

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	Inserted into a close fit hole, i.e. platens, dies and molds.	Incoloy®	up to 300	46.5	1400	760	13
		Stainless steel	up to 300	46.5	1000	540	13
Tubular Heaters	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	99
		Stainless steel	40	6.2	1200	650	99
		Round: Incoloy®	40	6.2	1600	870	73
		Stainless steel	40	6.2	1200	650	73
Flexible Heaters	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	455
		Silicone rubber	10	1.6	500	260	421
Cast-in Heaters	Integrating a tubular or cable heating element into a casting to form a heated part. Commonly used to reduce the total number of equipment parts.	Aluminum	60	9.3	700	370	461
High Temperature/ High Performance Heaters	MULTICELL - 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, i.e. glass bending and tempering or super plastic forming and diffusion bonding of titanium and other exotic aerospace alloys. Ceramic fiber - Form the heaters into an oversized chamber to surround the object being heated. Using radiant and convection heat transfer, ceramic fiber heaters are used as ovens and furnaces. ULTRAMIC advanced ceramic - Bonded or clamped to the object being heated.	Inconel®	60	9.3	2250	1230	65
		Incoloy®	60	9.3	2250	1230	65
		Molded ceramic fiber	30	4.6	2200	1205	477
Band/ Barrel Heaters	Clamped to cylindrical surfaces. i.e. extrusion barrels and nozzles.	Aluminized steel with mica insulation	20-55	3-8.5	900	480	537
		Stainless steel with mica insulation	20-55	3-8.5	1000	540	537
		Stainless steel with mineral insulation	30-200	4.6-31	1400	760	505
Strip/ Clamp-on Heaters	Bolted or clamped to surface of, i.e. dies, molds, ovens. Often used for freeze and moisture protection.	Aluminized steel with refractory insulation	50	7.7	1200	650	567
		Stainless steel with mica insulation	30	5.4	1000	540	557
		Stainless steel with mineral insulation	100	15.5	1400	760	553
		Aluminized steel with mica insulation	25	3.8	900	480	557
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.	Inconel® or stainless steel	30	4.6	1200	650	581
Radiant Heaters	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. Note: quartz tubes supply quick heat up and cool down.	Incoloy® tubular	40	6.2	1500	815	629
		Molded ceramic fiber	20	3	2000	1095	623
		Quartz tube	45	7	1600	870	635
		Stainless steel emitter strip	30	4.6	1300	700	619

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	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	13
Tubular Heaters	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	99
		Stainless steel	60	9.3	1200	650	99
		Round: Copper	60	9.3	350	180	73
		Incoloy®	60	9.3	1600	870	73
		Stainless steel	60	9.3	1200	650	73
Steel	60	9.3	750	400	73		
Immersion Heaters	FIREBAR - Multiple elements mounted in a flange or screw plug fitting. Immersed directly in a fluid or in a protective well.	Incoloy®	Up to 100	15.5	212 in water	100	123
	WATROD - Multiple elements mounted in a flange or screw plug fitting. Immersed directly in a fluid or in a protective well.	Incoloy®	Up to 100	15.5	212 in water	100	123
		316 stainless steel			1400 in air	760	
Circulation Heaters	CAST-X - Cast with tubing through which liquids pass and are heated. Most often used where long life, resistance to contamination and reliability are critical.	Tubing 316 stainless steel	60	9.3	500	260	313-329
	FREEFLEX - Heater polymeric tubing. Used to maintain temperature in medical applications where heated flexible tubing is required.	Polyimide	72 W/ft	22 W/m	212	100	301
	Thick film - Applied to the surface of a quartz tube. Used in deionized water and aggressive chemical heating.	Quartz	100	15.5	266	130	309
	UNIVERSAL SOLVENT - Cast with tubing through which liquids pass and are heated. Most often used where long life, resistance to contamination and reliability are critical.	Tubing 316 stainless steel	60	9.3	392	200	332
	Tubular - 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®	60	9.3	1600	870	333
Copper		60	9.3	350	180	333	
Stainless steel		60	9.3	1200	650	333	
Steel		60	9.3	750	400	333	
Flexible Heaters	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	455
		Silicone rubber	10	1.6	500	260	421
Cast-in Heaters	Cast with tubing through which liquids pass and are heated. Most often used where long life, resistance to contamination and reliability are critical.	Aluminum	60	9.3	700	370	461
High Temperature/High Performance Heaters	Assemble heaters into a chamber which surrounds the tank, vessel, crucible or bath. Radiant and convection heat transfer heat the load.	Molded ceramic fiber	30	4.6	2200	1205	477
Band/Barrel Heaters	Clamped to cylindrical surfaces, most commonly used to heat liquids flowing through pipes as freeze protection.	Aluminized steel with mica insulation	20-55	3-8.5	900	480	537
		Stainless steel with mica insulation	20-55	3-8.5	1000	540	537
		Stainless steel with mineral insulation	30-200	4.6-31	1400	760	505
Strip/Clamp-on Heaters	Bolted or clamped to the wall of a tank or vessel. Used in food warming and other applications offering a flat mounting surface.	Aluminized steel with refractory insulation	50	7.7	1200	650	567
		Stainless steel with mica insulation	30	4.6	1000	540	557
		Stainless steel with mineral insulation	100	15.5	1400	760	553
		Aluminized steel with mica insulation	25	3.8	900	480	557
Coil/Cable Heaters	Wrapped or wound around pipe or vessel containing a liquid, or used directly as an immersion heater. Often used in applications with space limitations, i.e. photo processing equipment, scientific instruments and heat tracing.	Inconel® or stainless steel	30	4.6	1200	650	581
Nozzle/Slip-on Heaters	Syringe - Formed heater to fit cylindrical part. Often used in medical applications for heating contrast media. Often incorporates sensor and on-board system.	Lexan	2	0.31	185	85	605
		Silicone rubber	3	0.47	428	220	605

