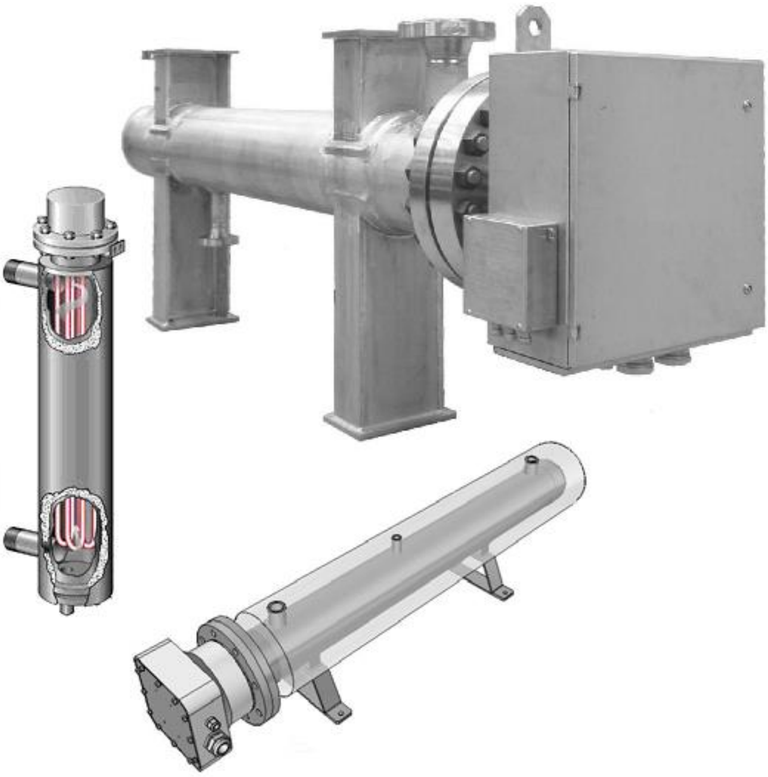
SYNHEAT

Manufacturer of Electric Heating Elements and Controls

Circulation Heaters



Circulation Heaters consist of an insulated pipe body containing a Screw-In Plug Heater or Flange Immersion Heater assembly. They are designed to heat moving air, gases or liquids through the vessel in a single pass or re-circulating, multi-pass system. These units can be mounted horizontally or vertically and are available with a variety of pipe thread and flanged inlet and outlet options. Terminal housings are available for indoor, outdoor (weather-proof) environments. Many options are available including thermostats, high limit and process thermocouples or RTD sensors.

Circulation Heaters Info :-

Material	Tube and element in stainless steel AISI 304, 316L
JIS or ANSI STANDARD FLANGE SIZES & MATERIALS	1-1/2” up to 24” Carbon Steel or Stainless Steel Flange Materials
BSP,BSPP or NPT STANDARD PLUG SIZES & MATERIALS	1”, 1 ¼”, 1 ½”, 2”, 2 ½” Brass or Stainless Steel Materials
Design	Wide range of electrical connections and water couplings Can also be supplied with thermal insulation Can also be supplied with different types of connection boxes
Water pressure	Depending on model: max 5- 10 bar water pressure
Safety Optional	The elements design built-in with Thermostat, temperature sensor, thermal cut-off, flow sensor, cable harness, connection box, thermal insulation, air vent, drainage valve, etc

Sheath Materials	Stainless Steel 304, 316L or Incoloy 800 Materials
Application	Air, Process Water, De-Ionized, Mild Acids, Lubricating Oil & Fuel Oils
Watt density	6.5 W/In^2 15 W/In^2 23 W/In^2 45 W/In^2 60W/In^2 or any other

Typical Applications

Circulation heaters are used to maintain, raise, preheat and boost process temperatures from -5° C to 500° C for a wide variety of liquids and gases found in commercial, industrial and military applications.

