microlight FLYING

HOUSE STYLE

Edition 36, 14.8.20
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Section 1: Spelling & Typography

1.1 **No full points** except at the end of sentences. Thus ‘Mr Brown’ not ‘Mr. Brown’.
Exception: No. for number, to avoid confusion with the negative.

1.2 **Initials** never carry full points. Thus BMW cars not B.M.W. cars.

1.3 **Initials** familiar to the reader need not be spelled out at all. Others should be spelled out the first time they are used in the story (with the initials in parentheses afterwards). See Appendix 1 for list of familiar initials.

1.4 **No double spaces** anywhere, not even after full stops.

1.5 **Quotes:** If your keyboard has proper opening and closing quotes as well as feet and inches marks, use them for speech (double quotes for speech, single quotes only for speech within speech).

1.6 **Apostrophes:** use single closing quote if your keyboard has one, otherwise feet mark.

1.7 **Type of units:** We use SI units (the international metric standard) except for altitude (ft), climb (ft/min), distance (miles), power (hp), and speed (mph). Knots (kt) and nautical miles (nm) are acceptable but not preferred. Any copy involving other imperial units, such as yards, pounds or inches, should be converted to SI and the imperial units deleted.

Exception 1: retain imperial if conversion would make technical nonsense of the copy, for instance if it was referring to a $^1/_4$ inch UNF bolt.

Exception 2: retain imperial if it is part of a quote.

NB 1: SI units use ‘h’ for hours and ‘s’ for seconds, so a roll rate of '45°/s' and a flight time of ‘2.5h’ or ‘2h 30min’. But in a quote or a colloquial piece, it is OK to spell out the unit, eg ‘he spent two hours in the pub complaining about his instructor’.

NB 2: Where the unit involves powers, we use a numerical format. Thus '$2m^2$’ not ‘2 square metres’ or ‘2 sq m’.

NB 3: The metric hp (PS) is virtually identical to the Imperial hp, so no arithmetic needed.

1.8 **Presentation of units where the unit is not spelt out:** type hard up to the number and never use the plural , eg ‘6mm’ not ‘6 mm’ or '6 mms' or '6mms.

Exception: where the unit starts with i or l, leave the space in, to avoid confusion with 1. Thus ‘fuel consumption was 10 l/h’ not ‘fuel consumption was 10l/h’.

1.9 **Presentation of units where a unit is spelt out,** use the plural if appropriate and leave the space in. Thus ‘6 miles;, not ‘6miles' or '6mile' or '6 mile’.

1.10 **Where there is no unit,** spell out numbers zero to nine, use arabic for 10 and up. Thus ‘He swore at the typist three times’ not ‘He swore at the typist 3 times’, but ‘the 10 children went off to play’ not ‘the ten children went off to play’.

Exception: spell out numbers if they begin the sentence, eg 'Twenty horsepower extra made all the difference'.

1.11 **Times of day:** avoid 24h clock, use am or pm instead with no space and just a full point between the hours and minutes. Thus ‘3.30pm’, not ‘3:30 p.m’.

1.12 **Dates:** Day-month-year in that order, with no suffix on the date number, eg ‘1 May 1994’, not ‘May 1 1994’ or ‘the 1st of May 1994’. If you are talking about a specific year and the context requires you to abbreviate it, use apostrophe followed by the last two digits, eg ‘I had a mid-life crisis in ’94 but my wife was very understanding’.

Exception: spell out numbers if they begin the sentence, eg ‘Nineteen ninety-eight was a momentous year’.

1.13 **Decades and centuries:** Use numbers not words, so avoid ‘eighties’, ‘Eighties’, ‘nineteenth Century’ etc. For decades, use the full numerical date with no apostrophes, eg ‘1980s’, not ‘ ’80s ’. ‘Century’ when used with a specific era, eg ‘the 19th Century’, has an initial cap, otherwise not.

Exception: spell out the time span if it begins the sentence, eg ‘Sixties children were a rebellious lot’.

1.14 **Groups of things or spans of time,** eg ‘1-6 May 1994’, ‘£10,000-15,000’. Note the absence of space around the hyphen. For spans of time that spread over one month, use a dash with a space either side, eg ‘30 May – 3 June’.

1.15 **Decimal point:** use full point.

1.16 **Series of full stops:** Use three full points with no space before and one space after. Thus ‘But that’s another story…’ not ‘But that’s another story ....’ If your computer has a single key that will produce all three points as one character (an ellipsis), use it.

