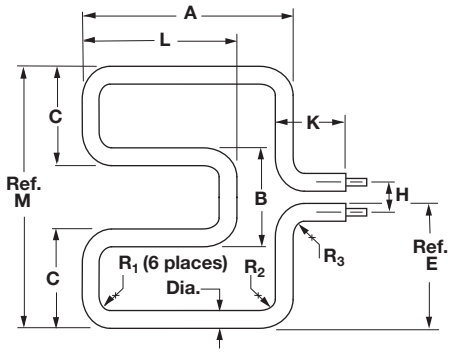
Bend Formations (Continued)

Figure 19



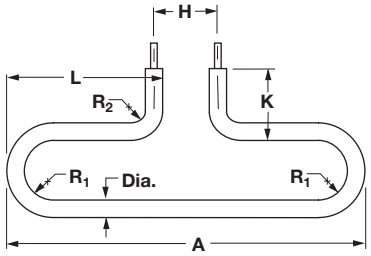
X = number of outside hairpins
SL = 2K + 2A + 2B + 2C + 2L (X - 1) + 1.14R_1 (X) + 1.14R_2 (X - 1) - 0.86R_3 - 0.86R_4 - 0.86R_5 - 7.29 Dia. - (2X - 1) 0.43 Dia.
(For pricing, use 11 bends if X = 3 hairpins)

Figure 20



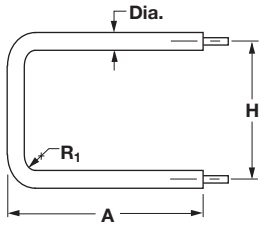
SL = 2K + 2C + B + 2A + 2L - 2.58R_1 - 0.86R_2 - 0.86R_3 - 12.15 Dia.
(For pricing, use 10 bends)

Figure 21



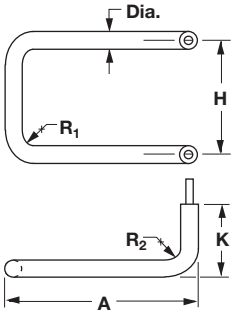
SL = 2A + 2K - H - 2.28R_1 - 0.86R_2 - 3.29 Dia.
(For pricing, use 4 bends)

Figure 22



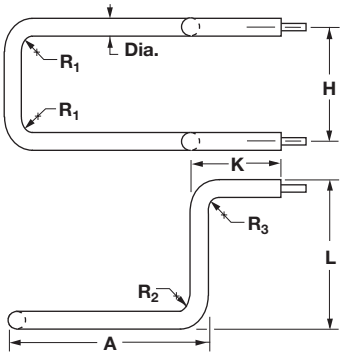
SL = 2A - 0.86R_1 - 1.43 Dia. + H
(For pricing, use 2 bends)

Figure 23



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

Figure 24

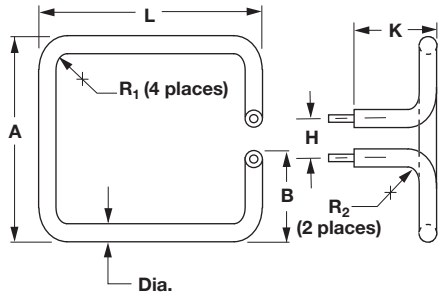


SL = 2K + 2L + H - 0.86R_1 - 0.86R_2 - 0.86R_3 - 7.29 Dia.
(For pricing, use 6 bends)

WATROD Single/Double-Ended Heaters

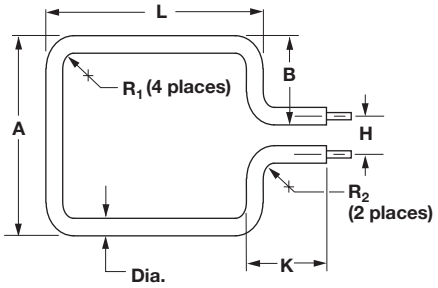
Bend Formations *(Continued)*

Figure 25



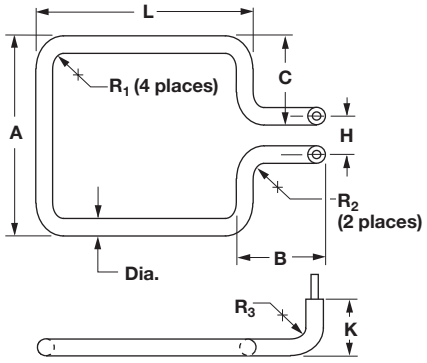
SL = 2K + 2A + 2L - H - 1.72R_1 - 0.86R_2
- 6.92 Dia.
(For pricing, use 6 bends)

Figure 26



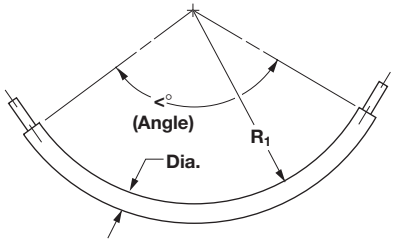
SL = 2K + 2A + 2L - H - 1.72R_1 - 0.86R_2
- 6.29 Dia.
(For pricing, use 6 bends)

Figure 27



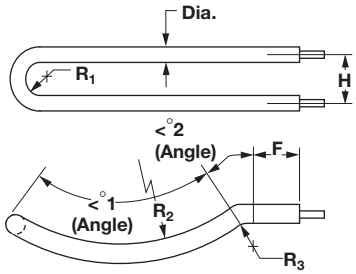
SL = 2K + 2A + 2L + 2B - H - 1.72R_1
- 1.72R_2 - 8.72 Dia.
(For pricing, use 8 bends)

Figure 28



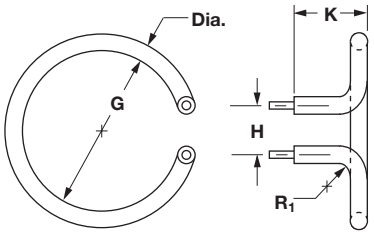
SL = 0.0175 <° (R_1 + 0.5 Dia.)
(For pricing, use 1 bend)

Figure 29



SL = 0.0175 <°1 (2R_2 + Dia.) + 2F + 1.14R_1
+ 0.0175 <°2 (2R_3 + Dia.) - 0.43 Dia.
(For pricing, use 5 bends)

Figure 30

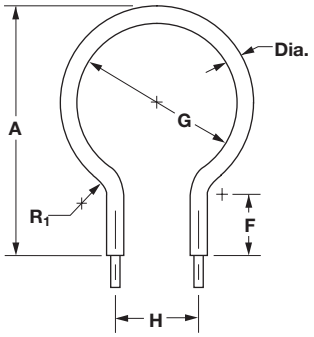


SL = (G + Dia.) 3.14 + 1.14R_1 + 2K
+ 3.28 Dia. - H
(For pricing, use 4 bends)