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	Mounted in pipes or vessels through which gases pass. Can be placed in protection tubes, making access and wiring easier.	Incoloy® or stainless steel	100	15.5	Contact Watlow		13
Tubular Heaters	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®	30	4.6	1400	760	99
		Stainless steel	30	4.6	1200	650	99
		Round: Incoloy®	30	4.6	1600	870	73
		Inconel®	30	4.6	1800	980	73
Circulation Heaters	Cast-in - Cast with tubing through which gases pass and are heated, functioning as a circulation heater. Most often used where long life, resistance to contamination and reliability are critical.	Tubing 316 stainless steel	60	9.3	500	260	313-329
	Tubular - 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®	30	4.6	1400	760	333
		304 stainless steel	30	4.6	1200	650	333
		Round: Incoloy®	30	4.6	1600	870	333
		Inconel®	30	4.6	1800	980	333
Air Heaters	Duct - Multiple elements placed in a duct through which gases pass.	Incoloy®	20 to 30	3 to 4.6	1400	760	392
	Enclosure - Prevents freezing and condensation in electrical and mechanical housings.	Stainless steel	15	2.3	1200	650	415
	Finned FIREBAR - Aluminized steel fins attached to a FIREBAR element. Used for forced air heating and radiant heating in drivers, ovens and duct work.	Stainless steel	Up to 50	7.7	1200	650	121
Flexible Heaters	Applied to the surface of a pipe or vessel containing gases. Well suited for curved surfaces and irregular shaped objects. Excellent for use in enclosures.	Polyimide	5	0.8	390	200	455
		Silicone rubber	5	0.8	500	260	421
High Temperature/ High Performance Heaters	MULTICELL - Multiple elements placed in a duct or vessel through which gases pass. Designs also available to heat pass tube externally to isolate gas from the element. Excellent for use in high temperature/high pressure applications.	Inconel®	60	9.3	2100	1150	65
		Incoloy®	60	9.3	2100	1150	65
	Ceramic fiber - 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	477
Strip/ Clamp-on Heaters	Generally modified with the addition of fins to increase surface area. Commonly used for air heating, drying ovens and space heaters.	Aluminized steel with refractory insulation	60	9.3	1200	650	567
		Stainless steel with mica insulation	20	3	1000	540	557
		Stainless steel with mineral insulation	100	15.5	1400	760	553
		Aluminized steel with mica insulation	20	3	900	480	557
Coil/Cable Heaters	Cable heaters are situated 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.	Inconel® or stainless steel	30	4.6	1200	650	581

Heater Selection Matrix

Heating Vacuums

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	Mounted in a vacuum vessel for radiant energy transfer.	Incoloy®	up to 35	5.4	1400	760	13	
		Stainless steel	up to 35	5.4	1000	540	13	
Tubular Heaters	Mounted in a vacuum vessel for radiant energy transfer.	Flat: Incoloy®	30	4.6	1400	760	99	
		Stainless steel	30	4.6	1200	650	99	
		Round: Incoloy®	30	4.6	1600	870	73	
		Inconel®	30	4.6	1800	980	73	
Flexible Heaters	Applied to the exterior surface of a pipe or vessel. 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	455	
		Silicone rubber	10	1.6	500	260	441	
Cast-in Heaters	Construction of a vacuum vessel with cast-in heaters so that the interior surface acts as a radiant heater. Possible zoned interior surface.	Aluminum	60	9.3	700	370	461	
High Temperature/ High Performance Heaters	MULTICELL - Mounted in a vacuum vessel for radiant energy transfer.	Inconel®	60	9.3	2250	1230	65	
		Incoloy®	60	9.3	2250	1230	65	
	Ceramic fiber - Surround the exterior surface of a vacuum vessel, using radiant energy for heat transfer.	Molded ceramic fiber	30	4.6	2200	1205	477	
Band and Barrel Heaters	Applied to exterior surface of a pipe or vessel.	ULTRAMIC advanced ceramic - Bonded or clamped to the object being heated.	Aluminum nitride	1000	155	752	400	471
		Stainless steel with mineral insulation	100	15.5	1400	760	505	
Coil/Cable Heaters	Wound into a coil or sinuated and mounted in a vacuum vessel for radiant energy transfer.	Inconel® or Stainless steel	20	3	1200	650	581	
Radiant Heaters	Mounted in a vacuum for radiant energy transfer.	Stainless steel	30	4.6	1300	700	635	

Code Number Index

How To Use This Index

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