1.17 **Hyphens and dashes:** Hyphens *connect* and have no space either side. Dashes (alt hyphen on most keyboards, as is our normal editorial style) *separate:* they are longer than hyphens and have a space either side. If in doubt about how to type a dash, use a hyphen but be sure to put the spaces in.

1.18 **Multiple questionmarks and exclamation marks,** or a combination of both: Avoid absolutely. They are a sure sign that the writer has run out of ideas.

1.19 **Numbers of five digits and up:** use a comma every third number, eg ‘10,000’ not ‘10000’. No need for a comma in a four-digit number.

1.20 **Ampersands:** Use only as part of proper names or abbreviations. Thus ‘J Brown & Sons’ not ‘J Brown and Sons’, ‘R&D Department’ not ‘R and D Department.

1.21 **Organisations** are singular and, except when they are spelled out in full, do not use initial caps. Thus ‘J Brown & Sons is introducing a new service’, not ‘J Brown & Sons are introducing a new service’, and ‘the Department of Justice is considering banning dissent’, not ‘the Department of Justice are considering banning dissent’. Continuing these examples, once either of them had been used in a story, they would be ‘the company’ not ‘the Company’ and ‘the department’ not ‘the Department’.

Exceptions: Sports teams and police forces are plural.

1.22 **Company names:** Omit ‘Ltd’, ‘Inc’, ‘plc’ and other indicators of legal status unless the company name is so general that it would be confusing without a suffix. Thus ‘J Brown & Sons’ not ‘J Brown & Sons Ltd’ but ‘He said he’d been let down by Telephone Maintenance Ltd’ not “He said he’d been let down by Telephone Maintenance’.

1.23 **Addresses etc:**

- No comma after a house number
- No punctuation between a post-town/county and a postcode
- No hyphens or slashes in phone numbers
- For a phone extension, use x with no space between it and the number
- For international numbers, use + followed by the country code (no double zero)
- Don’t underline email addresses (makes them hard to read in small type).
- Don't bother with www. before websites, unless omitting the www would lead to misdirection (eg fly-microlights.co.uk gives a different result from www.fly-microlights.co.uk.)

Where contact details are written into the story, run on all this information as one sentence, separated by semicolons and with words like Street, Road etc spelled out in full.
Example: ‘Full details are available from Paul Brown, J Brown & Sons, 15 Hamilton Street, Birmingham B12 5HJ; tel 0121 445 6789 x232; fax 0121 445 6790; mob 07790 123456; info@brown.com; www.brown.com. Note lack of capital letters and of superfluous punctuation.

Where contact details are tabulated or placed at the end of a story, St, Rd etc can be used in addresses.

1.24 **Names of ships, publications, films, radio and TV programmes and website sections** (but not the sites themselves), are italicised and use initial caps but no quote marks, the italicisation starting at the name proper.

Example: ‘She read the *Times* right through twice’ not ‘she read *The Times* right through twice’ or ‘she read ‘The Times’ right through twice’.

1.25 **Names of** events, championships, pubs, etc, are as above but without the italics.

1.26 **Titles:** Use initial caps for posts when preceding the name, lower case otherwise.

Example 1: ‘BMAA President Richard Meredith-Hardy said…’ but ‘being appointed president of the BMAA is a great honour for Richard Meredith-Hardy’.

Example 2: ‘P&M Managing Director Andrew Cranfield was busy in the workshop’ but ‘we found Andrew Cranfield, P&M’s managing director, busy in the workshop’.

1.27 **Compass directions** are lower case and hyphenated (eg ‘he flew south-east’, not ‘he flew South

East' or 'he flew southeast'). But parts of the country have initial caps, thus 'the South-East is overpopulated'. In a map reference, use 'N', 'E','S', and 'W', but not otherwise.

1.28 **World wars** are known as 'First World War' and 'Second World War'.

1.29 **Aircraft names** with one exception (see *) mostly follow the style of *World Directory of Light Aviation (WDLA)* and its sister publication, *World Directory of Free-Flight (WDFF).* In particular…

• avoid 'autogyro' and 'gyroplane', use 'gyrocopter' instead. 'Gyro' is acceptable in a colloquial piece. Diehards will not agree with gyrocopter, as it originated as a specific model name, but the word is now widely used generically and has the advantage of tieing in with helicopter. NB: Autogiro, with an 'i', is a specific (historic) gyrocopter.

