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.

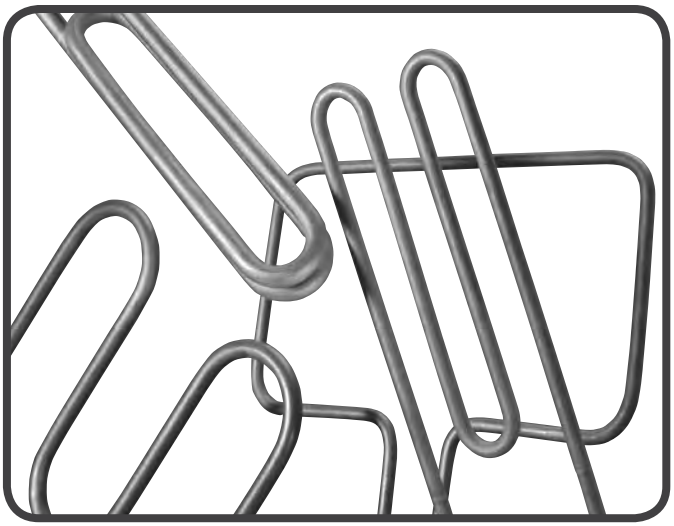
WATROD heating elements have a variety of mounting and termination options making them highly popular among industrial customers.

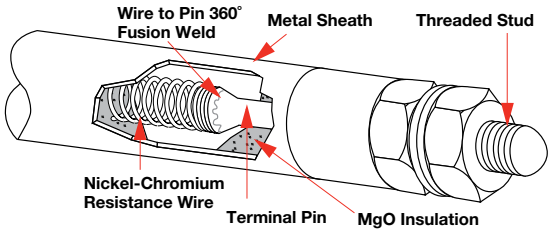
Single-Ended WATROD Performance Capabilities

- 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

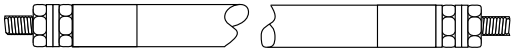
Single-Ended

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

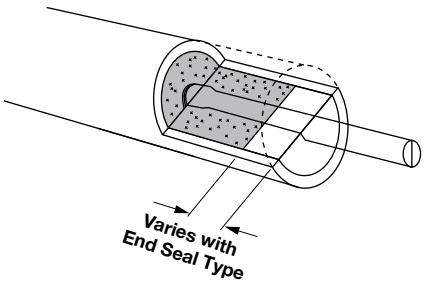
Ohms Per Heated Inch By Dia. in.	**Dia.**	**Min.**	**Max.**		**Dia.**	**Min.**	**Max.**	
	0.210	0.130Ω	14Ω		0.375	0.150Ω	25Ω	
	0.260	0.080Ω	16Ω		0.430	0.150Ω	24Ω	
	0.315	0.050Ω	25Ω		0.475	0.150Ω	22Ω	
	0.375	0.030Ω	20Ω					
	0.430	0.030Ω	25Ω					
	0.475	0.035Ω	25Ω					
Terminations	Standard:	Threaded stud Screw lug (plate) Quick connect (spade) Flexible lead wires			Standard:	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				Threaded bulkhead Locator washers Single leg bracket			
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**.

End-Seal Options

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

WATROD Single/Double-Ended Heaters

Terminations

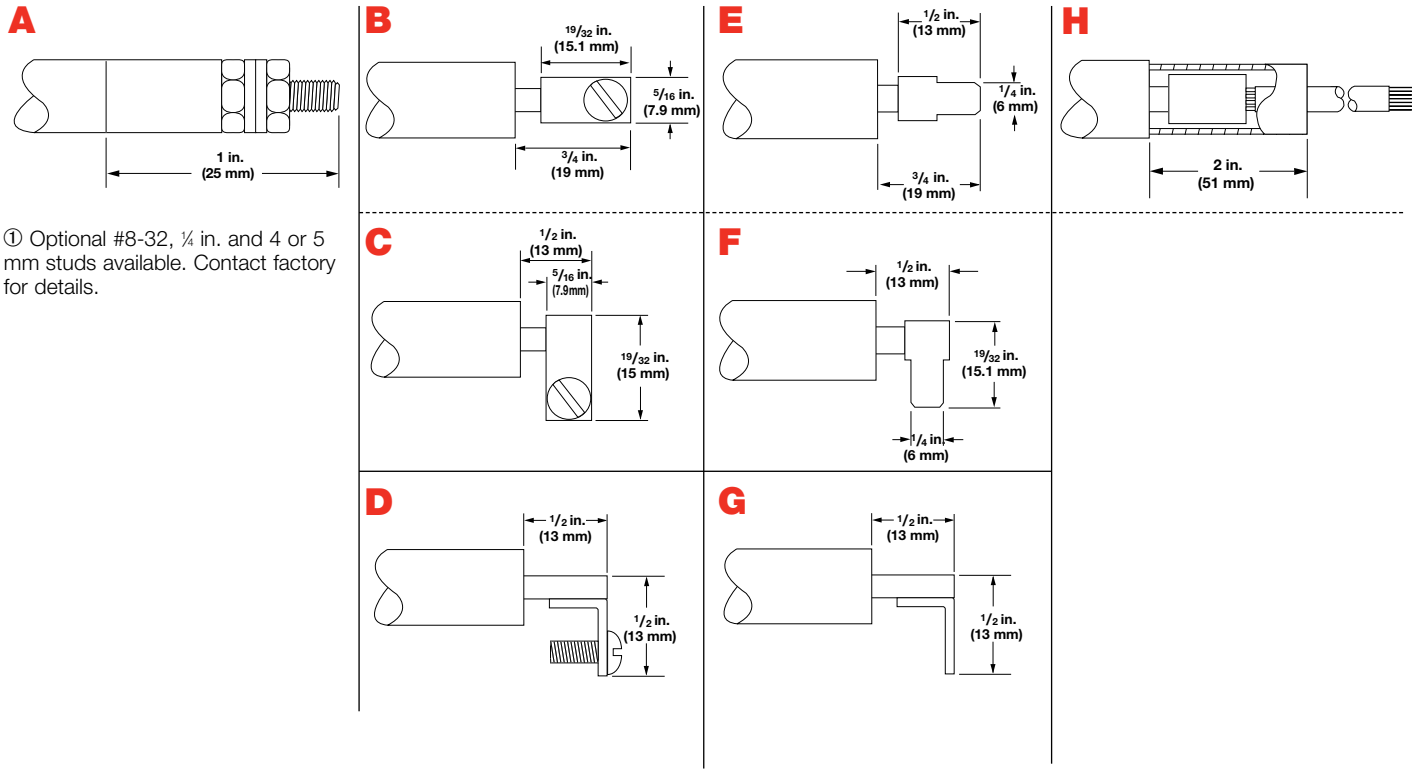
Double-ended WATROD elements are available with a variety of terminations. Single-ended WATROD elements are available with only flexible lead wires.