WATROD Single/Double-Ended Heaters

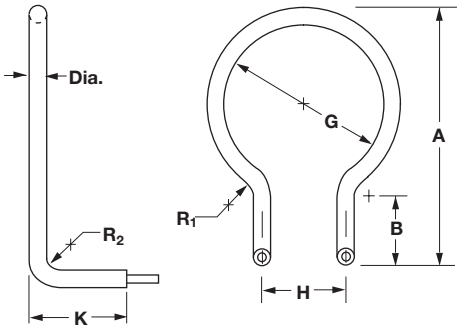
Bend Formations *(Continued)*

Figure 31



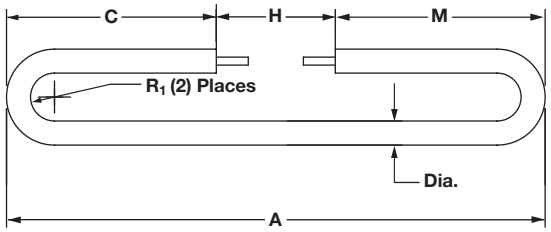
SL = (G + Dia.) 3.14 + 1.14R_1 + 2F
+ 3.71 Dia. - H
(For pricing, use 4 bends)

Figure 32



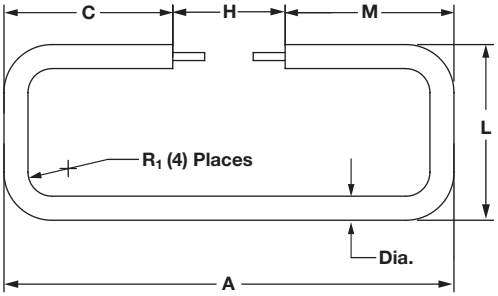
SL = (G + Dia.) 3.14 + 1.14R_1 + 2B + 1.14R_2 +
2K + 3.28 Dia. - H
(For pricing, use 6 bends)

Figure 37



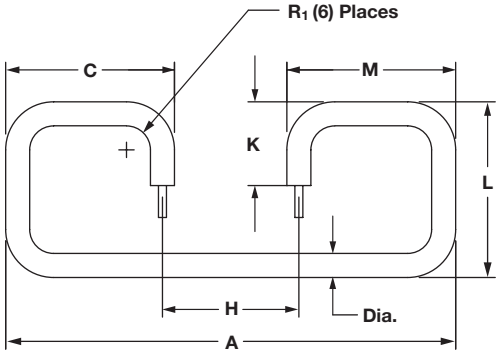
SL = (2A - H) + 2πR_1 - 2R_1
(For pricing, use 2 bends)

Figure 38



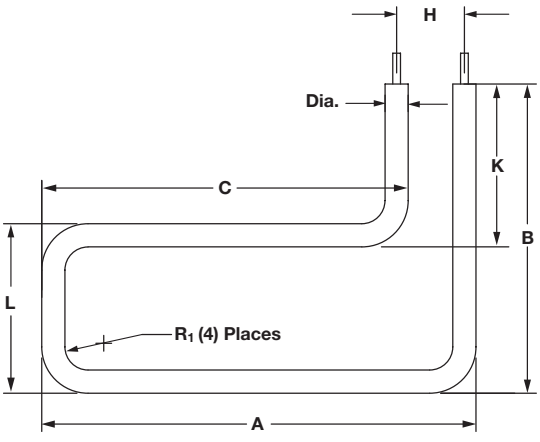
SL = (2A - H) + 2L + 2πR_1 - 4R_1
(For pricing, use 4 bends)

Figure 39



SL = (2A - H) + 2L + 2K + 3πR_1 - 6R_1
(For pricing, use 6 bends)

Figure 40

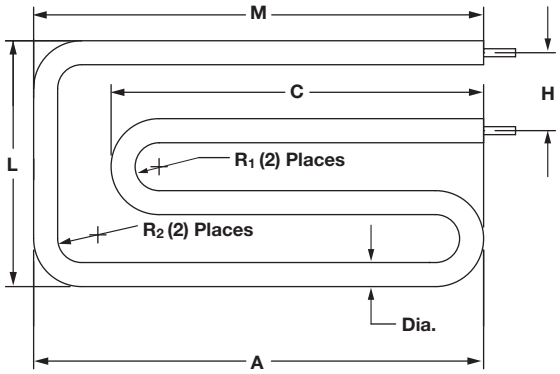


SL = (2A - H) + 2B + 2πR_1 - 4R_1
(For pricing, use 4 bends)

WATROD Single/Double-Ended Heaters

Bend Formations *(Continued)*

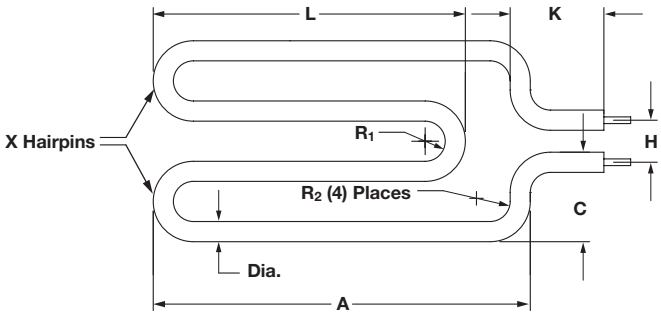
Figure 41



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

(For pricing, use 4 bends)

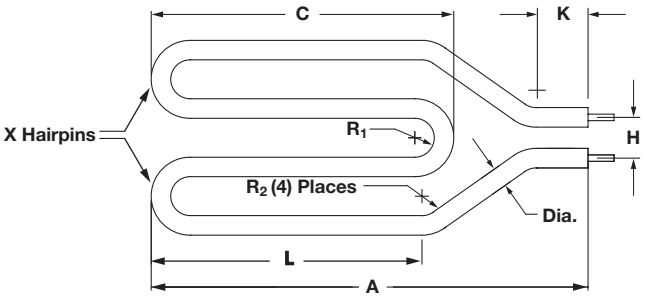
Figure 42



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

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

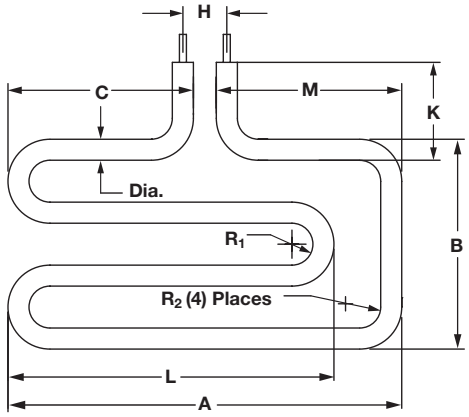
Figure 43



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

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

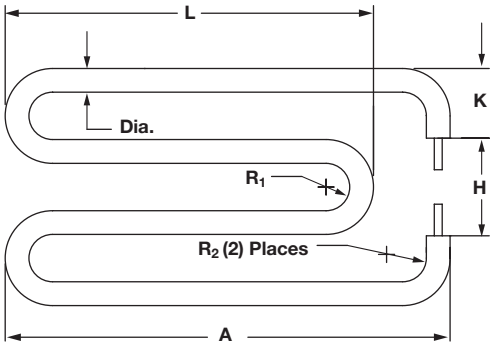
Figure 44



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

(For pricing, use 7 bends)

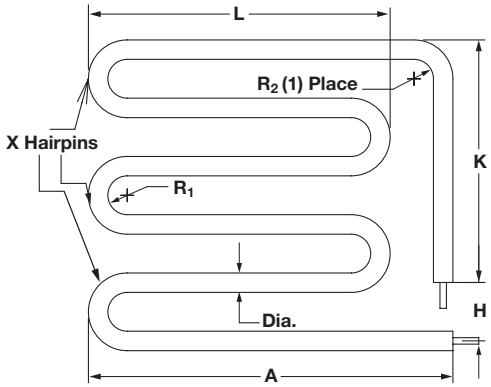
Figure 45



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

(For pricing, use 5 bends)

