SI

for HVAC&R

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This guide conforms to ANSI SI 10-1997, *Standard for Use of the International System of Units* (SI): *The Modern Metric System*. See ANSI SI 10 for more information and a complete list of conversion factors with more significant digits.

ASHRAE METRIC POLICY

The metric unit use or application policy shall include, as a minimum, time-dated directions on the use of SI and I-P units in all ASHRAE publications.

1. The Technical Committee on terminology, TC 1.6, shall serve as the authority on SI and I-P usage and application.
2. Research projects, Standards and Guidelines, Special Publications, Insights articles, Journal articles, and Handbooks shall be prepared using inch-pound (I-P) units and/or the International System of Units (SI) in formats approved by the Publishing Council.
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4. The Publishing Council shall consider this policy annually and shall recommend to the Board of Directors the formats to be used in ASHRAE publications.
   a. The format for ASHRAE publications shall be dual units, except in cases determined by the Publishing Council, where two separate versions are to be published, one rational I-P and the other rational SI. For selected ASHRAE Standards and Guidelines, the Standards Committee may approve use of SI units only.
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   c. Exceptions require the approval of the Director of Communications and Publications.
   d. All Handbook volumes are published in separate I-P and SI editions.

SI PRACTICE

1 General

1.1 The International System of Units (SI) consists of seven base units listed in Table 1 and numerous derived units, which are combinations of base units (Table 2).

Table 1 SI 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

2 Units

2.1 In SI each physical quantity has only one unit. The base and derived units may be modified by prefixes as indicated in Section 4. All derived units are defined by simple formulas using the base units. The basic simplicity of the system can only be kept by adhering to the approved units.

2.2 **Angle.** The unit of plane angle is the radian. The degree and its decimal fractions may be used, but the minute and second should not be used.

2.3 **Area.** The unit of area is the square metre. Large areas are expressed in hectares (ha) or square kilometres (km^2). The hectare is restricted to land or sea areas and equals 10 000 m^2.

2.4 **Energy.** The unit of energy, work, and quantity of heat is the joule (J). The kilowatthour (kWh) is presently permitted as an alternative in electrical applications, but should not be introduced in new applications.

1 kilowatthour (kWh) = 3.6 megajoules (MJ)

The unit of power and heat flow rate is the watt (W).

1 watt (W) = 1 joule per second (J/s)

2.5 **Force.** The unit of force is the newton (N). The newton is also used in derived units which include force.

Examples: pressure or stress = N/m^2 = Pa (pascal)
work = N·m = J (joule)
power = N·m/s = W (watt)

Table 2 Some SI Derived Units

Quantity	Expression in Other SI Units	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
conductivity, thermal	W/(m·K)		
density			
heat flux	W/m^2		
mass	kg/m^3		
energy, enthalpy			
work, heat	N·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·m/s^2	newton	N
frequency			
periodic	1/s	hertz	Hz
rotating	rev/s		
inductance	Wb/A	henry	H
magnetic flux	V·s	weber	
moment of a force	N·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
velocity			
angular	rad/s		
linear	m/s		
viscosity			
dynamic (absolute)(m)	Pa·s		
kinematic (n)	m^2/s		
volume	m^3		
volume, specific	m^3/kg		

2.6 **Length.** The unit of length is the metre. The millimetre is used on architectural or construction drawings and mechanical or shop drawings. The symbol mm does not need to be placed after each dimension; a note, “All dimensions in mm” is sufficient.

The centimetre is used only for cloth, clothing sizes, and anatomical measurements.

The metre is used for topographical and plot plans. It is always written with a decimal and three figures following the decimal, i.e., 38.560.

2.7 **Mass.** The unit of mass is the kilogram (kg). The unit of mass is the only unit whose name, for historical reasons, contains a prefix. Names of multiples of the unit mass are formed by attaching prefixes to the word gram. The megagram, Mg, (1000 kg, metric ton or tonne, t) is the appropriate unit for describing large masses. Do not use the term *weight* when *mass* is intended.

2.8 **Pressure.** The unit of stress or pressure, force per unit area, is the newton per square metre. This unit is called the *pascal* (Pa). SI has no equivalent symbol for psig or psia. If a misinterpretation is likely, spell out Pa (absolute) or Pa (gage).