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.

WATROD Element	Sheath Diameter in.	Sheath Diameter (mm)	Threaded Stud ① A	Screw Lug (Plate) B	Screw Lug (Plate) C	Screw Lug (Plate) D	Quick Connect (Spade) E	Quick Connect (Spade) F	Quick Connect (Spade) G	Flexible Lead Wires 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
	0.375	(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
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

Threaded Stud **Screw Lug (Plate)** **Quick Connect (Spade)** **Flexible Lead Wires**



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

WATROD Single/Double-Ended Heaters

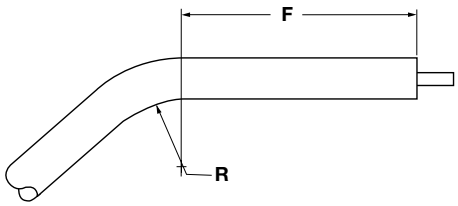
Bend Formations

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 62 to 71 are the 56 common bend configurations available on both standard and made-to-order WATROD heating elements.



WATROD Length Tolerance (T)			
Sheath Length in.	(mm)	Length Tolerance 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.

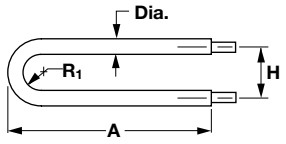
The four common bend configurations available for standard and made-to-order single-ended WATROD elements are Figures 1, 6, 22 and 28.

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

WATROD Minimum Radius							
Sheath Diameter in.	(mm)	Field Bend R① in.	(mm)	Factory R① in.	(mm)	F② Dimension 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)

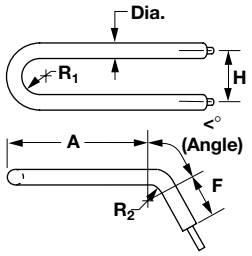
① R is the inside radius of a bend.
② F is the distance from the sheath's end to the start of the first bend.

Figure 1



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

Figure 2

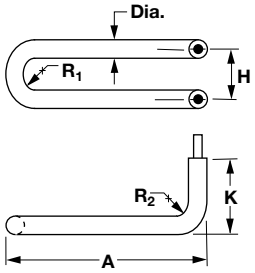


$SL = 2A + 2F + 1.14R_1 + 0.0175\ (<°)\ (2R_2 + Dia.) - 0.43\ Dia.$

WATROD Single/Double-Ended Heaters

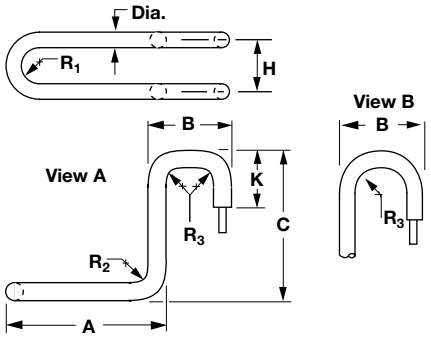
Bend Formations *(Continued)*

Figure 3



$SL = 2K - 0.86R_2 - 2.86\ Dia. + 2A + 1.14R_1$

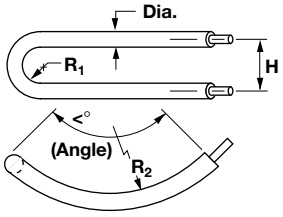
Figure 4



View A: $SL = 2K - 1.72R_3 - 7.72\ Dia. + 2C - 0.86R_2 + 2A + 1.14R_1$

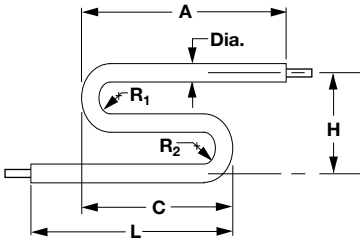
View B: $SL = 2K - 2.28R_3 - 3.72\ Dia. + 2C - 0.86R_2 + 2A + 1.14R_1$

Figure 5



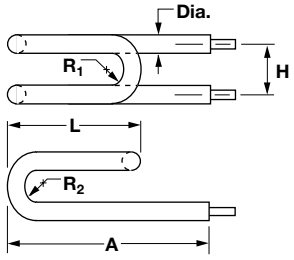
$SL = 0.0175(<^{\circ})(2R_2 + Dia.) + 1.14R_1 + 0.43\ Dia.$

Figure 6



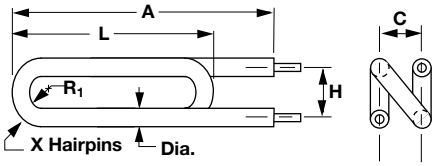
$SL = L + 1.14R_2 - 0.86\ Dia. + C + 1.14R_1 + A$