Figure 46



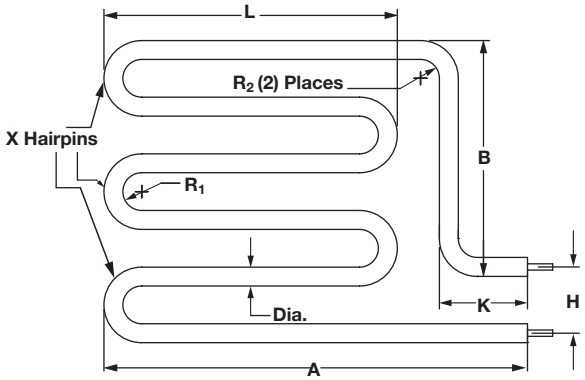
$SL = 2A + (\#)L + K + (\#\text{ of } R_1)\,\pi + \frac{\pi R_2}{2} - (\#\text{ of} R_1)\,R_1 - R_2$

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

WATROD Single/Double-Ended Heaters

Bend Formations *(Continued)*

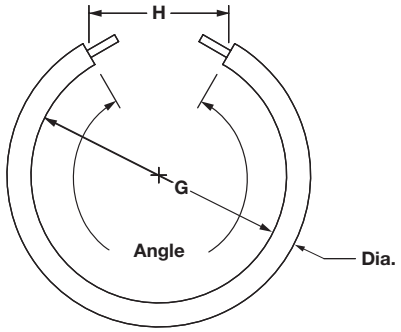
Figure 47



SL = 2A + (#)L + B + K + (# of R_1) π + πR_2 - (# of R_1) R_1- 2R_2

(For pricing, use 7 bends if X = 3)

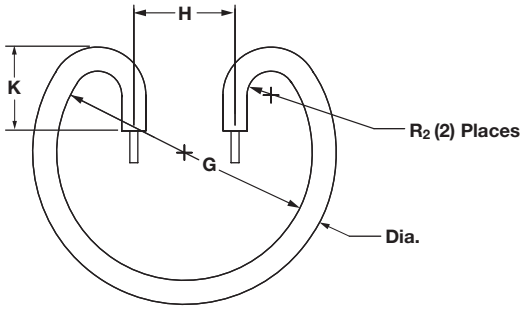
Figure 48



SL = πG - H

(For pricing, use 2 bends)

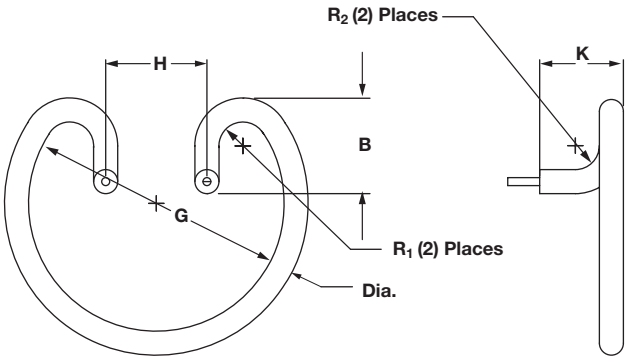
Figure 49



SL = πG - H + 2K + 2πR_2 - 2R_2

(For pricing, use 4 bends)

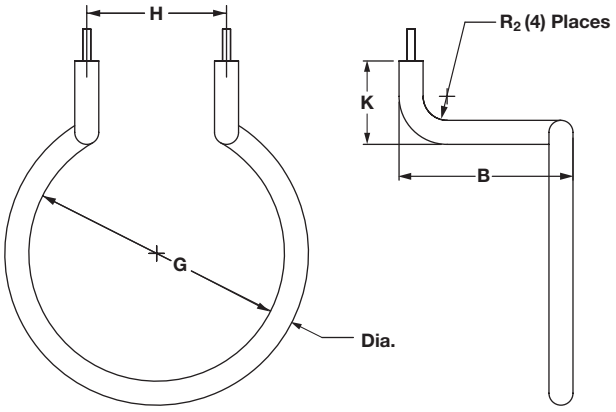
Figure 50



SL = πG - H + 2B + 2K + πR_2 + 2πR_1 - 2R_1- 2R_2

(For pricing, use 6 bends)

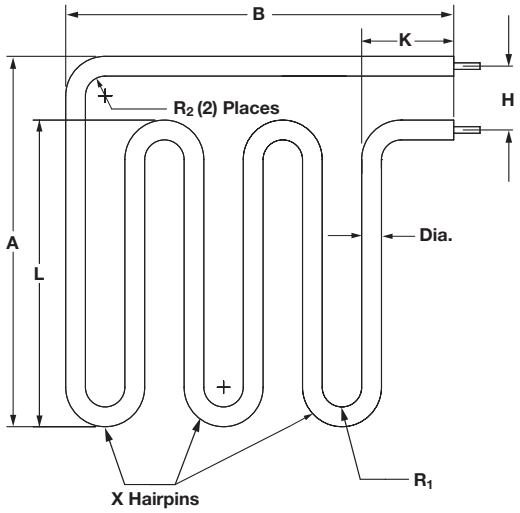
Figure 51



SL = πG - H + 2B + 2K + 2πR_2 - 4R_2

(For pricing, use 6 bends)

Figure 52



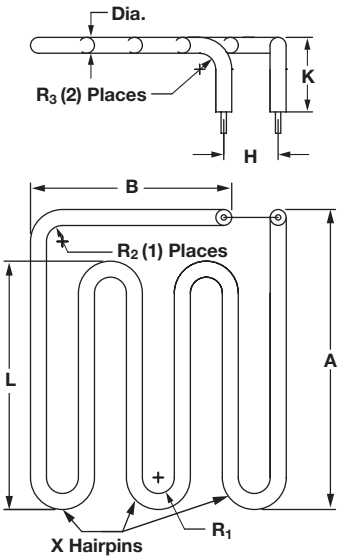
SL = 2A + B + (#)L - H + (# of R_1) π + πR_2 - (# of R_1) R_1- 2R_2

(For pricing, use 7 bends if X = 3)

WATROD Single/Double-Ended Heaters

Bend Formations *(Continued)*

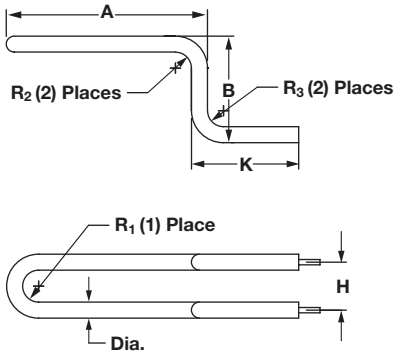
Figure 53



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

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

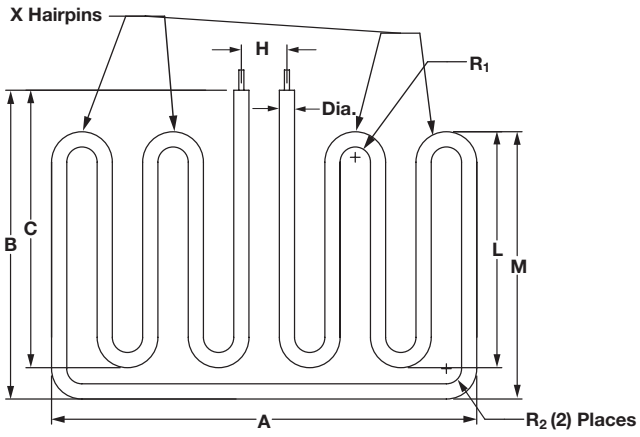
Figure 54



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

(For pricing, use 5 bends)

