

## Properties of Materials

### Properties of Metals

Material	*Density lb./in <sup>3</sup>	Specific Heat Btu (lb) (°F)	*Thermal Conductivity (Btu) (in.) (hr.) (ft <sup>2</sup> ) (°F)	Melting Point °F (Lowest)	Latent Heat of Fusion Btu/lb.	*Thermal Expansion in/in/°F × 10 <sup>-6</sup>
Aluminum 1100-0	.098	.24	1540	1190	169.0	13.1
Brass, Yellow	.306	.096	816	1710		11.3
Copper	.324	.095	2736	1981	91.1	9.2
Gold	.698	.032	2064	1945	29.0	7.9
Incoloy® 800	.290	.13	80	2500		7.9
Inconel® 600	.304	.13	103	2500		5.8
Invar 36% Ni	.289	.12	76	2600		0.6
Iron, Malleable Cast	.260	.11	320	2250		6.0
Lead, Solid	.410	.032	241	621	11.3	16.3
Lead, Liquid	.372	.037	107			
Magnesium	.063	.25	1068	1202	160.0	14.0
Molybdenum	.369	.071	980	4750	126.0	2.94
Monel 400	.319	.11	151	2400		6.4
Nickel 200	.321	.12	520	2615	133.0	5.8
Nichrome (80% Ni-20% Cr)	.302	.11	104	2550		7.3
Palladium 99.5%	.432	.06	490	2830	69.5	6.5
Platinum	.775	.035	480	3217	49.0	4.9
Silver	.379	.057	2904	1761	38.0	11.4
Solder (50% Pb-50% Sn)	.321	.051	323	421	17	13.0
Steel, Mild	.284	.12	460	2760		6.7
Steel, Stainless 304	.290	.12	113	2550		9.6
Steel, Stainless 430	.280	.11	181	2600		5.8
Tantalum	.600	.035	372	5425		3.57
Tin, Solid	.264	.065	468	449	26.1	12.8
Tin, Liquid	.246	.052	228			
Titanium 99.0%	.163	.13	112	3020	187	4.8
Tungsten	.697	.03	1140	6170	79.0	2.45
Type Metal (85% Pb-15% Sn)	.387	.04		500	14	
Zinc	.258	.096	785	787	43.3	22.0
Zirconium	.234	.067	145	3350	108	3.22

### Properties of Non-Metallic Solids

Asphalt	.076	.22	5.16	250	40	
Boron Nitride (Compacted)	.082	.33	125.00	5430		1-4
Brick, Hard	.072	.24	9.00			3-6
Carbon	.080	.20	165.00	6700		0.3-2.4
Cellulose Acetate	.048	.40	1.20-2.30			61-83
Delrin	.050	.35	1.56			45
Glass, Crown	.101	.16	7.50			5
Ice	.033	.49	15.60	32	144	28.3
Mica	.098	.12	4.80			18
MgO (Compacted)	.110	.21	14.40			7.7
Nylon	.042	.45	1.70			61-63
Paper	.033	.33	0.84			
Paraffin	.033	.69	1.60	133	63	
Phenolic (Cast Resin)	.047	.35	1.1			44-61
Polyethylene (High Density)	.035	.55	3.36			94
Polystyrene	.038	.32	0.70-1.00			33-44
Rubber, Hard	.043	.48	1.12			340
Steatite	.073	.20	20.40			4.5-5.5
Sulfur	.072	.20	1.80	230	17	
Teflon	.078	.25	1.70			55
Vinylidene	.062	.32	2.00			28-100
Wood, Oak	.027	.57	1.22			

### Properties of Liquids

Liquid	*Density lb./Gal.	Specific Heat Btu (lb) (°F)	*Thermal Conductivity (Btu) (in.) (hr.) (ft <sup>2</sup> ) (°F)	Boiling Point °F	Heat of Vaporization Btu/lb.
Acetic Acid, 20%**	8.60	.91	3.70	214±	810±
Alcohol (ethyl)	6.74	.60	1.30	173	367
Brine (25% NaCl)**	9.91	.79	2.88	220±	730±
Caustic Soda (18% NaOH)**	10.00	.84	3.90	221±	795±
Dowtherm A	8.80	.44	0.96	496	42.2
Ethylene Glycol	9.36	.56		387	
Freon 12	10.94	.23	0.49	-21.6	62
Glycerine	10.52	.58	1.97	556	
Hydrochloric Acid 10%**	8.89	.93	3.90	221	
Nitric Acid, 7%**	8.65	.92	3.80	220±	918±
Oils (Petroleum)	7.35	.45			
Paraffin (melted)	7.49	.69±	1.68	572	70
Potassium (K)***	5.96	.18	253.20	1400	893
Sodium (Na)***	6.84	.30	446.40	1638	1810
Sulfuric Acid 10%**	9.90	.92	4.00	216	
Therminol FR-2	12.10	.30	0.70	648±	
Turpentine	7.22	.42	0.90	319	133
Vegetable Oil	7.75	.43±	1.10		
Water	8.34	1.00	4.08	212	965



\* At or near room temperature  
 \*\* Percent concentration by weight in H<sub>2</sub>O solution

