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

Miami University and University of Cincinnati

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Term	Definition	in US units	in SI units	in CGS units
Absolute Temperature = T		C_P specific heat is about 1.005 kJ / (kg -	At Standard atmospheric pressure and 60 F, mass density and specific weight are about 0.0764 lb_f / ft^3	At Standard atmospheric pressure and 20 C, mass density is 1.204 kg /m^3 and the specific weight is 11.81 N / m^3
Acceleration = a	rate of change of the velocity	ft / s^2	m / s^2	cm / s^2
Electrical Work = W_{elec}	equals watts = volts x amperes	none	watt = joule per s	none
Elevation head	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		
Enthalpy = H	internal energy of a material + its flow energy (the latter is the product of the Pressure and Volume). See flow energy below.	Btu	joules	cal or ergs unit
Enthalpy per unit mass = h = specific enthalpy	internal energy of a material + its flow energy (the latter is the product of its Pressure and specific volume). See flow energy below.	Btu / lbm	joules / kg	cal / gm
Energy	Ability to do work. See Work below	ft - lb_f which also equals approximately ft - lb_m on earth. Commonly expressed in Btu since 1 Btu equals 778 ft - lb_f	(newton - meter) = J (joule)	erg = 1 dyne - cm
Flow Work or Energy (see also Pressure Head below)	work to push mass into a system = (P_{in}) (V_{in}) = (mass) (P_{in}) (v_{in}) or out of a system = (mass) (P_{out}) (v_{out}) where P, V, & v are pressure, total volume, and specific volume respectively. Net flow work = flow work out - flow work in	ft - lb_f or Btu unit	joule = newton - meter	ergs = dynes - cm or calorie unit
Force = F per Newton' s 2nd law	Net Force = (mass x acceleration) / g_c. Net means the resultant of 1 or more forces. Weight is the force of gravity (see below)	lb_f (pound force) defined as gravity accelerates a 32.174 lb_m by 1 ft / s^2, or 1 lb_f accelerates 1 lb_m by 32.174 ft / s^2	N (newton) = 1 (kg - m) / s^2	dyne = 1 (gm - cm) / s^2
Gas Constant (molar) = R		1546 (lb_f / ft^2 - ft^3) / (lb_m mole - R) = 1.987 Btu / (lb_m mole - R) = (0.7302 atm - ft^3) / (lb_m mole - R) = 10.73 (psia - ft^3) / (lb_m mole - R)	8.314 (kPa - m^3) / (kg mole - K) = 8.314 kJ / (kg mole - K) = 0.08134 (bar - m^3) / (kg mole - K)	1.987 cal / (gm - mole - K) = 82.06 (atm - cm^3) / (gm mole - K)
Heat = Q	thermal energy = energy that moves because of a temperature difference	Btu	J (joules)	cal