Figure 7



$SL = 2A + 2.28R_2 - 1.29\ Dia. + 2L + 1.14R_1$

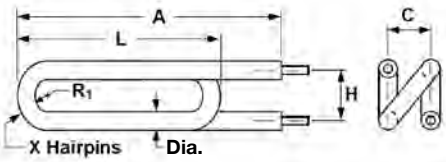
Figure 8



X = number of outside hairpins

$SL = 2A + 3.42R_1 - 1.29\ Dia. + 2L$

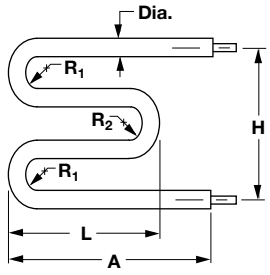
Figure 8 Reverse



WATROD Single/Double-Ended Heaters

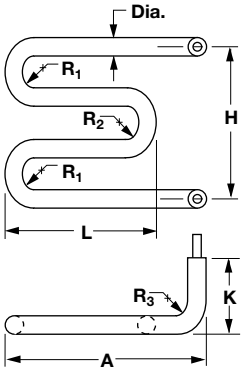
Bend Formations *(Continued)*

Figure 9



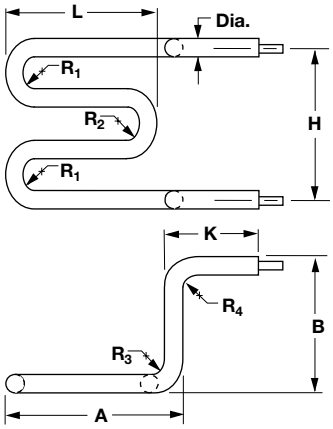
$SL = 2A + 2.28R_1 - 1.29\ Dia. + 2L + 1.14R_2$

Figure 10



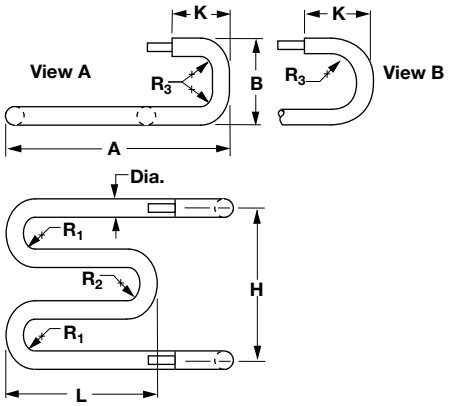
$SL = 2K - 0.86R_3 - 3.72\ Dia. + 2A + 2L + 2.28R_1 + 1.14R_2$

Figure 11



$SL = 2K - 086R_3 - 0.86R_4 - 6.15\ Dia. + 2B + 2A + 2L + 2.28R_1 + 1.14R_2$

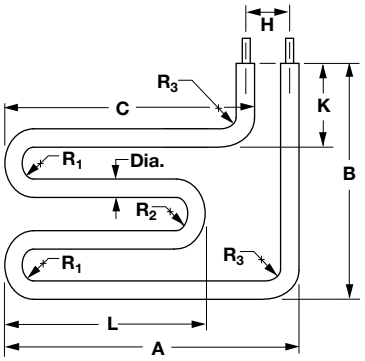
Figure 12



View A: $SL = 2K + 2B + 2A + 2L + 2.28R_1 + 1.14R_2 - 1.72R_3 - 6.15\ Dia.$

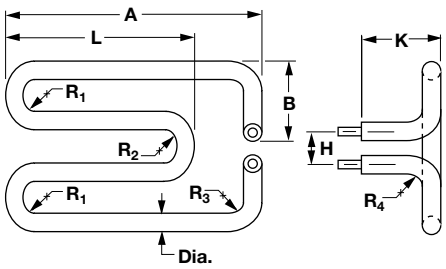
View B: $SL = 2K + 2A + 2L + 2.28R_1 + 1.14R_2 - 2.28R_3 - 2.15\ Dia.$

Figure 13



$SL = 2B + 2A + 2L - 6.717\ Dia. - 1.717R_1 - H - 0.858R_2 - 0.858R_3$

Figure 14

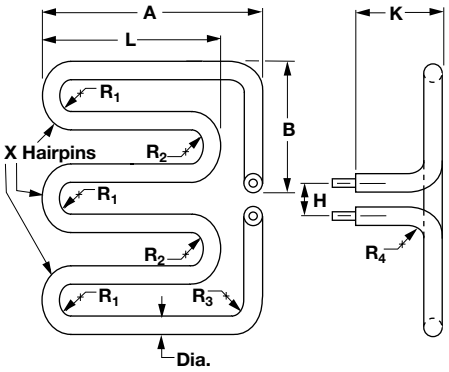


$SL+2K+2A+2L+2.28R_1+1.14R_2+2B -6.15\ Dia. -0.86R_3+0.86R_4$

WATROD Single/Double-Ended Heaters

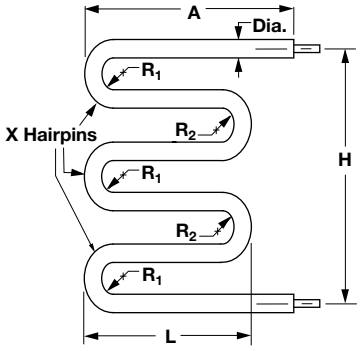
Bend Formations *(Continued)*

Figure 15



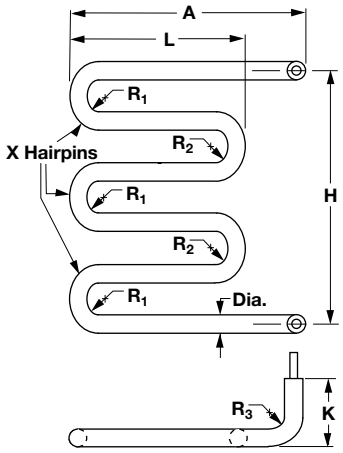
X = number of outside hairpins
SL = 2K + 2A + 2K(X - 1) + 2B - 0.86R_3 - 0.86R_4 + 1.14R_1 (X) + 1.14R_2 (X - 1) - 4.86 Dia. - (2X - 1) 0.43 Dia.

Figure 16



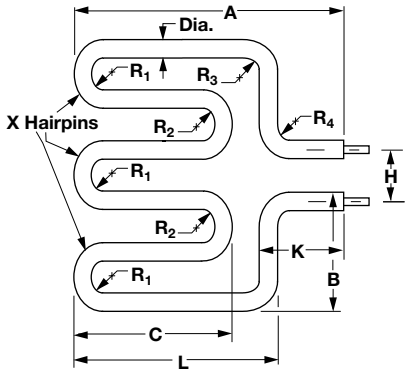
X = number of outside hairpins
SL = 2A + 0.43 Dia. (1 - 2X) + 2L (X - 1) + 1.14R_1 + 1.14R_2 (X - 1)

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

Figure 18

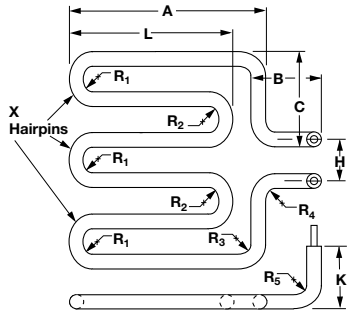


X = number of outside hairpins
SL = 2L + 2K + 2B + 2C (X - 1) - 0.86R_3 - 0.86R_4 - 4.86 Dia. + 1.14R_1 (X) + 1.14R_2 (X - 1) - (2X - 1) 0.43 Dia.

