TABLE 1 Derived Dimensions Expressed in Terms of Base Dimensions

QUANTITY	VARIABLE NAME	BASE DIMENSIONS
Area	A	$[L]^2$
Volume	V	$[L]^3$
Density	ρ	$[M]\,[L]^{-3}$
Force	F	$[M]\,[L]\,[t]^{-2}$
Pressure	P	$[M]\,[L]^{-1}\,[t]^{-2}$
Stress	σ	$[M]\,[L]^{-1}\,[t]^{-2}$
Energy	E	$[M]\,[L]^2\,[t]^{-2}$
Work	W	$[M]\,[L]^2\,[t]^{-2}$
Power	P	$[M]\,[L]^2\,[t]^{-3}$
Mass flow rate	$\dot{m}$	$[M]\,[t]^{-1}$
Specific heat	c	$[L]^2[t]^{-2}[T]^{-1}$
Dynamic viscosity	μ	$[M]\,[L]^{-1}\,[t]^{-1}$
Molar mass	M	$[M]\,[N]^{-1}$
Voltage	V	$[M]\,[L]^2\,[t]^{-3}\,[I]^{-1}$
Resistance	R	$[M]\,[L]^2\,[t]^{-3}\,[I]^{-2}$

TABLE 2 Base Dimensions and their SI Units

QUANTITY	UNIT	SYMBOL
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K
Electric current	ampere	A
Amount of substance	mole	mol
Luminous intensity	candela	cd

TABLE 4 Derived Dimensions and SI Units with Specific Names

QUANTITY	SI UNIT	UNIT NAME	BASE UNITS
Frequency	Hz	hertz	s^{-1}
Force	N	newton	$kg \cdot m \cdot s^{-2}$
Pressure	Pa	pascal	$kg \cdot m^{-1} \cdot s^{-2}$
Stress	Pa	pascal	$kg \cdot m^{-1} \cdot s^{-2}$
Energy	J	joule	$kg \cdot m^2 \cdot s^{-2}$
Work	J	joule	$kg \cdot m^2 \cdot s^{-2}$
Heat	J	joule	$kg \cdot m^2 \cdot s^{-2}$
Power	W	watt	$kg \cdot m^2 \cdot s^{-3}$
Electric charge	C	coulomb	$A \cdot s$
Electric potential (voltage)	V	volt	$kg \cdot m^2 \cdot s^{-3} \cdot A^{-1}$
Electric resistance	Ω	ohm	$kg \cdot m^2 \cdot s^{-3} \cdot A^{-2}$
Magnetic flux	Wb	weber	$kg^{-1} \cdot m \cdot s^{-2} \cdot A^{-1}$
Luminous flux	lm	lumen	$cd \cdot sr$

TABLE 5 Derived Dimensions and SI Units

QUANTITY	SI UNITS
Acceleration	$m \cdot s^{-2}$
Angular acceleration	$rad \cdot s^{-2}$
Angular velocity	$rad \cdot s^{-1}$
Area	m^2
Concentration	$mol \cdot m^{-3}$
Density	$kg \cdot m^{-3}$
Electric field strength	$V \cdot m^{-1}$
Energy	$N \cdot m$
Entropy	$J \cdot K^{-1}$
Heat	J
Heat transfer	W
Magnetic field strength	$A \cdot m^{-1}$
Mass flow rate	$kg \cdot s^{-1}$
Moment of force	$N \cdot m$
Radiant intensity	$W \cdot sr^{-1}$
Specific energy	$J \cdot kg^{-1}$
Surface tension	$N \cdot m^{-1}$
Thermal conductivity	$W \cdot m^{-1} \cdot K^{-1}$
Velocity	$m \cdot s^{-1}$
Viscosity, dynamic	$Pa \cdot s$
Viscosity, kinematic	$m^2 \cdot s^{-1}$
Volume	m^3
Volume flow rate	$m^3 \cdot s^{-1}$
Wavelength	m
Weight	N

TABLE 6 Standard Prefixes for SI Units

MULTIPLE	EXPONENTIAL FORM	PREFIX	PREFIX SYMBOL
1,000,000,000,000	10^{12}	tera	T
1,000,000,000	10^9	giga	G
1,000,000	10^6	mega	M
1,000	10^3	kilo	k
0.01	10^{-2}	centi	c
0.001	10^{-3}	milli	m
0.000 001	10^{-6}	micro	μ
0.000 000 001	10^{-9}	nano	n
0.000 000 000 001	10^{-12}	pico	p

TABLE 8 Base Dimensions and their English Units

QUANTITY	UNIT	SYMBOL
Length	foot	ft
Mass	slug(1)	slug
Time	second	s
Temperature	rankine	° R
Electric current	ampere(2)	A
Amount of substance	mole	mol
Luminous intensity	candela(2)	cd

(1) The unit pound-mass (lb_m) is also used. 1 slug = 32.2 lb_m.
(2) There are no English units for electrical current and luminous intensity. The SI units are given here for completeness only.

