Conversion of units

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Conversion of units is the conversion between different units of measurement for the same quantity, typically through multiplicative **conversion factors**.

Contents

Techniques

Process

The process of conversion depends on the specific situation and the intended purpose. This may be governed by regulation, contract, technical specifications or other published standards. Engineering judgment may include such factors as:

- The precision and accuracy of measurement and the associated uncertainty of measurement.
- The statistical confidence interval or tolerance interval of the initial measurement.
- The number of significant figures of the measurement.
- The intended use of the measurement including the engineering tolerances.
- Historical definitions of the units and their derivatives used in old measurements; e.g., international foot vs. US survey foot.

Some conversions from one system of units to another need to be exact, without increasing or decreasing the precision of the first measurement. This is sometimes called *soft conversion*. It does not involve changing the physical configuration of the item being measured.

By contrast, a *hard conversion* or an *adaptive conversion* may not be exactly equivalent. It changes the measurement to convenient and workable numbers and units in the new system. It sometimes involves a slightly different configuration, or size substitution, of the item. Nominal values are sometimes allowed and used.

Multiplication factors

Conversion between units in the metric system can be discerned by their prefixes (for example, 1 kilogram = 1000 grams, 1 milligram = 0.001 grams) and are thus not listed in this article. Exceptions are made if the unit is commonly known by another name (for example, 1 micron = 10^{-6} metre).

Table ordering

Within each table, the units are listed alphabetically, and the SI units (base or derived) are highlighted.

Tables of conversion factors

This article gives lists of conversion factors for each of a number of physical quantities, which are listed in the index. For each physical quantity, a number of different units (some only of historical interest) are shown and expressed in terms of the corresponding SI unit.

Legend

Symbol	Definition
≡	exactly equal
≈	approximately equal to
$\overline{\textit{digits}}$	indicates that *digits* repeat infinitely (e.g. 8.294 $\overline{369}$ corresponds to 8.294 369 369 369 369 …)
(H)	of chiefly historical interest

Length

Length

Name of unit	Symbol	Definition	Relation to SI units
ångström	Å	$\equiv 1 \times 10^{-10}$ m	≡ 0.1 nm
astronomical unit	AU	≡ 149 597 870 700 m ≈ Distance from Earth to Sun	≡ 149 597 870 700 m [1]
barleycorn (H)		= $\frac{1}{3}$ in (see note above about rounding)	$\approx 8.4\overline{6} \times 10^{-3}$ m
bohr, atomic unit of length	a_0	= Bohr radius of hydrogen	≈ 5.291 772 1092(17) × 10^{-11} m[2]
cable length (imperial)		≡ 608 ft	≈ 185.3184 m
cable length (International)		≡ $\frac{1}{10}$ nmi	≡ 185.2 m
cable length (US)		≡ 720 ft	= 219.456 m
chain (Gunter's; Surveyor's)	ch	≡ 66 ft (US) ≡ 4 rods [3]	≈ 20.116 84 m
cubit (H)		≡ Distance from fingers to elbow ≈ 18 in	≈ 0.5 m
ell (H)	ell	≡ 45 in [4] (In England usually)	= 1.143 m
fathom	ftm	≡ 6 ft [4]	= 1.8288 m
fermi	fm	≡ 1×10^{-15} m[4]	≡ 1×10^{-15} m
finger		≡ $\frac{7}{8}$ in	= 0.022 225 m
finger (cloth)		≡ $4\frac{1}{2}$ in	= 0.1143 m
foot (Benoît) (H)	ft (Ben)		≈ 0.304 799 735 m
foot (Cape) (H)		Legally defined as 1.033 English feet in 1859	≈ 0.314 858 m
foot (Clarke's) (H)	ft (Cla)		≈ 0.304 797 2654 m
foot (Indian) (H)	ft Ind		≈ 0.304 799 514 m
foot, metric	mf	≡ $\sqrt{\frac{1}{10}}$ m	≈ 0.31622776601 m
foot, metric (long)	lmf	≡ $\frac{1}{3}$ m	≈ $0.\overline{3}$ m
foot, metric (short)	smf	≡ 0.30 m	≡ 0.30 m
foot (International)	ft	≡ 0.3048 m ≡ $\frac{1}{3}$ yd ≡ 12 inches	≡ 0.3048 m
foot (Sear's) (H)	ft (Sear)		≈ 0.304 799 47 m
foot (US Survey)	ft (US)	≡ $\frac{1200}{3937}$ m [5]	≈ 0.304 800 610 m
french; charriere	F	≡ $\frac{1}{3}$ mm	= $0.\overline{3} \times 10^{-3}$ m

furlong	fur	≡ 10 chains = 660 ft = 220 yd [4]	= 201.168 m
hand		≡ 4 in [4]	≡ 0.1016 m
inch (International)	in	≡ 2.54 cm ≡ $^{1}⁄_{36}$ yd ≡ $^{1}⁄_{12}$ ft	≡ 0.0254 m
league (land)	lea	≈ 1 hour walk, Currently defined in US as 3 Statute miles,[3] but historically varied from 2 to 9 km	≈ 4828 m
light-day		≡ 24 light-hours	≡ 2.590 206 837 12 × 10^{13} m
light-hour		≡ 60 light-minutes	≡ 1.079 252 8488 × 10^{12} m
light-minute		≡ 60 light-seconds	≡ 1.798 754 748 × 10^{10} m
light-second		≡ Distance light travels in one second in vacuum	≡ 299 792 458 m
light-year	ly	≡ Distance light travels in vacuum in 365.25 days [6]	= 9.460 730 472 5808 × 10^{15} m
line	ln	≡ $^{1}⁄_{12}$ in [7]	= 0.002 11$\overline{6}$ m
link (Gunter's; Surveyor's)	lnk	≡ $^{1}⁄_{100}$ ch [4] ≡ 0.66 ft (US) ≡ 7.92 in	≈ 0.201 1684 m
link (Ramsden's; Engineer's)	lnk	≡ 1 ft [4]	= 0.3048 m
metre (SI base unit) (meter)	m	≡ Distance light travels in $^{1}⁄_{299\,792\,458}$ of a second in vacuum.[8] ≈ $^{1}⁄_{10\,000\,000}$ of the distance from equator to pole.	≡ 1 m
mickey		≡ $^{1}⁄_{200}$ in	= 1.27 × 10^{-4} m
micrometre (old: micron)	μ		≡ 1 × 10^{-6} m
mil; thou	mil	≡ 1 × 10^{-3} in	≡ 2.54 × 10^{-5} m
mil (Sweden and Norway)	mil	≡ 10 km	= 10 000 m
mile (geographical) (H)		≡ 6082 ft	= 1 853.7936 m
mile (international)	mi	≡ 80 chains ≡ 5280 ft ≡ 1760 yd	≡ 1 609.344 m
mile (tactical or data)		≡ 6000 ft	≡ 1 828.8 m
mile (telegraph) (H)	mi	≡ 6087 ft	= 1 855.3176 m

mile (US Survey)	mi	≡ 5280 US Survey feet ≡ (5280 × $^{1200}/_{3937}$) m	≈ 1 609.347 219 m
nail (cloth)		≡ $2^{1}/_{4}$ in [4]	= 0.057 15 m
nanometre	nm	≡ 1×10^{-9} m	≡ 1×10^{-9} m
nautical league	NL; nl	≡ 3 nmi [4]	= 5556 m
nautical mile (Admiralty)	NM (Adm); nmi (Adm)	= 6080 ft	= 1 853.184 m
nautical mile (international)	NM; nmi	≡ 1852 m[9]	≡ 1852 m
nautical mile (US pre 1954)		≡ 1853.248 m	≡ 1853.248 m
pace		≡ 2.5 ft [4]	= 0.762 m
palm		≡ 3 in [4]	= 0.0762 m
parsec	pc	Distance of star with ***par***allax shift of one arc ***sec***ond from a base of one astronomical unit	≈ $3.085\,677\,581 \times 10^{16}$ m[10]
pica		≡ 12 points	Dependent on point measures.
point (American, English)[11][12]	pt	≡ $^{1}/_{72.272}$ in	≈ 0.000 351 450 m
point (Didot; European) [12][13]	pt	≡ $^{1}/_{12} \times {}^{1}/_{72}$ of pied du roi; After 1878: ≡ $^{5}/_{133}$ cm	≈ 0.000 375 97 m; After 1878: ≈ 0.000 375 939 85 m
point (PostScript) [11]	pt	≡ $^{1}/_{72}$ in	= 0.000 352$\overline{7}$ m
point (TeX) [11]	pt	≡ $^{1}/_{72.27}$ in	= 0.00$\overline{0}$ $\overline{351}$ $\overline{4598}$ m
quarter		≡ $^{1}/_{4}$ yd	= 0.2286 m
rod; pole; perch (H)	rd	≡ $16^{1}/_{2}$ ft	= 5.0292 m
rope (H)	rope	≡ 20 ft [4]	= 6.096 m
shaku (Japan)		≡ 10/33 m	≈ 0.303 0303 m
span (H)		≡ 9 in [4]	= 0.2286 m
spat [14]			≡ 1×10^{12} m
stick (H)		≡ 2 in	= 0.0508 m
picometre (old: bicron, stigma)	pm		≡ 1×10^{-12} m

twip	twp	$\equiv {}^{1}\!/_{1440}$ in	$= 1.763\overline{8} \times 10^{-5}$ m
x unit; siegbahn	xu		$\approx 1.0021 \times 10^{-13}$ m [4]
yard (International)	yd	≡ 0.9144 m [5] ≡ 3 ft ≡ 36 in	≡ 0.9144 m

