

## Tubular and Process Assemblies

### Elements and Assemblies

Watlow tubular elements and assemblies are primarily used for direct immersion in water, oils, viscous materials, solvents, process solutions and molten materials as well as air and gases.

Additionally, round and flat surface tubular elements (WATROD and FIREBAR® heaters respectively) can be used for surface heating.

WATROD and FIREBAR heating elements may be purchased separately, or fabricated into process heating assemblies, including:

- Screw plug
- Flange
- Circulation
- Booster
- Engine Preheater
- Over-the-Side
- Vertical Loop
- Drum
- Duct

Both elements and assemblies are available from stock. They can be configured with a variety of watt and volt ratings, terminations, sheath materials and mounting options to satisfy the most demanding applications.

If our stock products do not meet your application needs, Watlow can custom engineer the optimum heater.

#### Performance Capabilities

- Sheath temperatures up to 1800°F (983°C)
- Assembly wattages to 2.2 megawatts
- Process assembly ratings up to 1000 psi (70 kg/cm<sup>2</sup>)
- Watt densities up to 120 W/in<sup>2</sup> (18.6 W/cm<sup>2</sup>)



Assemblies, left to right: WATROD duct, WATROD screw plug, circulation and FIREBAR flange heater. WATROD and FIREBAR elements are in front.

- Enhanced performance beyond these specifications available from Watlow Process Systems.®

#### Features and Benefits

- **36 standard bend formations** enable designing the heating element around available space to maximize heating efficiency.
- **FIREBAR flat surface geometry** enhances heat transfer in both immersion and air applications, and surface heating, too. Increased surface area per linear inch allows heaters to run cooler in viscous materials.

- **Wattages from 95 watts to 2.2 megawatts** (on individual elements and assemblies respectively) make tubular heaters one of the most versatile electric heating sources available.

#### Applications

- Liquids
- Air
- Gases
- Molten materials
- Contact surface heating
- Radiant surface heating

® Watlow Process Systems can design thermal systems to meet specific performance criteria. Contact your Watlow representative for details.

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The following two charts will help you select an appropriate heater based on your application and watt density restrictions. These charts are application driven. The total

wattage required by your application should be known before selecting a specific heater type(s) from the stock tables. If your required wattage is not known, please

consult your Watlow representative. Once the heater type has been identified, turn to the appropriate product section for information on the element or assembly.

### Element and Assembly Selection Guide

To identify the tubular heater type best suited to your application, consult the *Element and Assembly Selection Guide*.

In most cases Watlow recommends using single tubular heating elements for low kilowatt applications.

Assemblies are better suited for large kilowatt applications to heat liquids, air or gases.

When selecting a heater according to watt density, be sure to consider the following:

- Liquid viscosity at start up and at process temperature
- Operating temperature
- Chemical composition

Under the **"Heating Method"** column in the *Element and Assembly Selection Guide* locate the method that applies to your application to find the recommended "Heater Type."

After identifying the heater type(s) suitable for your application, refer to the *Supplemental Applications Chart* for further application data. This chart will assist you in selecting the appropriate watt density and sheath material for your specific application. It also presents the performance characteristics for both WATROD and FIREBAR elements.

### Element and Assembly Selection Guide

Application	Heating Method	Heater Type
<b>Liquids:</b>		
Acids	Direct immersion (circulating/non-circulating)	FIREBAR, WATROD, Screw Plug, Flange, Over-the-Side, Vertical Loop, and Pipe Insert
Caustic Soda 12% Concentrate 10% Concentrate 75% Concentrate	Direct immersion (circulating/non-circulating)	WATROD, Screw Plug, Square Flange, Flange, Over-the-Side, Vertical Loop, Circulation, and Pipe Insert
Degreasing Solutions	Direct immersion (circulating/non-circulating)	FIREBAR, WATROD, Screw Plug, Square Flange, Flange, Over-the-Side, and Pipe Insert
Electroplating	Direct immersion (circulating/non-circulating)	FIREBAR, WATROD, Screw Plug, Square Flange, Flange, Over-the-Side, Drum, Vertical Loop and Pipe Insert
Ethylene Glycol 50% Concentrate 100% Concentrate	Direct immersion (circulating/non-circulating)	FIREBAR, WATROD, Screw Plug, Flange, Over-the-Side, Circulation, Booster, and Engine Preheater
Oils Asphalt Fuel Oils Light Grades 1 & 2 Medium Grades 4 & 5 Heavy Grade 6 & Bunker C Heat Transfer Lubricating SAE 10, 20, 30 SAE 40, 50 API STD 614 Vegetable (Cooking)	Direct immersion (circulating/non-circulating)	FIREBAR, WATROD, Screw Plug, Square Flange, Flange, Over-the-Side, Drum, Vertical Loop, Circulation, Booster, and Pipe Insert
Paraffin or Wax	Direct immersion (circulating/non-circulating)	FIREBAR, WATROD, Screw Plug, Square Flange, Flange, Over-the-Side, Drum, and Pipe Insert

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### Element and Assembly Selection Guide