• 'weight-shift' (note hyphen) and 'trike' are acceptable alternatives to 'flexwing' (no hyphen), but flexwing is preferred.

• 'three-axis' (note hyphen) is an acceptable alternative to fixed-wing (note hyphen) but fixed-wing is preferred.

• 'powered hang glider' is the correct term for any aircraft with a Rogallo-style wing and a power unit but no undercarriage, eg a Doodlebug.

• avoid 'powered paraglider' and 'PPG', they are too general as they don't define whether the aircraft is footlaunched (a 'paramotor') or has wheels (a 'powered parachute'). 'Paratrike*' is an alternative to the latter but powered parachute is preferred. If you want a generic term to cover all aircraft with an inflatable wing, be they wheeled or footlaunched, powered or unpowered, use 'parawing'.

• 'Skyranger' is one word, no cap in the middle. EuroFox. is also one word, but has a capital F. X-air has no apostrophe or cap A.

** exception to WDLA/WDFF style, which uses paratrike*

1.30 **In general, avoid unnecessary capital letters and punctuation.**

IF IN DOUBT REFER TO:

• *Fowlers Modern English Usage,* third edition, for grammar and language usage

• *Oxford Dictionary of English,* second edition, for spelling. But note that we do not follow the recommended use of the z in words like 'standardize' and 'organize'.

If either of these two references conflicts with the above list, follow the list!

Section 2: Data Presentation

2.1 **Text:** Use Word files (.doc) or Rich Text Files (.rtf). These allow you to add emphasis with bold, italic, etc, and also support foreign characters (accents etc), while being readable by all modern page make-up software. You can make Rich Text Files from Word and from many other applications. Filenames should be no longer than 28 characters excluding any suffix. If in doubt about Rich Text Files, used text files instead (.txt). Where there is more than one file associated with a story, title them in families (see below).

2.2 **Graphics:** Don't embed graphics in word-processed files. Send separate graphics files instead, titling them in families so they naturally fall together when part of a long alphabetical list

Example: a story on Ballooning in Sweden with three photos as tif-format graphics (one aerial shot, one of the envelope, one of the pilot), plus a main story and an associated box:

SwedenAerial.tif SwedenEnvelope.tif SwedenPilot.tif Sweden main.rtf Swedenbox.rtf

would be much better than…

AerialSweden.tif EnvelopeSweden.tif PilotSweden.tif MainSweden.rtf BoxSweden.rtf

Graphic file formats can be (in order of preference) .jpg, .tif, .eps, .bmp, …other. For full details about graphics resolution, file types etc, see the Pagefast website: <www.pagefast.co.uk>.

2.3 **Photos:** Digital photos preferred, if hard copy is the only option, prints or slides are preferable to negatives. If you have negatives and prints, post only the prints, then if the post goes astray you can get more prints made.

2.4 **Captions for electronic photos:** If they are short, it is OK to use the filename as a caption, but maximum 28 characters excluding any suffix. For longer captions, write them at the end of the Word file to which they relate, each followed by the relevant file name. Alternatively, use the 'file info' facility in Photoshop.

2.5 **Captions for hard copy photos:** Write captions at the end of the Word file to which they relate, each followed by the relevant photo reference, as written on the back of the photo. Don't write on photos with ballpoint or felt tip as these can mark the photo underneath; use pencil on a self-adhesive label instead. Photo references should be 'Sweden 1', 'Sweden 2' etc, not just '1', '2' to avoid the risk of mix-ups between stories. Second best is to write captions straight on the back of hard-copy photos.

2.6 **Tables:** Tab once only between columns, even if this makes the table look crummy in Word.

2.7 **Paragraphs:** One return only between paragraphs. Do not attempt to create indents using tabs or spaces — we will do this later as necessary.

2.8 **Caps:** Avoid long strings of capital letters, use a mixture of upper and lower case as appropriate, with *italics* for emphasis as necessary.

2.9 **Emphasis:** Use *italics,* not bold which is reserved for…

2.10 **Bold:** …subheadings etc, and (where it is magazine policy to do so) names of individuals in a story.

2.11 **Fractions:** Even if your keyboard has a special key for a half, quarter, etc *don't use it:* unlike normal letters and numbers, these characters are not standardized between computers so the result may appear as gibberish at our end. Use number-oblique-number, eg '1/2', '3/4'. Do not attempt to create non-standard size numbers and do not put space around the oblique.