Area

Area

Name of unit	Symbol	Definition	Relation to SI units
acre (international)	ac	≡ 1 ch × 10 ch = 4840 sq yd	≡ 4 046.856 4224 m^2
acre (US survey)	ac	≡ 10 sq ch = 4840 sq yd, also 43 560 sq ft	≈ 4 046.873 m^2[15]
are	a	≡ 100 m^2	= 100 m^2
barn	b	≡ 10^{-28} m^2	= 10^{-28} m^2
barony		≡ 4000 ac	≈ 1.618 742 × 10^7 m^2
board	bd	≡ 1 in × 1 ft	= 7.741 92 × 10^{-3} m^2
boiler horsepower equivalent direct radiation	bhp EDR	≡ 1 ft^2 × 1 bhp / (240 BTU_{IT}/h)	≈ 12.958 174 m^2
circular inch	circ in	≡ $\pi/4$ sq in	≈ 5.067 075 × 10^{-4} m^2
circular mil; circular thou	circ mil	≡ $\pi/4$ mil^2	≈ 5.067 075 × 10^{-10} m^2
cord		≡ 192 bd	= 1.486 448 64 m^2
cuerda (PR Survey)	cda	≡ 1 cda x 1 cda = 0.971 222 acre	≡ 3 930.395 625 m^2
dunam		≡ 1000 m^2	= 1000 m^2
guntha (India)		≡ 121 sq yd	≈ 101.17 m^2
hectare	ha	≡ 10 000 m^2	≡ 10 000 m^2
hide		≈ 120 ac (variable)	≈ 5 × 10^5 m^2
rood	ro	≡ 1/4 ac	= 1 011.714 1056 m^2
section		≡ 1 mi × 1 mi	= 2.589 988 110 336 × 10^6 m^2
shed		≡ 10^{-52} m^2	= 10^{-52} m^2
square (roofing)		≡ 10 ft × 10 ft	= 9.290 304 m^2
square chain (international)	sq ch	≡ 66 ft × 66 ft = 1/10 ac	≡ 404.685 642 24 m^2
square chain (US Survey)	sq ch	≡ 66 ft (US) × 66 ft (US) = 1/10 US survey acre	≈ 404.6873 m^2
square foot	sq ft	≡ 1 ft × 1 ft	≡ 9.290 304 × 10^{-2} m^2
square foot (US Survey)	sq ft	≡ 1 ft (US) × 1 ft (US)	≈ 9.290 341 161 3275 × 10^{-2} m^2
square inch	sq in	≡ 1 in × 1 in	≡ 6.4516 × 10^{-4} m^2
square kilometre	km^2	≡ 1 km × 1 km	= 10^6 m^2
square link (Gunter's) (International)	sq lnk	≡ 1 lnk × 1 lnk ≡ 0.66 ft × 0.66 ft	= 4.046 856 4224 × 10^{-2} m^2
	sq lnk		

square link (Gunter's)(US Survey)		≡ 1 lnk × 1 lnk ≡ 0.66 ft (US) × 0.66 ft (US)	≈ $4.046\,872 \times 10^{-2}$ m^2
square link (Ramsden's)	sq lnk	≡ 1 lnk × 1 lnk ≡ 1 ft × 1 ft	= 0.092 903 04 m^2
square metre (SI unit)	m^2	≡ 1 m × 1 m	= 1 m^2
square mil; square thou	sq mil	≡ 1 mil × 1 mil	= 6.4516×10^{-10} m^2
square mile	sq mi	≡ 1 mi × 1 mi	= $2.589\,988\,110\,336 \times 10^6$ m^2
square mile (US Survey)	sq mi	≡ 1 mi (US) × 1 mi (US)	≈ $2.589\,998\,47 \times 10^6$ m^2
square rod/pole/perch	sq rd	≡ 1 rd × 1 rd	= 25.292 852 64 m^2
square yard (International)	sq yd	≡ 1 yd × 1 yd	≡ 0.836 127 36 m^2
stremma		≡ 1000 m^2	= 1000 m^2
township		≡ 36 sq mi (US)	≈ $9.323\,994 \times 10^7$ m^2
yardland		≈ 30 ac	≈ 1.2×10^5 m^2

Volume

Volume

Name of unit	Symbol	Definition	Relation to SI units
acre-foot	ac ft	≡ 1 ac x 1 ft = 43 560 cu ft	= 1 233.481 837 547 52 m^3
acre-inch		≡ 1 ac × 1 in	= 102.790 153 128 96 m^3
barrel (imperial)	bl (imp)	≡ 36 gal (imp)	= 0.163 659 24 m^3
barrel (petroleum)	bl; bbl	≡ 42 gal (US)	= 0.158 987 294 928 m^3
barrel (US dry)	bl (US)	≡ 105 qt (US) = 105/32 bu (US lvl)	= 0.115 628 198 985 075 m^3
barrel (US fluid)	fl bl (US)	≡ $31\frac{1}{2}$ gal (US)	= 0.119 240 471 196 m^3
board-foot	fbm	≡ 144 cu in	≡ 2.359 737 216 × 10^{-3} m^3
bucket (imperial)	bkt	≡ 4 gal (imp)	= 0.018 184 36 m^3
bushel (imperial)	bu (imp)	≡ 8 gal (imp)	= 0.036 368 72 m^3
bushel (US dry heaped)	bu (US)	≡ $1\frac{1}{4}$ bu (US lvl)	= 0.044 048 837 7086 m^3
bushel (US dry level)	bu (US lvl)	≡ 2 150.42 cu in	= 0.035 239 070 166 88 m^3
butt, pipe		≡ 126 gal (wine)	= 0.476 961 884 784 m^3
coomb		≡ 4 bu (imp)	= 0.145 474 88 m^3
cord (firewood)		≡ 8 ft × 4 ft × 4 ft	= 3.624 556 363 776 m^3
cord-foot		≡ 16 cu ft	= 0.453 069 545 472 m^3
cubic fathom	cu fm	≡ 1 fm × 1 fm × 1 fm	= 6.116 438 863 872 m^3
cubic foot	cu ft	≡ 1 ft × 1 ft × 1 ft	≡ 0.028 316 846 592 m^3
cubic inch	cu in	≡ 1 in × 1 in × 1 in	≡ 16.387 064 × 10^{-6} m^3
cubic metre (SI unit)	m^3	≡ 1 m × 1 m × 1 m	≡ 1 m^3
cubic mile	cu mi	≡ 1 mi × 1 mi × 1 mi	≡ 4 168 181 825.440 579 584 m^3
cubic yard	cu yd	≡ 27 cu ft	≡ 0.764 554 857 984 m^3
cup (breakfast)		≡ 10 fl oz (imp)	= 284.130 625 × 10^{-6} m^3
cup (Canadian)	c (CA)	≡ 8 fl oz (imp)	= 227.3045 × 10^{-6} m^3
cup (metric)	c	≡ 250.0 × 10^{-6} m^3	= 250.0 × 10^{-6} m^3
cup (US customary)	c (US)	≡ 8 US fl oz ≡ $\frac{1}{16}$ gal (US)	= 236.588 2365 × 10^{-6} m^3
cup (US food nutrition labeling)	c (US)	≡ 240 mL[16]	= 2.4 × 10^{-4} m^3
dash (imperial)		≡ $\frac{1}{384}$ gi (imp) = $\frac{1}{2}$ pinch (imp)	= 369.961 751 302 $08\overline{3}$ × 10^{-9} m^3
dash (US)			