Application	Heating Method	Heater Type
Water Clean Deionized Demineralized Potable Process	Direct immersion (circulating/non-circulating)	FIREBAR (non-process water only) WATROD, Screw Plug, Screw Plug with Control Assembly, Square Flange, Flange, Over-the-Side, Drum, Vertical Loop, Circulation, Booster, Engine Preheater and Pipe Insert
<b>Air:</b>	Direct (forced or natural convection)	FIREBAR, WATROD, FINBAR, WATROD Enclosure Heater, Screw Plug, Flange, Circulation, and Duct
<b>Gas:</b> Hydrocarbons, Nitrogen, Oxygen Ozone, Steam	Direct (forced)	FIREBAR, WATROD, Screw Plug, Flange, and Circulation
<b>Molten Materials:</b> Aluminum Lead Salt Solder	Indirect (radiant) Direct (non-circulating) Direct (non-circulating) Direct (non-circulating)	WATROD FIREBAR and WATROD FIREBAR and WATROD FIREBAR and WATROD
<b>Surface Heating:</b> Dies, Griddles, Molds, Platens	Direct	FIREBAR and WATROD

### Supplemental Applications Chart

This *Supplemental Applications Chart* is provided in addition to the *Element and Assembly Selection Guide*. This chart will help you select watt density and sheath

materials for either WATROD or FIREBAR heating elements according to the specific media being heated.

For example, if you're heating

vegetable oil, either WATROD or FIREBAR elements at 30 and 40 watts per square inch respectively (4.6 and 6.2 W/cm<sup>2</sup>) with 304 stainless steel sheath can be used.

### Supplemental Applications Chart

Heated Material	Maximum Operating Temperature °F (°C)	WATROD Element		FIREBAR Element		Sheath Material
		Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )	Sheath Material	Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )	Sheath Material	
<b>Acid Solutions (Mild)</b>						
Acetic	180 (82)	40 (6.2)	316 Stainless Steel	40 (6.2)		Incoloy® 800
Boric (30% max.)	257 (125)	40 (6.2)	Titanium	40 (6.2)		304 Stainless Steel
Carbonic	180 (82)	40 (6.2)	Inconel® 600	40 (6.2)		304 Stainless Steel
Chromic	180 (82)	40 (6.2)	Titanium	N/A	N/A	N/A
Citric	180 (82)	23 (3.6)	Incoloy®	30 (4.6)		Incoloy® 800
Fatty Acids	150 (65)	20 (3.1)	316 Stainless Steel	30 (4.6)		Incoloy® 800
Lactic	122 (50)	10 (1.6)	316 Stainless Steel	N/A	N/A	N/A
Levulinic	180 (82)	40 (6.2)	Inconel® 600	40 (6.2)		304 Stainless Steel
Malic	122 (50)	10 (1.6)	316 Stainless Steel	16 (2.5)		Incoloy® 800
Nitric (30% max.)	167 (75)	20 (3.1)	316 Stainless Steel	30 (4.6)		Incoloy® 800
Phenol—2-4						
Disulfonic	180 (82)	40 (6.2)	316 Stainless Steel	40 (6.2)		Incoloy® 800
Phosphoric	180 (82)	23 (3.6)	Incoloy®	30 (4.6)		Incoloy® 800
Phosphoric (Aerated)	180 (82)	23 (3.6)	304 Stainless Steel	30 (4.6)		304 Stainless Steel

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### Supplemental Applications Chart

Heated Material	Maximum Operating Temperature °F (°C)		WATROD Element		FIREBAR Element			
			Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )	Sheath Material	Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )	Sheath Material		
Proponic (10% max.)	180	(82)	40	(6.2)	Copper	40	(6.2)	304 Stainless Steel
Tannic	167/180	(75/82)	23/40	(3.6/6.2)	Steel/304 S. Steel	40	(6.2)	304 Stainless Steel
Tartaric	180	(82)	40	(6.2)	316 Stainless Steel	40	(6.2)	Incoloy® 800
Acetaldehyde	180	(82)	10	(1.6)	Copper	16	(2.4)	Incoloy® 800
Acetone	130	(54)	10	(1.6)	304 Stainless Steel	16	(2.4)	304 Stainless Steel
Air	①	①	①	①	Incoloy®	①	①	Incoloy® 800
Alcyl Alcohol	200	(93)	10	(1.6)	Copper	16	(2.4)	Incoloy® 800
Alkaline Solutions	212	(100)	40	(6.2)	Steel	48	(7.4)	304 Stainless Steel
Aluminum Acetate	122	(50)	10	(1.6)	316 Stainless Steel	16	(2.5)	Incoloy® 800
Aluminum Potassium Sulfate	212	(100)	40	(6.2)	Copper	N/A	N/A	N/A
Ammonia Gas	①	①	①	①	Steel	①	①	304 Stainless Steel
Ammonium Acetate	167	(75)	23	(3.6)	Incoloy®	30	(4.6)	Incoloy® 800
Amyl Acetate	240	(115)	23	(3.6)	Incoloy®	30	(4.6)	Incoloy® 800
Amyl Alcohol	212	(100)	20	(3.1)	304 Stainless Steel	30	(4.6)	304 Stainless Steel
Aniline	350	(176)	23	(3.6)	304 Stainless Steel	30	(4.6)	304 Stainless Steel
Asphalt	200-500	(93-260)	4-10	(0.6 - 1.6)	Steel	6-12	(0.9 - 1.8)	304 Stainless Steel
Barium Hydroxide	212	(100)	40	(6.2)	316 Stainless Steel	40	(6.2)	Incoloy® 800
Benzene, liquid	150	(65)	10	(1.6)	Copper	16	(2.5)	304 Stainless Steel
Butyl Acetate	225	(107)	10	(1.6)	316 Stainless Steel	16	(2.5)	Incoloy® 800
Calcium Bisulfate	400	(204)	20	(3.1)	316 Stainless Steel	N/A	N/A	N/A
Calcium Chloride	200	(93)	5-8	(0.8 - 1.2)	Inconel® 600	N/A	N/A	N/A
Carbon Monoxide	—	—	①	①	Incoloy®	①	①	Incoloy®
Carbon Tetrachloride	160	(71)	23	(3.6)	Incoloy®	30	(4.6)	Incoloy®
Caustic Soda:								
2%	210	(98)	48	(7.4)	Incoloy®	—	—	Consult factory
10% Concentrate	210	(98)	23	(3.6)	Incoloy®	—	—	Consult factory
75%	180	(82)	23	(3.6)	Incoloy®	—	—	Consult factory
Citric Juices	185	(85)	23	(3.6)	Incoloy®	30	(4.6)	Incoloy®
Degreasing Solution	275	(135)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
Dextrose	212	(100)	20	(3.1)	304 Stainless Steel	30	(4.6)	304 Stainless Steel
Dyes & Pigments	212	(100)	23	(3.6)	304 Stainless Steel	30	(4.6)	304 Stainless Steel

