

# Heater Selection Matrix



## Heating Solids

Heater Type	Application Description	Sheath Materials	Typical Max. Watt Densities		Max. Operating Temperatures		Catalog Page
			W/in <sup>2</sup>	W/cm <sup>2</sup>	°F	°C	
<b>Cartridge/Insertion Heaters</b>	These heaters are inserted into a close fit hole (i.e. platens, dies and molds).	Alloy 800	up to 400	62.0	1400	760	9
		Stainless steel	up to 400	62.0	1000	540	
<b>Tubular Heaters</b>	These heaters are clamped to the object to be heated, usually exterior surfaces of tanks or other process vessels or fitted into milled grooves in a platen.	Flat: Alloy 800	40	6.2	1400	760	84
		Stainless steel	40	6.2	1200	650	84
		Round: Alloy 800	40	6.2	1600	870	57
		Stainless steel	40	6.2	1200	650	57
<b>Flexible Heaters</b>	These heaters are bonded or otherwise fastened to the part. Commonly used to heat irregular surfaces and shapes, or applications requiring distributed wattage or limited space.	Polyimide	20	3.1	390	200	111
		Silicone rubber	10	1.6	500	260	109
<b>High-Temperature Heaters</b>	MULTICELL™ heaters are loosely inserted into the platen hole for radiant heating. Can also be used in any static or dynamic non-contact application as a radiant heat source. Commonly used for extreme high temperature applications. Ceramic fiber heaters can be formed into an oversized chamber to surround the object being heated. Using radiant and convection heat transfer, ceramic fiber heaters are used in ovens and furnaces. HT FIREROD® cartridge heaters are especially designed for high-temperature platen applications up to 1600°F (871°C). The HT FIREROD is inserted directly into the platen hole for conduction heating.	Alloy 600	60	9.3	2100	1150	411
		Alloy 800	60	9.3	2100	1150	
		Molded ceramic fiber	30	4.6	2200	1205	419
<b>Specialty Heaters</b>	ULTRAMIC® advanced ceramic heaters are bonded or clamped to the object being heated. Thick film conduction heaters are clamped to the part being heated. Coil/cable heaters can be formed to heat flat or curved surfaces, or wound around the object being heated. Typical applications include platen heating and plastic injection molding nozzles.	Aluminum nitride	1000	155	1112	600	449
		Dielectric glass on 430 stainless steel substrate	75	11.6	1022	550	453
		Stainless steel or alloy 600	30	4.6	1200	650	457
<b>Strip/Clamp-On Heaters</b>	These heaters are bolted or clamped to a surface (i.e. dies, molds, ovens). Often used for freeze and moisture protection.	Aluminized steel with refractory insulation	100	15.5	1100	595	471
		Stainless steel with mineral insulation	140	21.7	1400	760	467
<b>Band/Barrel Heaters</b>	These heaters are clamped to cylindrical surfaces (i.e. extrusion barrels and nozzles).	Stainless steel with mineral insulation	100	15.5	1400	760	483
<b>Radiant Heaters</b>	These heaters are used in any static or dynamic, non-contact application where conduction or convection heating is not practical. Commonly used in laminating processes, thermoforming and paint drying.	Molded ceramic fiber	20	3	2000	1095	502