		≡ $^{1}/_{96}$ US fl oz = $^{1}/_{2}$ US pinch	= 308.057 599 609 375 × 10^{-9} m^3
dessertspoon (imperial)		≡ $^{1}/_{12}$ gi (imp)	= 11.838 776 041$\overline{6}$ × 10^{-6} m^3
drop (imperial)	gtt	≡ $^{1}/_{288}$ fl oz (imp)	= 98.656 467 013$\overline{8}$ × 10^{-9} m^3
drop (imperial) (alt)	gtt	≡ $^{1}/_{1824}$ gi (imp)	≈ 77.886 684 × 10^{-9} m^3
drop (medical)		≡ $^{0.9964}/_{12}$ ml	= 83.0$\overline{3}$ × 10^{-9} m^3
drop (medical)		≡ $^{1}/_{12}$ ml	= 83.$\overline{3}$ × 10^{-9} m^3
drop (metric)		≡ $^{1}/_{20}$ mL	= 50.0 × 10^{-9} m^3
drop (US)	gtt	≡ $^{1}/_{360}$ US fl oz	= 82.148 693 229 1$\overline{6}$ × 10^{-9} m^3
drop (US) (alt)	gtt	≡ $^{1}/_{456}$ US fl oz	≈ 64.854 231 496 71 × 10^{-9} m^3
drop (US) (alt)	gtt	≡ $^{1}/_{576}$ US fl oz	≈ 51.342 933 268 23 × 10^{-9} m^3
fifth		≡ $^{1}/_{5}$ US gal	= 757.082 3568 × 10^{-6} m^3
firkin		≡ 9 gal (imp)	= 0.040 914 81 m^3
fluid drachm (imperial)	fl dr	≡ $^{1}/_{8}$ fl oz (imp)	= 3.551 632 8125 × 10^{-6} m^3
fluid dram (US); US fluidram	fl dr	≡ $^{1}/_{8}$ US fl oz	= 3.696 691 195 3125 × 10^{-6} m^3
fluid scruple (imperial)	fl s	≡ $^{1}/_{24}$ fl oz (imp)	= 1.183 877 604 1$\overline{6}$ × 10^{-6} m^3
gallon (beer)	beer gal	≡ 282 cu in	= 4.621 152 048 × 10^{-3} m^3
gallon (imperial)	gal (imp)	≡ 4.546 09 L	≡ 4.546 09 × 10^{-3} m^3
gallon (US dry)	gal (US)	≡ $^{1}/_{8}$ bu (US lvl)	= 4.404 883 770 86 × 10^{-3} m^3
gallon (US fluid; Wine)	gal (US)	≡ 231 cu in	≡ 3.785 411 784 × 10^{-3} m^3
gill (imperial); Noggin	gi (imp); nog	≡ 5 fl oz (imp)	= 142.065 3125 × 10^{-6} m^3
gill (US)	gi (US)	≡ 4 US fl oz	= 118.294 118 25 × 10^{-6} m^3
hogshead (imperial)	hhd (imp)	≡ 2 bl (imp)	= 0.327 318 48 m^3
hogshead (US)	hhd (US)	≡ 2 fl bl (US)	= 0.238 480 942 392 m^3
jigger (bartending)		≡ 1$^{1}/_{2}$ US fl oz	≈ 44.36 × 10^{-6} m^3
kilderkin		≡ 18 gal (imp)	= 0.081 829 62 m^3
lambda	λ	≡ 1 mm^3	= 1 × 10^{-9} m^3
last		≡ 80 bu (imp)	= 2.909 4976 m^3
litre (liter)	L	≡ 1 dm^3 [17]	≡ 0.001 m^3
load		≡ 50 cu ft	= 1.415 842 3296 m^3

minim (imperial)	min	≡ $^{1}/_{480}$ fl oz (imp) = 1/60 fl dr (imp)	= 59.193 880 208$\overline{3}$ × 10^{-9} m^3
minim (US)	min	≡ $^{1}/_{480}$ US fl oz = $^{1}/_{60}$ US fl dr	= 61.611 519 921 875 × 10^{-9} m^3
ounce (fluid imperial)	fl oz (imp)	≡ $^{1}/_{160}$ gal (imp)	≡ 28.413 0625 × 10^{-6} m^3
ounce (fluid US customary)	US fl oz	≡ $^{1}/_{128}$ gal (US)	≡ 29.573 529 5625 × 10^{-6} m^3
ounce (fluid US food nutrition labeling)	US fl oz	≡ 30 mL[16]	≡ 3 × 10^{-5} m^3
peck (imperial)	pk	≡ 2 gal (imp)	= 9.092 18 × 10^{-3} m^3
peck (US dry)	pk	≡ $^{1}/_{4}$ US lvl bu	= 8.809 767 541 72 × 10^{-3} m^3
perch	per	≡ 16$^{1}/_{2}$ ft × 1$^{1}/_{2}$ ft × 1 ft	= 0.700 841 953 152 m^3
pinch (imperial)		≡ $^{1}/_{192}$ gi (imp) = 1/16 tsp (imp)	= 739.923 502 604 1$\overline{6}$ × 10^{-9} m^3
pinch (US)		≡ $^{1}/_{48}$ US fl oz = 1/16 US tsp	= 616.115 199 218 75 × 10^{-9} m^3
pint (imperial)	pt (imp)	≡ $^{1}/_{8}$ gal (imp)	= 568.261 25 × 10^{-6} m^3
pint (US dry)	pt (US dry)	≡ $^{1}/_{64}$ bu (US lvl) ≡ $^{1}/_{8}$ gal (US dry)	= 550.610 471 3575 × 10^{-6} m^3
pint (US fluid)	pt (US fl)	≡ $^{1}/_{8}$ gal (US)	= 473.176 473 × 10^{-6} m^3
pony		≡ $^{3}/_{4}$ US fl oz	= 22.180 147 171 875 × 10^{-6} m^3
pottle; quartern		≡ $^{1}/_{2}$ gal (imp) = 80 fl oz (imp)	= 2.273 045 × 10^{-3} m^3
quart (imperial)	qt (imp)	≡ $^{1}/_{4}$ gal (imp)	= 1.136 5225 × 10^{-3} m^3
quart (US dry)	qt (US)	≡ $^{1}/_{32}$ bu (US lvl) = $^{1}/_{4}$ gal (US dry)	= 1.101 220 942 715 × 10^{-3} m^3
quart (US fluid)	qt (US)	≡ $^{1}/_{4}$ gal (US fl)	= 946.352 946 × 10^{-6} m^3
quarter; pail		≡ 8 bu (imp)	= 0.290 949 76 m^3
register ton		≡ 100 cu ft	= 2.831 684 6592 m^3
sack (imperial); bag		≡ 3 bu (imp)	= 0.109 106 16 m^3
sack (US)		≡ 3 bu (US lvl)	= 0.105 717 210 500 64 m^3
seam		≡ 8 bu (US lvl)	= 0.281 912 561 335 04 m^3
shot (US)		usually 1.5 US fl oz[14]	≈ 44 × 10^{-6} m^3
strike (imperial)		≡ 2 bu (imp)	= 0.072 737 44 m^3
strike (US)		≡ 2 bu (US lvl)	= 0.070 478 140 333 76 m^3
			≡ 20.0 × 10^{-6} m^3

tablespoon (Australian metric)			
tablespoon (Canadian)	tbsp	≡ ½ fl oz (imp)	= 14.206 531 25 × 10^{-6} m^3
tablespoon (imperial)	tbsp	≡ ⅝ fl oz (imp)	= 17.758 164 0625 × 10^{-6} m^3
tablespoon (metric)			≡ 15.0 × 10^{-6} m^3
tablespoon (US customary)	tbsp	≡ ½ US fl oz	= 14.786 764 781 25 × 10^{-6} m^3
tablespoon (US food nutrition labeling)	tbsp	≡ 15 mL[16]	= 1.5 × 10^{-5} m^3
teaspoon (Canadian)	tsp	≡ ⅙ fl oz (imp)	= 4.735 510 41$\overline{6}$ × 10^{-6} m^3
teaspoon (imperial)	tsp	≡ 1/24 gi (imp)	= 5.919 388 020 8$\overline{3}$ × 10^{-6} m^3
teaspoon (metric)		≡ 5.0 × 10^{-6} m^3	= 5.0 × 10^{-6} m^3
teaspoon (US customary)	tsp	≡ ⅙ US fl oz	= 4.928 921 593 75 × 10^{-6} m^3
teaspoon (US food nutrition labeling)	tsp	≡ 5 mL[16]	= 5 × 10^{-6} m^3
timber foot		≡ 1 cu ft	= 0.028 316 846 592 m^3
ton (displacement)		≡ 35 cu ft	= 0.991 089 630 72 m^3
ton (freight)		≡ 40 cu ft	= 1.132 673 863 68 m^3
ton (water)		≡ 28 bu (imp)	= 1.018 324 16 m^3
tun		≡ 252 gal (wine)	= 0.953 923 769 568 m^3
wey (US)		≡ 40 bu (US lvl)	= 1.409 562 806 6752 m^3

Plane angle

Plane angle

Name of unit	Symbol	Definition	Relation to SI units
angular mil	μ	$\equiv {}^{2\pi}\!/_{6400}$ rad	$\approx 0.981\,748 \times 10^{-3}$ rad
arcminute; MOA	′	$\equiv {}^{1^\circ}\!/_{60}$	$\approx 0.290\,888 \times 10^{-3}$ rad
arcsecond	″	$\equiv {}^{1^\circ}\!/_{3600}$	$\approx 4.848\,137 \times 10^{-6}$ rad
centesimal minute of arc	′	$\equiv {}^{1}\!/_{100}$ grad	$\approx 0.157\,080 \times 10^{-3}$ rad
centesimal second of arc	″	$\equiv {}^{1}\!/_{10\,000}$ grad	$\approx 1.570\,796 \times 10^{-6}$ rad
degree (of arc)	°	$\equiv {}^{1}\!/_{360}$ of a revolution $\equiv {}^{\pi}\!/_{180}$ rad	$\approx 17.453\,293 \times 10^{-3}$ rad
grad; gradian; gon	grad	$\equiv {}^{1}\!/_{400}$ of a revolution $\equiv {}^{\pi}\!/_{200}$ rad $\equiv 0.9^\circ$	$\approx 15.707\,963 \times 10^{-3}$ rad
octant		$\equiv 45^\circ$	$\approx 0.785\,398$ rad
quadrant		$\equiv 90^\circ$	$\approx 1.570\,796$ rad
radian (SI unit)	rad	The angle subtended at the center of a circle by an arc whose length is equal to the circle's radius. One full revolution encompasses 2π radians.	= 1 rad
sextant		$\equiv 60^\circ$	$\approx 1.047\,198$ rad
sign		$\equiv 30^\circ$	$\approx 0.523\,599$ rad

Solid angle

Solid angle

Name of unit	Symbol	Definition	Relation to SI units
square degree	$\deg^2$; sq.deg.; $(^\circ)^2$	$\equiv ({}^{\pi}\!/_{180})^2$ sr	$\approx 0.304\,62 \times 10^{-3}$ sr
steradian (SI unit)	sr	The solid angle subtended at the center of a sphere of radius r by a portion of the surface of the sphere having an area r^2. A sphere encompasses 4π sr.[14]	= 1 sr

Mass

Notes:

- See Weight for detail of mass/weight distinction and conversion.