#### Electroplating Baths:

Cadmium	180	(82)	40	(6.2)	304 Stainless Steel	40	(6.2)	304 Stainless Steel
Copper	180	(82)	40	(6.2)	316 Stainless Steel	N/A	N/A	N/A
Dilute Cyanide	180	(82)	40	(6.2)	316 Stainless Steel	N/A	N/A	N/A
Rochelle Cyanide	180	(82)	40	(6.2)	316 Stainless Steel	N/A	N/A	N/A
Sodium Cyanide	180	(82)	40	(6.2)	316 Stainless Steel	N/A	N/A	N/A
Potassium Cyanide	180	(82)	40	(6.2)	316 Stainless Steel	40	(6.2)	304 Stainless Steel
Ethylene Glycol	300	(148)	30	(4.6)	Steel	40	(6.2)	304 Stainless Steel
Formaldehyde	180	(82)	10	(1.6)	304 Stainless Steel	16	(2.5)	304 Stainless Steel
Freon® Gas	300	(148)	2-5	(0.3 - 0.8)	Steel	①	①	304 Stainless Steel
Gasoline	300	(148)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel

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① Consult your Watlow representative.  
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### Supplemental Applications Chart

Heated Material	Maximum Operating Temperature °F (°C)		WATROD Element			FIREBAR Element		
			Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )		Sheath Material	Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )		Sheath Material
Gelatin Liquid	150	(65)	23	(3.6)	304 Stainless Steel	30	(4.6)	304 Stainless Steel
Gelatin Solid	150	(65)	5	(0.8)	304 Stainless Steel	7	(1.0)	304 Stainless Steel
Glycerin	500	(260)	10	(1.6)	Incoloy®	12	(1.9)	304 Stainless Steel
Glycerol	212	(100)	23	(3.6)	Incoloy®	30	(4.6)	304 Stainless Steel
Grease:								
Liquid	—	—	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
Solid	—	—	5	(0.8)	Steel	7	(1.0)	304 Stainless Steel
Hydrazine	212	(100)	16	(2.5)	304 Stainless Steel	20	(3.1)	304 Stainless Steel
Hydrogen	①	①	—	—	Incoloy®	①	①	Incoloy® 800
Hydrogen Chloride	①	①	—	—	Inconel® 600	①	①	N/A
Hydrogen Sulfide	①	①	—	—	316 Stainless Steel (heavy wall)	①	①	N/A
Magnesium Chloride	212	(100)	40	(6.2)	Inconel® 600	40	(6.2)	Incoloy® 800
Magnesium Sulfate	212	(100)	40	(6.2)	304 Stainless Steel	40	(6.2)	304 Stainless Steel
Magnesium Sulfate	212	(100)	40	(6.2)	316 Stainless Steel	40	(6.2)	304 Stainless Steel
Methanol Gas	①	①	—	—	304 Stainless Steel	①	①	304 Stainless Steel
Methylamine	180	(82)	20	(3.1)	Inconel® 600	30	(4.6)	304 Stainless Steel
Methylchloride	180	(82)	20	(3.1)	Copper	N/A	N/A	N/A
Molasses	100	(37)	4-5	(0.6 - 0.8)	304 Stainless Steel	5-8	(0.8 - 1.2)	304 Stainless Steel
Molten Salt Bath	800-900	(426-482)	25-30	(3.8 - 4.6)	Monel®	N/A	N/A	N/A
Naphtha	212	(100)	10	(1.6)	Steel	16	(2.5)	304 Stainless Steel
<b>Oils</b>								
Fuel Oils:								
Grades 1 & 2 (distillate)	200	(93)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
Grades 4 & 5 (residual)	200	(93)	13	(2.0)	Steel	16	(2.5)	304 Stainless Steel
Grades 6 & Bunker C (residual)	160	(71)	8	(1.2)	Steel	10	(1.6)	304 Stainless Steel
Heat Transfer Oils: ②								
Static	500	(260)	16	(2.5)	Steel	23	(3.6)	304 Stainless Steel
600	600	(315)	10	(1.6)	Steel	16	(2.5)	304 Stainless Steel
Circulating	500	(260)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
600	600	(315)	15	(2.3)	Steel	20	(3.1)	304 Stainless Steel
Lubrication Oils:								
SAE 10, 90-100 SSU @ 130°F	250	(121)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
SAE 20, 120-185 SSU @ 130°F	250	(121)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
SAE 30, 185-255 SSU @ 130°F	250	(121)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
SAE 40, -80 SSU @ 210°F	250	(121)	13	(2.0)	Steel	18	(2.7)	304 Stainless Steel
SAE 50, 80-105 SSU @ 210°F	250	(121)	13	(2.0)	Steel	18	(2.7)	304 Stainless Steel
Miscellaneous Oils:								
Draw Bath	600	(315)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
Hydraulic	—	—	15 <sup>③</sup>	(2.3)	Steel	15 <sup>③</sup>	(2.3)	304 Stainless Steel
Linseed	150	(65)	50	(7.7)	Steel	60	(9.3)	304 Stainless Steel
Mineral	200	(93)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
400	400	(204)	16	(2.5)	Steel	23	(3.6)	304 Stainless Steel
Vegetable/Shortening	400	(204)	30	(4.6)	304 Stainless Steel	40	(6.2)	304 Stainless Steel