• Adhesives • Air Heating (Process) • Ammonia • Anodizing Equipment
• Automotive and Engines • Chemical Processing • Curing • Cryogenic Processing
• Degreasing Tanks • Desalinization Equipment • Drying
• Food Processing • Freeze Protection • Fuel Oils • Gasoline Refining
• Heat Transfer Systems • High Pressure Air or Gases • Hydraulic Oils
• Laboratory Work • Lubrication Oils • Metal Cleaning Baths • Nitrogen
• Oil Purifiers • Oil Refining • Oils • Paint Lines • Pasteurizing • Pipeline Heating

• Plastic Machinery and Processes • Platens • Plating Tanks • Preheating • Presses
• Process Air and Liquids • Purification Systems • Rinsing/Cleaning
• Rolls and Cylinders • Steam Heating • Superheating • Tank Heating Process Storage)
• Wash Tanks • Waste Water/Sewage Treatment • Water Process (Deion Potable)

Engineering Information

Calculating KW Requirements

Heater design and performance for your application.
When calculating the power required to heat a material flowing through the circulation heater, the KW equation shown bellow can be applied. This equation is based on the criteria that there is no vaporization occurring in the heater. The KW equation incorporates a 20% safety factor, allowing for heat losses of the jacket and piping, variation in voltage and wattage tolerance of the elements.

$$KW = \frac{M \times \Delta T°F \times Cp \times S.F.}{3412}$$

Where:
KW = power in kilowatts
M = flow rate in Lbs/Hr
ΔT = temperature rise in °F
(The difference between the minimum inlet temperature and maximum outlet temperature.)
Cp = specific heat in BTU/Lb °F
S.F. = safety factor, 1.2
3412 = conversion of BTU to KWH

Water Heating Example:
Application data: 6 GPM flow with an inlet temperature of 77° F and an outlet temperature of 140° F. First, convert the flow rate to Lbs/Hr.

$$\frac{6 \text{ Gal}}{\text{Min}} \times \frac{1 \text{ Ft3}}{7.48 \text{ Gal}} \times \frac{60 \text{ Min}}{1 \text{ Hr}} = 64.17 \text{ Ft3/Hr}$$

Obtain the specific heat (Cp) and density from Table III,

48.13 Ft3/Hr x 62.4 Lbs/Ft3 = 3003 Lbs/H

Now calculate KW:

$$KW = \frac{3003 \text{ Lbs/Hr} \times (140-77)°F \times 1 \text{ BTU/Lbs°F} \times 1.2}{3412}$$

KW = 67

Oil Heating Example:
Application data: Fuel oil heavy #5 #6 with a flow rate of 125 GPM, an inlet temperature of 50°F and an outlet temperature of 65°F. First, convert the flow rate to Lbs/Hr.

$$\frac{125 \text{ Gal}}{\text{Min}} \times \frac{1 \text{ Ft3}}{7.48 \text{ Gal}} \times \frac{60 \text{ Min}}{1 \text{ Hr}} = 1003 \text{ Ft3/Hr}$$

1003 Ft3/Hr x 58.9 Lbs/Ft3 = 59,077 Lbs/Hr

Now calculate KW:

$$KW = \frac{59{,}077 \text{ Lbs/Hr} \times (65-50)°F \times .41 \text{ BTU/Lbs°F} \times 1.2}{3412}$$

KW = 128

Gas Heating Example:
Application data: Nitrogen is flowing at 125 ACFM and 5 PSIG pressure. The inlet temperature of the air is 60° F and the outlet temperature is 200° F. First, convert the flow rate to SCFM.

$$SCFM = ACFM \times \frac{PSIA}{14.7 \text{ PSIA}} \times \frac{530°R}{(T°F+460°R)}$$

Where:
T = Inlet temperature in °F
ACFM = Actual cubic feet per minute (This is the actual volume flow rate value at inlet temperature and operating pressure, PSIA.)
SCFM = Standard cubic feet per minute (This is the volume flow rate value at 70° F and atmospheric pressure, 14.7 PSIA.)
PSIA = Pounds per square inch, absolute
PSIG = Pounds per square inch, gauge
PSIA = PSIG + 14.7 (Note: If value is given as psi, it is implied to be PSIG.)

$$125 \text{ ACFM} \times \frac{19.7 \text{ PSIA}}{14.7 \text{ PSIA}} \times \frac{530°R}{(90°F+460°R)} = SCFM$$

161 = SCFM

Now convert to Lbs/Hr.

$$161 \text{ SCFM} \times \frac{60 \text{ Min}}{1 \text{ Hr}} \times \frac{.073 \text{ Lbs}}{\text{Ft3}} = 705 \text{ Lbs/Hr}$$

Densities and specific heats are at atmospheric pressure (14.7 PSIA) and 70° F, except the temperature for steam is 212° F.