- Avoirdupois is a system of mass based on a pound of 16 ounces, while Troy weight is the system of mass where 12 troy ounces equals one troy pound.
- In this table, the unit *gee* is used to denote standard gravity in order to avoid confusion with the "g" symbol for grams.
- In physics, the pound of mass is sometimes written **lbm** to distinguish it from the pound-force (**lbf**). It should not be read as the mongrel unit "pound metre".

Mass

Name of unit	Symbol	Definition	Relation to SI units
atomic mass unit, unified	u; AMU		≈ 1.660 538 921(73) × 10^{-27} kg[18]
atomic unit of mass, electron rest mass	m_e		≈ 9.109 382 91(40) × 10^{-31} kg[19]
bag (coffee)		≡ 60 kg	= 60 kg
bag (Portland cement)		≡ 94 lb av	= 42.637 682 78 kg
barge		≡ 22½ short ton	= 20 411.656 65 kg
carat	kt	≡ 3⅙ gr	= 205.196 548$\overline{3}$ mg
carat (metric)	ct	≡ 200 mg	= 200 mg
clove		≡ 8 lb av	= 3.628 738 96 kg
crith			≈ 89.9349 mg
dalton	Da		≈ 1.660 538 921(73) × 10^{-27} kg[18]
dram (apothecary; troy)	dr t	≡ 60 gr	= 3.887 9346 g
dram (avoirdupois)	dr av	≡ 27 11/32 gr	= 1.771 845 195 3125 g
electronvolt	eV	≡ 1 eV (energy unit) / c^2	= 1.782 661 84(45) × 10^{-36} kg[20]
gamma	γ	≡ 1 μg	= 1 μg
grain	gr	≡ 1/7000 lb av	≡ 64.798 91 mg
grave	gv.	grave was the original name of the kilogram	≡ 1 kg
hundredweight (long)	long cwt or cwt	≡ 112 lb av	= 50.802 345 44 kg
hundredweight (short); cental	sh cwt	≡ 100 lb av	= 45.359 237 kg
kilogram (kilogramme)	kg	≡ mass of the prototype near Paris (≈ mass of 1 L of water)	≡ 1 kg (SI base unit)[8]
kip	kip	≡ 1000 lb av	= 453.592 37 kg
mark		≡ 8 oz t	= 248.827 8144 g
mite		≡ 1/20 gr	= 3.239 9455 mg
mite (metric)		≡ 1/20 g	= 50 mg
ounce (apothecary; troy)	oz t	≡ 1/12 lb t	= 31.103 4768 g
ounce (avoirdupois)	oz av	≡ 1/16 lb	= 28.349 523 125 g
	oz	≡ 28 g[16]	= 28 g

ounce (US food nutrition labelling)			
pennyweight	dwt; pwt	≡ $\frac{1}{20}$ oz t	= 1.555 173 84 g
point		≡ $\frac{1}{100}$ ct	= 2 mg
pound (avoirdupois)	lb av	≡ 0.453 592 37 kg = 7000 grains	≡ 0.453 592 37 kg
pound (metric)		≡ 500 g	= 500 g
pound (troy)	lb t	≡ 5760 grains	= 0.373 241 7216 kg
quarter (imperial)		≡ $\frac{1}{4}$ long cwt = 2 st = 28 lb av	= 12.700 586 36 kg
quarter (informal)		≡ $\frac{1}{4}$ short ton	= 226.796 185 kg
quarter, long (informal)		≡ $\frac{1}{4}$ long ton	= 254.011 7272 kg
quintal (metric)	q	≡ 100 kg	= 100 kg
scruple (apothecary)	s ap	≡ 20 gr	= 1.295 9782 g
sheet		≡ $\frac{1}{700}$ lb av	= 647.9891 mg
slug; geepound; hyl	slug	≡ 1 g_0 × 1 lb av × 1 s^2/ft	≈ 14.593 903 kg
stone	st	≡ 14 lb av	= 6.350 293 18 kg
ton, assay (long)	AT	≡ 1 mg × 1 long ton ÷ 1 oz t	= $32.\overline{6}$ g
ton, assay (short)	AT	≡ 1 mg × 1 short ton ÷ 1 oz t	= $29.1\overline{6}$ g
ton, long	long tn or ton	≡ 2240 lb	= 1 016.046 9088 kg
ton, short	sh tn	≡ 2000 lb	= 907.184 74 kg
tonne (mts unit)	t	≡ 1000 kg	= 1000 kg
wey		≡ 252 lb = 18 st	= 114.305 277 24 kg (variants exist)
Zentner	Ztr.	Definitions vary.[14][21]	

Density

Density

Name of unit	Symbol	Definition	Relation to SI units
gram per millilitre	g/mL	≡ g/mL	= 1000 kg/m^3
kilogram per cubic metre (SI unit)	kg/m^3	≡ kg/m^3	= 1 kg/m^3
kilogram per litre	kg/L	≡ kg/L	= 1000 kg/m^3
ounce (avoirdupois) per cubic foot	oz/ft^3	≡ oz/ft^3	≈ 1.001 153 961 kg/m^3
ounce (avoirdupois) per cubic inch	oz/in^3	≡ oz/in^3	≈ $1.729\,994\,044 \times 10^3$ kg/m^3
ounce (avoirdupois) per gallon (imperial)	oz/gal	≡ oz/gal	≈ 6.236 023 291 kg/m^3
ounce (avoirdupois) per gallon (US fluid)	oz/gal	≡ oz/gal	≈ 7.489 151 707 kg/m^3
pound (avoirdupois) per cubic foot	lb/ft^3	≡ lb/ft^3	≈ 16.018 463 37 kg/m^3
pound (avoirdupois) per cubic inch	lb/in^3	≡ lb/in^3	≈ $2.767\,990\,471 \times 10^4$ kg/m^3
pound (avoirdupois) per gallon (imperial)	lb/gal	≡ lb/gal	≈ 99.776 372 66 kg/m^3
pound (avoirdupois) per gallon (US fluid)	lb/gal	≡ lb/gal	≈ 119.826 4273 kg/m^3
slug per cubic foot	$slug/ft^3$	≡ $slug/ft^3$	≈ 515.378 8184 kg/m^3

Time

Time

Name of unit	Symbol	Definition	Relation to SI units
atomic unit of time	au	≡ $a_0/(\alpha \cdot c)$	≈ 2.418 884 254 × 10^{-17} s
Callippic cycle		≡ 441 mo (hollow) + 499 mo (full) = 76 a of 365.25 d	= 2.396 736 Gs or 2.398 3776 Gs[note 1]
century	c	≡ 100 years (100 a)	= 3.155 6952 Gs[note 2][note 3]
day	d	= 24 h = 1440 min	= 86.4 ks[note 3]
day (sidereal)	d	≡ Time needed for the Earth to rotate once around its axis, determined from successive transits of a very distant astronomical object across an observer's meridian (International Celestial Reference Frame)	≈ 86.1641 ks
decade	dec	≡ 10 years (10 a)	= 315.569 520 Ms[note 2][note 3]
fortnight	fn	≡ 2 wk	= 1.2096 Ms[note 3]
helek		≡ $^1/_{1080}$ h	= $3.\overline{3}$ s
Hipparchic cycle		≡ 4 Callippic cycles - 1 d	= 9.593 424 Gs
hour	h	≡ 60 min	= 3.6 ks[note 3]
jiffy	j	≡ $^1/_{60}$ s	= $16.\overline{6}$ ms
jiffy (alternative)	ja	≡ $^1/_{100}$ s	= 10 ms
ke (quarter of an hour)		≡ $^1/_4$ h = $^1/_{96}$ d = 15 min	= 900 s
ke (traditional)		≡ $^1/_{100}$ d = 14.4 min	= 864 s
lustre; lustrum		≡ 5 a of 365 d	= 157.68 Ms
Metonic cycle; enneadecaeteris		≡ 110 mo (hollow) + 125 mo (full) = 6940 d ≈ 19 a	= 599.616 Ms
millennium		≡ 1000 years (1000 a)	= 31.556 952 Gs[note 2][note 3]
milliday	md	≡ $^1/_{1000}$ d	= 86.4 s
minute	min	≡ 60 s, due to leap seconds sometimes 59 s or 61 s,	= 60 s[note 3]
moment		≡ 90 s	= 90 s
month (full)	mo	≡ 30 d[22]	= 2.592 × 10^6 s[note 3]
month (Greg. av.)	mo	= 30.436 875 d	≈ 2.6297 Ms[note 3]
month (hollow)	mo	≡ 29 d[22]	= 2.5056 Ms[note 3]
month (synodic)	mo	Cycle time of moon phases ≈ 29.530 589 d (average)	≈ 2.551 Ms