2.9 **Volume.** The unit of volume is the cubic metre. Smaller units are the litre, L (m^3/1000); millilitre, mL; and microlitre, μL. No prefix other than m or μ is used with litre.

2.10 **Temperature.** The unit of thermodynamic (absolute) temperature is the Kelvin. Celsius temperature is measured in degrees Celsius. Temperature intervals may be measured in kelvins or degrees Celsius and are the same in either scale. Thermodynamic temperature is related to Celsius temperature as follows:

$$t_c = T - T_0$$

where

t_c = Celsius temperature, °C
T = thermodynamic temperature, kelvins (K)
T_0 = 273.15 K by definition

2.11 **Time.** The unit of time is the second, which should be used in technical calculations. However, where time relates to life customs or calendar cycles, the minute, hour, day, and other calendar units may be necessary.

Exception: Revolutions per minute may be used, but revolutions per second is preferred.

3 Symbols

3.1 The correct use of symbols is important because an incorrect symbol may change the meaning of a quantity. Some SI symbols are listed in Table 3.

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

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

3.3 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; W, watt; Pa, pascal

Exception: L, litre

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

Example: . . . *a distance of* 56 km *between* . . .

3.5 Unit symbols are the same whether singular or plural.

Examples: 1 kg, 14 kg; 1 mm, 25 mm

3.6 Leave a space between the value and the symbol.

Examples: 55 mm, *not* 55mm; 100 W, *not* 100W

Table 3 SI Symbols

Symbol	Name	Quantity	Formula
A	ampere	electric current	base unit
a	atto	prefix	10^{-18}
Bq	becquerel	activity (of a radio nuclide)	1/s
C	coulomb	quantity of electricity	A·s
°C	degree Celsius	temperature	°C = K
c	centi	prefix	10^{-2}
cd	candela	luminous intensity	base unit
d	deci	prefix	10^{-1}
da	deka	prefix	10^{1}
E	exa	prefix	10^{18}
F	farad	electric capacitance	C/V
f	femto	prefix	10^{-15}
G	giga	prefix	10^{9}
Gy	gray	absorbed dose	J/kg
g	gram	mass	kg/1000
H	henry	inductance	Wb/A
Hz	hertz	frequency	1/s
h	hecto	prefix	10^{2}
ha	hectare	area	10 000 m^2
J	joule	energy, work, heat	N·m
K	kelvin	temperature	base unit
k	kilo	prefix	10^{3}
kg	kilogram	mass	base unit
L	litre	volume	m^3/1000
lm	lumen	luminous flux	cd·sr
lx	lux	illuminance	lm/m^2
M	mega	prefix	10^{6}
m	metre	length	base unit
m	milli	prefix	10^{-3}
mol	mole	amount of substance	base unit
μ	micro	prefix	10^{-6}
N	newton	force	kg·m/s^2
n	nano	prefix	10^{-9}
Ω	ohm	electric resistance	V/A
P	peta	prefix	10^{15}
Pa	pascal	pressure, stress	N/m^2
p	pico	prefix	10^{-12}
rad	radian	plane angle	dimensionless
S	siemens	electric conductance	A/V
Sv	sievert	dose equivalent	J/kg
s	second	time	base unit
sr	steradian	solid angle	dimensionless
T	tera	prefix	10^{12}
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

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

Note: Symbol for degree Celsius is °C; for coulomb, C.

Examples: 20°C, not 20 °C or 20° C; 45°, not 45 °

3.7 Do not mix symbols and names in the same expression.

Examples: m/s or metres per second,
not metres/second; *not* metres/s

J/kg or joules per kilogram,
not joules/kilogram; *not* joules/kg

3.8 Symbol for product—use the raised dot (·)

Examples: N·m; mPa·s; W/(m^2·K)

3.9 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.

3.10 Place modifying terms such as electrical, alternating current, etc. parenthetically after the symbol with a space in between.

Examples: MW (e); *not* MWe; *not* MW(e)
V (ac); *not* Vac; *not* V(ac)
kPa (gage); *not* kPa(gage); *not* KPa gage

4 Prefixes

4.1 Most prefixes indicate orders of magnitude in steps of 1000. Prefixes provide a convenient way to express large and small numbers and to eliminate nonsignificant digits and leading zeros in decimal fractions. Some prefixes are listed in Table 4.