Now calculate KW:

$$KW = \frac{705 \text{ Lbs/Hr} \times (200-60)°F \times 0.25 \text{ BTU/Lbs°F} \times 1.2}{3412}$$

KW = 8.7

PHYSICAL PROPERTIES OF MATERIALS

Liquids

Substance	Specific Heat Btu/lb.° F	Heat of Vaporization Btu/lb.	Boiling Point ° F	Density Weight in lbs./cu.ft.	Weight in lbs./gal.
Acetic acid 100%	0.48	175	245	65.4	8.74
Acetone 100%	0.51	225	133	49	6.5
Allyl Alcohol,	0.665	293	207	55	7.35
Ammonia 100%	1.1	589	-27	47.9	6.4
Amyl Alcohol	0.65	216	280	55	7.35
Anilline	0.514	198	63	64.6	8.63
Arochier Oil	0.28		650	89.7	12.0
Brine Sosium Chloride,25%	0.786	730	220	74.1	9.9
Butly Alcohol	0.687	254	244	45.3	6.0
Butyric Acid	0.515		345	50.4	6.73
Carbon Tetrachloride	0.21		170	98.5	13.16
Corn Syrup, Dextrose	0.65+-		231	87.8	11.73
Cottonseed Oil	0.47			59.2	7.9
Ether	0.503	160	95	46	6.14
Ethyl Acetate	0.475	183.5	180	51.5	6.88
Ethyl Alcohol, 95%	0.60	370		50.4	6.74
Ethyl Bromide	0.215	108	101	90.5	12.1
Ethyl Chloride	0.367	166.5	54	57	7.62
Ethyl lodide	0.161	81.3	160	113	15.1
Ethylene Bromide	0.172	83	270	120	16.0
Ethylene Chloride	0.299	139	240	71.7	9.58
Ethylene Glycol	0.555		387	70.0	9.36
Fatty Acid Aleic	0.7+-		547	55.4	7.4
Fatty Acid Palmitic	0.653		520	53.1	7.1
Fatty Acid Stearic	0.550		721	52.8	7.06

Substance	Specific Heat Btu/lb.° F	Heat of Vaporization Btu/lb.	Boiling Point ° F	Density Weight in lbs./cu.ft.	Weight in lbs./gal.
Formic Acid	0.525	216	213	69.2	9.25
Freon 11	0.208		74.9	92.1	12.3
Freon 12	0.232	62	-21.6	81.8	10.93
Freon 22	0.300		-41.36	74.53	9.96
Fruit, Fresh, Avg	0.88			50-60	6.7-8.0
Glycerine	0.58		556	78.7	10.5
Heptane	0.49	137.1	210	38.2	5.1
Hexane	0.6	142.5	155	38.2	5.1
Honey	0.34			2.22	
Hydrochloride, 10%	0.93		221	66.5	8.89
Lard	0.64			57.4	7.67
Linseed Oil	0.44		552	57.9	7.74
Maple Syrup	0.48				
Mercury	0.033	117	675	845	113.0
Methyl Acetate	0.47	176.5	133	54.8	7.3
Methyl Chloroform	0.26	95	165	82.7	11.0
Methylene Chloride	0.288	142	104	82.6	11.0
Milk, 3.5%	0.90			64.2	8.58
Molasses	0.60		220+-	87.4	11.68
Nitric Acid, 7%	0.92	918	220	64.7	8.65
Nitric Acid, 95%	0.5	207	187	93.5	12.5
Nitrobenzene	0.35	142.2	412		
Olive Oil	0.47		570	58	7.75
Perchlorethylene	0.21	90	250	101.3	13.54
Asphalt	0.42			62.3	8.33
Benzene	0.42	170	175	56	7.48
Fuel Oil #1 (Kerosene)	0.47	86	440+-	50.5	6.75
Fuel Oil #2	0.44			53.9	7.2
Fuel Oil Medium #3 #4	0.425	67	580+-	55.7	7.44
Fuel Oil Heavy #5 #6	0.41			58.9	7.87
Gasoline	0.53	116	280+-	41-43	5.5-5.75
SAE 10-30	0.43			55.4	7.4
SAE 40-50	0.43			55.4	7.4
Napthalene	0.396	103	424+-	54.1	7.23
Paraffin Melted 150'F +	0.69	70	572	56	7.5
Propane (Compressed)	0.576		-48.1	0.13	0.02