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Heat Transfer Coefficient = h_c	heat transfer due to convection or radiation per unit (time - area - temperature difference)	Btu/ (hr -ft^2- F)	watts / ($meter^2$ - C)	cal / (s - cm^2 - C)
Internal Energy / unit mass = u = specific internal energy	a measure of the energy in a material due to its temperature and phase (gas phase highest, solid phase lowest)	Btu / lbm	joules / kg	cal / gm or ergs / gm
Kinetic Energy = KE	1/ 2 mass times $velocity^2 / g_c$	ft - lb_f or Btu unit	joule = newton - meter	erg = dyne - cm or calorie unit
Kinetic energy per unit weight = Velocity head	kinetic energy of an incompressible fluid per unit weight = V_{ave}^2 / 2g where V_{ave} is the average fluid velocity	(ft - lb_f) / lbf fluid = ft head of fluid	(newton - meters) / newton fluid which is meters head of fluid	(dyne - cm) / dyne fluid which is cm head of fluid
Kinetic energy per unit mass = Velocity head per unit mass	kinetic energy of an incompressible fluid per unit mass = V_{ave}^2 / $2g_c$ where V_{ave} is the average fluid velocity	(ft - lb_f) / lb_m = ft head of fluid since lb_f approximately = lb_m on earth	(newton - meters) / kg fluid = J / kg fluid which is NOT meters head of fluid	(dyne - cm) / gm fluid which is NOT cm head of fluid
Kinematic Viscosity	dynamic viscosity / mass density	ft^2 / s	m^2 / s	St (stoke) = cm^2 / s = 100 cSt (centistokes)
Length = L		ft. (foot)	m (meter)	cm (centimeter)
Local Acceleration of gravity = g	how fast local gravity will accelerate unit mass when dropped in a vacuum. Local gravity varies only 0.5% around the earth	about 32.174 ft / s^2 on earth. .	about 9.807 m / s^2 on earth	about 980.7 cm / s^2 on earth
Mass = m	the amount of material. Does not depend on location (i.e., the local force of gravity) or the material's motion	lb_m. From Newtons' 2nd law, lb_m = lb_f / (32.174 ft / s^2). Alternative unit is slug = lb_m / 32.174. Slug defined as 1 lb_f accelerates 1 slug by 1 ft / s^2	kg (kilogram). From Newton's 2nd law, kg = newtons / (m / s^2)	gm (gram) . From Newton's 2nd law, gm = dynes / (cm / s^2)
Mass Density	mass per unit volume	lb_m / ft^3 which about equals lb_f / ft^3 on earth. Alternative unit = slugs / ft^3 = (lb_f - s^2) / ft^4	kg / m^3	gm / cm^3
Mass flow rate	mass flowing per unit time	lb_m / s	kg / s	gm / s
Molar Gas Volume	volume 1 mole of gas occupies at specified pressure & temperature	1 lb_m mole = 359 ft^3 at 1 std atm & 32 F	I kg mole = 22.4 m^3 at 0 C & 1 std. Atm.	1 gm mole = 22.4 liters at 1 std Atm & 0 C.
Mole	molecular weight in lb_m , kg, gm, etc.	lb_m mole = lb_m equal to molecular weight	kg mole = kg equal to the molecular weight	gm mole = grams equal to molecular weight
Potential Energy = PE	(weight) (height)	ft - lb_f or Btu unit	J (joules) = newton - meters	erg = dyne - cm or calorie unit
Potential energy per unit weight = Elevation head per unit weight	height of fluid	(ft - lb_f) / lb_f of fluid = ft head of fluid. Also expressed in Btu / lb_f fluid	(newtons- meters) / newton fluid = meters head of fluid	(dynes - cm) / dyne fluid = cm head of fluid
Potential energy per unit mass = Elevation head per unit mass	(height) (g / g_c)	(ft - lb_f) / lb_m = ft head of fluid since lb_f approximately = lb_m on earth	(newton - meters) / kg fluid = J / kg fluid which are NOT meters head of fluid	(dyne - cm) / dyne fluid which is NOT cm head of fluid
Power	Work / time	hp = 550 (ft - lb_f) / s	watt = joule / s	ergs / s