octaeteris		= 48 mo (full) + 48 mo (hollow) + 3 mo (full)[23][24] = 8 a of 365.25 d = 2922 d	= 252.4608 Ms[note 3]
Planck time		$\equiv \left(\frac{G\hbar}{c^5}\right)^{1/2}$	$\approx 1.351\,211\,868 \times 10^{-43}$ s
second	s	time of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom at 0 K [8] (but other seconds are sometimes used in astronomy). Also that time it takes for light to travel a distance of 299 792 458 metres.	(SI base unit)
shake		$\equiv 10^{-8}$ s	= 10 ns
sigma		$\equiv 10^{-6}$ s	= 1 μs
Sothic cycle		≡ 1461 a of 365 d	= 460.740 96 Ts
svedberg	S	$\equiv 10^{-13}$ s	= 100 fs
week	wk	≡ 7 d = 168 h = 10 080 min	= 604.8 ks[note 3]
year (common)	a, y, *or* yr	365 d	= 31.536 Ms[note 3][note 3][25]
year (Gregorian)	a, y, *or* yr	= 365.2425 d average, calculated from common years (365 d) plus leap years (366 d) on most years divisible by 4. See leap year for details.	= 31.556 952 Ms[note 3]
year (Julian)	a, y, *or* yr	= 365.25 d average, calculated from common years (365 d) plus one leap year (366 d) every four years	= 31.5576 Ms
year (leap)	a, y, *or* yr	366 d	= 31.6224 Ms[note 3][25]
year (mean tropical)	a, y, *or* yr	conceptually, the length of time it takes for the Sun to return to the same position in the cycle of seasons, [Converter 1] approximately 365.242 19 d, each day being 86 400 SI seconds[26]	≈ 31.556 925 Ms
year (sidereal)	a, y, *or* yr	≡ time taken for Sun to return to the same position with respect to the stars of the celestial sphere, approximately 365.256 363 d	≈ 31.558 149 7632 Ms

Notes:

1. see Callippic cycle for explanation of the differences
2. This is based on the average Gregorian year. See above for definition of year lengths.
3. Where UTC is observed, the length this unit may increase or decrease depending on the number of leap seconds which occur during the time interval in question.

Frequency

Frequency

Name of unit	Symbol	Definition	Relation to SI units
hertz (SI unit)	Hz	≡ Number of cycles per second	= 1 Hz = 1/s
revolutions per minute	rpm	≡ One unit rpm equals one rotation completed around a fixed axis in one minute of time.	≈ 0.104 719 755 rad/s

Speed or velocity

Speed

Name of unit	Symbol	Definition	Relation to SI units
foot per hour	fph	≡ 1 ft/h	$= 8.4\overline{6} \times 10^{-5}$ m/s
foot per minute	fpm	≡ 1 ft/min	$= 5.08 \times 10^{-3}$ m/s
foot per second	fps	≡ 1 ft/s	$= 3.048 \times 10^{-1}$ m/s
furlong per fortnight		≡ furlong/fortnight	$\approx 1.663\,095 \times 10^{-4}$ m/s
inch per hour	iph	≡ 1 in/h	$= 7.0\overline{5} \times 10^{-6}$ m/s
inch per minute	ipm	≡ 1 in/min	$= 4.2\overline{3} \times 10^{-4}$ m/s
inch per second	ips	≡ 1 in/s	$= 2.54 \times 10^{-2}$ m/s
kilometre per hour	km/h	≡ 1 km/h	$= 2.\overline{7} \times 10^{-1}$ m/s
knot	kn	≡ 1 nmi/h = 1.852 km/h	$= 0.51\overline{4}$ m/s
knot (Admiralty)	kn	≡ 1 NM (Adm)/h = 1.853 184 km/h	$= 0.514\ 77\overline{3}$ m/s
mach number	*M*	Ratio of the speed to the speed of sound [note 1] in the medium (unitless).	≈ 340 to 295 m/s
metre per second (SI unit)	m/s	≡ 1 m/s	= 1 m/s
mile per hour	mph	≡ 1 mi/h	= 0.447 04 m/s
mile per minute	mpm	≡ 1 mi/min	= 26.8224 m/s
mile per second	mps	≡ 1 mi/s	= 1 609.344 m/s
speed of light in vacuum	*c*	≡ 299 792 458 m/s	= 299 792 458 m/s
speed of sound in air	*s*	1225 to 1062 km/h (761–660 mph or 661 –574 kn)[note 1]	≈ 340 to 295 m/s

Note

1. The speed of sound varies especially with temperature and pressure from about 1225 km/h (761 mph or 661 kn) in air at sea level to about 1062 km/h (660 mph or 570 kn) at jet altitudes (12 200 m or 40 000 ft).[27]

A velocity consists of a speed combined with a direction; the speed part of the velocity takes units of speed.

Flow (volume)

Flow

Name of unit	Symbol	Definition	Relation to SI units
cubic foot per minute	CFM	≡ 1 ft^3/min	= 4.719 474 432 × 10^{-4} m^3/s
cubic foot per second	ft^3/s	≡ 1 ft^3/s	= 0.028 316 846 592 m^3/s
cubic inch per minute	in^3/min	≡ 1 in^3/min	= 2.731 177$\overline{3}$ × 10^{-7} m^3/s
cubic inch per second	in^3/s	≡ 1 in^3/s	= 1.638 7064 × 10^{-5} m^3/s
cubic metre per second (SI unit)	m^3/s	≡ 1 m^3/s	= 1 m^3/s
gallon (US fluid) per day	GPD	≡ 1 gal/d	= 4.381 263 63$\overline{8}$ × 10^{-8} m^3/s
gallon (US fluid) per hour	GPH	≡ 1 gal/h	= 1.051 503 27$\overline{3}$ × 10^{-6} m^3/s
gallon (US fluid) per minute	GPM	≡ 1 gal/min	= 6.309 019 64 × 10^{-5} m^3/s
litre per minute	LPM	≡ 1 L/min	= 1.$\overline{6}$ × 10^{-5} m^3/s

Acceleration

Acceleration

Name of unit	Symbol	Definition	Relation to SI units
foot per hour per second	fph/s	≡ 1 ft/(h·s)	= 8.46$\overline{}$ × 10^{-5} m/s^2
foot per minute per second	fpm/s	≡ 1 ft/(min·s)	= 5.08 × 10^{-3} m/s^2
foot per second squared	fps^2	≡ 1 ft/s^2	= 3.048 × 10^{-1} m/s^2
gal; galileo	Gal	≡ 1 cm/s^2	= 10^{-2} m/s^2
inch per minute per second	ipm/s	≡ 1 in/(min·s)	= 4.23$\overline{}$ × 10^{-4} m/s^2
inch per second squared	ips^2	≡ 1 in/s^2	= 2.54 × 10^{-2} m/s^2
knot per second	kn/s	≡ 1 kn/s	≈ 5.14$\overline{}$ × 10^{-1} m/s^2
metre per second squared (SI unit)	m/s^2	≡ 1 m/s^2	= 1 m/s^2
mile per hour per second	mph/s	≡ 1 mi/(h·s)	= 4.4704 × 10^{-1} m/s^2
mile per minute per second	mpm/s	≡ 1 mi/(min·s)	= 26.8224 m/s^2
mile per second squared	mps^2	≡ 1 mi/s^2	= 1.609 344 × 10^3 m/s^2
standard gravity	g_0	≡ 9.806 65 m/s^2	= 9.806 65 m/s^2

Force

Force

Name of unit	Symbol	Definition	Relation to SI units
atomic unit of force		$\equiv {m_e \cdot \alpha^2 \cdot c^2}/{a_0}$	$\approx 8.238\ 722\ 06 \times 10^{-8}$ N[28]
dyne (cgs unit)	dyn	$\equiv$ g·cm/s^2	$= 10^{-5}$ N
kilogram-force; kilopond; grave-force	kgf; kp; Gf	$\equiv g_0 \times 1$ kg	= 9.806 65 N
kip; kip-force	kip; kipf; klbf	$\equiv g_0 \times 1000$ lb	$= 4.448\ 221\ 615\ 2605 \times 10^3$ N
milligrave-force, gravet-force	mGf; gf	$\equiv g_0 \times 1$ g	= 9.806 65 mN
long ton-force	tnf	$\equiv g_0 \times 1$ short ton	= $9.964\ 016\ 418\ 183\ 52 \times 10^3$ N
newton (SI unit)	N	A force capable of giving a mass of one kilogram an acceleration of one metre per second per second.[29]	= 1 N = 1 kg·m/s^2
ounce-force	ozf	$\equiv g_0 \times 1$ oz	= 0.278 013 850 953 781 25 N
pound-force	lbf	$\equiv g_0 \times 1$ lb	= 4.448 221 615 2605 N
poundal	pdl	$\equiv$ 1 lb·ft/s^2	= 0.138 254 954 376 N
short ton-force	tnf	$\equiv g_0 \times 1$ short ton	$= 8.896\ 443\ 230\ 521 \times 10^3$ N
sthene (mts unit)	sn	$\equiv$ 1 t·m/s^2	$= 10^3$ N