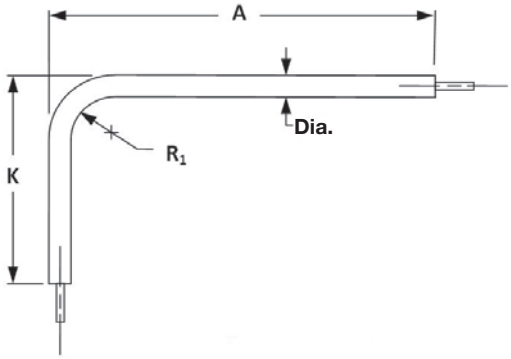
Figure 55



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

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

Figure 56



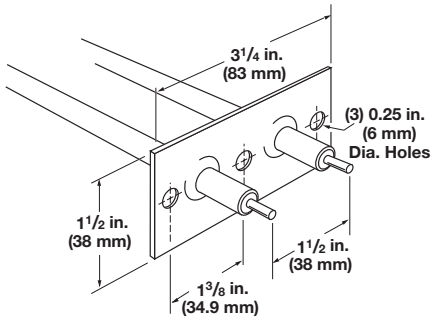
$SL = A + K - 0.86R_1$

(For pricing, use 1 bend)

WATROD Single/Double-Ended Heaters

Mounting Methods

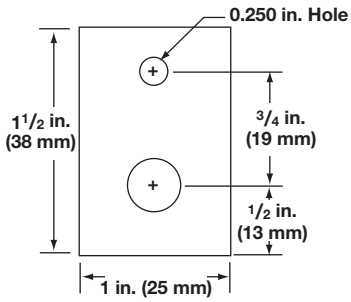
Brackets



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**.

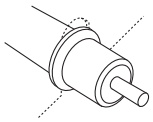
Single Leg Bracket



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**.

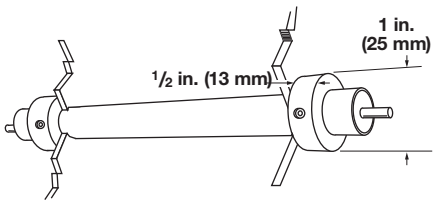
Locator Washers



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**.

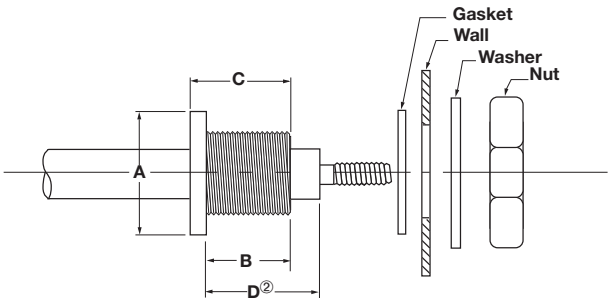
WATROD Single/Double-Ended Heaters

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 in.	(mm)	B Threaded Length in.	(mm)	C Overall Length 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.

EXTENDED CAPABILITY

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

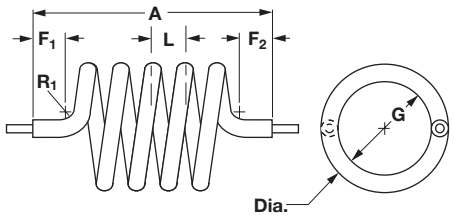
	Double-Ended				Single-Ended			
Element Diameters in. (mm) **and Surface Area per Linear** in² (cm²) Diameter Tolerance ± 0.005 in. (0.13 mm)	**Dia.** 0.490	**in²** 1.539	**Dia. (mm)** (12.45)	**cm²** (9.93)	**Dia.** 0.490	**in²** 1.539	**Dia. (mm)** (12.45)	**cm²** (9.930)
Sheath Materials Max. Operating Temperature	Extended:	Alloy 400 Titanium	Contact Watlow Contact Watlow			Extended: Steel	Alloy 600 750°F	1800°F (980°C) (400°C)
Sheath Length By Diameter in. (mm)	**Dia.** Extended: 0.490	**Sheath Length (in.)** 11 to 265	**Dia. (mm)** (12.45)	**Sheath Length (mm)** (280 to 6731)	**Dia.** Extended: 0.490	**Sheath Length (in.)** 11 to 125	**Dia. (mm)** (12.45)	**Sheath Length (mm)** (280 to 3175)
Max. Voltage/Amperage By Dia. in. (mm)	**Dia.** 0.490 (12.45)	**Volts** 600VAC	**Ampere** 40		**Dia.** 0.490 (12.45)	**Volts** 480VAC	**Ampere** 30	
Ohms Per Heated Inch By Dia.	**Dia.** 0.490	**Min.** 0.035Ω	**Max.** 21Ω		**Dia.** 0.490	**Min.** 0.150Ω	**Max.** 24Ω	

EXTENDED CAPABILITY

Extended Capabilities For WATROD Single/Double-Ended Heaters

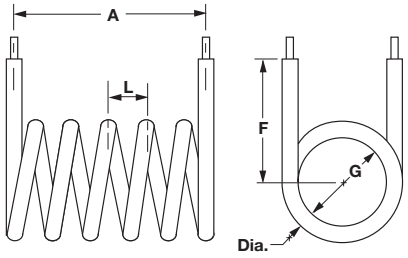
Bend Formations

Figure 33



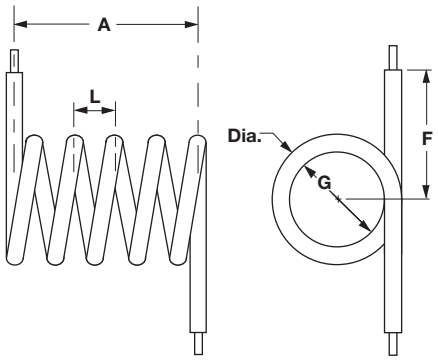
SL = [(G + Dia.) (3.14) (Number of 360°'s)]
+ F1 + F2
(For pricing, contact Watlow)

Figure 34



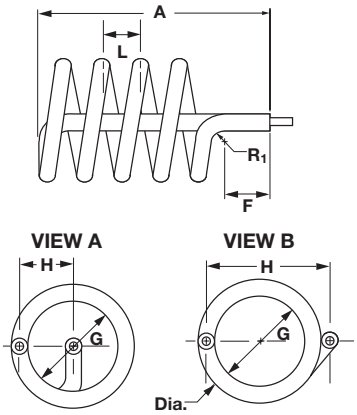
SL = [(G + Dia.) (3.14) (Number of 360°'s)] + 2F
(For pricing, contact Watlow)

Figure 35



SL = [(G + Dia.) (3.14) (Number of 360°'s)]
+ 2F
(For pricing, contact Watlow)

Figure 36



SL = [(G + Dia.) (3.14) (Number of 360°'s)]
+ (G ÷ 2) + A + F
(For pricing, contact Watlow)

EXTENDED CAPABILITY

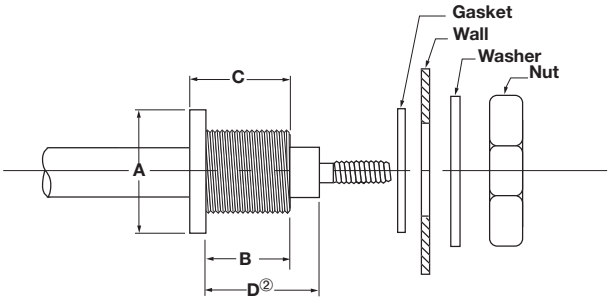
Extended Capabilities For WATROD Single/Double-Ended Heaters

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.