WATROD Single/Double-Ended Heaters

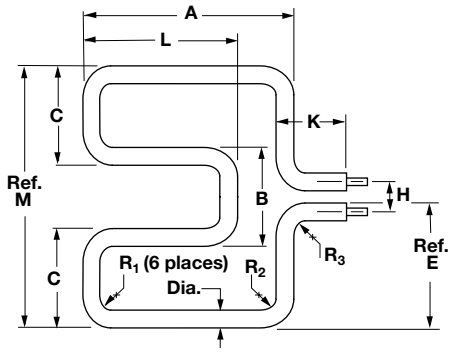
Bend Formations *(Continued)*

Figure 19



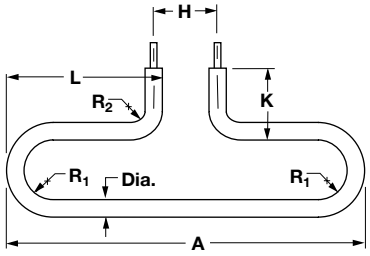
X = number of outside hairpins
SL = 2K + 2A + 2B + 2C + 2L (X - 1) + 1.14R_1 (X) + 1.14R_2 (X - 1) - 0.86R_3 - 0.86R_4 - 0.86R_5 - 7.29 Dia. - (2X - 1) 0.43 Dia.

Figure 20



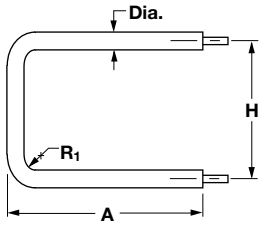
SL = 2K + 2C + B + 2A + 2L - 2.58R_1 - 0.86R_2 - 0.86R_3 - 12.15 Dia.

Figure 21



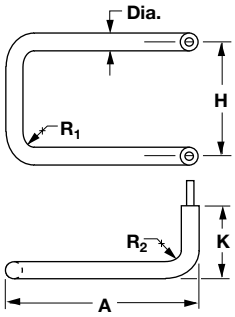
SL = 2A + 2K - H - 2.28R_1 - 0.86R_2 - 3.29 Dia.

Figure 22



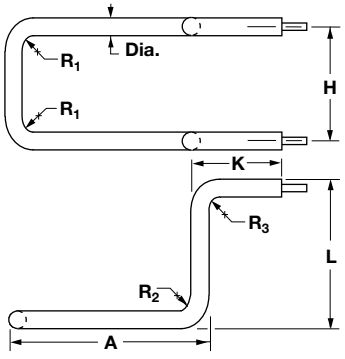
SL = 2A - 0.86R_1 - 1.43 Dia. + H

Figure 23



SL = 2K - 0.86R_2 - 3.86 Dia. + 2A - 0.86R_1 + H

Figure 24

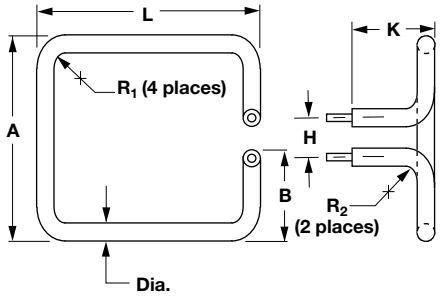


SL = 2K + 2L + H - 0.86R_1 - 0.86R_2 - 0.86R_3 - 7.29 Dia.

WATROD Single/Double-Ended Heaters

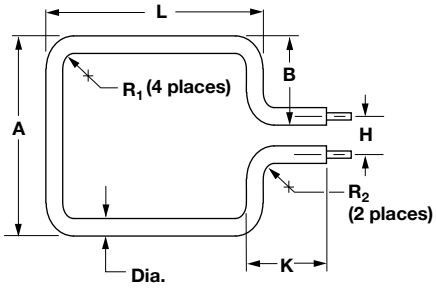
Bend Formations *(Continued)*

Figure 25



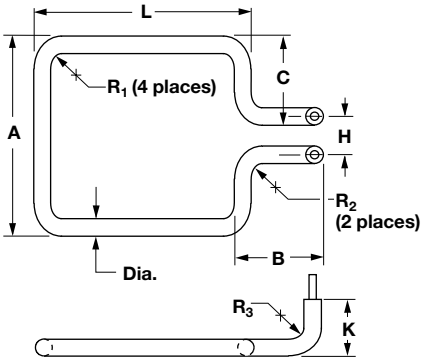
SL = 2K + 2A + 2L - H - 1.72R_1 - 0.86R_2 - 6.92 Dia.

Figure 26



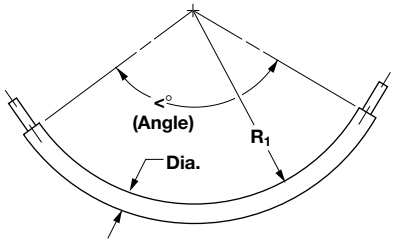
SL = 2K + 2A + 2L - H - 1.72R_1 - 0.86R_2 - 6.29 Dia.

Figure 27



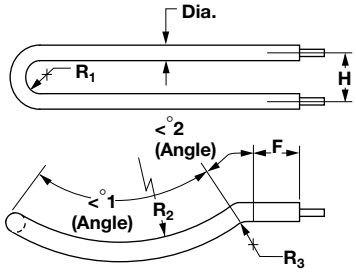
SL = 2K + 2A + 2L + 2B - H - 1.72R_1 - 1.72R_2 - 8.72 Dia.

Figure 28



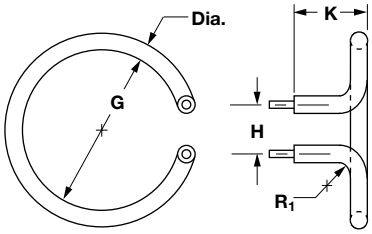
SL = 0.0175 <° (R_1 + 0.5 Dia.)