\*\*\* At 1000°F  
 ± Approximate

### Properties of Gases

Gas	*Density lb./ft <sup>3</sup>	Specific Heat Btu/(lb) (°F)	*Thermal Conductivity (Btu) (in.) (hr.) (ft <sup>2</sup> ) (°F)
Air at 80°F	.073	.240	.18
at 400°F	.046	.247	.27
Ammonia	.044	.523	.16
Argon	.102	.125	.12
Carbon Dioxide	.113	.199	.12
Carbon Monoxide	.072	.248	.18
Chlorine	.184	.115	.06
Helium	.011	1.250	1.10
Hydrogen	.0052	3.390	.13
Methane	.0447	.590	.21
Nitrogen	.072	.248	.19
Oxygen	.082	.218	.18
Sulphur Dioxide	.172	.152	.07

### Air Density Table (lb./cu. ft.)

Temp °F	Specific Heat	Gauge Pressure						
		0	10	50	100	200	250	300
0	.240	.086	.145	.380	.674	1.261	1.555	1.848
10	.240	.085	.142	.372	.659	1.234	1.522	1.808
20	.240	.083	.139	.364	.646	1.208	1.490	1.771
30	.240	.081	.136	.357	.632	1.184	1.459	1.735
40	.240	.079	.133	.350	.620	1.160	1.430	1.700
50	.240	.078	.131	.343	.608	1.137	1.402	1.667
60	.240	.076	.128	.336	.596	1.115	1.375	1.635
70	.240	.075	.126	.330	.585	1.094	1.349	1.600
80	.240	.074	.124	.324	.574	1.074	1.324	1.574
90	.240	.072	.121	.318	.563	1.055	1.300	1.546
100	.240	.071	.119	.312	.553	1.036	1.277	1.518
120	.240	.068	.115	.301	.534	1.000	1.233	1.466
140	.240	.066	.111	.291	.516	.967	1.192	1.417
160	.241	.064	.108	.282	.500	.936	1.153	1.371
180	.241	.062	.104	.273	.484	.906	1.117	1.328
200	.242	.060	.101	.265	.470	.879	1.084	1.288
220	.242	.058	.098	.257	.456	.853	1.052	1.250
240	.242	.057	.095	.250	.443	.829	1.022	1.215
260	.243	.055	.093	.243	.430	.806	.993	1.181
280	.243	.054	.090	.236	.419	.784	.966	1.149
300	.244	.052	.088	.230	.408	.763	.941	1.119
320	.244	.051	.086	.224	.397	.744	.917	1.090
340	.244	.050	.083	.219	.387	.725	.894	1.063
360	.246	.048	.081	.213	.378	.707	.872	1.037
380	.246	.047	.079	.208	.369	.691	.851	1.012
400	.247	.046	.078	.203	.360	.674	.832	.989
420	.247	.045	.076	.199	.352	.659	.813	.966
440	.247	.044	.074	.194	.344	.644	.795	.945
460	.248	.043	.073	.190	.337	.630	.777	.924
480	.248	.042	.071	.186	.330	.617	.761	.905
500	.249	.041	.070	.182	.323	.604	.745	.886
520	.249	.041	.068	.178	.316	.592	.730	.868
540	.249	.040	.067	.175	.310	.580	.715	.850
560	.250	.039	.065	.171	.304	.569	.701	.834
580	.251	.038	.064	.168	.298	.558	.688	.818
600	.252	.037	.063	.165	.292	.547	.675	.802
620	.252	.037	.062	.162	.287	.537	.662	.787
640	.252	.036	.061	.159	.281	.527	.650	.773
660	.253	.035	.060	.156	.277	.518	.639	.759
680	.253	.035	.059	.153	.272	.509	.627	.746
700	.254	.034	.058	.151	.267	.500	.616	.733
720	.254	.034	.057	.148	.263	.492	.606	.721
740	.255	.033	.056	.146	.258	.483	.596	.709
760	.256	.033	.055	.143	.254	.475	.586	.697
780	.256	.032	.054	.141	.250	.468	.577	.686
800	.257	.032	.053	.139	.246	.460	.568	.675
820	.257	.031	.052	.137	.242	.453	.559	.664
840	.257	.031	.051	.134	.238	.446	.550	.654
860	.258	.030	.051	.132	.235	.439	.542	.644
880	.259	.030	.050	.130	.231	.433	.534	.634
900	.260	.029	.049	.129	.228	.427	.526	.625
920	.260	.029	.048	.127	.225	.420	.518	.616
940	.260	.028	.048	.125	.221	.414	.511	.607
960	.261	.028	.047	.123	.218	.408	.504	.599
980	.261	.028	.046	.121	.215	.403	.497	.590
1000	.262	.027	.046	.120	.212	.397	.490	.582
1020	.262	.027	.045	.118	.209	.392	.483	.574
1040	.263	.026	.044	.117	.207	.387	.477	.567
1060	.264	.026	.044	.115	.204	.382	.470	.559
1080	.264	.026	.043	.114	.201	.377	.464	.552
1100	.265	.025	.043	.112	.199	.372	.458	.545
1120	.265	.025	.042	.111	.196	.367	.453	.538
1140	.265	.025	.042	.108	.194	.363	.447	.531
1160	.266	.025	.041	.108	.191	.358	.441	.525
1180	.266	.024	.041	.107	.189	.354	.436	.518
1200	.267	.024	.040	.105	.187	.349	.431	.512