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



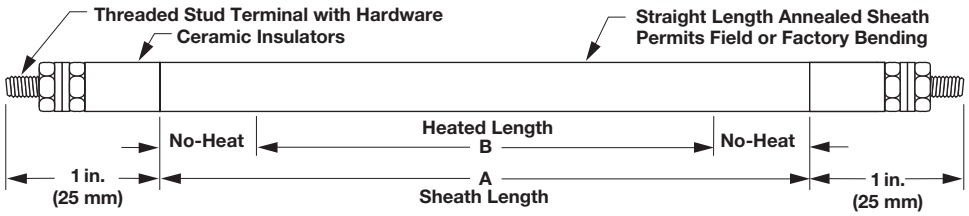
Threaded Bulkhead Specifications

Element Diameter in.	(mm)	Material	Thread Size	A ① Flange Size/Style in.	(mm)	B Threaded Length in.	(mm)	C Overall Length 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.

WATROD Single/Double-Ended Heaters

Double-Ended WATROD



WATROD Description	Sheath A Dimension in.	Sheath A Dimension (mm)	Heated B Dimension in.	Heated B Dimension (mm)	Watts	Part Number 120VAC	Part Number 240VAC	Part Number 480VAC	Est. Net Wt. lbs	Est. Net Wt. (kg)
Applications: Medium-Weight, Non-Circulating Oil, Heat-Transfer Oil										
15 W/in²	29 7/8	(758.8)	22 3/8	(568.4)	500		RGSS29R10S		1.0	(0.5)
0.475 in. Dia.	38 3/8	(974.7)	29 7/8	(758.8)	667		RGSS38G10S	RGSS38G11S	1.3	(0.6)
Steel	44 3/4	(1137.0)	37 1/4	(946.0)	833		RGSS44G10S	RGSS44G11S	1.7	(0.8)
(2.3 W/cm²)	53 3/8	(1355.7)	44 3/4	(1137.0)	1000		RGSS53G10S	RGSS53G11S	1.9	(0.9)
(12 mm)	68 3/8	(1736.7)	59 5/8	(1514.4)	1333		RGSS68G10S	RGSS68G11S	2.1	(1.0)
	83 3/8	(2117.7)	74 1/2	(1892.0)	1667		RGSS83G10S	RGSS83G11S	2.5	(1.1)
	98 3/8	(2498.7)	89 1/2	(2273.0)	2000		RGSS98G10S	RGSS98G11S	3.0	(1.4)
	120 3/8	(3057.5)	111 7/8	(2841.6)	2500		RGSS120G10S ①	RGSS120G11S ①	3.9	(1.8)
	142 7/8	(3629.1)	134 1/4	(3410.0)	3000		RGSS142R10S ①	RGSS142R11S ①	4.1	(1.9)
Application: Air Heating										
20 W/in²	48 3/4	(1238.0)	38 3/4	(984.0)	1000		RCN48N10S	RCN48N11S	1.0	(0.5)
0.430 in. Dia.	58 3/4	(1492.0)	48 3/4	(1238.0)	1250		RCN58N10S	RCN58N11S	1.1	(0.5)
Alloy 840	73 3/4	(1873.0)	63 3/4	(1619.0)	1667			RCN73N11S	1.4	(0.7)
(3.1 W/cm²)	91 3/4	(2330.0)	81 3/4	(2076.0)	2083			RCN91N11S	1.7	(0.8)
(10.9 mm)										
Applications: Caustic Solutions, Air Heating										
23 W/in²	29	(737.0)	22	(559.0)	500	RBN291S			0.4	(0.2)
0.315 in. Dia.	40	(1016.0)	33	(839.0)	750	RBN401S			0.5	(0.3)
Alloy 800	51	(1296.0)	44	(1118.0)	1000	RBN511S			0.7	(0.4)
(3.6 W/cm²)										
(8 mm)										
23 W/in²	39	(991.0)	27	(686.0)	1000	RGNA391S	RGNA3910S	RGNA3911S	1.2	(0.6)
0.475 in. Dia.	54	(1372.0)	42	(1067.0)	1500		RGNA5410S	RGNA5411S	1.6	(0.8)
Alloy 800	69	(1753.0)	57	(1448.0)	2000		RGNA6910S	RGNA6911S	2.1	(1.0)
(3.6 W/cm²)	84	(2134.0)	72	(1829.0)	2500		RGNA8410S	RGNA8411S	2.5	(1.2)
(12 mm)	99	(2515.0)	87	(2210.0)	3000		RGNA9910S	RGNA9911S	3.0	(1.4)
	106	(2692.0)	94	(2388.0)	2778			RGNA10611S ①	3.2	(1.5)
	132	(3353.0)	120	(3048.0)	4167		RGNA13210S ①	RGNA13211S ①	4.0	(1.8)
	157	(3988.0)	145	(3683.0)	5000		RGNA15710S ①	RGNA15711S ①	4.7	(2.2)
Applications: Light Oils, Greases, Heat-Transfer Oils										
23 W/in²	16	(406.0)	12	(305.0)	250	RBS161S	RBS1610S		0.2	(0.1)
0.315 in. Dia.	18	(457.0)	14	(356.0)	250	RBS181S			0.3	(0.2)
Steel	21	(533.0)	17	(432.0)	350	RBS211S	RBS2110S		0.3	(0.2)
(3.6 W/cm²)	23 3/8	(593.7)	19 3/8	(492.1)	375	RBS23G1S			0.3	(0.2)
(8 mm)	28 7/8	(733.4)	24 7/8	(631.8)	500	RBS28R1S			0.4	(0.2)
	29	(737.0)	24	(610.0)	500	RBS291S	RBS2910S		0.4	(0.2)
	42	(1067.0)	37	(940.0)	750	RBS421S	RBS4210S		0.6	(0.3)
	54	(1372.0)	49	(1245.0)	1000	RBS541S	RBS5410S		0.7	(0.4)
	77	(1956.0)	72	(1829.0)	1500	RBS771S	RBS7710S		1.0	(0.5)

CONTINUED

RAPID SHIP

Truck Shipment only

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

WATROD Single/Double-Ended Heaters

Double-Ended WATROD (Continued)

