TERMS & CONVERSION FACTORS - WINTER 2001 SEMESTER (1/27/01)

Miami University and University of Cincinnati

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PROPERTY DATA & CONVERSION FACTORS

Air Properties	Dry air is about 79 mole % N_2 and 21 mole% O_2 with average molecular weight of 28.97	C_P specific heat is about 1.005 kJ / (kg - C) at 27 C = 0.240 Btu / (lb_m - F). Cv specific heat is about 0.718 kJ / (kg - C) at 27 C = 0.171 Btu / (lbm - F) at 80 F.	At Standard atmospheric pressure and 60 F, mass density and specific weight are about 0.0764 lb_f / ft^3	At Standard stmospheric pressure and 20 C, mass density is 1.204 kg /m^3 and the specific weight is 11.81 N / m^3
Area = A	1m^2 = 10^4 cm^2 = 10^8 mm^2 = 10.76 ft^2	1 acre = 43,560 ft^2 = 4840 yd^2 = 0.4047 hectares = 4047 m^2	1 hectare = 10^4 m^2 = 2.471 acres = 1.076 x 10^5 ft^2	1 ft^2 = 144.0 in^2 = 929.0 cm^2 = 0.09290 m^2
Convection Heat Transfer Coefficient = h_c	1 Btu / (hr - ft^2 - F) = 5.678 Watts / (m^2 - C)	1 W / (m^2 - C) = 0.1761 Btu / (hr - ft^2 - F)		
Atmospheric or Barometric Pressure	1 Standard atm = 14.696 lb_f / in^3 and 59 F at sea level = 33.90 ft water at 4 Deg. C. = 29.921 inches mercury at 0 deg C	Atmospheric pressure drops about 1 in of mercury per 1000 ft altitude or 85 mm mercury per 1000 m altitude	1 Standard atm. at sea level = 10.333 m water at 4 deg C = 760 mm mercury at 0 deg C = 760 Torr = 101.3 kilopascals = 101.3 kN / m^2 = 1.013 bars = 1013 millibars	
Energy & Work:	1 Btu = 1055 joules = 252 cal = 778.3 ft - lb_f	1 ft - lb_f = 1.356 joules	1 hp - hr = (hp) (hours operates) = 0.7455 kW - hr = 2545 Btu = 2.684 MJ	1 kWh = (kW power) (hours operates) = 3.6 MJ = 1.3404 hp - hr
	1 joules = 10^7 ergs = 0.23901 cal = 0.7376 ft - lb_f		1 kWh = 3413 Btu = 1.341 hp - hr = 3600 joules = 3600 W - s	
Enthalpy h or Internal energy u per Unit Mass:	1 Btu / lb_m = 2.326 kJ / kg	1 kJ / kg = 0.430 Btu / lb_m		
Enthalpy of Phase Change or Reaction	1 kJ / gm mole = 0.239 kcal / g mole = 1 MJ / kg mole = 430.2 Btu / lb mole			
Force = F	1 newton = 0.2248 lb_f = 10^5 dynes		1 lb_f = 4.4482 N = 4.4482 x 10^5 dynes	
Heat Transfer Rate / unit time	1 Btu / hr = 1.050 kJ / hr = 0.2931 W	1 ton of refrigeration = 12,000 Btu / hr = 200 Btu / min. = 3.517 kW		
Heat transfer rate / unit area	1 Btu / ft^2 = 3.155 W / m^2	1 W / m^2 = 0.3171 Btu / (hr - ft^2)	1 W / cm^2 = 10^6 W / m^2	
Heat content or generation rate / unit volume	1 Btu / ft^3 = 37.26 kJ / m^3	1 W / m^3 = 0.09665 Btu / (hr - ft^3)		