See also: Conversion between weight (force) and mass

Pressure or mechanical stress

Pressure

Name of unit	Symbol	Definition	Relation to SI units
atmosphere (standard)	atm		≡ 101 325 Pa[30]
atmosphere (technical)	at	≡ 1 kgf/cm^2	= 9.806 65 × 10^4 Pa[30]
bar	bar		≡ 10^5 Pa
barye (cgs unit)		≡ 1 dyn/cm^2	= 0.1 Pa
centimetre of mercury	cmHg	≡ 13 595.1 kg/m^3 × 1 cm × g_0	≈ 1.333 22 × 10^3 Pa[30]
centimetre of water (4 °C)	cmH_2O	≈ 999.972 kg/m^3 × 1 cm × g_0	≈ 98.0638 Pa[30]
foot of mercury (conventional)	ftHg	≡ 13 595.1 kg/m^3 × 1 ft × g_0	≈ 4.063 666 × 10^4 Pa[30]
foot of water (39.2 °F)	ftH_2O	≈ 999.972 kg/m^3 × 1 ft × g_0	≈ 2.988 98 × 10^3 Pa[30]
inch of mercury (conventional)	inHg	≡ 13 595.1 kg/m^3 × 1 in × g_0	≈ 3.386 389 × 10^3 Pa[30]
inch of water (39.2 °F)	inH_2O	≈ 999.972 kg/m^3 × 1 in × g_0	≈ 249.082 Pa[30]
kilogram-force per square millimetre	kgf/mm^2	≡ 1 kgf/mm^2	= 9.806 65 × 10^6 Pa[30]
kip per square inch	ksi	≡ 1 kipf/sq in	≈ 6.894 757 × 10^6 Pa[30]
long ton per square foot		≡ 1 long ton × g_0 / 1 sq ft	≈ 1.072 517 801 1595 × 10^5 Pa
micrometre of mercury	μmHg	≡ 13 595.1 kg/m^3 × 1 μm × g_0 ≈ 0.001 torr	≈ 0.133 3224 Pa[30]
millimetre of mercury	mmHg	≡ 13 595.1 kg/m^3 × 1 mm × g_0 ≈ 1 torr	≈ 133.3224 Pa[30]
millimetre of water (3.98 °C)	mmH_2O	≈ 999.972 kg/m^3 × 1 mm × g_0 = 0.999 972 kgf/m^2	= 9.806 38 Pa
pascal (SI unit)	Pa	≡ N/m^2 = kg/(m·s^2)	= 1 Pa[31]
pièze (mts unit)	pz	≡ 1000 kg/m·s^2	= 10^3 Pa = 1 kPa
pound per square foot	psf	≡ 1 lbf/ft^2	≈ 47.880 26 Pa[30]
pound per square inch	psi	≡ 1 lbf/in^2	≈ 6.894 757 × 10^3 Pa[30]
poundal per square foot	pdl/sq ft	≡ 1 pdl/sq ft	≈ 1.488 164 Pa[30]
short ton per square foot		≡ 1 short ton × g_0 / 1 sq ft	≈ 9.576 0518 × 10^4 Pa
torr	torr	≡ $^{101\,325}/_{760}$ Pa	≈ 133.3224 Pa[30]

Torque or moment of force

Torque

Name of unit	Symbol	Definition	Relation to SI units
foot-pound force	ft·lbf	$\equiv g_0 \times 1$ lb $\times 1$ ft	= 1.355 817 948 331 4004 N·m
foot-poundal	ft·pdl	$\equiv 1$ lb·ft^2/s^2	= 4.214 011 009 380 48 × 10^{-2} N·m
inch-pound force	in·lbf	$\equiv g_0 \times 1$ lb $\times 1$ in	= 0.112 984 829 027 6167 N·m
metre kilogram-force	m·kgf	$\equiv g_0 \times$ N $\times$ m	= 9.806 65 N·m
Newton metre (SI unit)	N·m	$\equiv$ N $\times$ m = kg·m^2/s^2	= 1 N·m

Energy

Energy

Name of unit	Symbol	Definition	Relation to SI units
barrel of oil equivalent	boe	≈ 5.8×10^6 $BTU_{59\ °F}$	≈ 6.12×10^9 J
British thermal unit (ISO)	BTU_{ISO}	≡ 1.0545×10^3 J	= 1.0545×10^3 J
British thermal unit (International Table)	BTU_{IT}		= $1.055\ 055\ 852\ 62 \times 10^3$ J
British thermal unit (mean)	BTU_{mean}		≈ $1.055\ 87 \times 10^3$ J
British thermal unit (thermochemical)	BTU_{th}		≈ $1.054\ 350 \times 10^3$ J
British thermal unit (39 °F)	$BTU_{39\ °F}$		≈ $1.059\ 67 \times 10^3$ J
British thermal unit (59 °F)	$BTU_{59\ °F}$	≡ $1.054\ 804 \times 10^3$ J	= $1.054\ 804 \times 10^3$ J
British thermal unit (60 °F)	$BTU_{60\ °F}$		≈ $1.054\ 68 \times 10^3$ J
British thermal unit (63 °F)	$BTU_{63\ °F}$		≈ 1.0546×10^3 J
calorie (International Table)	cal_{IT}	≡ 4.1868 J	= 4.1868 J
calorie (mean)	cal_{mean}	$^1/_{100}$ of the energy required to warm one gram of air-free water from 0 °C to 100 °C @ 1 atm	≈ 4.190 02 J
calorie (thermochemical)	cal_{th}	≡ 4.184 J	= 4.184 J
Calorie (US; FDA)	Cal	≡ 1 kcal = 1000 cal	= 4184 J
calorie (3.98 °C)	$cal_{3.98\ °C}$		≈ 4.2045 J
calorie (15 °C)	$cal_{15\ °C}$	≡ 4.1855 J	= 4.1855 J
calorie (20 °C)	$cal_{20\ °C}$		≈ 4.1819 J
Celsius heat unit (International Table)	CHU_{IT}	≡ 1 BTU_{IT} × 1 K/°R	= $1.899\ 100\ 534\ 716 \times 10^3$ J
cubic centimetre of atmosphere; standard cubic centimetre	cc atm; scc	≡ 1 atm × 1 cm^3	= 0.101 325 J
cubic foot of atmosphere; standard cubic foot	cu ft atm; scf	≡ 1 atm × 1 ft^3	= $2.869\ 204\ 480\ 9344 \times 10^3$ J
cubic foot of natural gas		≡ 1000 BTU_{IT}	= $1.055\ 055\ 852\ 62 \times 10^6$ J

cubic yard of atmosphere; standard cubic yard	cu yd atm; scy	≡ 1 atm × 1 yd^3	= 77.468 520 985 2288 × 10^3 J
electronvolt	eV	≡ e × 1 V	≈ 1.602 176 565(35) × 10^{-19} J
erg (cgs unit)	erg	≡ 1 g·cm^2/s^2	= 10^{-7} J
foot-pound force	ft lbf	≡ g_0 × 1 lb × 1 ft	= 1.355 817 948 331 4004 J
foot-poundal	ft pdl	≡ 1 lb·ft^2/s^2	= 4.214 011 009 380 48 × 10^{-2} J
gallon-atmosphere (imperial)	imp gal atm	≡ 1 atm × 1 gal (imp)	= 460.632 569 25 J
gallon-atmosphere (US)	US gal atm	≡ 1 atm × 1 gal (US)	= 383.556 849 0138 J
hartree, atomic unit of energy	E_h	≡ m_e·α^2·c^2 (= 2 Ry)	≈ 4.359 744 × 10^{-18} J
horsepower-hour	hp·h	≡ 1 hp × 1 h	= 2.684 519 537 696 172 792 × 10^6 J
inch-pound force	in lbf	≡ g_0 × 1 lb × 1 in	= 0.112 984 829 027 6167 J
joule (SI unit)	J	The work done when a force of one newton moves the point of its application a distance of one metre in the direction of the force.[29]	= 1 J = 1 m·N = 1 kg·m^2/s^2 = 1 C·V = 1 W·s
kilocalorie; large calorie	kcal; Cal	≡ 1000 cal_{IT}	= 4.1868 × 10^3 J
kilowatt-hour; Board of Trade Unit	kW·h; B.O.T.U.	≡ 1 kW × 1 h	= 3.6 × 10^6 J
litre-atmosphere	l atm; sl	≡ 1 atm × 1 L	= 101.325 J
quad		≡ 10^{15} BTU_{IT}	= 1.055 055 852 62 × 10^{18} J
rydberg	Ry	≡ R_∞·$\hbar$·c	≈ 2.179 872 × 10^{-18} J
therm (E.C.)		≡ 100 000 BTU_{IT}	= 105.505 585 262 × 10^6 J
therm (US)		≡ 100 000 $BTU_{59\,°F}$	= 105.4804 × 10^6 J
thermie	th	≡ 1 $Mcal_{IT}$	= 4.1868 × 10^6 J
ton of coal equivalent	TCE	≡ 7 $Gcal_{th}$	= 29.288 × 10^9 J
tonne of oil equivalent	toe	≡ 10 $Gcal_{IT}$	= 41.868 × 10^9 J
ton of TNT	tTNT	≡ 1 $Gcal_{th}$	= 4.184 × 10^9 J