2.12 **Spreadsheet files (eg Excel):** These are helpful for results tables, etc, but otherwise Word-processed files are preferred.

2.13 **Database files:** Avoid absolutely. Convert to spreadsheet or Word.

Appendix 1: Familiar Abbreviations

excluding scientific units (see Section 1.7 and Appendix 2), points of the compass (see Section 1.26), and organizations known only by their initials (eg BMW cars)

A

AAIB	Air Accident Investigation Branch
AC	alternating current
AFI	assistant flying instructor
AFIS	aerodrome flight information service
AGL	above ground level
AM	amplitude modulation
AMSL	above mean sea level
ANO	Air Navigation Order
AOPA	Aircraft Owners & Pilots Association
APU	auxiliary power unit
ASI	airspeed indicator
ASTM	American Society for Testing & Materials
ATA	actual time of arrival
ATC	air traffic control (a generic term for a joint civil/military system for controlling traffic within a specific area)
ATIS	automatic terminal information service (recorded voice message that provides weather and airport services information)
ATPL	Airline Transport Pilot's Licence
ATZ	Air Traffic Zone
Avgas	Aviation fuel 100L (leaded)

B

BMAA	British Microlight Aircraft Association
BHPA	British Hang Gliding & Paragliding Association
BGA	British Gliding Association
BNC	Bayonet Neill-Concelman radio connector

C

C	Centigrade
CAA	Civil Aviation Authority
CAB	Civil Aeronautics Board
CAT I	facility providing operation down to 200ft decision height and runway visual range not less than 2600ft
CAT II	facility providing operation down to 100ft decision height and runway visual range not less than 1200ft
CAT II	facility providing operation with no decision height limit to and along the surface of the runway

	with external visual reference during final phase of landing and with a runway visual range not less than 700ft
CAVOK	ceiling and visibility OK
CFI	chief flying instructor
CHT	cylinder head temperature
CG	center of gravity
CPU	central processing unit
CTO	Chief Technical Officer
CTR	Controlled Traffic Region / Control Zone

D

D&D	Distress & Diversion
DC	direct current
DfT	Department for Transport
DVLA	Driver & Vehicle Licensing Agency

E

EAA	Experimental Aircraft Association
EAS	Europe Air Sports
EASA	European Aviation Safety Agency
EFATO	engine failure after takeoff
EFIS	electronic flight instrument system
EGT	exhaust gas temperature
ELT	emergency locator transmitter
EMF	European Microlight Federation
ETA	estimated time of arrival

F

F	Fahrenheit
FAA	Federal Aviation Administration
FAI	Fédération Aéronautique Internationale
FIC	flight instructor course
FIR	Flight Information Region
FIS	Flight Information Service

G

GA	general aviation
GAR	General Aviation Report
GASCo	General Aviation Safety Council
GFT	general flying test
GMT	Greenwich MeanTime
GP	general practitioner
GPS	Global Positioning System

H

HF	high frequency
HUD	head-up display

I

IAS	indicated airspeed
ICAO	International Civil Aviation Organization
ID	identifier
IDENT	identification
IFR	instrument flight rules
ILS	instrument landing system (uses precision localizer and glide-slope radio transmitters near a runway to provide landing approach guidance)
IMC	instrument meteorological conditions
IR	Instrument Rating

J

JAR	Joint Airworthiness Regulations

K

L

LAA	Light Aviation Association
LAN	local area network (computing term)

LSA	Light Sport Aircraft (MTOW 600kg)
LCD	Liquid-crystal display

M

MATZ	Military Aerodrome Traffic Zone
MF	Microlight Flying
METAR	aviation routine weather report (MÉTéorologique Aviation Régulière)
MSL	Mean Sea Level

N

NATS	National Air Traffic Services
NAVAID	navigational aid
NDB	nondirectional radio beacon
Notam	Notice for Airmen
NPPL	national private pilot's licence

O

P

PPR	prior permission required
PFL	power-off forced landing

Q

QFE	barometric pressure at a particular airfield
QFI	qualified flying instructor
QNH	regional barometric pressure

R

RAeC	Royal Aero Club
RAeS	Royal Aeronautical Society
RAF	Royal Air Force
RFC	Royal Flying Corps
RMZ	Radio Mandatory Zone
RT	Radio Telephony

S

SAR	search and rescue
SB	service bulletin
SIGMA	Standard Inspection Guidelines for Microlight Aircraft
SPHG	Self-Propelled Hang Glider
SSDR	Single Seat De-Regulated
SSEA	simple single-engined aircraft
STOL	short takeoff and landing

