SI QUICK REFERENCE GUIDE:
International System of Units (SI)
*The Modernized Metric System**

UNITS

The International System of Units (SI) is based on seven fundamental (base) units:

Base Units

Quantity	*Name*	*Symbol*
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

and a number of derived units which are combinations of base units and which may have special names and symbols:

Examples of Derived Units

Quantity	*Expression*	*Name*	*Symbol*
acceleration			
angular	rad/s^2		
linear	m/s^2		
angle			
plane	dimensionless	radian	rad
solid	dimensionless	steradian	sr
area	m^2		
Celsius temperature	K	degree Celsius	°C
density			
heat flux	W/m^2		
mass	kg/m^3		
current	A/m^2		
energy, enthalpy			
work, heat	$N \cdot m$	joule	J
specific	J/kg		
entropy			
heat capacity	J/K		
specific	J/(kg·K)		
flow, mass	kg/s		
flow, volume	m^3/s		
force	$kg \cdot m/s^2$	newton	N
frequency			
periodic	1/s	hertz	Hz
rotating	rev/s		
inductance	Wb/A	henry	H
magnetic flux	$V \cdot s$	weber	Wb
mass flow	kg/s		
moment of a force	$N \cdot m$		
potential,electric	W/A	volt	V
power, radiant flux	J/s	watt	W
pressure, stress	N/m^2	pascal	Pa
resistance, electric	V/A	ohm	Ω
thermal conductivity	$W/(m \cdot K)$		
velocity			
angular	rad/s		
linear	m/s		
viscosity			
dynamic (absolute)(μ)	$Pa \cdot s$		
kinematic (ν)	m^2/s		
volume	m^3		
volume, specific	m^3/kg		

*For complete information see *IEEE/ASTM SI-10*.

SYMBOLS

Symbol	*Name*	*Quantity*	*Formula*
A	ampere	electric current	base unit
Bq	becquerel	activity (of a radio nuclide)	1/s
C	coulomb	electric charge	A·s
°C	degree Celsius	temperature interval	°C = K
cd	candela	luminous intensity	base unit
F	farad	electric capacitance	C / V
Gy	gray	absorbed dose	J/kg
g	gram	mass	kg/1000
H	henry	inductance	Wb/A
Hz	hertz	frequency	1/s
ha	hectare*	area	10 000 m^2
J	joule	energy, work, heat	N·m
K	kelvin	temperature	base unit
kg	kilogram	mass	base unit
L	litre	volume	m^3/1000
lm	lumen	luminous flux	cd·sr
lx	lux	illuminance	lm/m^2
m	metre	length	base unit
mol	mole	amount of substance	base unit
N	newton	force	kg·m/s^2
Ω	ohm	electric resistance	V/A
Pa	pascal	pressure, stress	N/m^2
rad	radian	plane angle	m/m (dimensionless)
S	siemens	electric conductance	A/V
Sv	sievert	dose equivalent	J/kg
s	second	time	base unit
sr	steradian	solid angle	m^2/m^2 (dimensionless)
T	tesla	magnetic flux density	Wb/m^2
t	tonne, metric ton	mass	1000 kg; Mg
V	volt	electric potential	W/A
W	watt	power, radiant flux	J/s
Wb	weber	magnetic flux	V·s

*allowed with SI

Use of Symbols

The correct use of symbols is important because an incorrect symbol may change the meaning of a quantity. Some SI symbols are listed in the Symbol table.

SI has no abbreviations—only symbols. Therefore, no periods follow a symbol except at the end of a sentence.

Examples: A, *not* amp; s, *not* sec; SI, *not* S.I.

Symbols appear in lower case unless the unit name has been taken from a proper name. In this case the first letter of the symbol is capitalized.

Examples: m, metre; Pa, pascal; W, watt

Exception: L, litre

Symbols and prefixes are printed in upright (roman) type regardless of the type style in surrounding text.

Example: . . . *a distance of* 73 km *between* . . .

Unit symbols are the same whether singular or plural.

Examples: 1 mm, 100 mm; 1 kg, 65 kg

Leave a space between the value and the symbol.

Examples: 115 W, *not* 115W; 0.75 L, *not* 0.75L
88 °C, not 88°C or 88° C

Exception: No space is left between the numerical value and symbol for degree of plane angle.

Examples: 73°, not 73 °

Note: Symbol for for coulomb is C; for degree Celsius it is °C

Do not mix symbols and names in the same expression.

Examples: radians per second or rad/s
not radians/second; not radians/s
m/s or metres per second,
not metres/second; *not* metres/s
J/kg or joules per kilogram,
not joules/kilogram; *not* joules/kg

Symbol for product—use the raised dot (·)

Examples: N·m; mPa·s; W/(m^2·K)

Symbol for quotient—use one of the following forms:

Examples: m/s or $\frac{m}{s}$ or use negative exponent

Note: Use only one solidus (/) per expression and parentheses to avoid any ambiguity.