WATROD Description	Sheath A Dimension in.	(mm)	Heated B Dimension in.	(mm)	Watts	Part Number 120VAC	240VAC	480VAC	Est. Net Wt. lbs	(kg)
Applications: Light Oils, Greases, Heat-Transfer Oils										
23 W/in² 0.475 in. Dia. Steel (3.6 W/cm²) (12 mm)	23	(584)	14	(356)	500	**RGS231S**	**RGS2310S**		0.7	(0.4)
	31	(787)	22	(559)	750	**RGS311S**	**RGS3110S**		1.0	(0.5)
	39	(991)	27	(686)	1000	**RGS391S**	**RGS3910S**	**RGS3911S**	1.2	(0.6)
	45	(1143)	36	(914)	1250	**RGS451S**	**RGS4510S**		1.4	(0.7)
	54	(1372)	42	(1067)	1500	**RGS541S**	**RGS5410S**	**RGS5411S**	1.6	(0.8)
	69	(1753)	57	(1448)	2000	**RGS691S**	**RGS6910S**	**RGS6911S**	2.1	(1.0)
	84	(2134)	72	(1829)	2500	**RGS841S**	**RGS8410S**	**RGS8411S**	2.5	(1.2)
	99	(2515)	87	(2210)	3000		**RGS9910S**	**RGS9911S**	3.0	(1.4)
	106	(2692)	90	(2286)	2778			**RGS10611S** ①	3.2	(1.5)
	132	(3353)	120	(3048)	4167		**RGS13210S** ①	**RGS13211S** ①	4.0	(1.8)
	144	(3658)	128	(3251)	3889			**RGS14411S** ①	4.3	(2.0)
	157	(3988)	145	(3683)	5000		**RGS15710S** ①	**RGS15711S** ①	4.7	(2.2)
Application: Air Heating										
30 W/in² 0.260 in. Dia. Alloy 840 (4.7 W/cm²) (6.6 mm)	20	(508)	15	(381)	400		**RAN2010S**		0.2	(0.1)
	25	(635)	20	(508)	500		**RAN2510S**		0.3	(0.2)
	30	(762)	25	(635)	600		**RAN3010S**		0.3	(0.2)
	35	(889)	30	(762)	800		**RAN3510S**		0.4	(0.2)
	40	(1016)	35	(889)	900		**RAN4010S**		0.4	(0.2)
	45	(1143)	40	(1016)	1000		**RAN4510S**		0.5	(0.3)
	50	(1270)	45	(1143)	1200		**RAN5010S**		0.5	(0.3)
	55	(1397)	50	(1270)	1200		**RAN5510S**		0.6	(0.3)
	60	(1524)	55	(1397)	1400		**RAN6010S**		0.6	(0.3)
	65	(1651)	60	(1524)	1600		**RAN6510S**		0.7	(0.4)
	70	(1778)	65	(1651)	1800		**RAN7010S**		0.7	(0.4)
	75	(1905)	70	(1778)	1800		**RAN7510S**		0.8	(0.4)
	80	(2032)	75	(1905)	2000		**RAN8010S**		0.8	(0.4)
30 W/in² 0.315 in. Dia. Alloy 840 (4.7 W/cm²) (8 mm)	15	(381)	10	(254)	300		**RBN1510S**		0.2	(0.1)
	20	(508)	15	(381)	400		**RBN2010S**		0.3	(0.2)
	25	(635)	20	(508)	600		**RBN2510S**		0.4	(0.2)
	30	(762)	25	(635)	800		**RBN3010S**		0.4	(0.2)
	35	(889)	30	(762)	900		**RBN3510S**		0.5	(0.3)
	40	(1016)	35	(889)	1000		**RBN4010S**		0.5	(0.3)
	45	(1143)	40	(1016)	1200		**RBN4510S**		0.6	(0.3)
	50	(1270)	45	(1143)	1400		**RBN5010S**		0.7	(0.4)
	55	(1397)	50	(1270)	1600		**RBN5510S**		0.7	(0.4)
	60	(1524)	55	(1397)	1800		**RBN6010S**		0.8	(0.4)
	65	(1651)	60	(1524)	1800		**RBN6510S**		0.8	(0.4)
	70	(1778)	65	(1651)	2000		**RBN7010S**		0.9	(0.5)
	75	(1905)	70	(1778)	2200		**RBN7510S**		1.0	(0.5)
	80	(2032)	75	(1905)	2400		**RBN8010S**		1.0	(0.5)
	90	(2286)	85	(2159)	2600		**RBN9010S**		1.2	(0.6)
	100	(2540)	95	(2413)	3000		**RBN10010S**		1.3	(0.6)

CONTINUED

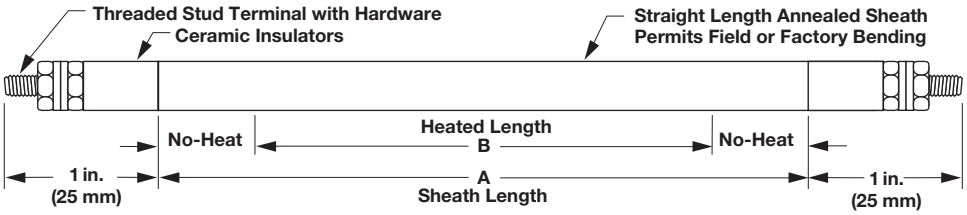
RAPID SHIP

Truck Shipment only

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

WATROD Single/Double-Ended Heaters

Double-Ended WATROD (Continued)