T

Tacho	tachometer
TAF	Terminal Aerodrome Forecast
TAS	true airspeed
TBA	to be announced
TBO	time before overhall
TCAS	traffic collision avoidance system
TIAS	true indicated airspeed
TIL	technical information leaflet
TMA	Terminal Manoeuvring Area
TMZ	Transponder Mandatory Zone

U

UAV	unmanned aerial vehicle
UHF	ultra-high frequency
UK	United Kingdom
ULM	ultra-léger motorisé
USAF	US Air Force
USB	universal serial bus
UTC	Co-ordinated Universal Time

V

V_a	design manoeuvring speed
VFR	visual flight rules
VHF	very high frequency
VLA	Very Light Aircraft (MTOW 750kg)
VMC	visual meteorological conditions
V_{ne}	never-exceed speed
VOR	VHF omnidirectional range
VSI	vertical speed indicator
VSTOL	vertical or short takeoff and landing
VTOL	vertical takeoff and landing

W

Waypoint	position in space (usually on aircraft's flight plan)

X

XC	cross-country

Y

Z

Z	Zulu (GMT time)

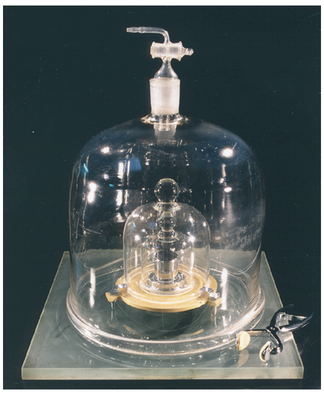
Appendix 2: SI Units

A concise summary of the International System of Units, the SI

Metrology is the science of measurement, embracing all measurements, made at a known level of uncertainty, in any field of human activity.

The Bureau International des Poids et Mesures, the BIPM, was established by Article 1 of the Convention du Mètre, on 20 May 1875, and is charged with providing the basis for a single, coherent system of measurements to be used throughout the world. The decimal metric system, dating from the time of the French Revolution, was based on the metre and the kilogram. Under the terms of the 1875 Convention, new international prototypes of the metre and kilogram were made and formally adopted by the first Conférence Générale des Poids et Mesures (CGPM) in 1889. Over time this system developed, so that it now includes seven base units. In 1960 it was decided at the 11th CGPM that it should be called the Système International d'Unités, the SI (in English: the International System of Units). The SI is not static but evolves to match the world's increasingly demanding requirements for measurements at all levels of precision and in all areas of science, technology, and human endeavour. This document is a summary of the **SI Brochure**, a publication of the BIPM which is a statement of the current status of the SI.

The seven **base units** of the SI, listed in Table 1, provide the reference used to define all the measurement units of the International System. As science advances, and methods of measurement are refined, their definitions have to be revised. The more accurate the measurements, the greater the care required in the realization of the units of measurement.



The international prototype of the kilogram, $\mathcal{K}$, the only remaining artefact used to define a base unit of the SI.

Table 1 *The seven base units of the SI*

Quantity	Unit, symbol: definition of unit
length	**metre, m:** The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second. *It follows that the speed of light in vacuum, c_0, is* 299 792 458 m/s *exactly.*
mass	**kilogram, kg:** The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram. *It follows that the mass of the international prototype of the kilogram, $m(\mathcal{K})$, is always* 1 kg *exactly.*
time	**second, s:** The second is the duration 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. *It follows that the hyperfine splitting in the ground state of the caesium* 133 *atom, ν(hfs Cs), is* 9 192 631 770 Hz *exactly.*
electric current	**ampere, A:** The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length. *It follows that the magnetic constant, μ_0, also known as the permeability of free space is* $4\pi \times 10^{-7}$ H/m *exactly.*
thermodynamic temperature	**kelvin, K:** The kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water. *It follows that the thermodynamic temperature of the triple point of water, T_{tpw}, is* 273.16 K *exactly.*
amount of substance	**mole, mol:** 1. The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12. 2. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles. *It follows that the molar mass of carbon* 12, *$M(^{12}C)$, is* 12 g/mol *exactly.*
luminous intensity	**candela, cd:** The candela is 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. *It follows that the spectral luminous efficacy, K, for monochromatic radiation of frequency* 540×10^{12} Hz *is* 683 lm/W *exactly.*

The seven **base quantities** corresponding to the seven **base units** are length, mass, time, electric current, thermodynamic temperature, amount of substance, and luminous intensity. The **base quantities** and **base units** are listed, with their symbols, in Table 2.

