

PHYSICAL PROPERTIES OF MATERIALS

6T: Metals and non-Metallic Solids

| SUBSTANCE | Specific Heat | Heat of Fusion Btu/lb. | Melting Point °F | Density—Weight in lbs./cu. ft. |
|-------------------------|---------------|------------------------|------------------|--------------------------------|
| Aluminum 2024-T3 | .24 | 167 | 935 | 173 |
| Aluminum 1100-0 | .24 | 169 | 1190 | 169 |
| Antimony | .23 | 25 | 1166 | 423 |
| Asbestos Cement Board | .25 ± | .. | ... | 121 |
| Asphalt | .40 | 40 | 250 | 131 |
| Bakelite Resin, Pure | .3-4 | .. | ... | 74-81 |
| Barium | .068 | .. | 1562 | 225 |
| Beeswax | ... | 75 | 144 | 60.5 |
| Beryllium | .052 | .. | 2345 | 113.5 |
| Bismuth | .031 | 23 | 520 | 612 |
| Boron | .309 | .. | 4172 | 144 |
| Brass, 70% | .096 | .. | 1750 | 532 |
| Brickwork & Masonry | .220 | .. | ... | 131 |
| Bronze (75%Cu; 25%Sn) | .082 | 75 | 1832 | 541 |
| Cadmium | .055 | 23.8 | 610 | 540 |
| Calcium | .149 | 140 | 1564 | 96.7 |
| Calcium Chloride | .17 | .. | 1422 | 157 |
| Carbon | .280 | .. | 6700 | 138 |
| Cement, Portland, Loose | .19 | .. | ... | 94 |
| Cerafelt Insulation | .25 @ 1000°F | .. | ... | 3 |
| Ceramic Fiber | .27 | .. | ... | 4-10 |
| Chalk | .215 | .. | ... | 112-175 |
| Chromium | .11 | .. | 2822 | 450 |
| Clay | .224 | .. | 3160 | 90 |
| Coal | .32 | .. | ... | 80 |
| Coal Tar | .35-.45 | .. | ... | 78 |
| Cobalt | .099 | 115.2 | 2696 | 554 |
| Coke | .265 | .. | ... | 62-88 |
| Concrete, Cinder | .16 | .. | ... | 100 |
| Concrete, Stone | .156 | .. | ... | 144 |
| Copper | .095 | 91.1 | 1981 | 556 |
| Cork | .36 | .. | ... | 13.5 |
| Cotton (Flax, Hemp) | .31 | .. | ... | 92.4 |
| Delrin | .350 | .. | ... | 88.1 |
| Firebrick, Fireclay | .243 | .. | 2900 | 137-150 |
| Firebrick, Silica | .258 | .. | 3000 | 144-162 |
| Glass | .20 | .. | 2200 ± | 164 |
| Gold | .032 | 29.0 | 1945 | 1206 |
| Granite | .192 | .. | ... | 160-175 |
| Graphite | .20 | .. | ... | 130 |
| Ice | .53 | 144 | 32 | 56.0 |
| Incoloy 800 | .13 | .. | 2475-2525 | 501 |
| Inconel 600 | .126 | .. | 2500 | 525 |
| Invar (36%Ni) | .126 | .. | 2600 | 506 |
| Iron, Cast | .12 | .. | 2150 | 449 |
| Iron, Wrought | .12 | .. | 2800 | 480 |
| Isoprene, Rubber | .48 | .. | ... | 58 |
| Lead, Solid | .032 | 11.3 | 620 | 708 |
| Limestone | .217 | .. | ... | 130-175 |
| Lithium | .79 | 59 | 367 | 367 |
| Manganese | .115 | 116 | 2268 | 463 |
| Magnesium | .27 | 160 | 1202 | 109 |
| Magnesia, 85% | .222 | .. | 5070 | 19 |
| Mg O (Compacted) | .209 | .. | ... | 194 |
| Mercury | .033 | 5 | - 38 | 844 |
| Mica | .21 | .. | ... | 176 |
| Molybdenum | .061 | 126 | 4750 | 638 |

