

PHYSICAL PROPERTIES OF GASES AND VAPOURS – SI UNITS

| <i>Referred to 0°C (32F) and 1013,25 mbar (14,7 psia)</i> | | | | | | | | |
|---|----------------------------------|------------------------|---|---------------------|-------------------------------------|------------------------|-------------------------------|-----------------|
| p - mass per unit volume | | | V - specific volume | | | | | |
| t_f - melting temperature | | | C_p - specific heat at constant pressure | | | | | |
| t_e - boiling temperature | | | λ - thermal conductivity | | | | | |
| p_e - mass per unit volume of the liquid at t _e | | | | | | | | |
| Gas or Vapour | Formula | ρ (kg/m ³) | t _f (°C) | t _e (°C) | ρ _e (kg/m ³) | V (m ³ /kg) | C _p (kcal/kg.h.°C) | λ (kcal/m.h.°C) |
| Acetone | C ₃ H ₆ O | 2,591 | -94,8 | 56,2 | 749 | 0,386 | 0,296 | 0,0083 |
| Acetylene | C ₂ H ₂ | 1,162 | -83,3 | -83,6 | 613 | 0,861 | 0,386 | 0,0158 |
| Ammonia | NH ₃ | 0,76 | -77,9 | -33,4 | 680 | 1,316 | 0,491 | 0,0187 |
| Argon | Ar | 1,782 | 189,2 | -185,7 | 1820 | 0,561 | 0,125 | 0,014 |
| Benzole | C ₆ H ₆ | 3,485 | - | - | - | 0,287 | 0,227 | 0,0076 |
| Biogas (40% CH ₄) | - | 1,467 | - | - | - | - | - | - |
| Biogas (56% CH ₄) | - | 1,267 | - | - | - | - | - | - |
| Biogas (70% CH ₄) | - | 1,092 | - | - | - | - | - | - |
| Butane | C ₄ H ₁₀ | 2,593 | -138,4 | -0,5 | 602 | 0,386 | 0,382 | 0,0119 |
| Carbon dioxide | CO ₂ | 1,964 | -56,6 | -78,2 | 1219 | 0,509 | 0,195 | 0,0122 |
| Carbon disulphide | CS ₂ | 3,397 | | | | 0,294 | 0,139 | 0,0058 |
| Carbon monoxide | CO | 1,25 | -205 | -191,6 | 801 | 0,8 | 0,248 | 0,0191 |
| Chlorine | Cl ₂ | 3,164 | -101 | -34,6 | 1512 | 0,316 | 0,116 | 0,0073 |
| Diethyl ether | C ₄ H ₁₀ O | 3,307 | | | | 0,302 | 0,345 | 0,0108 |
| Dry air | - | 1,293 | -213 | -192,3 | 875 | 0,773 | 0,24 | 0,0209 |
| Ethane | C ₂ H ₆ | 1,342 | -183,3 | -88,6 | 546 | 0,745 | 0,394 | 0,0155 |
| Ethyl alcohol | C ₂ H ₆ O | 2,055 | -114,2 | 78,3 | 747 | 0,487 | 0,364 | 0,0119 |
| Ethylene | C ₂ H ₄ | 1,251 | -169,5 | -103,7 | 568 | 0,799 | 0,349 | 0,0144 |
| Helium | He | 0,179 | -272,2 | -268,9 | 125 | 5,599 | 1,25 | 0,1233 |
| Hydrochloric acid | HCl | 1,627 | -111,2 | -84,8 | 1135 | 0,615 | 0,19 | 0,0072 |
| Hydrogen | H ₂ | 0,09 | -259,1 | -252,9 | 71 | 11,118 | 3,45 | 0,1508 |
| Hydrogen sulphide | H ₂ S | 1,52 | -85,6 | -60,4 | 957 | 0,658 | 0,237 | 0,0108 |
| Methane | CH ₄ | 0,716 | -182,5 | -161,5 | 415 | 1,397 | 0,517 | 0,0263 |
| Methyl alcohol | CH ₄ O | 1,429 | -97,6 | 64,7 | 737 | 0,7 | 0,32 | 0,012 |
| Natural gas | - | 0,6 | - | - | - | - | - | - |
| Nitrogen | N ₂ | 1,25 | -209,9 | -195,8 | 810 | 0,8 | 0,247 | 0,0205 |
| Oxygen | O ₂ | 1,428 | -218,4 | -183 | 1131 | 0,7 | 0,218 | 0,0208 |
| Propane | C ₃ H ₈ | 1,968 | -187,7 | -42,1 | 585 | 0,508 | 0,37 | 0,013 |
| Propylene | C ₃ H ₆ | 1,877 | -185 | -47,8 | 686 | 0,533 | 0,34 | - |
| Sulfur dioxide | SO ₂ | 2,858 | - | - | - | 0,35 | 0,14 | 0,0072 |