Do not use modifying terms such as electrical, alternating current, etc.

Examples: kPa (gage); MW (e); V (ac)

PREFIXES

Most prefixes indicate orders of magnitude in steps of 1000 and provide a convenient way to express large and small numbers and to eliminate nonsignificant digits and leading zeros in decimal fractions.

Examples: 64 000 watts is the same as 64 kilowatts*
0.057 metre is the same as 57 millimetres
16 000 metres is the same as 16 kilometres*
*except for intended accuracy

Prefix	*Symbol*	*Represents*
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h*	10^{2}
deka	da*	10^{1}
deci	d*	10^{-1}
centi	c*	10^{-2}
milli	m	10^{-3}
micro	µ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}
zepto	z	10^{-21}
yocto	y	10^{-24}

To realize the full benefit of the prefixes when expressing a quantity by numerical value, choose a prefix so that the number lies between 0.1 and 1000. For simplicity, give preference to prefixes representing 1000 raised to an integral power (i.e., µm, mm, km).

**Exceptions*:

In expressing area and volume, the prefixes hecto, deka, deci, and centi may by required; for example, cubic decimetre (L), square hectometre (hectare), cubic centimetre.

Tables of values of the same quantity.

Comparison of values.

For certain quantities in particular applications. For example, the millimetre is used for linear dimensions in architectural and engineering drawings even when the values lie far outside the range of 0.1 mm to 1000 mm; the centimetre is usually used for anatomical measurements and clothing sizes.

Compound units. A compound unit is a derived unit expressed with two or more units. The prefix is attached to a unit in the numerator.

Examples: V/m *not* mV/mm
MJ/kg *not* kJ/g

Compound prefixes formed by a combination of two or more prefixes are not used. Use only one prefix.

Examples: 2 nm *not* 2 mµm
6 m^3 *not* 6 kL
6 MPa *not* 6 kkPa

Exponential Powers. An exponent attached to a symbol containing a prefix indicates that the multiple (of the unit with its prefix) is raised to the power of 10 expressed by the exponent.

Examples: 1 $mm^3 = (10^{-3}\ m)^3 = 10^{-9}\ m^3$
1 $ns^{-1} = (10^{-9}\ s)^{-1} = 10^{9}\ s^{-1}$
1 $mm^2/s = (10^{-3}\ m)^2/s = 10^{-6}\ m^2/s$

NUMBERS

International practice separates the digits of large numbers into groups of three, counting from the decimal to the left and to the right, and inserts a space to separate the groups. In numbers of four digits, the space is not necessary except for uniformity in tables.

Examples: 6.358 568; 85 365; 51 845 953; 88 000;
0.246 113 562; 7 258

Small Numbers. When writing numbers less than one, always put a zero before the decimal marker.

Example: 0.046

Decimal Marker. The recommended decimal marker is a dot on the line (period). (In some countries, a comma is used as the decimal marker.)

Because **billion** means a million million in most countries but a thousand million in the United States, avoid using billion in technical writing.

DO'S AND DON'TS

The units in the international system of units are called SI units—*not* Metric Units and *not* SI Metric Units.

Non-SI units in the US are called Inch-Pound units (I-P units)—*not* conventional units, *not* U.S. customary units, *not* English units, and *not* Imperial units.)

Treat all spelled out names as nouns. Therefore, do not capitalize the first letter of a unit except at the beginning of a sentence or in capitalized material such as a title.

Examples: watt; pascal; ampere; volt; newton; kelvin
Exception: Always capitalize the first letter of Celsius.

Do not begin a sentence with a unit symbol—either rearrange the words or write the unit name in full.

Use plurals for spelled out words when required by the rules of grammar.

Examples: metre—metres; henry—henries;
kilogram—kilograms; kelvin—kelvins
Irregular: hertz—hertz; lux—lux; siemens—siemens

Do not put a space or hyphen between the prefix and unit name.

Examples: kilometre *not* kilo metre or kilo-metre;
milliwatt *not* milli watt or milli-watt

When a prefix ends with a vowel and the unit name begins with a vowel, retain and pronounce both vowels.

Example: kiloampere
Exceptions: hectare; kilohm; megohm

When compound units are formed by multiplication, leave a space between units that are multiplied.

Examples: newton metre, *not* newton-metre;
volt ampere, *not* volt-ampere

Use the modifier squared or cubed after the unit name.

Example: metre per second squared
Exception: For area or volume the modifier may be placed before the units.
Example: square millimetre; cubic metre

When compound units are formed by division, use the word *per*, not a solidus (/).

