WATT DENSITY AND OPERATING TEMPERATURE GUIDELINES FOR VARIOUS MATERIALS

23T: The information presented is only intended as a guideline. Adjustments may be necessary should variations occur in heat transfer, flow rates and temperatures. The sheath material and watt density selected must be based upon the specific dynamics of the application. See complete **Corrosion Resistance of Sheath Materials (24T**).

Material To Be Heated	Maximum Operating Temp (°F)	Max. Watt Density (W/sq. in.)	Sheath Material
Acid Solutions (Mild)			
Acetic	180	40	C-20, Quartz
Boric	257	40	Quartz
Carbonic	180	40	
Chromic	180	40	C-20, Quartz
Citric	180	23	316 S.S.
Fatty Acids	150	20	316 S.S.
Lactic	122	10	316 S.S.
Malic	122	10	316 S.S.
Nitric	167	20	Quartz
Phenol—2.4 Disulfonic	180	40	316 S.S.
Phosphoric	180	23	Quartz
Phosphoric (Aerated)	180	23	Stainless Steel
Proponic	180	40	Copper
Tannic	167/180	23/40	Quartz
Tartaric	180	40	316 S.S.
Acetaldehyde	180	10	Copper
Acetone	130	10	Incoloy
Air	C/F		Incoloy
Alcyl Alcohol	200	10	Copper
Alkaline Solutions	212	40	Steel
Aluminum Acetate	122	10	316 S.S.
Aluminum Potassium Sulfate	212	40	Copper
Ammonia Gas	C/F		Steel
Ammonium Acetate	167	23	Incoloy
Amyl Acetate	240	23	Incoloy
Amyl Alcohol	212	20	Stainless Steel
Aniline	350	23	Stainless Steel
Asphalt	200-500	4-10	Steel
Barium Hydroxide	212	40	316 S.S.
Benzene, liquid	150	10	Copper
Butyl Acetate	225	10	316 S.S.
Calcium Bisulfate	400	20	316 S.S.
Calcium Chloride	200	5-8	Quartz
Carbon Monoxide	—	23	Incoloy
Carbon Tetrachloride	160	23	Incoloy
Caustic Soda 2%	210	48	Incoloy
10%	210	25	Incoloy
75%	180	25	Incoloy
Citrus Juices	185	23	316 S.S.
Degreasing Solution	275	23	Steel
Dextrose	212	20	Stainless Steel
Dyes & Pigments	212	23	Stainless Steel
Electroplating Baths			
Cadmium	180	40	Stainless Steel
Copper	180	40	Quartz
Dilute Cyanide	180	40	316 S.S.
Potassium Cyanide	180	40	Quartz
Rochelle Cyanide	180	40	Stainless Steel
Sodium Cyanide	180	40	Stainless Steel
Ethylene Glycol	300	30	Steel
Formaldehyde	180	10	Stainless Steel
Freon gas	300	2-5	Steel