WATROD Description	Sheath A Dimension in.	Sheath A Dimension (mm)	Heated B Dimension in.	Heated B Dimension (mm)	Watts	Part Number 120VAC	Part Number 240VAC	Part Number 480VAC	Est. Net Wt. lbs	Est. Net Wt. (kg)
Application: Air Heating										
30 W/in² 0.430 in. Dia. Alloy 840 (4.7 W/cm²) (10.9 mm)	15	(381.0)	10	(254.0)	400		**RCN1510S**		0.3	(0.2)
	20	(508.0)	15	(381.0)	600		**RCN2010S**		0.4	(0.2)
	25	(635.0)	20	(508.0)	800		**RCN2510S**		0.5	(0.3)
	30	(762.0)	25	(635.0)	1000		**RCN3010S**		0.6	(0.3)
	35	(889.0)	30	(762.0)	1200		**RCN3510S**		0.7	(0.4)
	40	(1016.0)	35	(889.0)	1400		**RCN4010S**		0.8	(0.4)
	48 3/4	(1238.0)	38 3/4	(984.0)	1500		**RCNX48N10S**	**RCNX48N11S**	1.0	(0.5)
	45	(1143.0)	40	(1016.0)	1600		**RCN4510S**		0.9	(0.5)
	50	(1270.0)	45	(1143.0)	1800		**RCN5010S**		1.0	(0.5)
	58 3/4	(1492.0)	48 3/4	(1238.0)	1917		**RCNX58N10S**	**RCNX58N11S**	1.1	(0.5)
	55	(1397.0)	50	(1270.0)	2000		**RCN5510S**		1.0	(0.5)
	60	(1524.0)	55	(1397.0)	2200		**RCN6010S**		1.1	(0.5)
	65	(1651.0)	60	(1524.0)	2400		**RCN6510S**		1.2	(0.6)
	73 3/4	(1873.0)	63 3/4	(1619.0)	2500			**RCNX73N11S**	1.4	(0.7)
	70	(1778.0)	65	(1651.0)	2600		**RCN7010S**		1.3	(0.6)
	75	(1905.0)	70	(1778.0)	2800		**RCN7510S**		1.4	(0.7)
	80	(2032.0)	75	(1905.0)	3000		**RCN8010S**		1.5	(0.7)
	91 3/4	(2331.0)	81 3/4	(2077.0)	3167			**RCNX91N11S**	1.7	(0.8)
	90	(2286.0)	85	(2159.0)	3500		**RCN9010S**		1.7	(0.8)
	100	(2540.0)	95	(2413.0)	4000		**RCN10010S** ①		1.9	(0.9)
	110	(2794.0)	105	(2667.0)	4500		**RCN11010S** ①		2.1	(1.0)
	120	(3048.0)	115	(2921.0)	5000		**RCN12010S** ①		2.3	(1.1)
Application: Radiant Heating										
40 W/in² 0.375 in. Dia. Alloy 800 (6.2 W/cm²) (9.5 mm)	10 1/4	(260.0)	7 1/4	(184.0)	400	**RDN10E1S**			0.2	(0.1)
	16 5/8	(422.1)	13 5/8	(346.1)	650	**RDN16L1S**			0.3	(0.2)
	21 1/16	(535.0)	16 13/16	(427.0)	800	**RDN21B1S**	**RDN21B10S**		0.4	(0.2)
	27 1/8	(689.0)	22 7/8	(581.0)	1100	**RDN27C1S**	**RDN27C10S**		0.5	(0.3)
	32 1/8	(816.0)	27 7/8	(708.0)	1300		**RDN32C10S**	**RDN32C11S**	0.6	(0.3)
	42 7/8	(1089.0)	38 5/8	(981.1)	1800		**RDN42R10S**	**RDN42R11S**	0.8	(0.4)
	57 1/2	(1461.0)	53 1/4	(1353.0)	2500		**RDN57J10S**	**RDN57J11S**	1.1	(0.5)
	69 1/4	(1759.0)	65	(1651.0)	3000		**RDN69E10S**	**RDN69E11S**	1.3	(0.6)
	81 1/4	(2064.0)	77	(1956.0)	3600		**RDN81E10S**	**RDN81E11S**	1.6	(0.8)
	109 1/4	(2775.0)	105	(2667.0)	4000		**RDN109E10S**①		2.1	(1.0)
	134 1/2	(3416.0)	127 3/4	(3245.0)	5000		**RDN134J10S**①		2.6	(1.2)
	153 3/8	(3895.7)	145 7/8	(3705.2)	5500		**RDN153R10S**①		2.9	(1.4)
	179 1/4	(4553.0)	171 1/4	(4350.0)	6500		**RDN179E10S**①		3.4	(1.6)

CONTINUED

RAPID SHIP

Truck Shipment only

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

WATROD Single/Double-Ended Heaters

Double-Ended WATROD (Continued)

Special 208VAC and 277VAC Voltages

WATROD Description	Sheath A Dimension in.	Sheath A Dimension (mm)	Heated B Dimension in.	Heated B Dimension (mm)	Watts	Part Number 208VAC	Part Number 277VAC	Est. Net Wt. lbs	Est. Net Wt. (kg)
Application: Radiant Heating									
40 W/in²	21 1/16	(535)	16 13/16	(427)	800	**RDN21B2S** ①	**RDN21B4S** ①	0.4	(0.2)
0.375 in. Dia.	27 1/8	(689)	22 7/8	(581)	1100	**RDN27C2S** ①	**RDN27C4S** ①	0.5	(0.3)
Alloy 800	42 7/8	(1089)	38 5/8	(981)	1800	**RDN42R2S** ①	**RDN42R4S** ①	0.8	(0.4)
(6.2 W/cm²)	57 1/2	(1461)	53 1/4	(1353)	2500	**RDN57J2S** ①	**RDN57J4S** ①	1.1	(0.5)
(9.5 mm)	69 1/4	(1759)	65	(1651)	3000	**RDN69E2S** ①	**RDN69E4S** ①	1.3	(0.6)
	81 1/4	(2064)	77	(1956)	3600	**RDN81E2S** ①	**RDN81E4S** ①	1.6	(0.8)

WATROD Description	Sheath A Dimension in.	Sheath A Dimension (mm)	Heated B Dimension in.	Heated B Dimension (mm)	Watts	Part Number 120VAC	Part Number 240VAC	Part Number 480VAC	Est. Net Wt. lbs	Est. Net Wt. (kg)
Application: Process Water										
48 W/in²	23	(584)	14	(356)	1000	**RGN231S**	**RGN2310S**	**RGN2311S**	0.7	(0.4)
0.475 in. Dia.	30	(762)	21	(533)	1500	**RGN301S**	**RGN3010S**	**RGN3011S**	0.9	(0.5)
Alloy 800	39	(991)	27	(686)	2000	**RGN391S**	**RGN3910S**	**RGN3911S**	1.2	(0.6)
(7.4 W/cm²)	44	(1118)	35	(889)	2500	**RGN441S**	**RGN4410S**	**RGN4411S**	1.3	(0.6)
(12 mm)	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** ①	4.5	(2.1)
Application: Hot Runner Molds (Manifolds)										
60 W/in²	35	(889)	25	(635)	1500		**RBR3510S**		0.2	(0.1)
0.315 in. Dia.	44	(1118)	34	(864)	2000		**RBR4410S**		0.3	(0.2)
316 SS	52	(1321)	42	(1067)	2500		**RBR5210S**		0.3	(0.2)
(9.3 W/cm²)	60	(1524)	50	(1270)	3000		**RBR6010S**		0.4	(0.2)
(8 mm)	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/in²	20	(508)	11	(279)	1000	**RGR201S**	**RGR2010S**	**RGR2011S**	0.6	(0.3)
0.475 in. Dia.	26	(660)	17	(432)	1500	**RGR261S**	**RGR2610S**	**RGR2611S**	0.8	(0.4)
316 SS	34	(864)	22	(559)	2000		**RGR3410S**	**RGR3411S**	1.0	(0.5)
(9.3 W/cm²)	40	(1016)	28	(711)	2500		**RGR4010S**	**RGR4011S**	1.2	(0.6)
(12 mm)	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** ①	3.2	(1.5)

CONTINUED

RAPID SHIP

Truck Shipment only

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

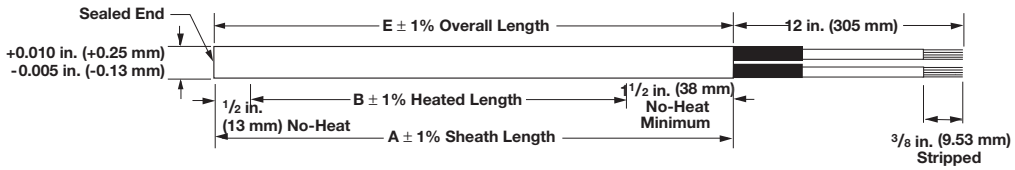
WATROD Single/Double-Ended Heaters

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.