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② Maximum operating temperatures and watt densities are detailed in Heat Transfer Oil charts on page 265.

③ Per API standards.

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### Supplemental Applications Chart

Heated Material	Maximum Operating Temperature °F (°C)		WATROD Element		FIREBAR Element			
			Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )	Sheath Material	Maximum Watt Density W/in <sup>2</sup> (W/cm <sup>2</sup> )	Sheath Material		
Paraffin or Wax (liquid)	150	(65)	16	(2.4)	Steel	20	(3.1)	304 Stainless Steel
Perchloroethylene	200	(93)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
Potassium Chlorate	212	(100)	40	(6.2)	316 Stainless Steel	N/A	N/A	N/A
Potassium Chloride	212	(100)	40	(6.2)	316 Stainless Steel	N/A	N/A	N/A
Potassium Hydroxide	160	(71)	23	(3.6)	Monel®	N/A	N/A	N/A
Soap, liquid	212	(100)	20	(3.1)	304 Stainless Steel	30	(4.6)	304 Stainless Steel
Sodium Acetate	212	(100)	40	(6.2)	Steel	50	(7.7)	304 Stainless Steel
Sodium Cyanide	140	(60)	40	(6.2)	Incoloy®	50	(7.7)	Incoloy® 800
Sodium Hydride	720	(382)	28	(4.3)	Incoloy®	36	(5.5)	Incoloy® 800
Sodium Hydroxide	—	—	—	—	See Caustic Soda	—	—	—
Sodium Phosphate	212	(100)	40	(6.2)	Copper	50	(7.7)	304 Stainless Steel
Steam, flowing	300	(148)	10	(1.6)	Incoloy®	①	①	Incoloy® 800
	500	(260)	5-10	(0.8-1.6)	Incoloy®	①	①	Incoloy® 800
	700	(371)	5	(0.8)	Incoloy®	①	①	Incoloy® 800
Sulfur, Molten	600	(315)	10	(1.6)	Incoloy®	12	(1.8)	Incoloy® 800
Toluene	212	(100)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
Trichlorethylene	150	(65)	23	(3.6)	Steel	30	(4.6)	304 Stainless Steel
Turpentine	300	(148)	20	(3.1)	304 Stainless Steel	25	(3.8)	304 Stainless Steel

#### Water

Clean	212	(100)	60	(9.3)	Incoloy®	45	(7)	Incoloy® 800
Deionized	212	(100)	60	(9.3)	316 SS (passivated)	90	(14)	Incoloy® 800
Demineralized	212	(100)	60	(9.3)	316 SS (passivated)	90	(14)	Incoloy® 800
Potable	212	(100)	60	(9.3)	Incoloy®	45	(7)	Incoloy® 800
Process	212	(100)	48	(9.3)	Incoloy®			Consult factory

① Consult your Watlow representative.

### Free Cross Sectional Area of WATROD and FIREBAR Circulation Heaters

Free cross sectional areas from the chart are in square feet.