Figure 29



SL = 0.0175 <°1 (2R_2 + Dia.) + 2F + 1.14R_1 + 0.0175 <°2 (2R_3 + Dia.) - 0.43 Dia.

Figure 30

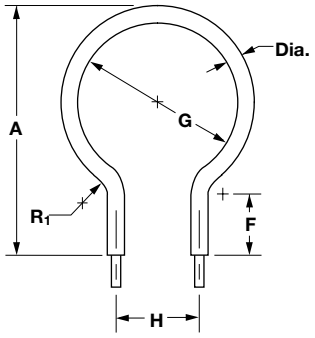


SL = (G + Dia.) 3.14 + 1.14R_1 + 2K + 3.28 Dia. - H

WATROD Single/Double-Ended Heaters

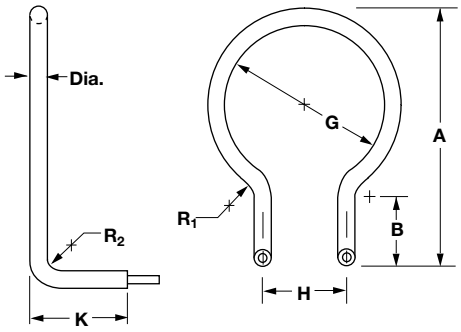
Bend Formations *(Continued)*

Figure 31



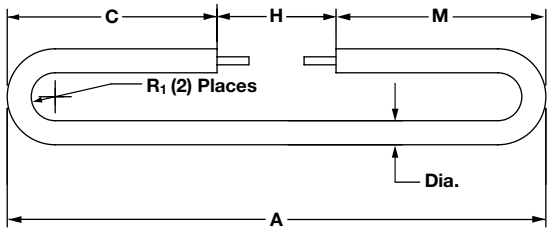
SL = (G + Dia.) 3.14 + 1.14R_1 + 2F
+ 3.71 Dia. - H

Figure 32



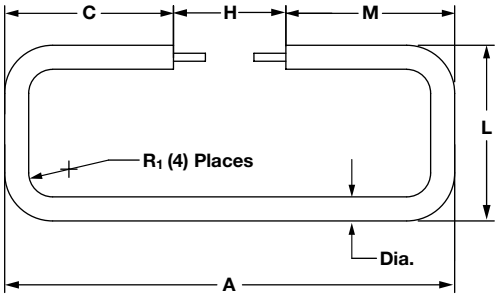
SL = (G + Dia.) 3.14 + 1.14R_1 + 2B + 1.14R_2 +
2K + 3.28 Dia. - H

Figure 37



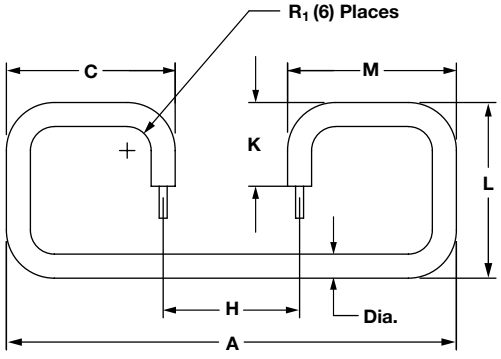
SL = (2A - H) + 2πR_1 - 2R_1

Figure 38



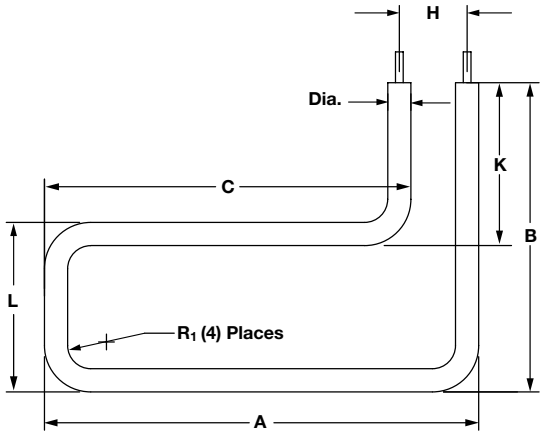
SL = (2A - H) + 2L + 2πR_1 - 4R_1

Figure 39



SL = (2A - H) + 2L + 2K + 3πR_1 - 6R_1

Figure 40

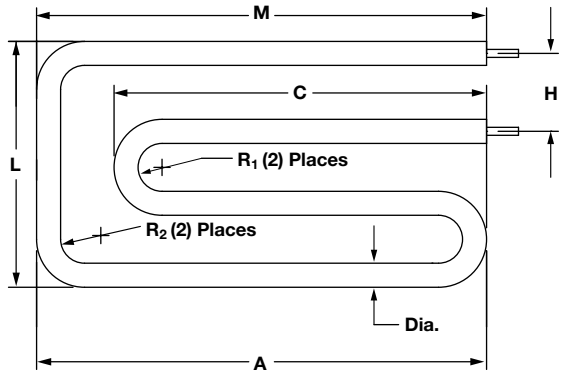


SL = (2A - H) + 2B + 2πR_1 - 4R_1

WATROD Single/Double-Ended Heaters

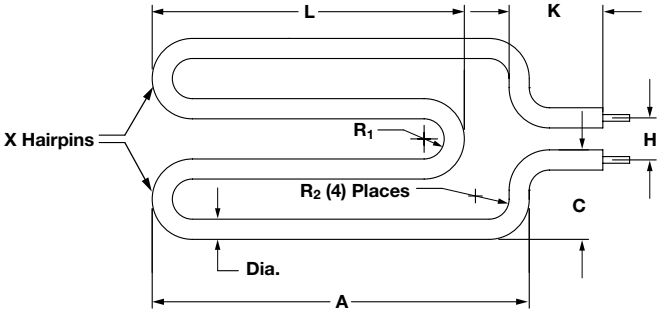
Bend Formations *(Continued)*

Figure 41



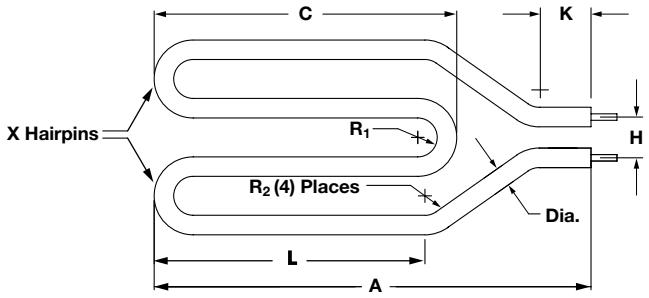
$SL = 2A + 2C + L - H + 2\pi R_1 + \pi R_2 - 2R_1 - 2R_2$