Substance	Specific Heat Btu/lb.° F	Heat of Vaporization Btu/lb.	Boiling Point ° F	Density Weight in lbs./cu.ft.	Weight in lbs./gal.
Toluene	0.42			53.7	7.18
Transformer Oils	0.42			56.3	7.5
Phoenol (Carbollic Acid)	0.56		346	66.6	8.9
Phosphoric Acid, 10%	0.93			65.4	8.74
Phosphoric Acid, 20%	0.85			69.1	9.24
Polyurethane foam Components :					
Part A Isocyanate	0.6			77	10.3
Part B Polyoil Resin	0.7			74.8	10.0
Potassium 1000°F	0.18	893	1400	44.6	5.96
Propionic Acid	0.56	177.8	286	61.8	8.26
Propyl Alcohol	0.57	295.2	208	50.2	6.7
Seawater	0.94			64.2	8.58
Sodium 1000°F	0.30	1810	1638	51.2	6.84
Sodium Hydroxide Caustic Soda					
30% Sol.	0.84			82.9	11.08
50% Sol.	0.78			95.4	12.75
Soybean Oil	0.24-0.33			57.4	7.67
Starch				95.4	12.75
Sucrose , 40% Sugar Syrup	0.66		214	73.5	9.8
Sucrose , 60% Sugar Syrup	0.74		218	80.4	10.75
Sulfur, Melthed 500°F	0.24	120	832	112	14.97
Sulfuric Acid, 20%	0.84		218	71	9.5
Sulfuric Acid, 60%	0.52		282	93.5	12.5
Sulfuric Acid, 98%	0.35	219	625	114.7	15.33
Trichloroethylene	0.23	103	188	91.3	12.2
Trichloro-Trifluoroethane	0.21	63	118	94.6	12.64
Turpentine	0.42	133	319	54	7.2
Vegetable Oil	0.43			57.5	7.69
Water	1.00	965	212	62.5	8.34
Xylene	0.411	149.2	288	53.8	7.2

*At near room temperature. ** Average value shown. Boils at various temperatures within the distillation range for the material.

- *1 kJ/(kg K) = 0.2389 kcal/(kg °C) = 0.2389 Btu/(lb_m °F)*
- *T(°C) = 5/9[T(°F) - 32]*

Gases and Vapors

Substance	Specific Heat @ Constant Pressure	Density Weight in lbs./cu.ft @70°F & Atmospheric Pressure	Specific Gravity Relative to Air
Acetylene (ethyne) C_2H_2	0.35	0.682	0.907
Air	0.24	0.075	1.00
Ammonia NH_3	0.523	0.0448	0.596
Argon A	0.124	0.1037	1.379
Butane C_4H_{10}	0.395	0.1554	2.067
Carbon Dioxide CO_2	0.199	0.115	1.529
Carbon Monoxide **CO**	0.248	0.0727	0.967
Chlorine Cl_2	0.115	0.1869	2.486
Ethane C_2H_6	0.386	0.0789	1.049
Ethylene C_2H_4	0.40	0.0733	0.975
Ethylene C_2H_4	0.40	0.0733	0.975
Helium **He**	1.25	0.0104	0.1381
Hydrogen Chloride **HCl**	0.191	0.0954	1.268
Hydrogen H_2	3.42	0.0052	0.0695
Hydrogen Sulphide H_2S	0.243	0.0895	1.19
Methane CH_4	0.593	0.0417	0.554
Methyl Chloride CH_3Cl	0.24	0.1342	1.785
Natural Gas	0.56	0.0502	0.667
Nitric Oxide **NO**	0.231	0.078	1.037
Nitrogen N_2	0.247	0.0727	0.967
Nitrous Oxide N_2O	0.221	0.1151	1.53
Oxygen O_2	0.217	0.0831	1.105
Propane C_3H_4	0.393	0.1175	1.562
Propene Propylene C_3H_6	0.358	0.1091	1.451
Sulpher Dioxide SO_2	0.154	0.1703	2.264
Water Vapor @ 212°F H_2O	0.482	0.037	0.489

Natural gas values are representative. Specific contents of samplings are required for exact characteristics.