

PROPERTIES OF AIR AND WATER

DENSITY kg/m³(Lbm/ft³): Fresh Water 999.87@0°C
1000.00(62.43)@4°C(39°F) 999.73@10°C 999.13@15°C 998.23@20°C
997.07@25°C 995.68@30°C 994.06@35°C 988.07@50°C 958.38@100°C Ice
917@0°C Sea Water 1020.0-1030.0 range 1027.7-1027.9 (64.18) >50% Air
(dry) 1.377@-20°C 1.275@0°C 1.225@15°C 1.188(0.074)@20°C(68°F)
1.09@50°C 0.933@100°C 0.736@200°C 0.517@400°C moist air
density(g/L) $1.2929 \cdot (273.15/T) \cdot ((P-V_p)/101325)$
SALINITY (S avg) 3.47% (3.3-3.7%) salinity=1.80655*chlorinity no density
anomaly if S>2.47% T_{freez} -1.33°C@S=2.47% -2.5°C@S=3.4%
COMPRESSIBILITY (K=Bulk Mod.) GN/m² K=2.24 (2.42 sea water) @20°C
 $\rho_1/\rho_0 = \exp((p_1-p_0)/K)$ ρ =density
SPEED OF SOUND m/s Water 1450@0°C&S=3.49% increases with T,S,p:
4m/s per 1K 1.5m/s per 0.1%S 18m/s per 100atm $c = \sqrt{K/\rho}$ Air(dry)
343@20°C(331@0°C,350@30°C) $c = \sqrt{kRT}$ R=8.31451J/(gmol*K)
 $k = c_p/c_v = 1.4019$
VISCOSITY (μ) dynamic, N*s/m² Water 1.79e-3@0°C 1.52e-3@4°C 1.14e-
3@15°C 1.00e-3@20°C 0.891e-3@25°C 0.282e-3@100°C Sea water
1.08@20°C Air 0.0161e-3@-20°C 0.0172e-3@0°C 0.0181e-3@20°C 0.0217e-
3@100°C 0.0257e-3@200°C
O₂/WATER SOLUBILITY(1 atm) mg/L 14.16@0°C 12.70@4°C 10.92@10°C
9.76@15°C 8.84@20°C 8.11@25°C 7.04@35°C
WATER(ICE) VAPOUR PRESS. kPa(g/m² air) 0.037997(0.341)@-30°C
0.10346(0.883)@-20°C 0.25998(2.140)@-10°C 0.61129(4.85)@0°C
0.81359(6.35)@4°C 1.2281(9.40)@10°C 1.7056(12.80)@15°C
2.3388(17.30)@20°C 3.1690(23.05)@25°C 5.6267(39.55)@35°C
12.344(83.05)@50°C 101.32@100°C 1553.6@200°C 8583.8@300°C
THERM. CONDUCTIVITY(k) W/(m*K) Water 0.58@0°C 0.59@20°C
0.68@100°C Ice 2.215@0°C Air 0.025@0°C 0.026@20°C 0.053@400°C
 $q = k \cdot A \cdot (T_h - T_c) / L$ (wall)
SOLAR CONSTANT (all wavelengths) 1360 W/m² outside atm. ~50% @
earth surface
SPECIFIC HEAT kJ/(kg*K) Water $c_p = 4.18$ Ice $c = 2.09$ Air $c_v = 1.005$ @0°C
 $c_p = 0.718$ @0°C
 $Q = c \cdot m \cdot (T_1 - T_0)$
LATENT HEAT kJ/kg(cal/g) Ice-fusion = 335(80) Water-evaporation =
2250(540)
AIR COMPOSITION (by volume) M.W.=28.97 N₂ 78% O₂ 21% Ar 1%
WATER SURFACE TENSION N/m 0.0747@280K 0.0733@290K
0.0717@300K 0.0685@320K 0.0651@340K 0.0615@360K 0.0576@380K
0.0536@400K
WATER BOILING POINT °C 32.88@5kPa 45.82@10kPa 60.07@20kPa
75.88@40kPa 85.95@60kPa 93.51@80kPa 96.71@90kPa 98.21@95kPa
99.63@100kPa 100.00@101.325kPa 101.00@105kPa 102.32@110kPa
104.81@120kPa 111.38@150kPa 120.24@200kPa

US STANDARD ATMOSPHERE h(m) T(°C) p/p0 ro/ro0 -500 18.2 1.061
1.049 0 15.0 1.000 1.000 500 11.7 0.9421 0.9529 1000 8.5 0.8870 0.9075
1500 5.2 0.8345 0.8638 2000 2.0 0.7846 0.8217 2500 -1.3 0.7372 0.7812
3000 -4.5 0.6920 0.7423 3500 -7.8 0.6492 0.7048 4000 -11.0 0.6085 0.6689
4500 -14.3 0.5700 0.6343 5000 -17.5 0.5334 0.6012 6000 -25.0 0.4660
0.5389 7000 -30.5 0.4057 0.4817 8000 -37.0 0.3519 0.4292 9000 -43.5
0.3040 0.3813 10000 -49.9 0.2615 0.3376 11000 -56.4 0.2240 0.2978 20000
-56.5 0.05457 0.07258 30000 -46.7 0.01181 0.01503 50000 -2.5 7.874e-4
8.383e-4 60000 -17.4 2.217e-4 2.497e-4 80000 -92.5 1.023e-5 1.632e-5
(p0=101325Pa, ro0=1.2250kg/m3) T(K)=T(°C)+273.15
by Maciej Tomczak 1997 All Rights Reserved Please send comments to:
tomczak@uwindsor.ca