# Heater Selection Matrix



## Heating Liquids/Surface Heating and Immersion

Heater Type	Application Description	Sheath Materials	Typical Max. Watt Densities		Max. Operating Temperatures		Catalog Page
			W/in <sup>2</sup>	W/cm <sup>2</sup>	°F	°C	
<b>Cartridge/ Insertion Heaters</b>	These are used as an immersion heater placed either directly in the liquid, or in a protective well (recommended for immersion in water or 90 plus percent water soluble solutions).	Alloy 800	Up to 300 in water	46.5	212 in water	100	9
<b>Tubular Heaters</b>	These heaters are immersed directly in the liquid being heated. Most commonly used when high kilowatts are required. Multiple style mounting adaptors, such as flanges and NPT fittings, provide excellent pressure boundaries.	Flat: Alloy 800	60	9.3	1400	760	84
		Stainless steel	60	9.3	1200	650	84
		Round: Alloy 800	60	9.3	350	180	57
		Stainless steel	60	9.3	1600	870	57
		Steel	60	9.3	1200	650	57
		Steel	60	9.3	750	400	57
<b>Flexible Heaters</b>	These heaters are applied to the surface of a pipe vessel containing a liquid (well suited for curved surfaces and irregular shaped objects; frequently used for freeze protection).	Polyimide	20	3.1	390	200	111
		Silicone rubber	10	1.6	500	260	109
<b>Immersion Heaters</b>	FIREBAR® heaters have multiple elements mounted in a screw plug fitting. They are immersed directly in a fluid.	Alloy 800 Stainless steel	Up to 100	15.5	212 in water	100	145
	WATROD™ heaters have multiple elements mounted in a flange or screw plug fitting. These are immersed directly in a fluid or in a protective well.	Alloy 800 316 stainless steel Steel	Up to 100	15.5	212 in water 1400 in air	100	145
<b>Circulation Heaters</b>	Tubular heaters have multiple elements mounted in a screw plug or ANSI flange fitting and placed in a vessel through which fluid is passed.	Alloy 800	60	9.3	1600	870	305
		Stainless steel	60	9.3	350	180	
		Steel	60	9.3	1200	650	
		Steel	60	9.3	750	400	
	FLUENT® heaters are high-performance in-line heaters that provide on-demand heating of fluids which flow directly through the heater.	444 Stainless steel (substrate tube), 316L stainless steel (baffle and fittings)	450	70	212 (in water)	100	445
<b>Fluid Delivery Heaters</b>	FREEFLEX® heaters have polymeric heated tubing, used to maintain temperature in medical applications where heated flexible tubing is required.	Polyimide	72 W/ft	22 W/m	212	100	369
	Syringe heaters are formed to fit a cylindrical part. They are often used in medical applications for heating contrast media and often incorporate a sensor and on-board system.	Lexan® Silicone rubber	2 3	0.31 0.47	185 428	85 220	372
	FLUENT heaters are high-performance in-line heaters that provide on-demand heating of fluids which flow directly through the heater.	444 Stainless steel (substrate tube), 316L stainless steel (baffle and fittings)	450	70	212 (in water)	100	445
<b>High-Temperature Heaters</b>	Ceramic fiber assembled heaters can be used in a chamber surrounding the tank, vessel, crucible or bath. Radiant and convection heat transfer heat the load.	Molded ceramic fiber	30	4.6	2200	1205	419
<b>Specialty Heaters</b>	Coil/cable heaters that are wrapped or wound around pipe or vessel containing a liquid can be used, or used directly as an immersion heater. They are often used in applications with space limitations (i.e. photo processing equipment, scientific instruments and heat tracing).	Stainless steel or Alloy 600	30	4.6	1200	650	457
	FLUENT heaters are high-performance in-line heaters that provide on-demand heating of fluids which flow directly through the heater.	444 Stainless steel (substrate tube), 316L stainless steel (baffle and fittings)	450	70	212 (in water)	100	445
<b>Strip/ Clamp-On Heaters</b>	These heaters are bolted or clamped to the wall of a tank or vessel. They are used in food warming and other applications offering a flat mounting surface.	Aluminized steel with refractory insulation	100	15.5	1100	595	471
		Stainless steel with mineral insulation	140	21.7	1400	760	467
<b>Band/ Barrel Heaters</b>	These heaters are clamped to cylindrical surfaces and are most commonly used to heat liquids flowing through pipes as freeze protection.	Stainless steel with mineral insulation	100	15.5	1400	760	483