Table 2 *Base quantities and base units used in the SI*

Base quantity	Symbol	Base unit	Symbol
length	l, h, r, x	metre	m
mass	m	kilogram	kg
time, duration	t	second	s
electric current	I, i	ampere	A
thermodynamic temperature	T	kelvin	K
amount of substance	n	mole	mol
luminous intensity	I_v	candela	cd

All other quantities are described as **derived quantities**, and are measured using **derived units**, which are defined as products of powers of the **base units**. Examples of **derived quantities** and **units** are listed in Table 3.

Table 3 *Examples of derived quantities and units*

Derived quantity	Symbol	Derived unit	Symbol
area	A	square metre	m^2
volume	V	cubic metre	m^3
speed, velocity	υ	metre per second	m/s
acceleration	a	metre per second squared	m/s^2
wavenumber	$\sigma, \tilde{\nu}$	reciprocal metre	m^{-1}
mass density	ρ	kilogram per cubic metre	kg/m^3
surface density	ρ_A	kilogram per square metre	kg/m^2
specific volume	υ	cubic metre per kilogram	m^3/kg
current density	j	ampere per square metre	A/m^2
magnetic field strength	H	ampere per metre	A/m
concentration	c	mole per cubic metre	mol/m^3
mass concentration	ρ, γ	kilogram per cubic metre	kg/m^3
luminance	L_v	candela per square metre	cd/m^2
refractive index	n	one	1
relative permeability	μ_r	one	1

Note that refractive index and relative permeability are examples of dimensionless quantities, for which the SI unit is the number one, 1, although this unit is not written.

Some **derived units** are given a **special name**, these being simply a compact form for the expression of combinations of **base units** that are used frequently. Thus, for example, the joule, symbol J, is by definition equal to $m^2\ kg\ s^{-2}$. There are 22 special names for units approved for use in the SI at present, and these are listed in Table 4.

Table 4 *Derived units with special names in the SI*

Derived quantity	Name of derived unit	Symbol for unit	Expression in terms of other units
plane angle	radian	rad	m/m = 1
solid angle	steradian	sr	$m^2/m^2 = 1$
frequency	hertz	Hz	s^{-1}
force	newton	N	$m\ kg\ s^{-2}$
pressure, stress	pascal	Pa	$N/m^2 = m^{-1}\ kg\ s^{-2}$
energy, work, amount of heat	joule	J	$N\ m = m^2\ kg\ s^{-2}$
power, radiant flux	watt	W	$J/s = m^2\ kg\ s^{-3}$
electric charge, amount of electricity	coulomb	C	s A
electric potential difference	volt	V	$W/A = m^2\ kg\ s^{-3} A^{-1}$
capacitance	farad	F	$C/V = m^{-2}\ kg^{-1}\ s^4\ A^2$
electric resistance	ohm	Ω	$V/A = m^2\ kg\ s^{-3}\ A^{-2}$
electric conductance	siemens	S	$A/V = m^{-2}\ kg^{-1}\ s^3\ A^2$
magnetic flux	weber	Wb	$V\ s = m^2\ kg\ s^{-2} A^{-1}$
magnetic flux density	tesla	T	$Wb/m^2 = kg\ s^{-2}\ A^{-1}$
inductance	henry	H	$Wb/A = m^2\ kg\ s^{-2}\ A^{-2}$
Celsius temperature	degree Celsius	°C	K
luminous flux	lumen	lm	cd sr = cd
illuminance	lux	lx	$lm/m^2 = m^{-2}\ cd$
activity referred to a radionuclide	becquerel	Bq	s^{-1}
absorbed dose, specific energy (imparted), kerma	gray	Gy	$J/kg = m^2\ s^{-2}$
dose equivalent, ambient dose equivalent	sievert	Sv	$J/kg = m^2\ s^{-2}$
catalytic activity	katal	kat	s^{-1} mol

Although the hertz and the becquerel are both equal to the reciprocal second, the hertz is only used for cyclic phenomena, and the becquerel for stochastic processes in radioactive decay.

The unit of Celsius temperature is the degree Celsius, °C, which is equal in magnitude to the kelvin, K, the unit of thermodynamic temperature. The quantity Celsius temperature t is related to thermodynamic temperature T by the equation $t/°C = T/K - 273.15$.