Figure 42



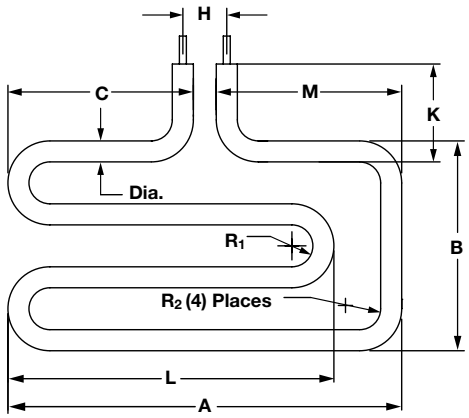
$SL = 2A + (\#)L + 2K + 2C + 2\pi R_2 + (\#\text{ of } R_1)\ \pi R_1 - (\#\text{ of } R_1)\ R_1$

Figure 43



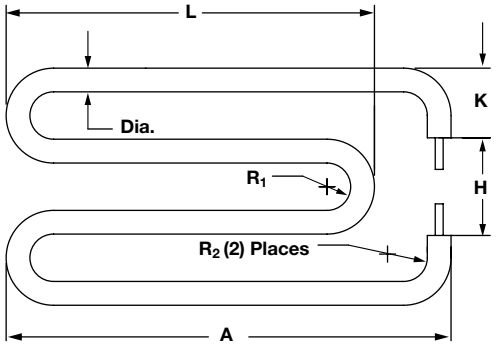
$SL = 2A + (\#)C + (\#\text{ of } R_1)\ \pi + 2\pi R_2 - (\#\text{ of } R_1)\ R_1 - 4R_2$

Figure 44



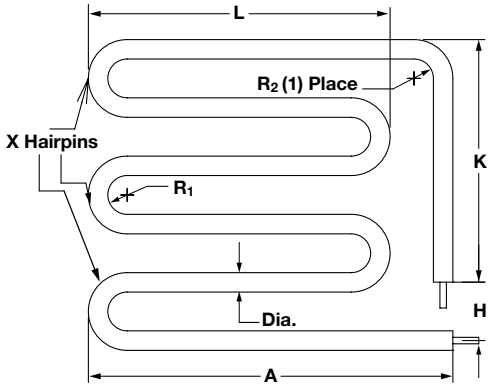
$SL = 2A + 2L + B + 2K + 2\pi R_2 + 3\pi R_1 - 4R_2 - 3R_1$

Figure 45



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

Figure 46

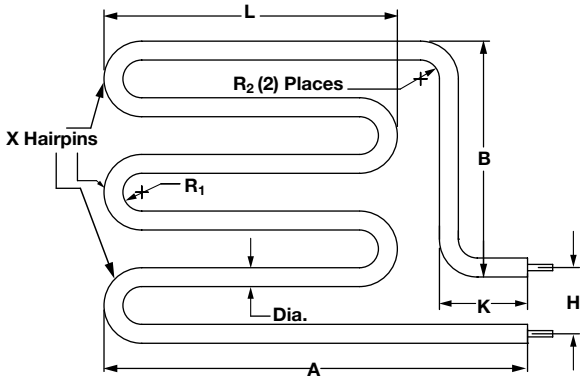


$SL = 2A + (\#)L + K + (\#\text{ of } R_1)\ \pi + \frac{\pi R_2}{2} - (\#\text{ of} R_1)\ R_1 - R_2$

WATROD Single/Double-Ended Heaters

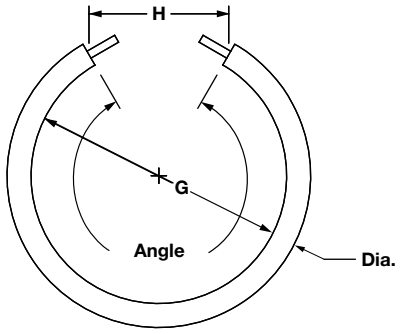
Bend Formations *(Continued)*

Figure 47



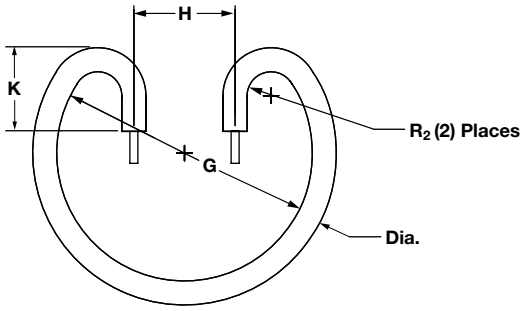
SL = 2A + (#)L + B + K + (# of R_1) π + πR_2 - (# of R_1) R_1- 2R_2