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Kinematic Viscosity	1 cSt = centistoke = (1 cp viscosity) / (1 g per cm^3 density) = 1.076 x 10^{-5} ft^2 / s = 1.000 x 10^{-6} m^2 / s = 0.01 St (stoke)	1 m^2 / s = 10.76 ft^2 / s = 10^4 St (Stokes) = 10^6 cSt (centistokes)	1 ft^2 / s = 0.09290 m^2 / s = 929 St (Stokes)	
Length = L	1 m = 3. 281 ft = 39.37 in = 1000 mm = 10^6 microns	1 in = 2.540 cm = 0.02540 m	1 statute mile = 5280 ft = 1760 yd = 320 rods = 8 furlongs = 1.609 km	1 Nautical mile = 6080 ft = 1852 m
Mass = m	1 lb_m = 453.6 g = 16 oz. = 7000 grains 1 slug = (1 lb_m / 32.174) = 14.594 kg	1 kg = 2.2046 lb_m	1 US ton = 2000 lb_m = 907.2 kg	1 MT = Metric ton = 1000 kg = 2204.6 lb_m
Mass Density	1000 kg / m^3 = 1 g / cm^3 = 62.43 lb_m / ft^3 = 1.941 slugs / ft^3	1 lb_m / ft^3 = 16.018 kg / m^3	1 slug / ft^3 = 32.17 lb_m / ft^3 = 515.4 kg / m^3	
Mass flow rate	1 lb_m / s = 60 lb_m / min = 0.4536 kg / s	1 kg / s = 60 kg / hr		
Mercury properties	s.g = 13.54 at 77 F (25 C) for mass density and specific weight of 844.9 lb_f / ft^3 In SI, mass density of 13, 540 kg / m^3 and specific weight of 132.8 kN / m3			
Power	1 hp = 0.7457 kW = 550 (ft - lb_f) / s = 33,000 (ft - lb_f) / min = 42.44 Btu / min = 0.7068 Btu / s = 2544 Btu / hr		1 watt = 3.412 Btu / hr = 5.688 x 10^{-2} Btu / min = 0.23901 cal / s = 0.7376 (ft - lb_f) / s = 44.25 (ft - lb_f) / min	1 kW = 3412 Btu / hr = 56.88 Btu / min = 0.9478 Btu / s = 1.3405 hp = = 737.6 (ft - lb_f) / s = 239.0 cal / s
Pressure = P	1 lb_f / in^2 = 6.895 kPa = 27.7 inches H_20 = 2.04 inches of Hg = 51.9 mm of Hg = 144 lb_f / ft^2	1 in Hg = 3.387 kPa and 1 in H_2O = 249 Pa and 1 mm Hg = 132.8 Pa	Also see Atmospheric Pressure above	1 dyne / cm^2 = 0.1 Pa
	1 lb_f / ft^2 = 47.88 Pa	1 bar = 14.50 lb_f / in^2 = 100 kPa		
Specific Heat	1 Btu / (lb_m - F)= 4.1868 kJ / (kg - C) = 1 cal / (gm - C)		1 kJ / (kg - C) = 0.2389 Btu / (lb_m - F)	
Specific volume = v	1 ft^3 / lbm = 0.062428 m^3 / kg	1 m^3 / kg = 1000 liters / kg = 10^3 cm^3 / kg = 16.02 ft^3 / lb_m		
Specific Weight	1lb_f / ft^3 = 157.1 N / m^3			
Temperature = T	0.00 C = 273.15 K = 32.00 F = 492.2 R		0.00 F = 460.2 R = -17.8 C	
Thermal Conductivity = k	1 Btu / (hr - ft - F) = 1.731 watts / (m - C)	1 W / (m - C) = 0.5778 Btu / (hr - ft - F)		
Velocity = v_{ave}	1 m / s = 3.2803 ft / s = 2.237 miles / hr = 3.600 km / hr	60 miles / hr = 88.00 ft / s = 96.56 km / hr	1 ft /s = 0.6818 miles / hr = 0.3048 m / s	1 knot = 1.1508 miles / hr = 1.852 km / hr = 101.3 ft / min
Viscosity or Dynamic Viscosity = μ	1 cp = 0.01 g / (cm - s) = 6.72 x 10^{-4} lb_m / (ft - s) = 1 x 10^{-3} kg / (m - s) = 10^{-3} pascal - s = 0. 01 poises = 2.089 x 10^{-5} (lb_f / ft^2) - s = 2.089 x 10^{-5} slugs / (ft - s)		1 pascal - s = 1 kg / (m - s) = 1(N / m^2) - s = 10 Poises = 0. 02089 (lb_f / ft^2) - s = 0. 02089 slugs / (lb_f - s)	1 (lb_f / ft^2) -s = 47.99 Pa - s = 478.8 Poise