The sievert is also used for the quantities directional dose equivalent and personal dose equivalent.

The last four special names for units in Table 4 were adopted specifically to safeguard measurements related to human health.

For each quantity, there is only one SI unit (although it may often be expressed in different ways by using the special names). However the same SI unit may be used to express the values of several different quantities (for example, the SI unit J/K may be used to express the value of both heat capacity and entropy). It is therefore important not to use the unit alone to specify the quantity. This applies both to scientific texts and also to measuring instruments (i.e. an instrument read-out should indicate both the quantity concerned and the unit).

Dimensionless quantities, also called quantities of dimension one, are usually defined as the ratio of two quantities of the same kind (for example, refractive index is the ratio of two speeds, and relative permittivity is the ratio of the permittivity of a dielectric medium to that of free space). Thus the unit of a dimensionless quantity is the ratio of two identical SI units, and is therefore always equal to one. However in expressing the values of dimensionless quantities the unit one, 1, is not written.

Decimal multiples and sub-multiples of SI units

A set of prefixes have been adopted for use with the SI units, in order to express the values of quantities that are either much larger than or much smaller than the SI unit used without any prefix. The SI prefixes are listed in Table 5. They may be used with any of the **base units** and with any of the **derived units** with special names.

Table 5 *The SI prefixes*

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

When the prefixes are used, the prefix name and the unit name are combined to form a single word, and similarly the prefix symbol and the unit symbol are written without any space to form a single symbol, which may itself be raised to any power. For example, we may write: kilometre, km; microvolt, µV; femtosecond, fs; $50\ \text{V/cm} = 50\ \text{V}\ (10^{-2}\ \text{m})^{-1} = 5000\ \text{V/m}$.

When the **base units** and **derived units** are used without any prefixes, the resulting set of units is described as being **coherent**. The use of a coherent set of units has technical advantages (see the **SI Brochure**). However the use of the prefixes is convenient because it avoids the need to use factors of 10^n to express the values of very large or very small quantities. For example, the length of a chemical bond is more conveniently given in nanometres, nm, than in metres, m, and the distance from London to Paris is more conveniently given in kilometres, km, than in metres, m.

The kilogram, kg, is an exception, because although it is a **base unit** the name already includes a prefix, for historical reasons. Multiples and sub-multiples of the kilogram are written by combining prefixes with the gram: thus we write milligram, mg, not microkilogram, µkg.

Units outside the SI

The SI is the only system of units that is universally recognized, so that it has a distinct advantage in establishing an international dialogue. Other units, i.e. non-SI units, are generally defined in terms of SI units. The use of the SI also simplifies the teaching of science. For all these reasons the use of SI units is recommended in all fields of science and technology.

Nonetheless some non-SI units are still widely used. A few, such as the minute, hour and day as units of time, will always be used because they are so deeply embedded in our culture. Others are used for historical reasons, to meet the needs of special interest groups, or because there is no convenient SI alternative. It will always remain the prerogative of a scientist to use the units that are considered to be best suited to the purpose. However when non-SI units are used, the conversion factor to the SI should always be quoted. A few non-SI units are listed in Table 6 below with their conversion factors to the SI. For a more complete list, see the **SI Brochure**, or the BIPM website.

Table 6 *A few non-SI units*

Quantity	Unit	Symbol	Relation to SI
time	minute	min	1 min = 60 s
	hour	h	1 h = 3600 s
	day	d	1 d = 86 400 s
volume	litre	L or l	1 L = 1 dm^3
mass	tonne	t	1 t = 1000 kg
energy	electronvolt	eV	1 eV ≈ 1.602 × 10^{-19} J
pressure	bar	bar	1 bar = 100 kPa
	millimetre of mercury	mmHg	1 mmHg ≈ 133.3 Pa
length	ångström	Å	1 Å = 10^{-10} m
	nautical mile	M	1 M = 1852 m
force	dyne	dyn	1 dyn = 10^{-5} N
energy	erg	erg	1 erg = 10^{-7} J

Symbols for units begin with a capital letter when they are named after an individual (for example, ampere, A; kelvin, K; hertz, Hz; coulomb, C). Otherwise they always begin with a lower case letter (for example, metre, m; second, s; mole, mol). The symbol for the litre is an exception: either a lower case

letter or a capital L may be used, the capital being allowed in this case to avoid confusion between the lower case letter l and the number one, 1.
The symbol for a nautical mile is given here as M; however there is no general agreement on any symbol for a nautical mile.

