

Appendix A: Symbols and Prefixes

(Appendix A last revised November 2020)

This appendix of the Author's Kit provides recommendations on prefixes, unit symbols and abbreviations, and factors for conversion into units of the International System.

Prefixes

Recommended prefixes indicating decimal multiples or submultiples of units and their symbols are as follows:

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

Avoid using compound prefixes, such as micromicro for pico and kilomega for giga. The abbreviation of a prefix is considered to be combined with the abbreviation/symbol to which it is directly attached, forming with it a new unit symbol, which can be raised to a positive or negative power and which can be combined with other unit abbreviations/symbols to form abbreviations/symbols for compound units. For example:

$$1 \text{ cm}^3 = (10^{-2} \text{ m})^3 = 10^{-6} \text{ m}^3$$

$$1 \mu\text{s}^{-1} = (10^{-6} \text{ s})^{-1} = 10^6 \text{ s}^{-1}$$

$$1 \text{ mm}^2/\text{s} = (10^{-3} \text{ m})^2/\text{s} = 10^{-6} \text{ m}^2/\text{s}$$

Abbreviations and Symbols

Whenever possible, avoid using abbreviations and symbols in paragraph text; however, when it is deemed necessary to use such, define all but the most common at first use. The following is a recommended list of abbreviations/symbols for some important units. The form of unit abbreviations/symbols is the same for both singular and plural usage, and they are not followed by a period. The distinction between uppercase and lowercase letters should be carefully observed. When a compound unit is formed by the multiplication of two or more units, its abbreviation/symbol consists of the symbols for the separate units joined by a raised dot, for example, N·m for newton-meter. When a compound unit is formed by division of one unit by another, its abbreviation/symbol consists of the symbols for the separate symbols either separated by a solidus (slant) or multiplied using negative powers, for example, m/s or $\text{m}\cdot\text{s}^{-1}$ for meters per second.

ampere	A
bar	bar
barn	b
billion electronvolts	GeV
calorie	cal
calorie (International Table calorie)	cal _{IT}
calorie (thermochemical calorie)	cal _{th}
candela	cd
candela per square meter	cd/m ²
centimeter	cm
centimeter-gram-second	CGS
coulomb	C
cubic centimeter	cm ³
cubic meter	m ³
cubic meter per second	m ³ /s
degree (temperature) Celsius	°C
electronvolt	eV
farad	F
gal	Gal
gigaelectronvolt	GeV
gigahertz	GHz
gram	g
henry	H
hertz	Hz
joule	J
joule per kelvin	J/K

kelvin	K
kiloelectronvolt	keV
kilogram	kg
kilohertz	kHz
kilohm	k Ω
kilojoule	kJ
kilometer	km
kilovar	kvar
kilovolt	kV
kilovoltampere	kVA
kilowatt	kW
liter	L
liter per second	L/s
lumen	lm
lumen per square meter	lm/m ²
lumen per watt	lm/W
lumen second	lm·s
lux	lx
megaelectronvolt	MeV
megahertz	MHz
megavolt	MV
megawatt	MW
megohm	M Ω
meter	m
meter-kilogram-second	MKS
mho	mho
microampere	μ A
microbar	μ bar
microfarad	μ F
microgram	μ g
microhenry	μ H
micrometer	μ m
micron	μ m
microsecond	μ s
microsiemens	μ S
microwatt	μ W
milliampere	mA
millibar	mbar
millibarn	mb
milligram	mg
millihenry	mH
milliliter	mL
millimeter	mm
millimeter of mercury, conventional	mmHg

millisecond	ms
millisiemens	mS
millivolt	mV
milliwatt	mW
nanoampere	nA
nanofarad	nF
nanometer	nm
nanosecond	ns
nanowatt	nW
newton	N
newton meter	Nm
newton per square meter	N/m ²
ohm	Ω
pascal	Pa
picoampere	pA
picoloumb	pC
picofarad	pF
picosecond	ps
picowatt	pW
rad	rd
radian	rad
rem	rem
roentgen	R
siemens	S
square meter	m ²
steradian	sr
tesla	T
volt	V
voltampere	VA
watt	W
watt per steradian	W/sr
watt per steradian square meter	W/(sr m ²)
weber	Wb

Conversion Factors

The following are some factors for conversion into units of the International System.