Examples: metre per second, *not* metre / second; watt per square metre, *not* watt / square meter

Do not use modifying terms such as electrical, alternating current, etc. after the symbol.

Examples: kPa (gage); MW (e); V (ac)

SELECTED CONVERSION FACTORS

CAUTION: These conversion values are rounded to three or four significant figures, which is sufficiently accurate for most applications. When making conversions, remember that a converted value is no more precise than the original value. Round off the final value to the same number of significant figures as those in the original value. See ANSI SI 10 for additional conversions with more significant figures.

Multiply	*By*	*To Obtain*
acre	0.4047	ha
atmosphere, standard	*101.325	kPa
bar	*100	kPa
barrel (42 US gal, petroleum)	159	L
Btu, (International Table)	1.055	kJ
Btu / lb·°F (specific heat, c^p)	4.184	kJ/(kg·K)
bushel	0.03524	m^3
calorie, kilogram (kilocalorie)	4.187	kJ
candle, candlepower	*1.0	cd
centipoise, dynamic vicosity, μ	*1.00	mPa·s
centistokes, kinematic viscosity, ν	*1.00	mm^2/s
ft	*0.3048	m
ft	*304.8	mm
ft / min, fpm	*0.00508	m/s
ft / s, fps	*0.3048	m/s
ft of water	2.99	kPa
ft^2	0.09290	m^2
ft^2/s, kinematic viscosity, ν	92 900	mm^2/s
ft^3	28.32	L
ft^3	0.02832	m^3
ft^3/h, cfh	7.866	mL/s
ft^3/min, cfm	0.4719	L/s
ft^3/s, cfs	28.32	L/s
footcandle	10.76	lx
ft·lb_f (torque or moment)	1.36	N·m
ft·lb_f (work)	1.36	J
ft·lb_f / lb (specific energy)	2.99	J/kg
ft·lb_f / min (power)	0.0226	W
gallon, US (*231 in^3)	3.785	L
gph	1.05	mL/s
gpm	0.0631	L/s
gpm/ft^2	0.6791	$L/(s·m^2)$
gr/gal	17.1	g/m^3
horsepower (550 ft·lb_f / s)	0.746	kW
inch	*25.4	mm
in of mercury (60°F)	3.377	kPa
in of water (60°F)	248.8	Pa
in·lb_f (torque or moment)	113	mN·m
in^2	645	mm^2
in^3 (volume)	16.4	mL
in^3 (section modulus)	16 400	mm^3
in^4 (section moment)	416 200	mm^4
km / h	0.278	m/s
kWh	*3.60	MJ
kip / in^2 (ksi)	6.895	MPa
litre	*0.001	m^3
micron (μm) of mercury (60°F)	133	mPa
mil (0.001 in.)	*25.4	μm
mile	1.61	km
mile, nautical	1.85	km
mph	1.61	km/h
mph	0.447	m/s
millibar	*0.100	kPa
mm of mercury (60°F)	0.133	kPa
mm of water (60°F)	9.80	Pa
ounce (mass, avoirdupois)	28.35	g
ounce (force of thrust)	0.278	N
ounce (liquid, US)	29.6	mL
ounce (avoirdupois) per gallon	7.49	kg/m^3
pint (liquid, US)	473	mL
pound		
lb_m (mass)	0.4536	kg
lb_m (mass)	453.6	g
lb_f (force or thrust)	4.45	N
lb_m / ft (uniform load)	1.49	kg/m
lb_m / (ft·h) (dynamic viscosity, μ)	0.413	mPa·s
lb_m / (ft·s) (dynamic viscosity, μ)	1490	mPa·s
lb_f·s / ft^2 (dynamic viscosity, μ)	47 880	mPa·s
lb_m / min	0.00756	kg/s
lb_m / h	0.126	g/s
lb_f / ft^2	47.9	Pa
lb_m / ft^2	4.88	kg/m^2
lb_m / ft^3 (density, ρ)	16.0	kg/m^3
lb_m / gallon	120	kg/m^3
ppm (by mass)	*1.00	mg/kg
psi	6.895	kPa
quad (10^{15} Btu)	1.06	EJ
quart (liquid, US)	0.946	L
rpm	0.105	rad/s
tablespoon (approx.)	15	mL
teaspoon (approx.)	5	mL
therm (100,000 Btu)	105.5	MJ
ton, short (2000 lb)	0.907	Mg; t (tonne)
yd	*0.9144	m
yd^2	0.836	m^2
yd^3	0.7646	m^3

*Conversion factor is exact.

Note: In this list the kelvin (K) expresses temperature intervals. The degree Celsius symbol (°C) may be used for this purpose as well.