Calculations are based on:

- Flange 12 inches and under, pipes are schedule 40
- Flanges 14 inches and above, pipes are standard wall thickness (0.375 inch/9.5 mm)
- All WATROD heating elements are 0.475 inch diameter (12 mm)

Circulation Heater Size Inches	Free Cross Sectional Area in Square Feet (Number of Elements in Parenthesis)			
<b>WATROD</b>				
2½ NPT	0.044	(3)		
3 Flange	0.044	(3)	0.037	(6)
4 Flange	0.074	(6)		
5 Flange	0.124	(6)	0.117	(9)
6 Flange	0.172	(12)	0.164	(15)
8 Flange	0.303	(18)	0.296	(21)
10 Flange	0.481	(27)	0.460	(36)
12 Flange	0.697	(36)	0.652	(54)
14 Flange	0.848	(45)	0.781	(72)
16 Flange	1.091	(72)	1.054	(87)
18 Flange	1.372	(102)	1.357	(108)
20 Flange	1.748	(108)	1.733	(114)
			1.017	(102)
			1.342	(114)
			1.704	(126)
<b>FIREBAR</b>				
2½ NPT	0.0417	(3)		
4 Flange	0.0692	(6)		
6 Flange	0.154	(15)		

# Tubular and Process Assemblies

## Elements and Assemblies

### Heat Transfer Oil Chart

Heat Transfer Fluid	Recommended Maximum Temperature °F (°C)		Flammability Data °F (°C)			Minimum Velocity Thru Heater in Feet/second at W/in <sup>2</sup> (M/second at W/cm <sup>2</sup> )				
	Process		Flash Point	Fire Point		Autoignition	8 (1.2)	16 (2.8)	23 (3.6)	30 (4.7)
	F (°C)	°F (°C)	°F (°C)	°F (°C)	°F (°C)	W/in <sup>2</sup> (W/cm <sup>2</sup> )	W/in <sup>2</sup> (W/cm <sup>2</sup> )	W/in <sup>2</sup> (W/cm <sup>2</sup> )	W/in <sup>2</sup> (W/cm <sup>2</sup> )	
Calflo HTF	600 (316)	650 (343)	414 (212)	462 (239)	670 (354)	1.5 (0.5)	3 (0.9)	5 (1.52)	7 (2.1)	
Calflo AF	550 (288)	600 (316)	400 (204)	437 (225)	650 (343)	1.5 (0.5)	3 (0.9)	5 (1.52)	7 (2.1)	
Caloria HT-43	600 (316)	680 (360)	400 (204)	no data	no data	670 (354)	1.5 (0.5)	2.5 (0.75)	3 (0.9)	4 (1.22)
Dow therm® A	750 (399)	835 (446)	255 (124)	275 (135)	1150 (621)	0.5 (0.15)	1 (0.3)	2 (0.61)	3 (0.9)	
Dow therm® G	700 (371)	775 (413)	305 (152)	315 (157)	1150 (621)	0.7 (0.2)	1.5 (0.5)	2.5 (0.75)	3.5 (1.1)	
Dow therm® J	575 (302)	650 (343)	145 (63)	155 (68)	806 (430)	1 (0.3)	2 (0.61)	3 (0.9)	4.5 (1.37)	
Dow therm® LF	600 (316)	675 (357)	260 (127)	280 (138)	1020 (549)	0.7 (0.2)	1.5 (0.5)	2.5 (1.75)	3.5 (1.1)	
Dow therm® HT	650 (343)	700 (371)	no data	no data	no data	no data	1.5 (0.5)	2.5 (0.75)	3.5 (1.1)	5 (1.52)
Dow therm® Q	625 (329)	700 (371)	no data	no data	773 (412)	0.7 (0.2)	1.5 (0.5)	2.5 (0.75)	3.5 (1.1)	
Marlotherm S	662 (350)	698 (370)	374 (190)	no data	no data	932 (500)	1.5 (0.5)	3 (0.9)	5 (1.52)	7 (2.1)
Mobiltherm 603	590 (310)	625 (329)	380 (193)	no data	no data	no data	1.5 (0.5)	3 (0.9)	5 (1.52)	7 (2.1)
Multitherm IG-2	600 (316)	650 (343)	440 (227)	500 (260)	700 (371)	0.8 (0.24)	1.7 (0.52)	2.3 (0.7)	3 (0.9)	
Multitherm PG-1	600 (316)	640 (338)	340 (171)	385 (196)	690 (368)	1 (0.3)	2 (0.61)	3 (0.9)	4 (1.22)	
Para Cymene	600 (316)	650 (343)	117 (47)	152 (72)	817 (438)	0.7 (0.2)	1.5 (0.5)	2.5 (0.75)	3.5 (1.1)	
Syltherm 800	750 (399)	800 (427)	350 (177)	380 (193)	725 (385)	1.5 (0.5)	3 (0.9)	5 (1.52)	7 (2.1)	
Syltherm XLT	500 (260)	550 (288)	116 (47)	130 (54)	662 (350)	1.5 (0.5)	2.5 (0.75)	4 (1.22)	5 (1.52)	
Texatherm	600 (316)	640 (338)	430 (221)	no data	no data	no data	2 (0.61)	4 (1.22)	6 (1.83)	8 (2.4)
Thermia 33	600 (316)	650 (343)	455 (235)	495 (257)	no data	no data	1.5 (0.5)	3 (0.9)	5 (1.52)	7 (2.1)
Therminol 44	400 (204)	475 (246)	405 (207)	438 (228)	705 (374)	1 (0.3)	2 (0.61)	3 (0.9)	4 (1.22)	
Therminol 55	550 (288)	605 (318)	350 (177)	410 (210)	675 (357)	1.5 (0.5)	2.5 (0.75)	3.5 (1.1)	5 (1.52)	
Therminol 59	600 (316)	650 (343)	302 (150)	335 (168)	770 (410)	1.5 (0.5)	2.5 (0.75)	3.5 (1.1)	5 (1.52)	
Therminol 60	620 (327)	655 (346)	310 (154)	320 (160)	835 (448)	1.5 (0.5)	3 (0.9)	5 (1.52)	7 (2.1)	
Therminol 68	650 (343)	705 (374)	350 (177)	380 (183)	705 (374)	1.5 (0.5)	2.5 (0.75)	3 (0.9)	4.5 (1.37)	
Therminol 75	750 (399)	805 (429)	390 (199)	440 (227)	1000 (538)	1 (0.3)	2 (0.61)	3 (0.9)	4 (1.22)	
Therminol LT	600 (316)	650 (343)	134 (57)	150 (66)	805 (429)	1.5 (0.5)	2.5 (0.75)	4 (1.22)	5 (1.52)	
Therminol VP-1	750 (399)	800 (427)	255 (124)	280 (127)	1150 (621)	1 (0.3)	2 (0.61)	3 (0.9)	4 (1.22)	
U-Con 500	500 (260)	550 (288)	540 (282)	600 (316)	750 (399)	1 (0.3)	2 (0.61)	3 (0.9)	4 (1.22)	