Length

1 inch = 2.54 centimeters (exactly)

1 foot = 0.3048 meter (exactly)

1 mile = 1609.3 meters

1 nautical mile = 1852 meters (exactly)

1 micron = 1 micrometer (exactly)

1 angstrom = 0.1 nanometer (exactly)

Area

1 square inch = 6.4516 square centimeters (exactly)

1 square foot = 0.092 903 square meter

1 circular mil = 5.0671×10^{-4} square millimeter

1 acre = 4046.9 square meters

1 barn = 10^{-28} square meter (exactly)

1 hectare = 10 000 square meters (exactly)

Volume

1 cubic inch = 16.387 cubic centimeters

1 cubic foot = 0.028 317 cubic meter

1 fluid ounce (UK) = 28.413 cubic centimeters

1 fluid ounce (US) = 29.574 cubic centimeters

1 gallon (UK) = 4546.1 cubic centimeters

1 gallon (US) = 3785.4 cubic centimeters

1 barrel (US) (for petroleum; etc) = 0.158 99 cubic meter

1 acre foot = 1233.5 cubic meters

1 liter = 1000 cubic centimeters (exactly)

Speed

1 foot per minute = 5.08 millimeters per second (exactly)

1 mile per hour = 0.44704 meter per second (exactly)

1 knot = 0.514 44 meter per second

1 kilometer per hour = 0.277 78 meter per second

Mass

1 ounce (avoirdupois) = 28.350 grams

1 pound = 0.453 59 kilogram

1 slug = 14.594 kilograms

1 short ton = 907.18 kilograms

1 long ton = 1016.0 kilograms

1 tonne = 1000 kilograms (exactly)

Density

1 pound per cubic foot = 16.018 kilograms per cubic meter

1 pound per cubic inch = 27 680 kilograms per cubic meter

Force

1 poundal = 0.138 25 newton

1 ounce-force = 0.278 01 newton

1 pound-force = 4.4482 newtons

1 kilogram-force = 9.806 65 newtons (exactly)

1 dyne = 10^{-5} newton (exactly)

Pressure

1 poundal per square foot = 1.4882 pascals (newtons per square meter)

1 pound-force per square foot = 47.880 pascals

1 pound-force per square inch = 6894.8 pascals

1 conventional foot of water = 2989.1 pascals

1 conventional millimeter of mercury = 133.32 pascals

1 torr = 133.32 pascals

1 standard atmosphere (760 torr) = 101 325 pascals (exactly)

1 technical atmosphere (1 kgf/cm²) = 98 066.5 pascals (exactly)

1 bar = 100 000 pascals (exactly)

Energy, Work

1 foot poundal = 0.042 140 joule

1 foot pound-force = 1.3558 joules

1 British thermal unit (thermochemical) = 1054 joules

1 British thermal unit (International Table) = 1055 joules

1 calorie (thermochemical) = 4.184 joules (exactly)

1 calorie (International Table) = 4.1868 joules (exactly)

1 electronvolt = 1.602×10^{-19} joule

1 erg = 10^{-7} joule (exactly)

Power

1 foot pound-force per second = 1.3558 watts

1 horsepower (metric) = 735.50 watts

1 horsepower (British) = 745.70 watts

1 horsepower (electrical) = 746 watts (exactly)

1 British thermal unit (International Table) per hour = 0.2931 watt

1 erg per second = 10^{-7} watt (exactly)

Quantities of Light

1 footcandle = 10.764 lux (lumens per square meter)

1 footlambert = 3.4263 candelas per square meter

Quantities of Electricity and Magnetism

1 ESU of current $\approx 3.3356 \times 10^{-10}$ ampere

1 EMU of current = 10 amperes (exactly)

1 ESU of electric potential ≈ 299.79 volts

1 EMU of electric potential = 10^{-8} volt (exactly)

1 ESU of capacitance $\approx 1.1126 \times 10^{-12}$ farad

1 EMU of capacitance = 10^9 farads (exactly)

1 ESU of inductance $\approx 8.9876 \times 10^{11}$ henrys

1 EMU of inductance = 10^{-9} henry (exactly)

1 ESU of resistance $\approx 8.9876 \times 10^{11}$ ohms

1 EMU of resistance = 10^{-9} ohm (exactly)

1 gilbert ≈ 0.79577 ampere

1 oersted ≈ 79.577 amperes per meter

1 maxwell = 10^{-8} weber (exactly)

1 gauss = 10^{-4} tesla (exactly)

Note that ESU means electrostatic CGS unit; EMU means electromagnetic CGS unit. In this list, the sign \approx is to be read "corresponds to." Since the change from either CGS system to the International System of Units involves a change in quantities, conversion of units by multiplication by a pure number is not, strictly speaking, possible. However, a physical situation which can be described as a "current" of 1 abampere can also be described as a current of 10 amperes.