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

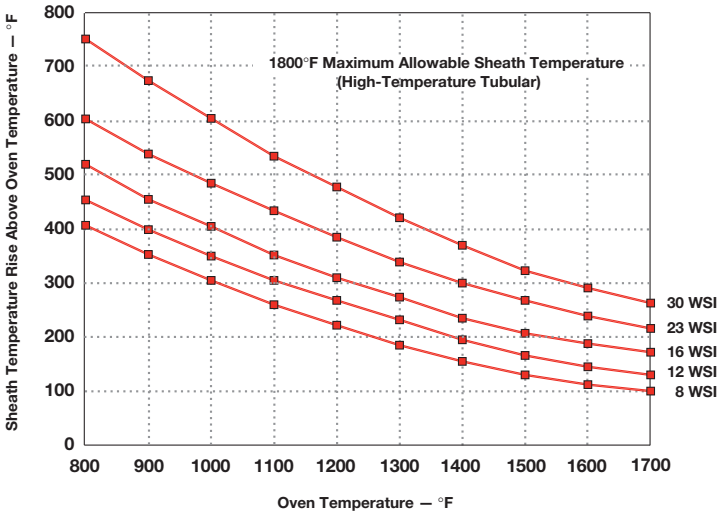
- High temperature ovens and furnaces
- Radiant heating
- Drying
- Environmental—VOC abatement
- Process air heating: duct heaters, circulation heaters
- Vacuum applications
- Flue gas cleaning (desulphurization)
- Fluidized beds

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.

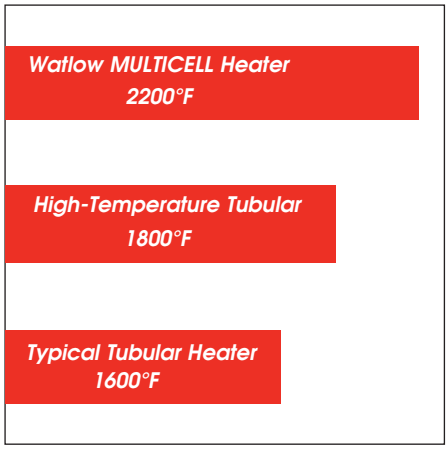


Heater Life Estimate Service

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.

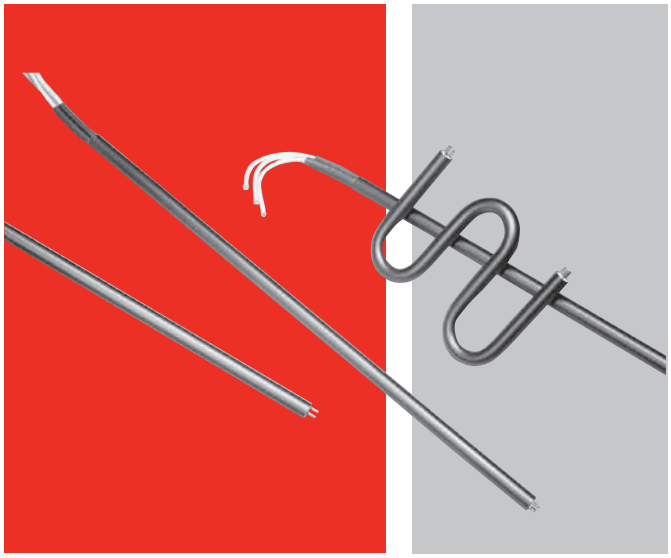
EXTENDED CAPABILITY

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^2 (9.3 W/cm^2)
- 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

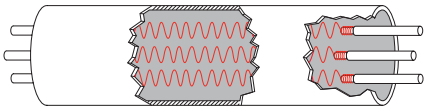
EXTENDED CAPABILITY

WATROD Single/Double-Ended Heaters

Extended Capabilities For MULTICOIL Tubular Heaters

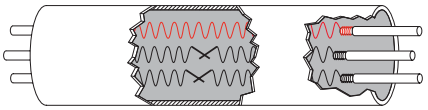
Options

Option A



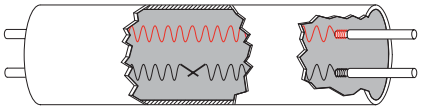
3-phase tubular, 0.475 and 0.490 inch diameter.

Option C



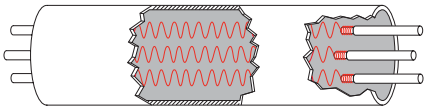
1-phase tubular with one resistance wire and two thermocouples, 0.475 and 0.490 inch diameter.

Option D



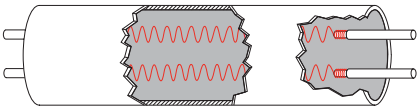
1-phase tubular with one resistance coil and one thermocouple, 0.375, 0.430, 0.475 and 0.490 inch diameter.

Option E



1-phase tubular with three different one phase circuits, 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.

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.

EXTENDED CAPABILITY

WATROD Single/Double-Ended Heaters

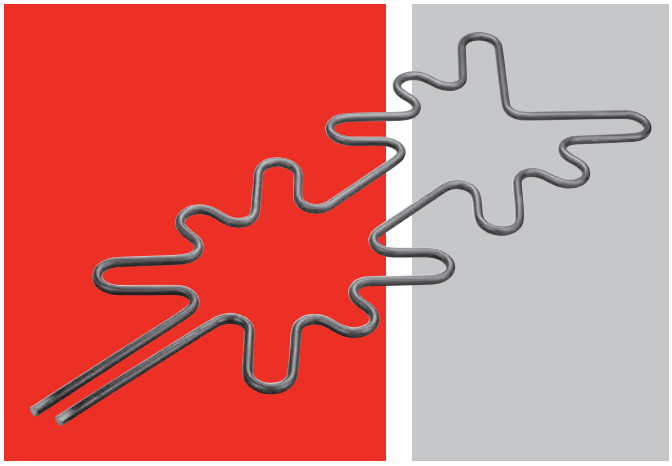
Extended Capabilities For Milled Groove Tubular Heaters

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 ±0.062 to ±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 ± 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

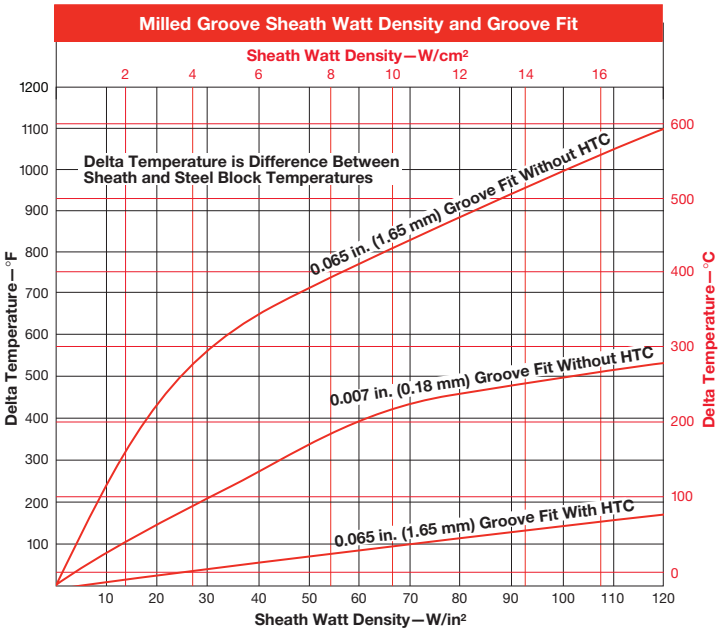
- Hot runner molds
- Precise heat uniformity

EXTENDED CAPABILITY

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/in² (6.2 to 10.9 W/cm²)
- 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