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Pressure = P	the Normal (i.e., perpendicular) Force / area	lb_f / ft^2 or lbf / in^2 (abbreviated psi)	newtons / m^2 = Pa (pascal)	dynes / cm^2
$\frac{\text{Pressure Head}}{\text{Weight}} = \frac{P}{\gamma} = P v$	Flow Energy per unit weight where P is Pressure and gamma is the weight density, and v is specific volume	(ft - lb_f) / lb_f of fluid = ft head of fluid.	(newtons- meters) / newton fluid = meters head of fluid	(dynes - cm) / dyne fluid = cm head of fluid
$\frac{\text{Pressure Head}}{\text{mass}} = \frac{P}{\rho} = P v$	Flow Energy per unit mass where P is Pressure, rho is mass density, and v is specific volume	(ft - lb_f) / lb_m = ft head of fluid since lb_f approximately = lb_m on earth	1 (lb_f / ft^2) - s = 1 slug / (ft - s)	(dyne - cm) / dyne fluid which is NOT cm head of fluid
Specific enthalpy = h	same as enthalpy per unit mass above	Btt / lb_m		
Specific gravity (s.g.)	The ratio of a material's mass density or specific weight to that of water. Has no units. Often with reference to water at 4 C while the material may be at another temperature .			
Specific heat at constant pressure = c_p = change in enthalpy with temperature	Strictly speaking, amt. heat at constant pressure to raise specified amount a specified deg.. **For ideal gases, incompressible solids, & incompressible liquids, equals enthalpy change regardless of any pressure changes. For incompressible solids and liquids, c_p = c_v**	Btu / (lb_m - F)	J / (kg - C)	cal / (gm - C)
Specific heat at constant volume = c_v = change in internal energy with temperature	Strictly speaking, amount of heat at constant volume of the material to raise specified amount a specified deg. **For ideal gases, incompressible solids, and incompressible liquids, equals internal energy changes regardless of volume - pressure changes**. Likewise, for incompressible solids and liquids, c_v = c_p, .	Btu / (lb_m - F)	J / (kg - C)	cal / (gm - C)
Specific heat ratio for an ideal gas = k	ratio of specific heat at constant pressure to that at constant volume	doesn't change with units	about 1.67 for monatomic gases and 1.4 for air and other diatomic gases	
Specific internal energy = u	same as internal energy per unit mass above			
Specific volume = v	volume per unit mass = reciprocal of mass density	ft^3 / lb_m	m^3 / kg	cm^3 / gm
Specific weight = γ	weight density = weight per unit volume = pull of local gravity per unit volume	lb_f / ft^3 or about 1 lb_m / ft^3 since local earth gravity equals standard gravity within 0.5%	newtons / m^3 which does not equal kg / m^3	dynes / cm^3 which does not equal grams / cm^3
Temperature = T		deg. Fahrenheit = F	deg. Centigrade = C	deg. Centigrade = C
Thermal Conductivity = k	Heat conduction per unit time per unit area per deg. temp difference over unit thickness	Btu / (hr - ft - F)	W / (m - C)	

file = Units.xls.xls
sheet = Terms Only

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Time = t		seconds = s	seconds = s	seconds = s
Therm of Natural Gas	Heat from burning Natural Gas	1 therm = 10^5 Btu	1 therm = 1.055 x 10^5 kJ	
Ton of Refrigeration	Rate heat is removed from confined space (refrigerator) or living space (air conditioner)	1 ton of refrigeration = 12,000 Btu / hr = 200 Btu / min	1 ton of refrigeration = 211 KJ / min = 3.517 kW	
Value of g_c	**factor to convert mass times acceleration to force**	**32.174 (ft - lb_m) / (lb_f - s^2). Also 1 (slug - ft) / (lb_f - s^2)**	**1 (kg - meter) / (newton - s^2)**	**1 (gm - cm) / (dyne - s^2)**
Velocity = v_{ave}	the rate of motion (of an object or fluid) with respect to some fixed reference frame	ft / s or miles / hr	m / s or km / hr	cm / s
Velocity head	Same as kinetic energy per unit weight or mass above			
Viscosity or Dynamic Viscosity = μ	resistance to flow = force per unit area to move 2 parallel plates past each other at unit velocity when separated apart by unit distance	lb_m / (ft - s) or (lb_f / ft^2) - s	1 kg / (m - s) = 1 pascal - s = 1 (N / m^2) - s	1 poise = 1 (dyne / cm^2) = 1 gm / (cm - s) = 100 cp
Volumetric flow rate = $\dot{V}$	Volume flowing per unit time	ft^3 / s or commonly gpm which is gallons per minute	m^3 / s	cm^3 / s
Weight = w	the pull of gravity = mass x (g / g_c) where g is the local acceleration of gravity	1 lb_f = 1 lb_m x (g / gc) or about 1 lb_m on earth. By definition, weight of 1 lb_f accelerates 1 lb_m by 32.174 ft / s^2. Also, 1 lb_f accelerates 1 slug mass by 1 ft / s^2	newton = kg mass x 9.807 m / s^2. Note a newton DOES NOT accelerate 1 kg by 1 m / s^2	dynes = gm x 980.7 cm / s^2. Note a dyne DOES NOT accelerate 1 gram by 1 cm / s2
Weight density = γ	same as specific weight above			
Work and Energy	Work = force x distance. Energy is the ability to do work	ft - lb_f which also equals approximately ft - lb_m on earth. Commonly expressed in Btu since 1 Btu equals 778 ft - lb_f	(newton - meter) = J (joule)	erg = 1 dyne - cm