# Heater Selection Matrix



## Heating Gases

Heater Type	Application Description	Sheath Materials	Typical Max. Watt Densities		Max. Operating Temperatures		Catalog Page
			W/in <sup>2</sup>	W/cm <sup>2</sup>	°F	°C	
<b>Cartridge/Insertion Heaters</b>	These heaters are mounted in pipes or vessels through which gases pass. They can be placed in protection tubes, making access and wiring easier.	Alloy 800 or stainless steel	100	15.5	Contact Watlow		9
<b>Tubular Heaters</b>	These heaters have multiple elements mounted in an array and placed in a duct or vessel through which gases pass. Flat tubular elements can be modified with the addition of fins to increase surface area.	Flat: Alloy 800 Stainless steel Round: Alloy 800 Alloy 600	30 30 30 30	4.6 4.6 4.6 4.6	1400 1200 1600 1800	760 650 870 980	220
<b>Flexible Heaters</b>	These heaters are applied to the surface of a pipe or vessel containing gases. They are well suited for curved surfaces and irregular shaped objects. Excellent for use in enclosures.	Polyimide Silicone rubber Coated fiberglass cloth	5 5 3.22	0.8 0.8 0.5	390 500 482	200 260 250	111 109 124,131 133
<b>Circulation Heaters</b>	Tubular heaters have multiple elements mounted in a screw plug or ANSI flange fitting and placed in a vessel through which fluid is passed. FLUENT <sup>®</sup> heaters are high-performance in-line heaters that provide on-demand heating of fluids which flow directly through the heater.	Round: Alloy 800 Alloy 600 444 Stainless steel (substrate tube), 316L stainless steel (baffle and fittings)	30 30 150	4.6 4.6 23	1600 1800 482 (internal)	870 980 250	305 445
<b>Air Heaters</b>	Duct heaters have multiple elements placed in a duct through which gases pass. Enclosure heaters prevent freezing and condensation in electrical and mechanical housings. Finned FIREBAR heaters have aluminized steel fins attached to a FIREBAR element. They are used for forced air heating and radiant heating in drivers, ovens and duct work. Finned strip have aluminized steel fins attached to a 375 heater. They are used for air heating, freeze protection and load bank resistors.	Alloy 800 Stainless steel Aluminum Stainless steel Alloy 800 Aluminized steel	20 to 30 15 5 Up to 50 30	3 to 4.6 2.3 0.8 7.7 4.7	1400 1200 150 1200 1100	760 650 66 650 595	377 403 405 103 395
<b>High-Temperature Heaters</b>	MULTICELL heaters have multiple elements placed in a duct or vessel through which gases pass. Designs are also available to heat a pass tube externally to isolate gas from the element. Excellent for use in high temperature/high pressure applications. Ceramic fiber heaters are used to construct chambers and furnaces through which gases are passed. Heaters function as high-temperature radiant heaters surrounding transfer pipes or other special vessels.	Alloy 600 Alloy 800 Molded ceramic fiber	60 60 30	9.3 9.3 4.6	2100 2100 2200	1150 1150 1205	411 419
<b>Specialty Heaters</b>	Coil/cable heaters are sinuated or wound into coils, which can be inserted into a pipe or vessel to heat flowing air or gases. Cable heaters readily lend themselves to applications where space is restricted. FLUENT heaters are high-performance in-line heaters that provide on-demand heating of fluids which flow directly through the heater.	Stainless steel or Alloy 600 444 Stainless steel (substrate tube), 316L stainless steel (baffle and fittings)	30 150	4.6 23	1200 482 (internal)	650 250	457 445

# Heater Selection Matrix



## Heating Within a Vacuum

Heater Type	Application Description	Sheath Materials	Typical Max. Watt Densities		Max. Operating Temperatures		Catalog Page
			W/in <sup>2</sup>	W/cm <sup>2</sup>	°F	°C	
<b>Cartridge/ Insertion Heaters</b>	These heaters are mounted in a vacuum vessel for radiant energy transfer.	Alloy 800	up to 35	5.4	1400	760	9
		Stainless steel	up to 35	5.4	1000	538	
<b>Tubular Heaters</b>	These heaters are mounted in a vacuum vessel for radiant energy transfer.	Alloy 800	30	4.6	1600	870	57
		Alloy 600	30	4.6	1800	980	57
<b>Flexible Heaters</b>	These heaters are applied to the exterior surface of a pipe or vessel. They are well suited for curved surfaces and irregular shaped objects. Note: Polyimide is the only flexible heater type recommended for use in the vacuum.	Polyimide	7	1.1	390	200	111
<b>High-Temperature Heaters</b>	MULTICELL heaters are mounted in a vacuum vessel for radiant energy transfer.	Alloy 600	60	9.3	2250	1230	411
	Ceramic fiber heaters surround the exterior surface of a vacuum vessel, using radiant energy for heat transfer.	Alloy 800	60	9.3	2250	1230	419
<b>Specialty Heaters</b>	ULTRAMIC advanced ceramic heaters are bonded or clamped to the object being heated.	Molded ceramic fiber	30	4.6	2200	1205	
	Coil/cable heaters are wound into a coil or sinuated pattern and mounted in a vacuum vessel for radiant energy transfer.	Aluminum nitride	1000	155	1112	600	
<b>Band/Barrel Heaters</b>	These heaters are applied to exterior surface of a pipe or vessel.	Alloy 600 or Stainless steel	20	3.1	1200	650	457
		Stainless steel with mineral insulation	100	15.5	1400	760	483