| SUBSTANCE | Specific Heat | Heat of Fusion Btu/lb. | Melting Point °F | Density—Weight in lbs./cu. ft. |
|------------------------------|---------------|------------------------|------------------|--------------------------------|
| Monel 400 | .11 | .. | 2370 | 551 |
| Nickel 200 | .12 | 133 | 2615 | 555 |
| Nichrome (80% Ni.-20% Cr.) | .11 | .. | 2550 | 522 |
| Paper | .45 | .. | ... | 58.8 |
| Paraffin | .69 | 63 | 133 | 55.3 |
| Pitch (Hard) | ... | .. | 300 ± | 83 |
| Plastics: | | | | |
| ABS | .35 | .. | ... | 69-76 |
| Acrylic | .34 | .. | ... | 69-74 |
| Cellulose Acetate | .3-5 | .. | ... | 76-83 |
| Cellulose Acetate Butyrate | .3-4 | .. | ... | 74 |
| Epoxy | .25-.3 | .. | ... | 66-88 |
| Fluoroplastics | .28 | .. | ... | 131-150 |
| Nylon | .3-5 | .. | ... | 67-72 |
| Phenolic | .35 | .. | ... | 85-124 |
| Polycarbonate | .3 | .. | ... | 74-78 |
| Polyester | .2-35 | .. | ... | 66-92 |
| Polyethylene | .54 | .. | ... | 57-60 |
| Polyimides | .27-.31 | .. | ... | 90 |
| Polypropylene | .46 | .. | ... | 55-57 |
| Polystyrene | .32 | .. | ... | 66 |
| Polyvinyl Chloride Acetate | .2-3 | .. | ... | 72-99 |
| Platinum | .035 | 49 | 3225 | 1339 |
| Porcelain | .26 | .. | ... | 145-155 |
| Potassium | .058 | 26.2 | 146 | 750 |
| Potassium Chloride | .17 | .. | 1454 | 124 |
| Potassium Nitrate | .26 | .. | 633 | 132 |
| Quartz | .26 | .. | ... | 138 |
| Rhodium | .059 | .. | 3570 | 776 |
| Rubber | .44 | .. | ... | 76.0 |
| Rubber, Synthetic | .40 | .. | ... | 58 |
| Silicone Rubber | .45 | .. | ... | 78 |
| Silicon | .162 | .. | 2570 | 14.5 |
| Silver | .057 | 38 | 1760 | 665 |
| Sodium | .295 | 49.5 | 207 | 60 |
| Solder (50% Pb-50% Sn.) | .051 | 17 | 361 | 558 |
| Steatite | .20 | .. | ... | 162 |
| Steel Mild | .122 | .. | 2760 | 491 |
| Steel S. 304 | .12 | .. | 2550 | 494 |
| Steel S. 430 | .11 | .. | 2650 | 475 |
| Sulfur | .175 | 17 | 246 | 130 |
| Sugar | .30 | .. | 320 | 105 |
| Tallow | ... | .. | 90 + | 60.0 |
| Tantalum | .035 | .. | 5425 | 104 |
| Teflon | .25 | .. | ... | 135 |
| Tin, Solid | .065 | 261 | 450 | 454 |
| Titanium 99.0% | .13 | .. | 3035 | 283 |
| Tungsten | .032 | 79 | 6170 | 1200 |
| Type Metal (85% Pb.-13% Sb.) | .040 | 14 + | 500 | 669 |
| Uranium | .028 | .. | 3075 | 1170 |
| Vinyl | .3-5 | .. | ... | 79.5 |
| Wood (Pine) | .45 ± | .. | ... | 34 |
| Wood (Oak) | .57 | .. | ... | 50 |
| Zirconium | .066 | 108 | 3350 | 400 |
| Zinc | .096 | 43.3 | 787 | 445 |

± Estimated

7T: Metals in Liquid State

| SUBSTANCE | Specific Heat | Heat of Fusion Btu/lb. | Melting Point °F | Temperature °F | Density—Weight in lbs./cu. ft. |
|-----------|---------------|------------------------|------------------|----------------|--------------------------------|
| Aluminum | .26 | 173 | 1220.4 | 1220 | 148.6 |
| | .26 | ... | ... | 1292 | 147.7 |
| | .26 | ... | ... | 1454 | ... |
| Bismuth | .034 @ 520° F | 21.6 | 520 | 572 | 626.2 |
| | .0354 | ... | ... | 752 | 618.7 |
| | .0376 | ... | ... | 1112 | 603.1 |
| Cadmium | .0632 | 23.8 | 609 | 626 | 500 |
| | .0632 | ... | ... | 662 | 498.8 |
| | .0632 | ... | ... | 680 | ... |
| | .0632 | ... | ... | 752 | 495 |
| Gold | .0355 | 26.9 | 1945 | 2012 | 1076 |
| Lead | .038 | 10.6 | 621 | 700 | 655.5 |
| | .037 | ... | ... | 932 | 648.7 |
| Lithium | 1.0 | 284.4 | 354 | 392 | 31.7 |
| | 1.0 | ... | ... | 752 | 31 |
| Magnesium | .317 | 148 | 1204 | 1204 | 98. |
| | ... | ... | ... | 1328 | 94.3 |
| | .321 | ... | ... | 1341 | ... |