Figure 48



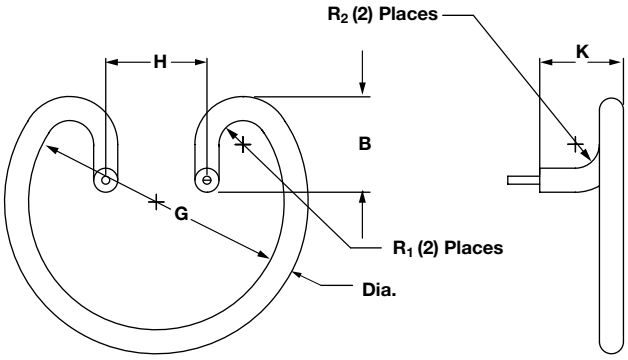
SL = πG - H

Figure 49



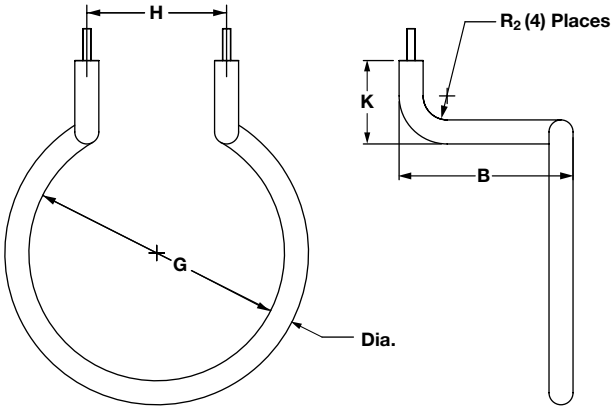
SL = πG - H + 2K + 2πR_2 - 2R_2

Figure 50



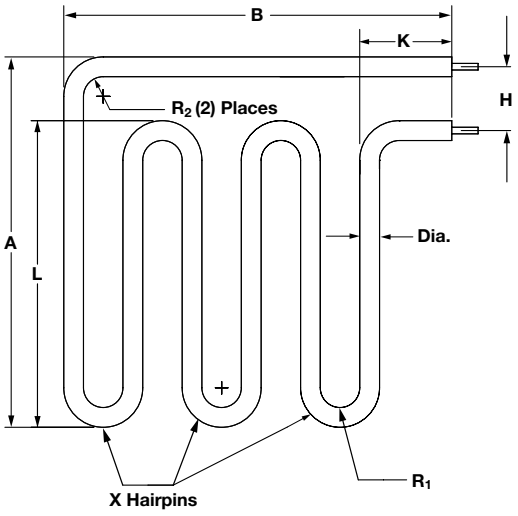
SL = πG - H + 2B + 2K + πR_2 + 2πR_1 - 2R_1- 2R_2

Figure 51



SL = πG - H + 2B + 2K + 2πR_2 - 4R_2

Figure 52

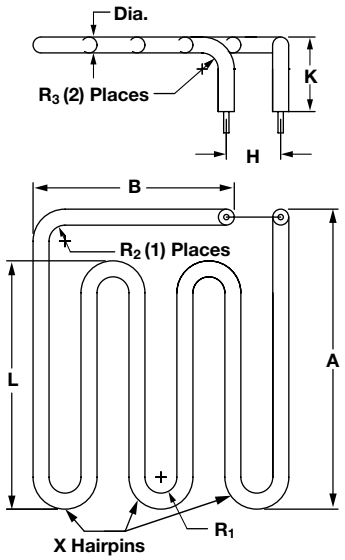


SL = 2A + B + (#)L - H + (# of R_1) π + πR_2 - (# of R_1) R_1- 2R_2

WATROD Single/Double-Ended Heaters

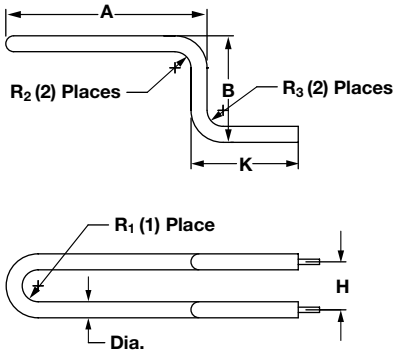
Bend Formations *(Continued)*

Figure 53



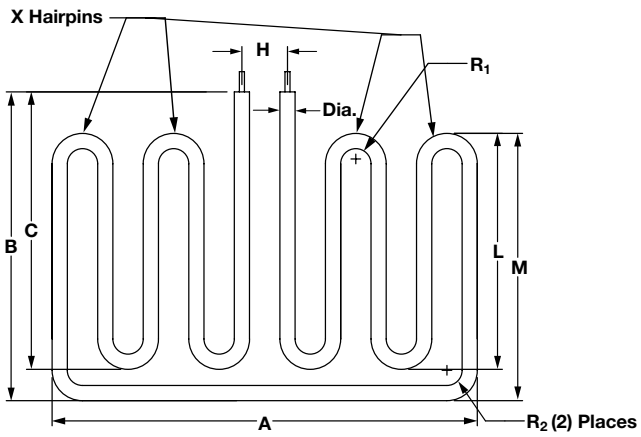
$$SL = 2A + (\#)L + B + 2K + (\text{\# of } R_1)\,\pi + 2\,\frac{(\pi R_3)}{2} - (\text{\# of } R_1)\,R_1 - 2R_3 - R_2$$

Figure 54



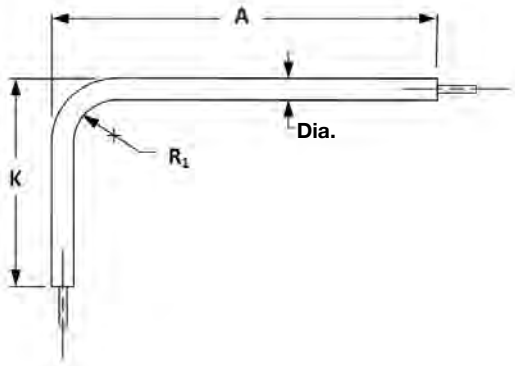
$$SL = 2A + 2B + 2K + \pi R_1 + 2\pi R_2 - R_1 - 4R_2$$

Figure 55



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

Figure 56

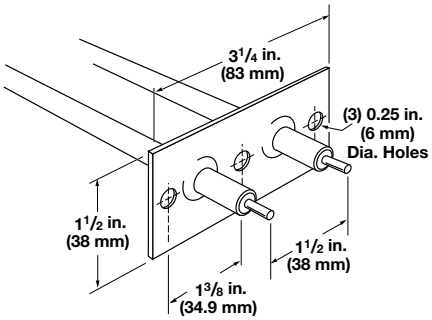


$$SL = A + K - 0.86R_1$$

WATROD Single/Double-Ended Heaters

Mounting Methods

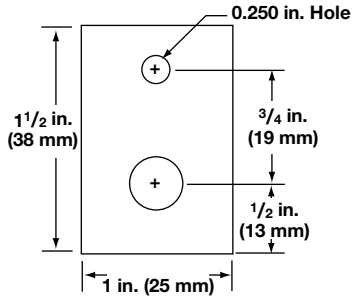
Brackets



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**.