TABLE 9 Derived Dimensions and English Units

QUANTITY	ENGLISH UNITS
Acceleration	$ft \cdot s^{-2}$
Angular acceleration	$rad \cdot s^{-2}$
Angular velocity	$rad \cdot s^{-1}$
Area	ft^2
Concentration	$mol \cdot ft^{-3}$
Density	$slug \cdot ft^{-3}$
Electric field strength	$V \cdot ft^{-1}$
Energy	Btu
Entropy	$Btu \cdot slug^{-1} \cdot °R^{-1}$
Force	lb_f
Heat	Btu
Heat transfer	$Btu \cdot s^{-1}$
Magnetic field strength	$A \cdot ft^{-1}$
Mass flow rate	$slug \cdot s^{-1}$
Moment of force	$lb_f \cdot ft$
Radiant intensity	$Btu \cdot s^{-1} \cdot sr^{-1}$
Specific energy	$Btu \cdot slug^{-1}$
Surface tension	$lb_f \cdot ft^{-1}$
Thermal conductivity	$Btu \cdot s^{-1} \cdot ft^{-1} \cdot R$
Velocity	$ft \cdot s^{-1}$
Viscosity, dynamic	$slug \cdot ft^{-1} \cdot s^{-1}$
Viscosity, kinematic	$ft^2 \cdot s^{-1}$
Volume	ft^3
Volume flow rate	$ft^3 \cdot s^{-1}$
Wavelength	ft

TABLE 10 Non-SI Units Commonly Used in the United States

QUANTITY	UNIT NAME	SYMBOL	SI EQUIVALENT
Length	inch	in	0.0254 m(1)
	yard	yd	0.9144 m (36 in)
Mass	metric ton	t	1000 kg
	short ton	t	907.18 kg (2000 lb_m)
Time	minute	min	60 s
	hour	h	3600 s
	day	d	86,400 s
Plane angle	degree	°	π/180 rad
	minute	'	π/10,800 rad
	second	"	π/648,000 rad
Volume	liter	L	$10^{-3} m^3$
Land area	hectare	ha	$10^4 m^2$
Energy	electron-volt	eV	1.602177×10^{-19} J

(1) Exact conversion.

Sources

K. D. Hagan. "Dimensions and Units." *Introduction to Engineering Analysis*, 2/e — 0-13-145332-7. ESource/Pearson Prentice Hall: Upper Saddle River, NJ, 2000.

R. M. Felder; R. W. Rousseau. *Elementary Principles of Chemical Engineering*, 3rd Ed. John Wiley & Sons, Inc.: New York, 2000.

TABLE 11 Some Common SI-to-English Unit Conversions

QUANTITY	UNIT CONVERSION
Acceleration	$1\ m/s^2 = 3.2808\ ft/s^2$
Area	$1\ m^2 = 10.7636\ ft^2 = 1550\ in^2$
Density	$1\ kg/m^3 = 0.06243\ lb_m/ft^3$
Energy, work, heat	$1055.06\ J = 1\ Btu = 252\ cal$
Force	$1\ N = 0.22481\ lb_f$
Length	$1\ m = 3.2808\ ft = 39.370\ in$
	$0.0254\ m = 1\ in^{(1)}$
Mass	$1\ kg = 2.20462\ lb_m = 0.06852\ slug$
Power	$1\ W = 3.4121\ Btu/h$
	$745.7\ W = 1\ hp$
Pressure	$1\ kPa = 20.8855\ lb_f/ft^2 = 0.14504\ lb_f/in^2$
Specific heat	$1\ kJ/kg \cdot °C = 0.2388\ Btu/lb_m \cdot °F$
Temperature	$T(K) = T(°C) + 273.16 = T(°R)/1.8 = [T(°F) + 459.67]/1.8$
Velocity	$1\ m/s = 2.2369\ mi/h$

(1) Exact conversion

FACTORS FOR UNIT CONVERSIONS

Quantity	Equivalent Values
Mass	$1\ kg = 1000\ g = 0.001$ metric ton $= 2.20462\ lb_m = 35.27392\ oz$ $1\ lb_m = 16\ oz = 5 \times 10^{-4}$ ton $= 453.593\ g = 0.453593\ kg$
Length	$1\ m = 100\ cm = 1000\ mm = 10^6$ microns (μm) $= 10^{10}$ angstroms (Å) $= 39.37$ in. $= 3.2808\ ft = 1.0936\ yd = 0.0006214$ mile $1\ ft = 12$ in. $= 1/3\ yd = 0.3048\ m = 30.48\ cm$
Volume	$1\ m^3 = 1000\ L = 10^6\ cm^3 = 10^6\ mL$ $= 35.3145\ ft^3 = 220.83$ imperial gallons $= 264.17$ gal $= 1056.68$ qt $1\ ft^3 = 1728$ in.$^3 = 7.4805$ gal $= 0.028317\ m^3 = 28.317\ L$ $= 28{,}317\ cm^3$
Force	$1\ N = 1\ kg{\cdot}m/s^2 = 10^5$ dynes $= 10^5\ g{\cdot}cm/s^2 = 0.22481\ lb_f$ $1\ lb_f = 32.174\ lb_m{\cdot}ft/s^2 = 4.4482\ N = 4.4482 \times 10^5$ dynes
Pressure	$1\ atm = 1.01325 \times 10^5\ N/m^2$ (Pa) $= 101.325\ kPa = 1.01325$ bar $= 1.01325 \times 10^6\ dynes/cm^2$ $= 760$ mm Hg at 0°C (torr) $= 10.333$ m H_2O at 4°C $= 14.696\ lb_f/in.^2$ (psi) $= 33.9$ ft H_2O at 4°C $= 29.921$ in. Hg at 0°C
Energy	$1\ J = 1\ N{\cdot}m = 10^7$ ergs $= 10^7$ dyne·cm $= 2.778 \times 10^{-7}\ kW{\cdot}h = 0.23901$ cal $= 0.7376$ ft-$lb_f = 9.486 \times 10^{-4}$ Btu
Power	$1\ W = 1\ J/s = 0.23901\ cal/s = 0.7376\ ft{\cdot}lb_f/s = 9.486 \times 10^{-4}\ Btu/s$ $= 1.341 \times 10^{-3}$ hp

Example: The factor to convert grams to lb_m is $\left(\frac{2.20462\ lb_m}{1000\ g}\right)$.