# Tubular and Process Assemblies

## Elements and Assemblies

### Agency Recognition

UL® and CSA recognition information charts are provided to ensure:

- Safety parameters in relationship to stated voltage and amperage
- Approved sheath materials, end seals and assembly electrical enclosures

Watlow believes that UL® and CSA recognition information is necessary to confirm the reliability of our heating products in relationship to your application. As such, the accompanying Agency Recognition charts illustrate the extent of coverage each heater type

provides. Specific end use application information is required for each agency marking. Some products carry U.S. and Canada approvals.



### UL® Recognition and Listing

#### File Number E52951 (UL® 499) — Component Recognition

All information for UL® file #E52951 can be found under "Heaters Miscellaneous" (Classification KSOT2).

### Elements

WATROD Diameter mm (inch)	Code Number Designation	Max. Volts	Max Amps	Max. Watt Density		Min. Bend Radius		Allowable Sheath Materials	End Seal Types
				W/cm <sup>2</sup>	W/in <sup>2</sup>	mm	(inch)		
6.0 (0.210)	<b>RK</b> series <b>U0-xx</b>	250	15	N/A	N/A	2	( <sup>1</sup> / <sub>6</sub> )	Aluminum	
6.6 (0.260)	<b>RA</b> series <b>U1-xx</b>	250	15	N/A	N/A	2	( <sup>1</sup> / <sub>6</sub> )	Copper	Epoxy resin
8.0 (0.315)	<b>RB</b> series <b>U3-xx</b>	480	30	N/A	N/A	2	( <sup>1</sup> / <sub>6</sub> )	Nickel alloy	Lavacone
8.5 (0.335)	<b>UE-xx</b>	480	30	N/A	N/A	5	( <sup>3</sup> / <sub>16</sub> )	Inconel®	Silicone resin
9.5 (0.375)	<b>RD, RS</b> series <b>U5-xx</b>	480	30	N/A	N/A	5	( <sup>3</sup> / <sub>16</sub> )	Stainless steel	Silicone rubber
10.9 (0.430)	<b>RC</b> series <b>U6-xx</b>	600	40	N/A	N/A	4	( <sup>5</sup> / <sub>32</sub> )	Steel	ULTRAGARD
12.0 (0.475)	<b>RG</b> series <b>U7-xx</b>	600	40	N/A	N/A	5	( <sup>3</sup> / <sub>16</sub> )	Titanium	SF 99
12.4 (0.490)	<b>RJ</b> series <b>U8-xx</b>	600	40	N/A	N/A	5	( <sup>3</sup> / <sub>16</sub> )	Hastelloy®	
15.9 (0.625)	<b>RF</b> series <b>U9-xx</b>	600	40	N/A	N/A	11	( <sup>1</sup> / <sub>6</sub> )	Copper-coated steel	

FIREBAR® Height mm (inch)	Code Number Designation	Max. Volts	Max. Amps	Max. Watt Density W/cm <sup>2</sup> (W/in <sup>2</sup> )	Min. Bend Radius		Allowable Sheath Materials	End Seal Types
					Major Axis mm (inch)	Minor Axis mm (inch)		

### Air or Immersion Heating

16 ( <sup>5</sup> / <sub>8</sub> )	<b>FA, FS</b> series <b>A-xx</b>	250	N/A	7.7 (50)	25 (1)	13 ( <sup>1</sup> / <sub>2</sub> )	Nickel alloy	Epoxy resin
25.4 (1)	<b>FB, FS</b> series	250	N/A	7.7 (50)	25 (1)	13 ( <sup>1</sup> / <sub>2</sub> )	Stainless steel Titanium	Lavacone Silicone resin Silicone rubber ULTRAGARD

### Liquid Immersion Heating Only

16 ( <sup>5</sup> / <sub>8</sub> )	<b>FA, FS</b> series <b>U-xx</b>	480	N/A	24.7 (160)	25 (1)	2 ( <sup>1</sup> / <sub>8</sub> )	Nickel alloy	Epoxy resin
25.4 (1)	<b>FB, FS</b> series	480	N/A	24.7 (160)	25 (1)	2 ( <sup>1</sup> / <sub>8</sub> )	Stainless steel Titanium	Lavacone Silicone resin Silicone rubber ULTRAGARD

**Note:** UL® and CSA must be requested at the time the order is placed.

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Hastelloy® is a registered trademark of Haynes International.



