APPENDIX-1
DIMENSIONLESS DECEPTIONS

Measurement of physical quantity involves two elements:

-*a dimension*, which identifies the nature of the quantity and also the choice of the *unit* used as a basis comparison,

-a number which states how many of these units are contained in the quantity being measured.

The majority of physical quantities have dimensions, which can be derived from, or expressed in terms of, the dimensions of a limited number of fundamental or primary quantities. The time rate of change of position, for example, has the dimensions of velocity by definition. Velocity, however, can be expressed as a length divided by a time interval. Then the unit of velocity used in subsequent measurements of like quantities would be fixed by the choice of length unit and time unit used in its definition. A sufficient choice of primary quantities for most engineering work is *mass*, *length*, *time* and *temperature*.

The fundamental standards of length and mass designed for the entire world are the distance between two lines inscribed on a particular-platinium-iridium bar and the mass of a certain block of platinium.

It would be difficult, if it were possible at all, to maintain a fixed quantity of force as an unvarying physical standard. For by its nature, the very existence of a force can only be inferred from the changes it produces in the state of motion of a material body. Newton's law of motion attributes the acceleration **a** produced in a body of constant mass **m** attributed to the action of force **F** whose magnitude is proportional to the mass and acceleration of the body:

$$\mathbf{F} \propto \mathbf{ma}$$

The force of attraction, which the earth exerts on a material body, is called the weight of the body. Being a force quantity, the weight **W** of a body of mass **m** can be calculated using Newton's law in the form of:

$$W = (1/g_c)\, mg$$

where, g_c is the acceleration which gravity would impart to the body in a free fall. Unfortunately, the term "weight" is sometimes used improperly as a synonym for mass. To make matters worse, in two of the unit systems to be discussed, the unit of weight has the same name as the unit of mass, and the necessary distinction between these quantities becomes even more elusive. Therefore, it cannot be overemphasized that weight has the dimensions of force.

Each time an arbitrary choice of basic units is made for mass, length and time, a new system of units is established together with an opportunity for defining a new unit of force. The following table represents two systems commonly used in scientific and engineering calculations.

Appendix-1.1 Common Unit Systems

Quantity	Symbol	Metric	Engineering (English)
Mass	m	gram,gm	lbm
Length	L	centimeter,cm	ft
Time	t	second,sec	Sec
Force	F	dyne	pound, lbf
Density	ρ	gm / cu cm	lbm / cu ft
Specific Volume	V	cu cm / gm	cu ft / lbm
Absolute Viscosity	μ	gm / cm sec	lbm / ft sec
Energy	E	dyne cm (erg)	ft lbf
Power	P	erg / sec	horsepower

Appendix-1.2 Common Conversion factors

acres x 43560 = sg ft	m^3 x 61.023= cu inch	km x 328.1 = ft	lb x 453.5924 = gr
acres x 40471 sq m	ft x 30.48 = cm	km x 0.6214 = miles	psi x 0.06804 = atm
acre-ft x 43560 = cu ft	ft x 0.3048 = m	km/hr x 27.78 = cm/sec	psi x 2.307 = ft water
atm x 76 = cm of Hg	(F-32) x 0.555 = ^{O}C	km/hr x 54.68 = ft/min	psi x 2.036= inch Hg
atm x 29.92 = inch of Hg	ft/min x 0.508 = cm/sec	km/hr x 0.9113 = ft/sec	radian x 57.30 = degree
atm x 14.7 = psi	ft/min x 0.0166 = ft/sec	kw x 1.341 = hp	rad/sec x 9.549 = rpm
bbl oil x 42 = gal oil	ft/min x 0.01829 = km/hr	liter x 0.03531 = cu ft	rev. x 360 = degree
bll cem. x 376 = lb cem.	gal x 0.1337 = cu ft	liter x 0.61.02 = cu inch	cm^2 x 0.1550 = $inch^2$
bars x 14.504 = psi	gal x 231 = cu inch	liter x 0.2642 = gal	$inch^2$ x 6.452 = cm^2
^{O}C x 1.8 + 32 = F	gr x 980.7 = dtne	meter x 3.281 = ft	$inch^2$ x $6.944x10^{-3}$ = ft^2
cm Hg x 0.01316 = atm	hp x 33000 = ft-lb/min	meter x 29.37 = inch	ton (long) x 1016 = kg
cm^3 x 2.642 x 10^{-4} = gal	hp x 550 = ft-lb/sec	m/sec x 196.8 = ft/min	ton (long) x 1.12 = ton
in^3 x 5.78 x 10^{-4} = cu ft	inch x 2.54 = cm	m/sec x 3.281 = ft/sec	ton (short) x 907.18 = kg
m^3 x 35.31 = cu ft	kg x 980665 = dyne	m/sec x 3.6 = km/hr	yard x 91.44 = cm