PHYSICAL PROPERTIES OF WATER – SI UNITS

| t_{ref} - reference temperature for | | | | | Ca - actual specific heat at t_{ref} | | | | |
|---|----------------------------|-----------------------------|-----------------|-------------------------|---|----------------------------|-----------------------------|-----------------|-------------------------|
| M_s - mass per unit volume at 20°C (68°F) | | | | | λ - thermal conductivity at t_{ref} | | | | |
| Temp. (°C) | M_s (kg/m ³) | V (m ³ /kgx1000) | Ca (kcal/kg.°C) | λ (kcal/m.h.°C) | Temp. (°C) | M_s (kg/m ³) | V (m ³ /kgx1000) | Ca (kcal/kg.°C) | λ (kcal/m.h.°C) |
| 0 | 999,87 | 1,00013 | - | - | 70 | 977,81 | 1,02269 | 1,0002 | 0,57 |
| 4 | 999,99 | 1,00001 | - | - | 71 | 977,23 | 1,0233 | - | - |
| 6 | 999,97 | 1,00003 | - | - | 72 | 976,66 | 1,0239 | - | - |
| 8 | 999,89 | 1,00011 | - | - | 73 | 976,07 | 1,02452 | - | - |
| 10 | 999,75 | 1,00025 | 1 | 0,493 | 74 | 975,48 | 1,02514 | - | - |
| 12 | 999,55 | 1,00045 | - | - | 75 | 974,89 | 1,02576 | 1,0013 | 0,574 |
| 14 | 999,3 | 1,0007 | - | - | 76 | 974,29 | 1,02639 | - | - |
| 16 | 999 | 1,001 | - | - | 77 | 973,68 | 1,02703 | - | - |
| 18 | 998,65 | 1,00135 | - | - | 78 | 973,07 | 1,02768 | - | - |
| 20 | 998,2 | 1,0018 | 1 | 0,51 | 79 | 972,45 | 1,02833 | - | - |
| 22 | 997,83 | 1,00217 | - | - | 80 | 971,83 | 1,02899 | 1,0025 | 0,577 |
| 24 | 997,37 | 1,00264 | - | - | 81 | 971,21 | 1,02964 | - | - |
| 26 | 996,87 | 1,00314 | - | - | 82 | 970,57 | 1,03032 | - | - |
| 28 | 996,33 | 1,00368 | - | - | 83 | 969,94 | 1,03099 | - | - |
| 30 | 995,76 | 1,00426 | 1 | 0,526 | 84 | 969,3 | 1,03167 | - | - |
| 32 | 995,12 | 1,0049 | - | - | 85 | 968,65 | 1,03236 | 1,0037 | 0,58 |
| 34 | 994,49 | 1,00554 | - | - | 86 | 968 | 1,03306 | - | - |
| 36 | 993,74 | 1,0063 | - | - | 87 | 967,34 | 1,03376 | - | - |
| 38 | 993,02 | 1,00703 | - | - | 88 | 966,68 | 1,03447 | - | - |
| 40 | 992,24 | 1,00782 | 1 | 0,539 | 89 | 966,01 | 1,03519 | - | - |
| 41 | 991,86 | 1,00821 | - | - | 90 | 965,34 | 1,0359 | 1,0049 | 0,582 |
| 42 | 991,47 | 1,0086 | - | - | 91 | 964,67 | 1,03662 | - | - |
| 43 | 991,07 | 1,00901 | - | - | 92 | 963,99 | 1,03736 | - | - |
| 44 | 990,66 | 1,00943 | - | - | 93 | 963,3 | 1,0381 | - | - |
| 45 | 990,25 | 1,00985 | - | - | 94 | 962,61 | 1,03884 | - | - |
| 46 | 989,82 | 1,01028 | - | - | 95 | 961,92 | 1,03959 | 1,006 | 0,584 |
| 47 | 989,4 | 1,01071 | - | - | 96 | 961,22 | 1,04034 | - | - |
| 48 | 988,96 | 1,01116 | - | - | 97 | 960,51 | 1,04111 | - | - |
| 49 | 988,52 | 1,01161 | - | - | 98 | 959,81 | 1,04187 | - | - |
| 50 | 988,07 | 1,01207 | 1 | 0,551 | 99 | 959,09 | 1,04266 | - | - |
| 51 | 987,62 | 1,01254 | - | - | 100 | 958,38 | 1,04343 | 1,0061 | 0,586 |
| 52 | 987,15 | 1,01302 | - | - | 105 | - | - | 1,0071 | 0,588 |
| 53 | 986,69 | 1,01349 | - | - | 110 | - | - | 1,0084 | 0,589 |
| 54 | 986,21 | 1,01398 | - | - | 115 | - | - | 1,0098 | 0,59 |
| 55 | 985,73 | 1,01448 | 1 | 0,556 | 120 | - | - | 1,0114 | 0,591 |
| 56 | 985,25 | 1,01497 | - | - | 125 | - | - | 1,0132 | 0,591 |
| 57 | 984,75 | 1,01549 | - | - | 130 | - | - | 1,0152 | 0,592 |
| 58 | 984,25 | 1,016 | - | - | 135 | - | - | 1,0175 | 0,592 |
| 59 | 983,75 | 1,01652 | - | - | 140 | - | - | 1,02 | 0,592 |
| 60 | 983,24 | 1,01705 | 1 | 0,561 | 145 | - | - | 1,0228 | 0,591 |
| 61 | 982,72 | 1,01758 | - | - | 150 | - | - | 1,0258 | 0,591 |
| 62 | 982,2 | 1,01812 | - | - | 160 | - | - | 1,0328 | 0,589 |
| 63 | 981,67 | 1,01867 | - | - | 170 | - | - | 1,0411 | 0,586 |
| 64 | 981,13 | 1,01923 | - | - | 180 | - | - | 1,0507 | 0,582 |
| 65 | 980,59 | 1,01979 | 1 | 0,566 | 190 | - | - | 1,0619 | 0,578 |
| 66 | 980,05 | 1,02036 | - | - | 200 | - | - | 1,0746 | 0,572 |
| 67 | 979,5 | 1,02093 | - | - | 210 | - | - | 1,089 | 0,565 |
| 68 | 978,94 | 1,02151 | - | - | 220 | - | - | 1,1052 | 0,558 |
| 69 | 978,38 | 1,0221 | - | - | 230 | - | - | 1,1234 | 0,55 |