Examples: 126 000 watts is the same as 126 kilowatts
0.045 metre is the same as 45 millimetres
65 000 metres is the same as 65 kilometres

4.2 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:

1. In expressing area and volume, the prefixes hecto, deka, deci, and centi are sometimes used; for example, cubic decimetre (L), square hectometre (hectare), cubic centimetre.
2. Tables of values of the same quantity.
3. Comparison of values.

Table 4 SI Prefixes

Prefix	Pronunciation	Symbol	Represents	
exa	ex′a (a as in about)	E	10^{18}	
peta	pet′a (e as in pet, a as in about)	P	10^{15}	
tera	as in *terra* firma	T	10^{12}	
giga	jig′ (i as in jig, a as in about)	G	10^{9}	
mega	as in *mega*phone	M	10^{6}	
kilo	kill′oh	k	10^{3}	= 1000
hecto	heck′ toe	h*	10^{2}	= 100
deka	deck′a (a as in about)	da*	10^{1}	= 10
deci	as in *deci*mal	d*	10^{-1}	= 0.1
centi	as in *centi*pede	c*	10^{-2}	= 0.01
milli	as in *mili*tary	m	10^{-3}	= 0.001
micro	as in *micro*phone	μ	10^{-6}	
nano	nan′oh (an as in ant)	n	10^{-9}	
pico	peek′oh	p	10^{-12}	

*See paragraph 4.2 regarding use of this prefix.

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

4.3 **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
mN·m *not* N·mm (torque)
MJ/kg not kJ/g

4.4 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

4.5 **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: $1\ \text{mm}^3 = (10^{-3}\ \text{m})^3 = 10^{-9}\ \text{m}^3$
$1\ \text{ns}^{-1} = (10^{-9}\ \text{s})^{-1} = 10^9\ \text{s}^{-1}$
$1\ \text{mm}^2/\text{s} = (10^{-3}\ \text{m})^2/\text{s} = 10^{-6}\ \text{m}^2/\text{s}$

5 Numbers

5.1 **Large 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: 2.345 678; 73 846; 635 041; 600.000;
0.113 501; 7 258

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

Example: 0.046

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

5.4 **Billion.** Because billion means a thousand million in the United States and a million million in most other countries, avoid using the term in technical writing.

5.5 **Roman Numerals.** Do not use M to indicate thousands (MBtu for a thousand Btu), nor MM to indicate millions, nor C to indicate hundreds because they conflict with SI prefixes.

6 Words

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

(Inch-Pound units are called I-P units—not conventional units, not U.S. customary units, not English units, and not Imperial units.)

6.2 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.

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

6.4 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

6.5 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

6.6 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

6.7 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

6.8 Use the modifier squared or cubed after the unit name.

Example: metre per second squared

Exception: For area or volume place the modifier before the units. *Example*: square millimetre; cubic metre

6.9 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 metre

TEMPERATURE CONVERSION

(exact)

$$t_C = (t_F - 32)/1.8 \qquad t_F = 1.8\,t_C + 32$$
$$t_C = T - 273.15 \qquad t_F = T_R - 459.67$$
$$T = T_R/1.8 \qquad T_R = 1.8T$$
$$T = t_C + 273.15 \qquad T_R = t_F + 459.67$$

where

t_C = Celsius temperature, °C
T = thermodynamic (absolute) temperature, kelvins (K)
t_F = Fahrenheit temperature, °F
T_R = thermodynamic (absolute) temperature, degrees Rankine (°R)

and °C = K = 1.8°F °F = °R = °C/1.8

SI Units for HVAC&R Catalogs

Quantity	Unit
Boilers	
Heat output	kW
Heat input	kW
Heat release	kW/m^2
Steam generation rate	kg/s
Fuel firing rate:	
solid	kg/s
gaseous	L/s
liquid	kg/s, L/s
Volume flow rate (combust. products)	m^3/s, L/s
Power input (to drives)	kW
Operating pressure	kPa
Hydraulic resistance	kPa
Draft conditions	Pa
Coil, Cooling and Heating	
Heat exchange rate	kW
Primary medium:	
mass flow rate	kg/s
hydraulic resistance	kPa
Air volume flow rate	m^3/s, L/s
Airflow static pressure loss	Pa
Face area	m^2
Fin spacing, center to center	mm
Controls and Instruments	
Flow rate:	
mass	kg/s
volume	m^3/s, L/s, mL/s
Operating pressure	kPa
Hydraulic resistance	kPa
Rotational frequency	rev/s (rpm)*
Cooling Towers	
Heat extraction rate	kW
Volume flow rate:	
air	m^3/s, L/s
water	m^3/s, L/s
Power input (to drive)	kW