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	(lb_m / (ft - s)) / 32.174 = 1 (lb_f / ft^2) - s = 1 slug / (ft - s)		1 (lb_f / ft^2) - s = 1 slug / (ft - s)	
Volume = V	1 ft^3 = 1728 in^3 = 7.4805 US gal = 28.317 liters = 0.028317 m^3 = 2.8317 x 10^4 cm^3 = 2.8317 x 10^7 mm^3	1 barrel = 42 US gal liquid = 55 US gal oil	1 m^3 = 264.17 US gal = 35.314 ft^3 = 10^3 liters = 10^6 cm^3 = 10^9 mm^3	1 yd^3 = 21.7 Bushels = 0.7646 m^3 = 211.0 US gal = 764.5 liters
	1 US gal = 4 US liquid quarts = 8 US liquid pints = 16 US liquid cups = 3.785 liters = 8.346 lb_f water at 4 deg C = 231.0 in^3 = 0.1337 ft^3 = 128.0 fl. oz.		1 US liquid quart = 0. 0.9463 liters = 0. 8594 US dry quarts = 32 fl. oz.	1 fl. Oz. = 29.57 cm^3 = 0.02957 liters = 1.805 in^3
	1 acre - ft = 1233 m^3 = 43560 ft^3	1 US Bushel = 4 pecks = 1.2843 ft^3 = 32 US dry quarts = 64 US dry pints		1 liter = 1000 ml = 61.03 in^3 = 2.114 US liquid pints = 4.227 US liquid cups = 33.82 fl. oz.
Volumetric flow rate = $\dot{V}$	1 ft^3 / s = 448.8 US gal / min = 0.0283 m^3 / s = 28.317 liters / s = 1699 liters / min = 101.9 m^3 / hr.	1 gal / min = 3.785 liters/ min = 0.002228 ft^3 / s = 6.309 x 10^{-5} m^3 / s	1 m^3 / s = 10^3 liters / s = 35.31 ft^3 / s = 1.5850 x 10^4 US gal / min = 2,120 ft^3 / min = 6.000 x 10^4 liters / min	
Water's Properties	At 4 deg C, liquid has specific weight of 62.43 lb_f / ft^3 = 8.346 lb_f / US gal = 9.807 kN / m^3 at 4 deg C . Liquid has mass density of 62.43 lb_m / ft^3 = 8.345 lb_m / gal = 1.94 slugs / ft^3 = 1 gram / cm^3 = 1,000 kg / m^3 = 9.807 kN / m^3 Ice at 32 F has mass density of 57.5 lb_m / ft^3 = 921 kg / m^3	Vapor has C_p specific heat at 27 C of about 1.87 kJ / (kg - C) = 0.445 Btu / (lb_m - F) at 80 F. Corresponding values for C_v are 1.4108 kJ / (kg - C) and 0.335 Btu / (lb_m - F). Ice has specific heat of 2.11 kJ / (kg - C) at 0 C = 0.502 Btu / (lb_m - F)	specific heat of liquid = about 1 Btu / (lb_m - F) = 4.187 kJ / (kg - C). The viscosity of liquid at 20 C = about 1 cp = 0.001 Pa -s = 0.001 (N / m^2) - s = 0.001 kg / (m - s) = 6.72 x 10^{-4} lb_m / (ft - s)	at one atm, heat of vaporization = 970.5 Btu / lb_m = 2,256 kJ / kg = 540 cal / gm and the heat of melting ice = 143.5 Btu / lb_m = 335 kJ / kg = 79.6 cal / g
Work = W	See Energy & Work above			