| SUBSTANCE | Specific Heat | Heat of Fusion Btu/lb. | Melting Point °F | Temperature °F | Density—Weight in lbs./cu. ft. |
|---------------------|---------------|------------------------|------------------|----------------|--------------------------------|
| Mercury | .03334 | 5 | -38 | 32 | ... |
| | .03279 | ... | ... | 212 | 833.6 |
| | ... | ... | ... | 320 | ... |
| | .03245 | ... | ... | 392 | 818.8 |
| Potassium | .1901 | 26.3 | 147 | 300 | 50.6 |
| | .1826 | ... | ... | 752 | 46.6 |
| Silver | .0692 | 44.8 | 1761 | 1761 | 580.6 |
| | .0692 | ... | ... | 1832 | 578.1 |
| | .0692 | ... | ... | 2000 | 574.4 |
| Sodium | .331 | 48.7 | 208 | 212 | 57.9 |
| | .320 | ... | ... | 400 | 56.2 |
| | .301 | ... | ... | 752 | 53.3 |
| Solder .5 Sn, .5 Pb | .0556 | 17 | 421 | ... | ... |
| .6 Sn, .4 Pb | .0584 | 28 | 375 | ... | ... |
| Tin | .058 | 26.1 | 449 | 482 | ... |
| | ... | ... | ... | 768 | 426.6 |
| | ... | ... | ... | 783 | ... |
| Zinc | .12 | 43.9 | 787 | 787 | 432 |
| | ... | ... | ... | 932 | ... |
| | .117 | ... | ... | 1112 | 425 |