Material To Be Heated	Maximum Operating Temp (°F)	Max. Watt Density (W/sq. in.)	Sheath Material
Fuel Oils			
Grades 1 & 2 (distilate)	200	23	Steel
Grades 4 & 5 (residual)	200	13	Steel
Grades 6 & bunker C (residual)	160	8	Steel
Gasoline	300	23	Steel
Gelatin; Liquid	150	23	Stainless Steel
Solid	150	5	Stainless Steel
Glycerine	500	10	Incoloy
Glycerol	212	23	Incoloy
Grease; Liquid	—	23	Steel
Solid	—	5	Steel
Hydrazine	212	16	Stainless Steel
Hydrogen	C/F	—	Incoloy
Hydrogen Sulfide	C/F	—	316 S.S.
Linseed Oil	150	50	Steel
Lubrication Oil			
SAE 10	250	23	Steel
SAE 20	250	23	Steel
SAE 30	250	23	Steel
SAE 40	250	13	Steel
SAE 50	250	13	Steel
Magnesium Chloride	212	40	C-20, Quartz
Manganese Sulfate	212	40	Quartz
Methanol gas	C/F	—	Stainless Steel
Methylchloride	180	20	Copper
Mineral Oil	200	23	Steel
	400	16	Steel
Molasses	100	4-5	Stainless Steel
Naptha	212	10	Steel
Oil Draw Bath	600	23	Steel
Oils (see specific type)	400	24	Steel
Paraffin or Wax (liquid state)	150	16	Steel
Perchloroethylene	200	23	Steel
Potassium Chlorate	212	40	316 S.S.
Potassium Chloride	212	40	316 S.S.
Potassium Hydroxide	160	23	Monel
Soap, liquid	212	20	Stainless Steel
Sodium Acetate	212	40	Steel
Sodium Cyanide	140	40	Stainless Steel
Sodium Hydride	720	28	Incoloy
Sodium Hydroxide	—	See Caustic Soda	—
Sodium Phosphate	212	40	Quartz
Steam, flowing	300	10	Incoloy
	500	5-10	Incoloy
	700	5	Incoloy
Sulfur, Molten	600	10	Incoloy
Toluene	212	23	Steel
Trichlorethylene	150	23	Steel
Turpentine	300	20	Stainless Steel
Vegetable Oil & Shortening	400	30	Stainless Steel
Water (Process)	212	60	S.S., Incoloy

Properties of Heat Transfer Oils: Sheath material utilized is typically steel

Material	Maximum Fluid Temperature °F	Maximum Sheath Temperature °F	Maximum w/in.^{2}	Density Weight in lbs/cu. ft.	Specific Heat	Flammability °F			Minimum Velocity of Material Through Elements in Ft./Second			
						Flash Point	Fire Point	Auto Ignition	8 w/in.^{2}	16 w/in.^{2}	23 w/in.^{2}	30 w/in.^{2}
Caloria HT 43	475	680	12	52.0	0.43	400	—	670	1.5	2.5	3	4
Dowtherm A	725	835	20	66.0	0.38	255	275	1150	.5	1	2	3
Dowtherm J	575	650	20	54.1	0.43	145	155	806	1	2	3	4.5
Dowtherm LF	575	675	20	63.0	0.40	260	280	1020	.7	1.5	2.5	3.5
Dowtherm G	675	775	20	68.6	0.37	305	315	1150	.7	1.5	2.5	3.5
Dowtherm HT	625	700	20	60.6	0.37	—	—	—	1.5	2.5	3.5	5
Marlotherm S	675	695	12	60.8	0.43	374	—	932	1.5	3	5	7
Mobiltherm 603	550	625	20	53.9	0.44	380	—	—	1.5	3	5	7
Multitherm PG-1	565	640	12	54.2	0.45	340	385	690	1	2	3	4
Multitherm IG-2	575	650	20	54.8	0.47	440	500	700	.8	1.7	2.3	3
Syltherm XLT	475	550	12	52.6	0.40	116	130	662	1.5	2.5	4	5
Syltherm 800	725	800	12	58.7	0.38	350	380	725	1.5	3	5	7
Therminol 44	400	475	12	57.8	0.47	405	438	705	1	2	3	4
Therminol 55	560	605	12	55.2	0.46	350	410	675	1.5	2.5	3.5	5
Therminol 59	575	650	20	60.6	0.41	302	335	770	1.5	2.5	3.5	5
Therminol 60	560	655	20	62.6	0.39	310	320	835	1.5	3	5	7
Therminol 75	675	805	20	68.8	0.38	390	440	1000	1	2	3	4
Therminol LT	475	650	20	53.7	0.43	134	150	805	1.5	2.5	4	5
Therminol VP-1	725	800	20	66.7	0.37	255	280	1150	1	2	3	4
UCON 500	475	550	12	64.8	0.47	540	600	750	1	2	3	4

C/F –Consult Factory NOTE: C-20 designates Carpenter Stainless #20