Power or heat flow rate

Power

Name of unit	Symbol	Definition	Relation to SI units
atmosphere-cubic centimetre per minute	atm ccm	≡ 1 atm × 1 cm^3/min	= 1.688 75 × 10^{-3} W
atmosphere-cubic centimetre per second	atm ccs	≡ 1 atm × 1 cm^3/s	= 0.101 325 W
atmosphere-cubic foot per hour	atm cfh	≡ 1 atm × 1 cu ft/h	= 0.797 001 247 04 W
atmosphere-cubic foot per minute	atm cfm	≡ 1 atm × 1 cu ft/min	= 47.820 074 682 24 W
atmosphere-cubic foot per second	atm cfs	≡ 1 atm × 1 cu ft/s	= 2.869 204 480 9344 × 10^3 W
BTU (International Table) per hour	BTU_{IT}/h	≡ 1 BTU_{IT}/h	≈ 0.293 071 W
BTU (International Table) per minute	BTU_{IT}/min	≡ 1 BTU_{IT}/min	≈ 17.584 264 W
BTU (International Table) per second	BTU_{IT}/s	≡ 1 BTU_{IT}/s	= 1.055 055 852 62 × 10^3 W
calorie (International Table) per second	cal_{IT}/s	≡ 1 cal_{IT}/s	= 4.1868 W
erg per second	erg/s	≡ 1 erg/s	= 10^{-7} W
foot-pound-force per hour	ft·lbf/h	≡ 1 ft lbf/h	≈ 3.766 161 × 10^{-4} W
foot-pound-force per minute	ft·lbf/min	≡ 1 ft lbf/min	= 2.259 696 580 552 334 × 10^{-2} W
foot-pound-force per second	ft·lbf/s	≡ 1 ft lbf/s	= 1.355 817 948 331 4004 W
horsepower (boiler)	hp	≈ 34.5 lb/h × 970.3 BTU_{IT}/lb	≈ 9 809.5 W[32]
horsepower (European electrical)	hp	≡ 75 kp·m/s	= 736 W
horsepower (electrical)	hp	≡ 746 W	= 746 W[32]
horsepower (mechanical)	hp	≡ 550 ft·lbf/s[32]	= 745.699 871 582 270 22 W
horsepower (metric)	hp or PS	≡ 75 m·kgf/s	= 735.498 75 W[32]
litre-atmosphere per minute	L·atm/min	≡ 1 atm × 1 L/min	= 1.688 75 W
litre-atmosphere per second	L·atm/s	≡ 1 atm × 1 L/s	= 101.325 W
lusec	lusec	≡ 1 L·μmHg/s [14]	≈ 1.333 × 10^{-4} W
poncelet	p	≡ 100 m·kgf/s	= 980.665 W

square foot equivalent direct radiation	sq ft EDR	≡ 240 BTU_{IT}/h	≈ 70.337 057 W
ton of air conditioning		≡ 2000 lb of ice melted / 24 h	≈ 3504 W
ton of refrigeration (imperial)		≡ 2240 lb × ice_{IT} / 24 h: ice_{IT} = 144 °F × 2326 J/kg·°F	≈ 3.938 875 × 10^3 W
ton of refrigeration (IT)		≡ 2000 lb × ice_{IT} / 24 h: ice_{IT} = 144 °F × 2326 J/kg·°F	≈ 3.516 853 × 10^3 W
watt (SI unit)	W	The power which in one second of time gives rise to one joule of energy.[29]	= 1 W = 1 J/s = 1 N·m/s = 1 kg·m^2/s^3

Action

Action

Name of unit	Symbol	Definition	Relation to SI units
atomic unit of action	au	≡ $\hbar \equiv {}^{h}/_{2\pi}$	≈ 1.054 571 68 × 10^{-34} J·s[33]

Dynamic viscosity

Dynamic viscosity

Name of unit	Symbol	Definition	Relation to SI units
pascal second (SI unit)	Pa·s	≡ N·s/m^2, kg/(m·s)	= 1 Pa·s
poise (cgs unit)	P	≡ 1 barye·s	= 0.1 Pa·s
pound per foot hour	lb/(ft·h)	≡ 1 lb/(ft·h)	≈ 4.133 789 × 10^{-4} Pa·s
pound per foot second	lb/(ft·s)	≡ 1 lb/(ft·s)	≈ 1.488 164 Pa·s
pound-force second per square foot	lbf·s/ft^2	≡ 1 lbf·s/ft^2	≈ 47.880 26 Pa·s
pound-force second per square inch	lbf·s/in^2	≡ 1 lbf·s/in^2	≈ 6 894.757 Pa·s

Kinematic viscosity

Kinematic viscosity

Name of unit	Symbol	Definition	Relation to SI units
square foot per second	ft^2/s	≡ 1 ft^2/s	= 0.092 903 04 m^2/s
square metre per second (SI unit)	m^2/s	≡ 1 m^2/s	= 1 m^2/s
stokes (cgs unit)	St	≡ 10^{-4} m^2/s	= 10^{-4} m^2/s

Electric current

Electric current

Name of unit	Symbol	Definition	Relation to SI units
ampere (SI base unit)	A	≡ The constant current needed to produce a force of 2×10^{-7} newton per metre between two straight parallel conductors of infinite length and negligible circular cross-section placed one metre apart in a vacuum.[8]	= 1 A = 1 C/s
electromagnetic unit; abampere (cgs unit)	abamp	≡ 10 A	= 10 A
esu per second; statampere (cgs unit)	esu/s	$\equiv {}^{0.1\ \mathrm{A\cdot m/s}}\!/_{c}$	≈ $3.335\,641 \times 10^{-10}$ A

Electric charge

Electric charge

Name of unit	Symbol	Definition	Relation to SI units
abcoulomb; electromagnetic unit (cgs unit)	abC; emu	≡ 10 C	= 10 C
atomic unit of charge	au	≡ e	≈ $1.602\,176\,462 \times 10^{-19}$ C
coulomb	C	≡ The amount of electricity carried in one second of time by one ampere of current.[29]	= 1 C = 1 A·s
faraday	F	≡ 1 mol × $N_A \cdot e$	≈ 96 485.3383 C
milliampere hour	mA·h	≡ 0.001 A × 1 h	= 3.6 C
statcoulomb; franklin; electrostatic unit (cgs unit)	statC; Fr; esu	$\equiv {}^{0.1\ \mathrm{A\cdot m}}\!/_{c}$	≈ $3.335\,641 \times 10^{-10}$ C

Electric dipole

Electric dipole

Name of unit	Symbol	Definition	Relation to SI units
atomic unit of electric dipole moment	ea_0		≈ $8.478\,352\,81 \times 10^{-30}$ C·m[34]
coulomb meter	C·m		= 1 C · 1 m
debye	D	= 10^{-10} esu·Å	= $3.335\,640\,95 \times 10^{-30}$ C·m[35]

Electromotive force, electric potential difference

Voltage, electromotive force

Name of unit	Symbol	Definition	Relation to SI units
abvolt (cgs unit)	abV	≡ 10^{-8} V	= 10^{-8} V
statvolt (cgs unit)	statV	≡ c·(1 μJ/A·m)	= 299.792 458 V
volt (SI unit)	V	The difference in electric potential across two points along a conducting wire carrying one ampere of constant current when the power dissipated between the points equals one watt.[29]	= 1 V = 1 W/A = 1 kg·m^2/(A·s^3)

Electrical resistance

Electrical resistance

Name of unit	Symbol	Definition	Relation to SI units
ohm (SI unit)	Ω	The resistance between two points in a conductor when one volt of electric potential difference, applied to these points, produces one ampere of current in the conductor.[29]	= 1 Ω = 1 V/A = 1 kg·m^2/(A^2·s^3)

Capacitance

Capacitor's ability to store charge

Name of unit	Symbol	Definition	Relation to SI units
farad (SI unit)	F	The capacitance between two parallel plates that results in one volt of potential difference when charged by one coulomb of electricity.[29]	= 1 F = 1 C/V = 1 A^2·s^4/(kg·m^2)

Magnetic flux

magnetic flux

Name of unit	Symbol	Definition	Relation to SI units
maxwell (CGS unit)	Mx	≡ 10^{-8} Wb[32]	= 10^{-8} Wb
weber (SI unit)	Wb	Magnetic flux which, linking a circuit of one turn, would produce in it an electromotive force of 1 volt if it were reduced to zero at a uniform rate in 1 second.[29]	= 1 Wb = 1 V·s = 1 kg·m^2/(A·s^2)

Magnetic flux density

What physicists call Magnetic field is called Magnetic flux density by electrical engineers and magnetic induction by applied mathematicians and electrical engineers.