8T: Liquids

| SUBSTANCE | Specific Heat | Heat of Vaporization Btu/lb. | Boiling Point °F | Density— Weight in lbs./cu.ft. | Weight in lbs./gal. |
|----------------------------|---------------|---------------------------------|---------------------|--------------------------------------|------------------------|
| Acetic Acid, 100% | .48 | 175 | 245 | 65.4 | 8.74 |
| Acetone, 100% | .514 | 225 | 133 | 49 | 6.5 |
| Allyl Alcohol | .665 | 293 | 207 | 55 | 7.35 |
| Ammonia, 100% | 1.1 | 589 | -27 | 47.9 | 6.4 |
| Amyl Alcohol | .65 | 216 | 280 | 55 | 7.35 |
| Aniline | .514 | 198 | 63 | 64.6 | 8.63 |
| Arochier Oil | .28 | | 650 | 89.7 | 12.00 |
| Brine Sodium Chloride, 25% | .786 | 730 | 220 | 74.1 | 9.9 |
| Butyl Alcohol | .687 | 254 | 244 | 45.3 | 6.0 |
| Butyric Acid | .515 | | 345 | 50.4 | 6.73 |
| Carbon Tetrachloride | .21 | | 170 | 98.5 | 13.16 |
| Corn Syrup, Dextrose | .65 ± | | 231 | 87.8 | 11.73 |
| Cottonseed Oil | .47 | | | 59.2 | 7.9 |
| Ether | .503 | 160 | 95 | 46 | 6.14 |
| Ethyl Acetate | .475 | 183.5 | 180 | 51.5 | 6.88 |
| Ethyl Alcohol, 95% | .60 | 370 | | 50.4 | 6.74 |
| Ethyl Bromide | .215 | 108 | 101 | 90.5 | 12.1 |
| Ethyl Chloride | .367 | 166.5 | 54 | 57 | 7.62 |
| Ethyl Iodide | .161 | 81.3 | 160 | 113 | 15.1 |
| Ethylene Bromide | .172 | 83 | 270 | 120 | 16.0 |
| Ethylene Chloride | .299 | 139 | 240 | 71.7 | 9.58 |
| Ethylene Glycol | .555 | | 387 | 70.0 | 9.36 |
| Fatty Acid-Aleic | .7 ± | | 547 | 55.4 | 7.4 |
| Fatty Acid-Palmitic | .653 | | 520 | 53.1 | 7.1 |
| Fatty Acid-Stearic | .550 | | 721 | 52.8 | 7.06 |
| Formic Acid | .525 | 216 | 213 | 69.2 | 9.25 |
| Freon 11 | .208 | | 74.9 | 92.1 | 12.3 |
| Freon 12 | .232 | 62 | -21.6 | 81.8 | 10.93 |
| Freon 22 | .300 | | -41.36 | 74.53 | 9.96 |
| Fruit, Fresh, Avg. | .88 | | | 50-60 | 6.7-8.0 |
| Glycerine | .58 | | 556 | 78.7 | 10.5 |
| Heptane | .49 | 137.1 | 210 | 38.2 | 5.1 |
| Hexane | .6 | 142.5 | 155 | 38.2 | 5.1 |
| Honey | .34 | | | | |
| Hydrochloric Acid, 10% | .93 | | 221 | 66.5 | 8.89 |
| Lard | .64 | | | 57.4 | 7.67 |
| Linseed Oil | .44 | | 552 | 57.9 | 7.74 |
| Maple Syrup | .48 | | | | |
| Mercury | .033 | 117 | 675 | 845 | 113.0 |
| Methyl Acetate | .47 | 176.5 | 133 | 54.8 | 7.3 |
| Methyl Chloroform | .26 | 95 | 165 | 82.7 | 11.0 |
| Methylene Chloride | .288 | 142 | 104 | 82.6 | 11.0 |
| Milk, 3.5% | .90 | | | 64.2 | 8.58 |
| Molasses | .60 | | 220 ± | 87.4 | 11.68 |
| Nitric Acid, 7% | .92 | 918 | 220 | 64.7 | 8.65 |
| Nitric Acid, 95% | .5 | 207 | 187 | 93.5 | 12.5 |
| Nitrobenzene | .35 | 142.2 | 412 | | |
| Olive Oil | .47 | | 570 | 58 | 7.75 |
| Perchlorethylene | .21 | 90 | 250 | 101.3 | 13.54 |

| SUBSTANCE | Specific Heat | Heat of Vaporization Btu/lb. | Boiling Point °F | Density— Weight in lbs./cu.ft. | Weight in lbs./gal. |
|---------------------------------|---------------|---------------------------------|---------------------|--------------------------------------|------------------------|
| Petroleum Products: | | | | | |
| Asphalt | .42 | | | 62.3 | 8.33 |
| Benzene | .42 | 170 | 175 | 56 | 7.48 |
| Fuel Oils: | | | | | |
| Fuel Oil #1 (Kerosene) | .47 | 86 | **440 ± | 50.5 | 6.75 |
| Fuel Oil #2 | .44 | | | 53.9 | 7.2 |
| Fuel Oil Medium #3, #4 | .425 | 67 | **580 ± | 55.7 | 7.44 |
| Fuel Oil Heavy #5, #6 | .41 | | | 58.9 | 7.87 |
| Gasoline | .53 | 116 | **280 ± | 41-43 | 5.5-5.75 |
| Machine/Lube Oils: | | | | | |
| SAE 10-30 | .43 | | | 55.4 | 7.4 |
| SAE 40-50 | .43 | | | 55.4 | 7.4 |
| Napthalene | .396 | 103 | 424 + | 54.1 | 7.23 |
| Paraffin, Melted (150°F +) | .69 | 70 | 572 | 56 | 7.5 |
| Propane (Compressed) | .576 | | -48.1 | .13 | .02 |
| Toluene | .42 | | | 53.7 | 7.18 |
| Transformer Oils | .42 | | | 56.3 | 7.5 |
| Phenol (Carbolic Acid) | .56 | | 346 | 66.6 | 8.9 |
| Phosphoric Acid, 10% | .93 | | | 65.4 | 8.74 |
| Phosphoric Acid, 20% | .85 | | | 69.1 | 9.24 |
| Polyurethane Foam Components: | | | | | |
| Part A Isocyanate | .6 | | | 77 | 10.3 |
| Part B Polyol Resin | .7 | | | 74.8 | 10.0 |
| Potassium (1000°F) | .18 | 893 | 1400 | 44.6 | 5.96 |
| Propionic Acid | .56 | 177.8 | 286 | 61.8 | 8.26 |
| Propyl Alcohol | .57 | 295.2 | 208 | 50.2 | 6.7 |
| Sea Water | .94 | | | 64.2 | 8.58 |
| Sodium (1000°F) | .30 | 1810 | 1638 | 51.2 | 6.84 |
| Sodium Hydroxide (Caustic Soda) | | | | | |
| 30% Sol. | .84 | | | 82.9 | 11.08 |
| 50% Sol. | .78 | | | 95.4 | 12.75 |
| Soybean Oil | .24-.33 | | | 57.4 | 7.67 |
| Starch | | | | 95.4 | 12.75 |
| Sucrose, 40% Sugar Syrup | .66 | | 214 | 73.5 | 9.8 |
| Sucrose, 60% Sugar Syrup | .74 | | 218 | 80.4 | 10.75 |
| Sulfur, Melted (500°F) | .24 | 120 | 832 | 112 | 14.97 |
| Sulfuric Acid, 20% | .84 | | 218 | 71 | 9.5 |
| Sulfuric Acid, 60% | .52 | | 282 | 93.5 | 12.5 |
| Sulfuric Acid, 98% | .35 | 219 | 625 | 114.7 | 15.33 |
| Trichloroethylene | .23 | 103 | 188 | 91.3 | 12.2 |
| Trichloro-Trifluoroethane | .21 | 63 | 118 | 94.6 | 12.64 |
| Turpentine | .42 | 133 | 319 | 54 | 7.2 |
| Vegetable Oil | .43 | | | 57.5 | 7.69 |
| Water | 1.00 | 965 | 212 | 62.5 | 8.34 |
| Xylene | .411 | 149.2 | 288 | 53.8 | 7.2 |