# Tubular and Process Assemblies

## Elements and Assemblies

### Assemblies

Refer to applicable WATROD and FIREBAR elements for maximum voltage, watt density and sheath materials.

Heater Type	Code Number Designations	Electrical Enclosure Options
Screw Plug	All catalog "B" models Series <b>U1</b> to <b>U9</b>	General purpose without thermostat
Flange	All catalog models <b>FE, FG, FH, FK, FL, FM, FN, FO, FP, FR, FS, FT, FW</b> —Series <b>U1</b> to <b>U9, U0</b> and <b>UE</b>	General purpose without thermostat *Moisture resistant
Circulation	All catalog models <b>CB, CF, CP</b> Series <b>U1</b> to <b>U9</b>	General purpose without thermostat *Moisture resistant
Over-the-Side	All catalog "OL," "OR" and "VL" models Series <b>U1</b> to <b>U9</b> , <i>except</i> <b>U2</b> and <b>U4</b>	Moisture resistant without thermostat
Duct	All catalog "D6 to D125" models Series <b>U1</b> to <b>U9, U0</b> and <b>UE</b>	General purpose enclosure only (Incoloy® sheath only)

\* 4, 5, 6 and 8 inch flange size only

### File Number E56488 (UL® 1030)—Water Immersion Only (Classification UBJY2). — Component Recognition

#### Elements

WATROD Diameter mm (inch)	Code Number Designation	Max. Volts	Max. Amps	Max. Watt Density W/cm <sup>2</sup> (W/in <sup>2</sup> )	Min. Bend Radius		Allowable Sheath Materials	End Seal Types
					mm (inch)	(inch)		
8.0 (0.315)	<b>T</b> series Example: <b>T085CN3S</b>	480	7	18.5 (120)	3	( <sup>1</sup> / <sub>8</sub> )	Copper Incoloy® Stainless steel	Epoxy RTV Silicone
9.5 (0.315)		480	7	18.5 (120)	3	( <sup>1</sup> / <sub>8</sub> )		
10.9 (0.430)		575	7	18.5 (120)	8	( <sup>5</sup> / <sub>16</sub> )		
12.0 (0.475)		575	7	18.5 (120)	8	( <sup>5</sup> / <sub>16</sub> )		
12.4 (0.490)		575	7	18.5 (120)	8	( <sup>5</sup> / <sub>16</sub> )		
15.9 (0.625)		575	7	18.5 (120)	8	( <sup>5</sup> / <sub>16</sub> )		

FIREBAR® Height mm (inch)	Code Number Designation	Max. Volts	Max. Amps	Max. Watt Density W/cm <sup>2</sup> (W/in <sup>2</sup> )	Min. Bend		Allowable Sheath Materials	End Seal Types
					Major Axis mm (inch)	Minor Axis mm (inch)		
25.4 (1)	<b>T</b> series Example: <b>T085HN3W</b>	250	N/A	12.4 (80)	25 (1)	4 ( <sup>5</sup> / <sub>32</sub> )	Incoloy® Stainless steel	Epoxy RTV Silicone

### Assemblies

Refer to applicable WATROD and FIREBAR elements for maximum voltage, watt density and sheath materials.

Heater Type	Code Number Designations	Electrical Enclosure Options
Screw Plug	Models <b>T3, T5, T6, T7, T8, T9</b> Example: <b>T336xxxx</b>	General purpose without thermostat
Flange	Models <b>T3, T5, T6, T7, T8, T9</b> Example: <b>T621xxxx</b>	General purpose without thermostat

**Note:** UL® and CSA must be requested at the time the order is placed.

# Tubular and Process Assemblies

## Elements and Assemblies

### Allowed UL® MULTICOIL Configurations, File #E52951

Part Description	Phase	Sheath Diameter		Max. Sheath Temperature		Min. Bend Radius		Max. Volts
		mm	(inch)	°C	(°F)	mm	(inch)	
U 6 M 1	1	10.92	(0.43)	692	(1278)	12.7	(0.50)	480
U 6 M 1 T	1	10.92	(0.43)	692	(1278)	12.7	(0.50)	480
U 7 M 1	1	12.065	(0.475)	612	(1134)	15.88	(0.625)	480
U 7 M 1 T	1	12.065	(0.475)	612	(1134)	15.88	(0.625)	480
U 7 M 2	1	12.065	(0.475)	612	(1134)	15.88	(0.625)	480
U 7 M 2 T	1	12.065	(0.475)	612	(1134)	15.88	(0.625)	480
U 7 M 3	3	12.065	(0.475)	802	(1477)	15.88	(0.625)	480
U 8 M 1	1	12.446	(0.49)	612	(1134)	15.88	(0.625)	480
U 8 M 1 T	1	12.446	(0.49)	612	(1134)	15.88	(0.625)	480
U 8 M 2	1	12.446	(0.49)	612	(1134)	15.88	(0.625)	480
U 8 M 2 T	1	12.446	(0.49)	612	(1134)	15.88	(0.625)	480
U 8 M 3	3	12.446	(0.49)	802	(1477)	15.88	(0.625)	480
U 9 M 1	1	15.875	(0.625)	612	(1134)	19.05	(0.75)	480
U 9 M 1 T	1	15.875	(0.625)	612	(1134)	19.05	(0.75)	480
U 9 M 2	1	15.875	(0.625)	612	(1134)	19.05	(0.75)	480
U 9 M 2 T	1	15.875	(0.625)	612	(1134)	19.05	(0.75)	480
U 9 M 3	3	15.875	(0.625)	802	(1477)	19.05	(0.75)	480