The language of science: using the SI to express the values of quantities

The value of a quantity is written as the product of a number and a unit, and the number multiplying the unit is the numerical value of the quantity in that unit. One space is always left between the number and the unit. For dimensionless quantities, for which the unit is the number one, the unit is omitted. The numerical value depends on the choice of unit, so that the same value of a quantity may have different numerical values when expressed in different units, as in the examples below.

The speed of a bicycle is approximately
$\upsilon = 5.0\ \mathrm{m/s} = 18\ \mathrm{km/h}$.
The wavelength of one of the yellow sodium lines is
$\lambda = 5.896 \times 10^{-7}\ \mathrm{m} = 589.6\ \mathrm{nm}$.

Quantity symbols are printed in an italic (slanting) type, and they are generally single letters of the Latin or Greek alphabet. Either capital or lower case letters may be used, and additional information on the quantity may be added as a subscript or as information in brackets.
There are recommended symbols for many quantities, given by authorities such as ISO (the International Organization for Standardization) and the various international scientific unions such as IUPAP and IUPAC. Examples are:

- T for temperature
- C_p for heat capacity at constant pressure
- x_i for the mole fraction (amount fraction) of species i
- μ_r for relative permeability
- $m(\mathcal{K})$ for the mass of the international prototype of the kilogram $\mathcal{K}$.

Unit symbols are printed in a roman (upright) type, regardless of the type used in the surrounding text. They are mathematical entities and not abbreviations; they are never followed by a stop (except at the end of a sentence) nor by an s for the plural. The use of the correct form for unit symbols is mandatory, and is illustrated by the examples in the **SI Brochure**. Unit symbols may sometimes be more than a single letter. They are written in lower case letters, except that the first letter is a capital when the unit is named after an individual. However when the name of a unit is spelled out, it should begin with a lower case letter (except at the beginning of a sentence), to distinguish the unit from the man.

In writing the value of a quantity as the product of a numerical value and a unit, both the number and the unit may be treated by the ordinary rules of algebra. For example, the equation $T = 293$ K may equally be written T/K = 293. This procedure is described as the use of quantity calculus, or the algebra of quantities. It is often useful to use the ratio of a quantity to its unit for heading the columns of tables, or labelling the axes of graphs, so that the entries in the table or the labels of the tick marks on the axes are all simply numbers. The example below shows a table of vapour pressure as a function of temperature, and the logarithm of vapour pressure as a function of reciprocal temperature, with the columns labelled in this way.

T/K	10^3 K/T	p/MPa	ln(p/MPa)
216.55	4.6179	0.5180	−0.6578
273.15	3.6610	3.4853	1.2486
304.19	3.2874	7.3815	1.9990

Algebraically equivalent forms may be used in place of 10^3 K/T, such as kK/T, or 10^3 (T/K)$^{-1}$.

In forming products or quotients of units the normal rules of algebra apply. In forming products of units, a space should be left between units (or alternatively a half high centred dot can be used as a multiplication symbol). Note the importance of the space, for example, m s denotes the product of a metre and a second, but ms denotes a millisecond. Also, when forming complicated products of units, use brackets or negative exponents to avoid ambiguities. For example, the molar gas constant R is given by:

$$pV_\mathrm{m}/T = R = 8.314\ \mathrm{Pa\ m^3\ mol^{-1}\ K^{-1}}$$
$$= 8.314\ \mathrm{Pa\ m^3/(mol\ K)}.$$

When formatting numbers the decimal marker may be either a point (i.e. a stop) or a comma, as appropriate to the circumstances. For documents in the English language a point is usual, but for many continental European languages and in some other countries a comma is usual.
When a number has many digits, it is customary to group the digits into threes about the decimal point for easy reading. This is not essential, but it is often done, and is generally helpful. When this is done, the groups of three digits should be separated only by a (thin) space; neither a point nor a comma should be used. The uncertainty in the numerical value of a quantity may often be conveniently shown by giving the uncertainty in the least significant digits in brackets after the number.

Example: The value of the elementary charge is given in the 2002 CODATA listing of fundamental constants as

$e = 1.602\ 176\ 53\ (14) \times 10^{-19}$ C,

where 14 is the standard uncertainty in the final digits quoted for the numerical value.

For further information
see the BIPM website,
or the **SI Brochure** 8th edition,
which is available at

http://www.bipm.org

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