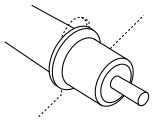
Single Leg Bracket



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.

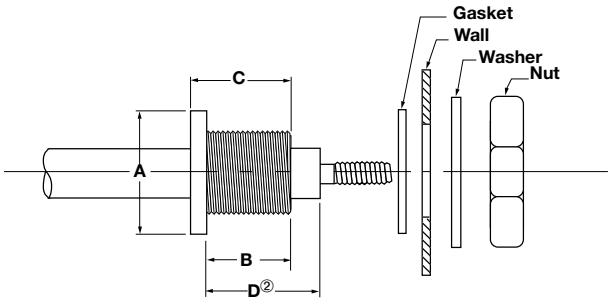
WATROD Single/Double-Ended Heaters

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.



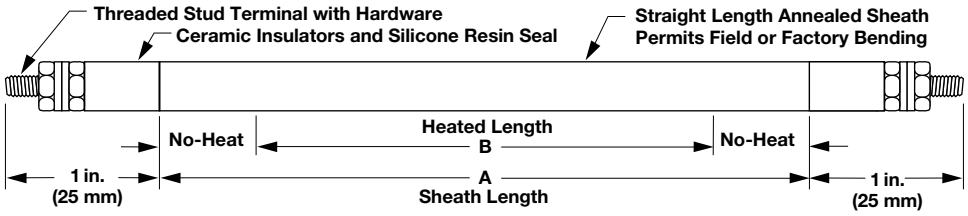
Threaded Bulkhead Specifications

Element Diameter in.	Element Diameter (mm)	Material	Thread Size	A ① Flange Size/Style in.	A ① Flange Size/Style (mm)	B Threaded Length in.	B Threaded Length (mm)	C Overall Length in.	C Overall Length (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)	Steel ③	1/2 - 20 UNF	3/4 Hex	(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.
③ Extended capability only.

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**	**RGSS120G11S**	3.9	(1.8)
	142 7/8	(3629.1)	134 1/4	(3410.0)	3000		**RGSS142R10S**	**RGSS142R11S**	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**	3.2	(1.5)
	132	(3353.0)	120	(3048.0)	4167		**RGNA13210S**	**RGNA13211S**	4.0	(1.8)
	157	(3988.0)	145	(3683.0)	5000		**RGNA15710S**	**RGNA15711S**	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

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)
Applications: Light Oils, Greases, Heat-Transfer Oils										
23 W/in²	23	(584)	14	(356)	500	**RGS231S**	**RGS2310S**		0.7	(0.4)
0.475 in. Dia.	31	(787)	22	(559)	750	**RGS311S**	**RGS3110S**		1.0	(0.5)
Steel	39	(991)	27	(686)	1000	**RGS391S**	**RGS3910S**	**RGS3911S**	1.2	(0.6)
(3.6 W/cm²)	45	(1143)	36	(914)	1250	**RGS451S**	**RGS4510S**		1.4	(0.7)
(12 mm)	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**	3.2	(1.5)
	132	(3353)	120	(3048)	4167		**RGS13210S**	**RGS13211S**	4.0	(1.8)
	144	(3658)	128	(3251)	3889			**RGS14411S**	4.3	(2.0)
	157	(3988)	145	(3683)	5000		**RGS15710S**	**RGS15711S**	4.7	(2.2)
Application: Air Heating										
30 W/in²	20	(508)	15	(381)	400		**RAN2010S**		0.2	(0.1)
0.260 in. Dia.	25	(635)	20	(508)	500		**RAN2510S**		0.3	(0.2)
Alloy 840	30	(762)	25	(635)	600		**RAN3010S**		0.3	(0.2)
(4.7 W/cm²)	35	(889)	30	(762)	800		**RAN3510S**		0.4	(0.2)
(6.6 mm)	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	15	(381)	10	(254)	300		**RBN1510S**		0.2	(0.1)
0.315 in. Dia.	20	(508)	15	(381)	400		**RBN2010S**		0.3	(0.2)
Alloy 840	25	(635)	20	(508)	600		**RBN2510S**		0.4	(0.2)
(4.7 W/cm²)	30	(762)	25	(635)	800		**RBN3010S**		0.4	(0.2)
(8 mm)	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)

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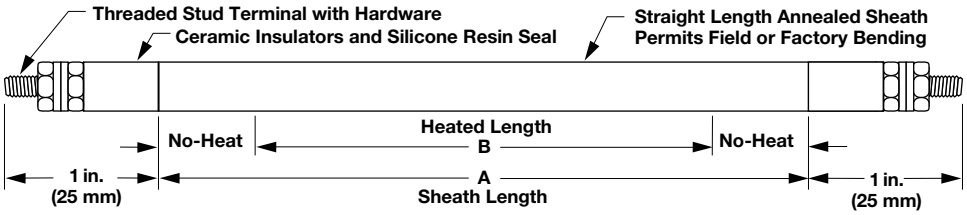
WATROD Single/Double-Ended Heaters

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**		1.9	(0.9)
	110	(2794.0)	105	(2667.0)	4500		**RCN11010S**		2.1	(1.0)
	120	(3048.0)	115	(2921.0)	5000		**RCN12010S**		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**		2.1	(1.0)
	134 1/2	(3416.0)	127 3/4	(3245.0)	5000		**RDN134J10S**		2.6	(1.2)
	153 3/8	(3895.7)	145 7/8	(3705.2)	5500		**RDN153R10S**		2.9	(1.4)
	179 1/4	(4553.0)	171 1/4	(4350.0)	6500		**RDN179E10S**		3.4	(1.6)

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WATROD Single/Double-Ended Heaters

Double-Ended WATROD *(Continued)*

Special 208VAC and 277VAC Voltages

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

WATROD Description	Sheath A Dimension in.	(mm)	Heated B Dimension in.	(mm)	Watts	Part Number 120VAC	Part Number 240VAC	Part Number 480VAC	Est. Net Wt. lbs	(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**	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**	3.2	(1.5)

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 62 to 67 for details).
- Ensure termination temperatures do not exceed 390°F (200°C) or the seal's maximum rating.
- Keep terminations clean, dry and tight.