**Allowable Sheaths:** Nickel alloy 800, 840

**Allowable Seals:** Lavacone, RTV, Epoxy, ULTRAGARD, Silicone Resin

**Allowable Terminations:** Lead wire only

# Tubular and Process Assemblies

## Elements and Assemblies

### CSA Certification File Number LR 31388



All information for CSA file LR 31388 can be found in the CSA *List of Certified Electrical Equipment* catalog, Volume II, under Heaters—Miscellaneous.

#### Elements

Heater Type— Diameter/Height mm (inch)	Code Number Designation	Max. Volts	Max. Watt Density W/cm <sup>2</sup> (W/in <sup>2</sup> )	Allowable Sheath Materials <sup>①</sup>	End Seal Type (All Diameters)
<b>WATROD:</b>					
6.6 (0.260)	<b>RA, 1-xx</b>	250	18.5 (120)	Copper	Epoxy resin, Lavacone, Silicone resin, Silicone rubber ULTRAGARD
8.0 (0.315)	<b>RB, 3-xx</b>	250	18.5 (120)	Nickel alloy	
9.5 (0.375)	<b>5-xx</b>	250	18.5 (120)	Stainless steel	
10.9 (0.430)	<b>RC, 6-xx</b>	600	18.5 (120)	Steel	
12.0 (0.475)	<b>RG, 7-xx</b>	600	18.5 (120)	Titanium	
12.4 (0.490)	<b>8-xx</b>	600	18.5 (120)		
15.9 (0.625)	<b>9-xx</b>	600	18.5 (120)		
<b>FIREBAR:</b>					
½ (15.9)	<b>FA, FS</b> models, <b>4-xx</b>	480	18.5 (120)	Nickel alloy	Epoxy resin, Lavacone, Silicone resin, Silicone rubber
1 (25.4)	<b>FB, FS</b> models, <b>2-xx</b>	480	18.5 (120)	Stainless steel Titanium	

**Note:** Heating elements are certified only for use in equipment where the acceptability of the construction combination is determined by the Canadian Standards Association.

① Some sheath materials not available on all diameters. Consult factory.

#### Assemblies - File LR31388

Heater Type	Code Number Designations	Electrical Enclosure Options
Screw Plug	All catalog models <b>BA, BC, BD, BE, BG, BH, BL</b> Series <b>1-xx</b> to <b>9-xx</b>	General purpose with or without thermostat Enclosure 4 with or without thermostat
Flange	All catalog models <b>FM, FN, FO, FP, FR, FS, FT, FW</b> Series <b>1-xx</b> to <b>9-xx</b>	General purpose with or without thermostat *Enclosure 4 with or without thermostat
Circulation	All catalog models <b>CBD, CBE, CBL, CFM, CFN, CFO, CFP, CFR, CFS, CFT, CFW</b> —Series <b>1-10</b> to <b>9-10</b>	General purpose with or without thermostat *Enclosure 4 with or without thermostat
Over-the-Side	All catalog “ <b>OL</b> ” and “ <b>OR</b> ” models Series <b>1-30</b> to <b>9-30</b>	Enclosure 4 with or without thermostat
Duct	All catalog “ <b>D</b> ” and “ <b>MDH</b> ” models Series <b>1-1</b> to <b>9-1</b>	General purpose enclosure only

\* 4, 5, 6 and 8 inch flange size only.



#### File Number LR 61707—Heater Assemblies—Miscellaneous—For Hazardous Locations

Heater Type	Code Number Designations	Electrical Enclosure Options
Screw Plug	All catalog models <b>BA, BC, BD, BE, BG, BH, BL</b> Series <b>1-xx</b> to <b>9-xx</b>	Class I, Groups B, C and D Enclosure 4 with or without thermostat
Flange	All catalog models <b>FM, FN, FO, FP, FR, FS, FT, FW</b> Series <b>1-xx</b> to <b>9-xx</b>	Class I, Groups B, C and D and Enclosure 4 with or without thermostat
Circulation	All catalog models <b>CFM, CFN, CFO, CFP, CFR, CFS, CFT, CFW</b> Series <b>1-10</b> to <b>9-10</b>	Class I, Groups B, C and D and Enclosure 4 with or without thermostat

**Note:** UL® and CSA must be requested at the time the order is placed.