PHYSICAL PROPERTIES OF LIQUIDS – SI UNITS

| t_{ref} - reference temperature for M_s - mass per unit volume at 20°C (68°F) | | | | | C_a - actual specific heat at t_{ref} λ - thermal conductivity at t_{ref} | | | | |
|--|----------------|----------------------------|--------------------|-------------------------|--|----------------|----------------------------|--------------------|-------------------------|
| Liquid | t_{ref} (°C) | M_s (kg/m ³) | C_a (kcal/kg.°C) | λ (kcal/m.h.°C) | Liquid | t_{ref} (°C) | M_s (kg/m ³) | C_a (kcal/kg.°C) | λ (kcal/m.h.°C) |
| Acetic acid | 25 | 1049 | 0,51 | 0,166 | Methane | -90 | 162 | - | - |
| Acetone | 20 | 790 | 0,515 | 0,139 | Methanol | 20 | 791 | 0,33 | - |
| Ammonia sol. (25%) | 20 | 771 | - | 0,425 | Methyl alcohol (95%vol.) | 20 | 792 | 0,596 | 0,174 |
| Apple juice | 20 | 1356 | 0,446 | - | Milk, cow, heavy cream | 20 | 994 | 0,94 | 0,434 |
| Argon | -186 | 1430 | - | - | Naphta | 15 | 665 | 0,92 | - |
| Automobile oils | 15 | 880-940 | - | 0,125 | Nitric acid | 20 | 1520 | 0,411 | 0,456 |
| Beer | 10 | 1010 | - | - | Nitrogen | -201 | 808 | - | - |
| Benzene | 20 | 870 | 0,43 | 0,138 | Oil, coconut | 20 | 924 | - | - |
| Benzole | 20 | 879 | 0,43 | 0,132 | Oil, corn | 20 | 922 | - | - |
| | 80 | - | 0,44 | 0,13 | Oil, castor | 25 | 956,1 | 0,43 | 0,155 |
| Butane | 25 | 599 | 0,55 | - | Oil, cotton seed | 15 | 926 | - | - |
| Butter | 20 | 911 | 0,557-0,688 | - | Oil, olive | 10 | 918 | 0,47 | 0,146 |
| Carbon tetrachloride | 25 | 1584 | 0,207 | 0,089 | Oil, palm | 20 | 915 | - | - |
| Carbon disulphide | 20 | 1266 | 0,241 | 0,138 | Oil, soya | 20 | 927 | 0,47 | - |
| Chloride | 25 | 1560 | - | - | Oil, sunflower | 20 | 920 | - | - |
| Chloroform | 20 | 1489 | 0,251 | 0,11 | Oil, peanut | 20 | 914 | - | - |
| Citric acid | 25 | 1660 | - | - | Oil, whale | 15 | 925 | - | - |
| Crude oil | 20 | 900 | - | 0,113 | Oxygen (liquid) | -186 | 1155 | - | - |
| Diesel | 20 | 800 | - | - | Petrol | 30 | 680 - 710 | 0,45 | 0,112 |
| Ethane (liquid) | -89 | 570 | - | - | Phenol | 25 | 1072 | 0,34 | 0,163 |
| Ethyl acetate | 20 | 901 | - | - | Propanol | 25 | 804 | - | - |
| Ethyl alcohol (95%vol.) | 0 | 789 | 0,547 | 0,166 | Propyl alcohol | 25 | 800 | 0,57 | 0,138 |
| | 40 | - | 0,648 | 0,144 | Sea water | 25 | 1025 | 0,94 | - |
| Fuel oil | 20 | 840 - 920 | 0,471 | 0,103 | Sodium carbonate | 20 | 2530 | 0,86 | 0,516 |
| Gasoline | 20 | 803 | 0,53 | 0,129 | Sodium Hydroxide (caustic soda) | 15 | 1250 | 0,77 | 0,37 |
| Glycerine | 10 | 1260 | 0,576 | 0,25 | Sulphuric acid | 12 | 1853 | 0,33 | 0,28 |
| Glycerol | 25 | 1126 | - | - | Sulphurous acid (96%) | 20 | 1840 | 0,351 | 0,43 |
| Helium | -271 | 147 | - | - | Water | 8 | 999,88 | 1 | 0,485 |
| Honey | 20 | 1420 | 0,54-0,6 | 0,00648 | | 41 | 991,66 | 1 | 0,538 |
| Hydrazine | 25 | 795 | - | - | | 72 | 976,36 | 1 | 0,58 |
| Hydrochloric acid (25%) | 20 | 1150 | 0,75 | 0,404 | | 100 | 958,38 | 1,006 | 0,586 |
| Kerosene | 16 | 820,1 | 0,48 | 0,125 | | 200 | 0 - 200 | 1,037 | 0,572 |
| Lubricating oil | 81 | 920 | - | 0,105 | | | | | |
| | 0 | - | - | 0,133 | | | | | |
| | 100 | - | - | 0,128 | | | | | |
| | 200 | - | - | 0,122 | | | | | |