Quantity	Unit
Diffusers and Grilles	
Air volume flow rate	m^3/s, L/s
Airflow pressure loss	Pa
Velocity	m/s
Fans	
Air volume flow rate	m^3/s, L/s
Power input (to drive)	kW
Fan static pressure	Pa
Fan total pressure	Pa
Rotational frequency	rev/s (rpm)*
Outlet velocity	m/s
Air Filters	
Air volume flow rate	m^3/s, L/s
Static pressure loss	Pa
Face area	m^2
Fuels	
Heating value:	
solid	MJ/kg
gaseous	MJ/m^3
liquid	MJ/kg
Heat Exchangers	
Heat output	kW
Mass flow rate	kg/s
Hydraulic resistance	kPa
Operating pressure	kPa
Flow velocity	m/s
Heat exchange surface	m^2
Fouling factor	m^2/W
Induction Terminals	
Heating or cooling output	kW
Primary air volume flow rate	m^3/s, L/s
Primary air static pressure loss	Pa
Secondary water mass flow rate	kg/s
Secondary water hydraulic resistance	kPa

Quantity	Unit
Pumps	
Mass flow rate	kg/s
Volume flow rate	L/s
Power input (to drive)	kW
Developed pressure	kPa
Operating pressure	kPa
Rotational frequency	rev/s (rpm)*
Space Heating Apparatus	
Heat output	kW
Airflow volume flow rate	m^3/s, L/s
Power input (to drive)	kW
Primary medium mass flow rate	kg/s
Hydraulic resistance	kPa
Operating pressure	kPa
Airflow static pressure loss	Pa
Vessels	
Operating pressure	kPa
Volumetric capacity	m^3, L
Air Washers	
Volume flow rate:	
air	m^3/s, L/s
water	m^3/s, L/s
Mass flow rate, water	kg/s
Power input (to drive)	kW
Airflow static pressure loss	Pa
Hydraulic resistance	kPa
Water Chillers	
Cooling capacity	kW
Mass flow rate, water	kg/s
Power input (to drive)	kW
Refrigerant pressure	kPa
Hydraulic resistance	kPa

*Acceptable

PHYSICAL PROPERTIES

Atmospheric Pressure

Standard pressure = 101.325 kPa, exact value by definition (approximately 29.921 in. Hg at 32°F; 760 mm Hg at 0°C; 14.696 psi at 32°F).

Gravity

Standard acceleration = 9.806 65 m/s^2, exact value by definition (approximately 32.1740 ft/s^2).

Typical Densities (kg/m^3 at 20°C)

Gases (101.325 kPa)		Liquids		Solids	
butane	2.412	mercury	13 550	lead	11 300
propane	1.829	sulphuric acid	1 830	copper	8 900
oxygen	1.330	refrigerant 12	1 329	steel	7 830
air, dry	1.204	glycerine	1 264	cast iron	7 200
carbon dioxide	1.970	battery electr.	1 260	aluminum	2 700
air, 50% rh	1.191	refrigerant 22	1 213	glass	2 500
acetylene	1.173	water	998	concrete	2 300
nitrogen	1.164	mineral oil	900	brick	1 920
natural gas	0.719	kerosene	820	hardwood	750
helium	0.166	ethyl alcohol	791	softwood	540
hydrogen	0.083	gasoline	730	fiberglass board	80
		propane	580	polystyrene	20

Standard Air

Dry air at 101.325 kPa and 20°C (density ≈ 1.204 kg/m^3)

Specific heat (constant pressure), c_p = 1.006 kJ/(kg·K)

Heating of Air

Sensible heat $q_s = 1.2\, Q\Delta t$

Latent heat $q_l = 3.0\, Q\Delta w$

Total heat $q_t = 1.2\, Q\Delta h$

where

Δt = temperature difference, K or °C

Δw = moisture content difference, g/kg (dry air)

Δh = enthalpy difference, kJ/kg (dry air)

Q = volume flow rate, m^3/s (standard air)

q_s, q_l, q_t = heat flow, kW

Water

Heat of vaporization

at 101.325 kPa and 100°C = 2257 kJ/kg

Heat of fusion at 0°C = 334 kJ/kg

CONVERSION FACTORS

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.

