

Heater Selection Matrix

Heating Solids

Heater Type	Application Description	Sheath Materials	Typical Max. Watt Densities		Max. Operating Temperatures		Catalog Page
			W/in ²	W/cm ²	°F	°C	
Cartridge/Insertion Heaters	These heaters are inserted into a close fit hole (i.e. platens, dies and molds)	Incoloy® Stainless steel	up to 400 up to 400	62.0 62.0	1400 1000	760 540	9
Tubular Heaters	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: Incoloy®	40	6.2	1400	760	91
		Stainless steel	40	6.2	1200	650	91
		Round: Incoloy®	40	6.2	1600	870	59
		Stainless steel	40	6.2	1200	650	59
Flexible Heaters	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	175
		Silicone rubber	10	1.6	500	260	115
High-Temperature Heaters	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.	Inconel®	60	9.3	2100	1150	461
		Incoloy®	60	9.3	2100	1150	461
Specialty Heaters	ULTRAMIC® advanced ceramic heaters are bonded or clamped to the object being heated.	Aluminum nitride	1000	155	752	400	497
	Thick film conduction heaters are clamped to the part being heated.	Dielectric glass on 430 stainless steel substrate	75	11.6	1200	650	501
	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.	Stainless steel or Inconel®	30	4.6	1200	650	505
Strip/Clamp-On Heaters	These heaters are bolted or clamped to surface of, (i.e. dies, molds, ovens). Often used for freeze and moisture protection.	Aluminized steel with refractory insulation	100	15.5	1100	595	518
		Stainless steel with mineral insulation	140	21.7	1400	760	515
Band/Barrel Heaters	These heaters are clamped to cylindrical surfaces (i.e. extrusion barrels and nozzles).	Stainless steel with mineral insulation	100	15.5	1400	760	529
Radiant Heaters	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	562
		Stainless steel emitter strip	30	4.6	1300	700	558

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 ²	W/cm ²	°F	°C	
Cartridge/Insertion Heaters	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).	Incoloy®	Up to 300 in water	46.5	212 in water	100	9
Tubular Heaters	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: Incoloy®	60	9.3	1400	760	91
		Stainless steel	60	9.3	1200	650	91
		Round: Copper	60	9.3	350	180	59
		Incoloy®	60	9.3	1600	870	59
		Stainless steel	60	9.3	1200	650	59
		Steel	60	9.3	750	400	59
Flexible Heaters	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	175
		Silicone rubber	10	1.6	500	260	115
Immersion Heaters	FIREBAR® heaters have multiple elements mounted in a flange or screw plug fitting. They are immersed directly in a fluid or in a protective well.	Incoloy®	Up to 100	15.5	212 in water	100	187
	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.	Incoloy® 316 stainless steel Steel Copper	Up to 100	15.5	212 in water 1400 in air	100 760	187
Circulation Heaters	Thick film heaters are applied to the surface of a quartz tube. (Used in deionized water and aggressive chemical heating).	Quartz	100	15.5	266	130	359
	Tubular heaters have multiple elements mounted in a screw plug or ANSI flange fitting and placed in a vessel through which fluid is passed. FIREBAR or WATROD elements may be utilized.	Round: Incoloy® Copper Stainless steel Steel	60 60 60 60	9.3 9.3 9.3 9.3	1600 350 1200 750	870 180 650 400	367
Fluid Delivery Heaters	FREEFLEX® heaters have polymeric heating tubing, used to maintain temperature in medical applications where heated flexible tubing is required.	Polyimide	72 W/ft	22 W/m	212	100	421
	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	424
High-Temperature Heaters	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	469
Specialty Heaters	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 Inconel®	30	4.6	1200	650	505
Strip/Clamp-On Heaters	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	518
		Stainless steel with mineral insulation	140	21.7	1400	760	515
Band/Barrel Heaters	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	529

Heater Selection Matrix

Heating Gases

Heater Type	Application Description	Sheath Materials	Typical Max. Watt Densities		Max. Operating Temperatures		Catalog Page
			W/in ²	W/cm ²	°F	°C	
Cartridge/ Insertion Heaters	These heaters are mounted in pipes or vessels through which gases pass. They can be placed in protection tubes, making access and wiring easier.	Incoloy® or stainless steel	100	15.5	Contact Watlow		9
Tubular Heaters	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: Incoloy® Stainless steel Round: Incoloy® Inconel®	30 30 30 30	4.6 4.6 4.6 4.6	1400 1200 1600 1800	760 650 870 980	427
Flexible Heaters	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	5 5	0.8 0.8	390 500	200 260	175 115
Circulation Heaters	Tubular heaters have multiple elements mounted in a screw plug or ANSI flange fitting and placed in a vessel through which fluid is passed. FIREBAR or WATROD elements may be utilized.	Flat: Incoloy® 304 stainless steel Round: Incoloy® Inconel®	30 30 30 30	4.6 4.6 4.6 4.6	1400 1200 1600 1800	760 650 870 980	367
Air Heaters	Duct heaters have multiple elements placed in a duct through which gases pass.	Incoloy®	20 to 30	3 to 4.6	1400	760	427
	Enclosure heaters prevent freezing and condensation in electrical and mechanical housings.	Stainless steel	15	2.3	1200	650	453
	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.	Stainless steel	Up to 50	7.7	1200	650	110
	Finned Strip have aluminized steel fins attached to 375 heater. They are used for air heating, freeze protection and load bank resistors.	Aluminized steel	30	4.7	1100	595	445
High-Temperature Heaters	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.	Inconel® Incoloy®	60 60	9.3 9.3	2100 2100	1150 1150	461
	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.	Molded ceramic fiber	30	4.6	2200	1205	469
Specialty Heaters	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.	Stainless steel or Inconel®	30	4.6	1200	650	505

Heater Selection Matrix

Heating Within a Vacuum

Heater Type	Application Description	Sheath Materials	Typical Max. Watt Densities		Max. Operating Temperatures		Catalog Page
			W/in ²	W/cm ²	°F	°C	
Cartridge/ Insertion Heaters	These heaters are mounted in a vacuum vessel for radiant energy transfer.	Incoloy® Stainless steel	up to 35 up to 35	5.4 5.4	1400 1000	760 538	9
Tubular Heaters	These heaters are mounted in a vacuum vessel for radiant energy transfer.	Flat: Incoloy®	30	4.6	1400	760	91
		Stainless steel	30	4.6	1200	650	91
		Round: Incoloy®	30	4.6	1600	870	59
		Inconel®	30	4.6	1800	980	59
Flexible Heaters	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	175
		Silicone rubber	10	1.6	500	260	115
High-Temperature Heaters	MULTICELL heaters are mounted in a vacuum vessel for radiant energy transfer.	Inconel® Incoloy®	60 60	9.3 9.3	2250 2250	1230 1230	461
	Ceramic fiber heaters surround the exterior surface of a vacuum vessel, using radiant energy for heat transfer.	Molded ceramic fiber	30	4.6	2200	1205	469
Specialty Heaters	ULTRAMIC advanced ceramic heaters are bonded or clamped to the object being heated.	Aluminum nitride	1000	155	752	400	497
	Coil and cable heaters are wound into a coil or sinuated pattern and mounted in a vacuum vessel for radiant energy transfer.	Inconel® or Stainless steel	20	3.1	1200	650	505
Band/Barrel Heaters	These heaters are applied to exterior surface of a pipe or vessel.	Stainless steel with mineral insulation	100	15.5	1400	760	529