PHYSICAL PROPERTIES OF METALS – SI UNITS

| t_{ref} - reference temperature for Ms - mass per unit volume at 20°C | | λ - thermal conductivity at t_{ref} Ca - actual specific heat at t_{ref} | | |
|--|----------------|---|-------------------------|-------------------|
| Metal | t_{ref} (°C) | Ms (kg/m ³) | λ (kcal/m.h.°C) | Ca (kcal/kg.h.°C) |
| Alloy Steel (5%Cr) | 20 | 7790 | 28 | 0,11 |
| | (20%Cr) | 7670 | 20 | 0,11 |
| | (10%Cr) | 7760 | 27 | 0,11 |
| Alloy Steel (5%Ni) | 30 | 7850 | 25 | - |
| | (10%Ni) | - | 22 | - |
| | (40%Ni) | 8120 | 9 | - |
| | (20%Ni) | - | 14 | - |
| Aluminum | 0 | 2700 | 173 | 0,21 |
| | 100 | - | 176 | 0,224 |
| | 300 | - | 198 | 0,241 |
| Brass | 20 | 8400 | 79-96 | - |
| | 100 | - | 90-110 | - |
| Bronze | 20 | 8700 | 50 | 0,0913 |
| | 100 | - | 62 | 0,0937 |
| Carbon Steel (0,1%C) | 100 | 7830 | 47 | - |
| | 300 | - | 43 | - |
| | 600 | - | 32 | - |
| Carbon Steel (0,5%C) | 100 | 7820 | 45 | 0,113 |
| | 300 | - | 38 | - |
| | 600 | - | 31 | - |
| Carbon Steel (1,5%C) | 100 | 7740 | 32 | - |
| | 300 | - | 31 | - |
| | 600 | - | 29 | - |
| Cast Iron (4%C) | 20 | - | 50 | - |
| Chromium | 0 | 7190 | - | 0,102 |
| | 100 | - | - | 0,113 |
| | 300 | - | - | 0,125 |
| Copper | 20 | 8960 | 332 | 0,0911 |
| Gold | 0 | 19320 | 268 | 0,0311 |
| | 200 | - | 266 | - |
| Magnesium | 100 | 1738 | 135 | 0,257 |
| Nikel | 10 | 8902 | 54 | 0,105 |
| | 500 | - | 44 | - |
| Silver | 0 | 10500 | 360 | 0,057 |
| | 100 | - | 312 | 0,0572 |
| | 900 | - | - | 0,0676 |
| Tin | 0 | 7310 | 56 | 0,0536 |
| | 200 | - | 52 | - |
| Zinc | 0 | 7133 | 95 | 0,0918 |
| | 200 | - | 90 | - |