CAUTION: The conversion values are rounded to three or four significant figures, which is sufficiently accurate for most applications. 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/ft^2	11.36	kJ/m^2
Btu·ft/h·ft^2·°F	1.731	W/(m·K)
Btu·in/h·ft^2·°F		
(thermal conductivity, k)	0.1442	W/(m·K)
Btu/h	0.2931	W
Btu/h·ft	0.9615	W/m
Btu/h·ft^2	3.155	W/m^2
Btu/h·ft^2·°F		
(heat transfer coefficient, U)	5.678	W/(m^2·K)
Btu/lb	*2.326	kJ/kg
Btu/lb·°F (specific heat, c_p)	4.184	kJ/(kg·K)
bushel	0.03524	m^3
calorie, (thermochemical)	*4.184	J
calorie, nutrition (kilocalorie)	*4.184	kJ
candle, candlepower	*1.0	cd
centipoise, dynamic vicosity, μ	*1.00	mPa·s
centistokes, kinematic viscosity, ν	*1.00	mm^2/s
clo	0.155	m^2·K/W
dyne/cm^2	*0.100	Pa
EDR hot water (150 Btu/h)	44.0	W
EDR steam (240 Btu/h)	70.3	W
fuel cost comparison at 100% eff.		
cents per gallon (no. 2 fuel oil)	0.0677	$/GJ
cents per gallon (no. 6 fuel oil)	0.0632	$/GJ
cents per gallon (propane)	0.113	$/GJ
cent per kWh	2.78	$/GJ
cents per therm	0.0948	$/GJ
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 of water per 100 ft of pipe	0.0981	kPa/m
ft^2	0.09290	m^2
ft^2·h·°F/Btu (thermal resistance, R)	0.176	m^2·K/W
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)
gpm/ton refrigeration	0.0179	mL/J
grain (1/7000 lb)	0.0648	g
gr/gal	17.1	g/m^3
horsepower (boiler)(33,470 Btu/h)	9.81	kW
horsepower (550 ft·lb_f/s)	0.746	kW
inch	*25.4	mm
inch of mercury (60°F)	3.377	kPa
inch of water (60°F)	248.8	Pa
To Obtain	**By**	**Divide**

Multiply	**By**	**To Obtain**
in/100 ft (thermal expansion)	0.833	mm/m
in·lb_f (torque or moment)	113	mN·m
in^2	645	mm^2
in^3 (volume)	16.4	mL
in^3/min (SCIM)	0.273	mL/s
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
kW/1000 cfm	2.12	kJ/m^3
kilopond (kg force)	9.81	N
kip (1000 lb_f)	4.45	kN
kip/in^2 (ksi)	6.895	MPa
litre	*0.001	m^3
MBtuh (1000 Btu/h)	0.2931	kW
met	58.15	W/m^2
micron (μm) of mercury (60°F)	133	mPa
mil (0.001 in.)	*25.4	mm
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
perm (permeance)	57.45	ng/(s·m^2·Pa)
perm inch (permeability)	1.46	ng/(s·m·Pa)
pint (liquid, US)	473	mL
pound		
lb (mass)	0.4536	kg
lb (mass)	453.6	g
lb_f (force or thrust)	4.45	N
lb/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/min	0.00756	kg/s
lb/h	0.126	g/s
lb/h (steam at 212°F)(970 Btu/h)	0.284	kW
lb_f/ft^2	47.9	Pa
lb/ft^2	4.88	kg/m^2
lb/ft^3 (density, ρ)	16.0	kg/m^3
lb/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
revolutions per minute (rpm)	*1/60	Hz
square (100 ft^2)	9.29	m^2
tablespoon (approx.)	15	mL
teaspoon (approx.)	5	mL
therm (100,000 Btu)	105.5	MJ
ton, short (2000 lb)	0.907	Mg; t (tonne)
ton, refrigeration (12,000 Btu/h)	3.517	kW
torr (1 mm Hg at 0°C)	133	Pa
watt per square foot	10.8	W/m^2
yd	*0.9144	m
yd^2	0.836	m^2
yd^3	0.7646	m^3
To Obtain	**By**	**Divide**

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

*Conversion factor is exact.