Name of unit	Symbol	Definition	Relation to SI units
gauss (CGS unit)	G	≡ $Mx/cm^2 = 10^{-4}$ T	= 10^{-4} T [36]
tesla (SI unit)	T	≡ Wb/m^2	= 1 T = 1 Wb/m^2 = 1 $kg/(A \cdot s^2)$

Inductance

Inductance

Name of unit	Symbol	Definition	Relation to SI units
henry (SI unit)	H	The inductance of a closed circuit that produces one volt of electromotive force when the current in the circuit varies at a uniform rate of one ampere per second.[29]	= 1 H = 1 Wb/A = 1 $kg \cdot m^2/(A \cdot s)^2$

Temperature

Temperature

Name of unit	Symbol	Definition	Relation to SI units
degree Celsius	°C	[°C] ≡ [K] − 273.15	[K] ≡ [°C] + 273.15
degree Delisle	°De		[K] = 373.15 − [°De] × $^{2}/_{3}$
degree Fahrenheit	°F	[°F] ≡ [°C] × $^{9}/_{5}$ + 32	[K] ≡ ([°F] + 459.67) × $^{5}/_{9}$
degree Newton	°N		[K] = [°N] × $^{100}/_{33}$ + 273.15
degree Rankine	°R;	[°R] ≡ [K] × $^{9}/_{5}$	[K] ≡ [°R] × 5/9
degree Réaumur	°Ré		[K] = [°Ré] × $^{5}/_{4}$ + 273.15
degree Rømer	°Rø		[K] = ([°Rø] − 7.5) × $^{40}/_{21}$ + 273.15
Regulo Gas Mark	GM;	[°F] ≡ [GM] × 25 + 300	[K] ≡ [GM] × $^{125}/_{9}$ + 422.038
kelvin (SI base unit)	K	≡ $^{1}/_{273.16}$ of the thermodynamic temperature of the triple point of water.[8]	≡ 1 K

Information entropy

Information entropy

Name of unit	Symbol	Definition	Relation to SI units	Relation to bits
SI unit	J/K	≡ J/K	= 1 J/K	
nat; nip; nepit	nat	≡ k_B	= 1.380 6505(23) × 10^{-23} J/K	
bit; shannon	bit; b; Sh	≡ ln(2) × k_B	= 9.569 940(16) × 10^{-24} J/K	= 1 bit
ban; hartley	ban; Hart	≡ ln(10) × k_B	= 3.179 0653(53) × 10^{-23} J/K	
nibble		≡ 4 bits	= 3.827 9760(64) × 10^{-23} J/K	= 2^2 bit
byte	B	≡ 8 bits	= 7.655 952(13) × 10^{-23} J/K	= 2^3 bit
kilobyte (decimal)	kB	≡ 1000 B	= 7.655 952(13) × 10^{-20} J/K	= 8000 bit
kilobyte (kibibyte)	KB; KiB	≡ 1024 B	= 7.839 695(13) × 10^{-20} J/K	= 2^{13} bit = 8192 bit

Often, information entropy is measured in shannons, whereas the (discrete) storage space of digital devices is measured in bits. Thus, uncompressed redundant data occupy more than one bit of storage per shannon of information entropy. The multiples of a bit listed above are usually used with this meaning. Other times the bit is used as a measure of information entropy and is thus a synonym of shannon.

Luminous intensity

The candela is the preferred nomenclature for the SI unit.

Luminous intensity

Name of unit	Symbol	Definition	Relation to SI units
candela (SI base unit); candle	cd	The luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 × 10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.[8]	= 1 cd
candlepower (new)	cp	≡ cd The use of *candlepower* as a unit is discouraged due to its ambiguity.	= 1 cd
candlepower (old, pre-1948)	cp	Varies and is poorly reproducible.[37] Approximately 0.981 cd.[14]	≈ 0.981 cd

Luminance

Luminance

Name of unit	Symbol	Definition	Relation to SI units
candela per square foot	cd/ft^2	$\equiv cd/ft^2$	$\approx 10.763\ 910\ 417\ cd/m^2$
candela per square inch	cd/in^2	$\equiv cd/in^2$	$\approx 1\ 550.0031\ cd/m^2$
candela per square metre (SI unit); nit (deprecated [14])	cd/m^2	$\equiv cd/m^2$	$= 1\ cd/m^2$
footlambert	fL	$\equiv (1/\pi)\ cd/ft^2$	$\approx 3.426\ 259\ 0996\ cd/m^2$
lambert	L	$\equiv (10^4/\pi)\ cd/m^2$	$\approx 3\ 183.098\ 8618\ cd/m^2$
stilb (CGS unit)	sb	$\equiv 10^4\ cd/m^2$	$= 10^4\ cd/m^2$

Luminous flux

Luminous flux

Name of unit	Symbol	Definition	Relation to SI units
lumen (SI unit)	lm	≡ cd·sr	= 1 lm = 1 cd·sr

Illuminance

Illuminance

Name of unit	Symbol	Definition	Relation to SI units
footcandle; lumen per square foot	fc	$\equiv lm/ft^2$	= 10.763 910 417 lx
lumen per square inch	lm/in^2	$\equiv lm/in^2$	≈ 1 550.0031 lx
lux (SI unit)	lx	$\equiv lm/m^2$	$= 1\ lx = 1\ lm/m^2$
phot (CGS unit)	ph	$\equiv lm/cm^2$	$= 10^4\ lx$

Radiation - source activity

Radioactivity

Name of unit	Symbol	Definition	Relation to SI units
becquerel (SI unit)	Bq	≡ Number of disintegrations per second	= 1 Bq = 1/s
curie	Ci	$\equiv 3.7 \times 10^{10}$ Bq[38]	$= 3.7 \times 10^{10}$ Bq
rutherford (H)	rd	≡ 1 MBq	$= 10^6$ Bq

Please note that although becquerel (Bq) and hertz (Hz) both ultimately refer to the same SI base unit (s^{-1}), Hz is used only for periodic phenomena, and Bq is only used for stochastic processes associated with radioactivity.[39]

Radiation - exposure

Radiation - exposure

Name of unit	Symbol	Definition	Relation to SI units
roentgen	R	1 R ≡ 2.58×10^{-4} C/kg[32]	= 2.58×10^{-4} C/kg

The roentgen is not an SI unit and the NIST strongly discourages its continued use.[40]

Radiation - absorbed dose

Radiation - absorbed dose

Name of unit	Symbol	Definition	Relation to SI units
gray (SI unit)	Gy	≡ 1 J/kg = 1 m^2/s^2 [41]	= 1 Gy
rad	rad	≡ 0.01 Gy[32]	= 0.01 Gy

Radiation - equivalent dose

Radiation - equivalent dose

Name of unit	Symbol	Definition	Relation to SI units
Röntgen equivalent man	rem	≡ 0.01 Sv	= 0.01 Sv
sievert (SI unit)	Sv	≡ 1 J/kg[39]	= 1 Sv

Although the definitions for sievert (Sv) and gray (Gy) would seem to indicate that they measure the same quantities, this is not the case. The effect of receiving a certain dose of radiation (given as Gy) is variable and depends on many factors, thus a new unit was needed to denote the biological effectiveness of that dose on the body; this is known as the equivalent dose and is shown in Sv. The general relationship between absorbed dose and equivalent dose can be represented as

$$H = Q \cdot D$$

where H is the equivalent dose, D is the absorbed dose, and Q is a dimensionless quality factor. Thus, for any quantity of D measured in Gy, the numerical value for H measured in Sv may be different.[42]

Software tools

There are many conversion tools. They are found in the function libraries of applications such as spreadsheets databases, in calculators, and in macro packages and plugins for many other applications such as the mathematical, scientific and technical applications.

There are many standalone applications that offer the thousands of the various units with conversions. For example, the free software movement offers a command line utility GNU units (https://www.gnu.org/software/units/) for Linux and Windows.

See also

- Accuracy and precision
- Conversion of units of temperature
- English units
- False precision
- Imperial units
- International System of Units
- Mesures usuelles
- Metric prefix (e.g. "kilo-" prefix)
- Metric system
- Natural units
- Rounding
- Significant figures
- United States customary units
- Units (software)
- Units conversion by factor-label
- Units of measurement

Notes and references

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Notes

1. The technical definition of tropical year is the period of time for the ecliptic longitude of the Sun to increase 360 degrees. (Urban & Seidelmann 2013, Glossary, s.v. year, tropical)

External links

- Statutory Instrument 1995 No. 1804 (http://legislation.gov.uk/uksi/1995/1804) *Units of measurement regulations 1995* From legislation.gov.uk (http://legislation.gov.uk)
- *How Many? A dictionary of units of measurement* (http://www.unc.edu/~rowlett/units/)
- "NIST: Fundamental physical constants — Non-SI units" (PDF). (35.7 KB)
- NIST Guide to SI Units (http://physics.nist.gov/Pubs/SP811/appenB9.html) Many conversion factors listed.
- Online Unit Conversion Website (http://www.onlineconversions.org/) Convert any unit from and to other units.
- The Unified Code for Units of Measure (http://aurora.rg.iupui.edu/~schadow/units/UCUM/ucum.html)
- Units, Symbols, and Conversions XML Dictionary (http://w3.energistics.org/uom/poscUnits22.xml)
- Units, Symbols, Exchange, Equations, Human Readable (https://www.unitwolf.com)
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- Units of Measurement Online Conversion (https://www.dmoz.org/Science/Reference/Units_of_Measurement/Online_Conversion/) at DMOZ