* At or near room temperature.

** Average value shown. Boils at various temperatures within the distillation range for the material.

9T: Gases and Vapors

| SUBSTANCE | Chemical Formula or Symbol | Specific Heat at Constant Pressure | Density— Weight in lbs./cu. ft. at 70°F and Atmospheric Pressure | Specific Gravity Relative to Air |
|--------------------|--------------------------------|------------------------------------|---|--|
| Acetylene (ethyne) | C ₂ H ₂ | .35 | .0682 | .907 |
| Air | | .24 | .075 | 1.00 |
| Ammonia | NH ₃ | .523 | .0448 | .596 |
| Argon | A | .124 | .1037 | 1.379 |
| Butane | C ₄ H ₁₀ | .395 | .1554 | 2.067 |
| Carbon Dioxide | CO ₂ | .199 | .115 | 1.529 |
| Carbon Monoxide | CO | .248 | .0727 | .967 |
| Chlorine | Cl ₂ | .115 | .1869 | 2.486 |
| Ethane | C ₂ H ₆ | .386 | .0789 | 1.049 |
| Ethylene | C ₂ H ₄ | .40 | .0733 | .975 |
| Helium | He | 1.25 | .0104 | .1381 |
| Hydrogen Chloride | HCl | .191 | .0954 | 1.268 |
| Hydrogen | H ₂ | 3.42 | .0052 | .0695 |
| Hydrogen Sulphide | H ₂ S | .243 | .0895 | 1.19 |

| SUBSTANCE | Chemical Formula or Symbol | Specific Heat at Constant Pressure | Density— Weight in lbs./cu. ft. at 70°F and Atmospheric Pressure | Specific Gravity Relative to Air |
|---------------------------|-------------------------------|------------------------------------|---|--|
| Methane | CH ₄ | .593 | .0417 | .554 |
| Methyl Chloride | CH ₃ Cl | .24 | .1342 | 1.785 |
| Natural Gas | | .56 | .0502 | .667 |
| Nitric Oxide | NO | .231 | .078 | 1.037 |
| Nitrogen | N ₂ | .247 | .0727 | .967 |
| Nitrous Oxide | N ₂ O | .221 | .1151 | 1.53 |
| Oxygen | O ₂ | .217 | .0831 | 1.105 |
| Propane | C ₃ H ₈ | .393 | .1175 | 1.562 |
| Propene (propylene) | C ₃ H ₆ | .358 | .1091 | 1.451 |
| Sulphur Dioxide | SO ₂ | .154 | .1703 | 2.264 |
| Water Vapor at 212 deg. F | H ₂ O | .482 | .037 | .489 |

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

