GUIDE

TO THE USE

OF THE

METRIC SYSTEM

[SI Version]

Published by

US Metric Association, Inc.
PO Box 471
Windsor CO 80550-0471

GUIDE TO THE USE OF THE METRIC SYSTEM [SI VERSION]

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18th edition, revised 2022

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FOREWORD

The US Metric Association (USMA) *Guide to the Use of the Metric System [SI Version]* is prepared to serve as a primary source of information for using the modern version of the metric system, which is known as SI (pronounced ess-EYE) for *Système International d'Unités* (International System of Units).

The SI version of the metric system has been adopted by most major nations of the world, including the USA. An international body (located near Paris, France), known as the CGPM (for *Conférence Générale des Poids et Mesures*), is responsible for the standards and rules for using the metric system. Those rules not covered by the CGPM (such as pronunciation) are set by the appropriate authority of each country.

The United States and many other nations in the world belong to the CGPM and supply representatives to work on the committees responsible for metric system development, refinement, and setting of usage rules. The National Institute of Standards and Technology (NIST), an agency of the US Department of Commerce, represents the USA on the CGPM.

The SI version of the metric system was established by the CGPM in 1960. Previous versions of the metric system, such as the centimeter gram second (CGS) and meter kilogram second ampere (MKSA), are no longer acceptable and should not be used.

The *Metric Act of 1866* legalized the metric system in the United States, but did not mandate its use. Over a century later, President Gerald Ford signed the *Metric Conversion Act of 1975*, declaring a national policy of increasing and voluntary use of the SI version of the metric system.

Section 5164 of the *Omnibus Trade & Competitiveness Act of 1988* amended the 1975 metric law and established that the metric system of measurement is the preferred system of weights and measures for trade and commerce in the United States. Federal agencies were directed to convert regulatory standards to the metric system by the end of fiscal year 1992. Because some operations in a changeover to metric usage take longer than others, the transition to SI is a gradually evolving process, requiring a number of years beyond the date given in the metric law for government agencies to make a complete transition. However, the transition is gradually taking place in government, industry, and education.

This style guide's purpose is to expedite the correct use of SI metric measurement units in industry, federal/state/local governments, companies of all sizes, schools, and in consumer areas.

The first edition of this style guide was published in 1920. This 2022 edition conforms to the change in the SI definition of the kilogram (based on fundamental constants) adopted in 2018.

NOTE: The spellings of meter and liter are used in this book, but the international spellings (metre and litre) are also correct.

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1 INTRODUCTION

This metric system style guide is based upon the version of the metric system called SI (for *Système International d'Unités* or International System of Units). It consists of:

- Commonly used metric system units and symbols
- Rules and conventions for using the metric system
- Guidance for using some commonly used technical SI (metric) units

1.1 Definitions

Following are definitions for some of the terms used in this guide.

unit	A quantity chosen as a standard for a type of measurement (e.g., meter and yard for measuring length; liter and quart for measuring volume)
stem unit	A metric system foundation unit to which a prefix may be added. The prefix (combined with the stem unit) provides a larger or smaller unit of the same measurement unit
prefix	A word element that is affixed to the beginning of a metric system stem unit to indicate a larger or smaller unit of measurement than that stem unit
symbol	The short form for a metric system measurement unit or prefix [similar to an abbreviation, but no period is used, and no "s" is added for the plural form]
base unit	One of the 7 units that form the foundation for the SI version of the metric system: second, meter, kilogram, ampere, kelvin, mole, candela. This will be discussed in the *Technical Metric Data* section
derived unit	A metric system unit that may be shown as modifying a metric unit as follows: (1) Squaring or cubing a base or derived unit (2) Combining [via multiplying or dividing] more than one base and/or derived unit (3) The two dimensionless units, radian and steradian, that measure plane and solid angles, respectively (see Figure 2)

2 COMMONLY USED METRIC SYSTEM UNITS & SYMBOLS

2.1 Commonly Used Units

Each *type* of measurement (length, volume, etc.) is represented by a specific metric unit that is called a stem unit. Larger and smaller units of the same type are formed by adding a prefix. In everyday usage, there are only a few commonly used stem units; they consist of the following:

Type of Measurement	Stem Unit Name	Symbol	Approximate Size
length/width/distance/ thickness/girth/height	meter	m	a yard plus 3½ inches
mass (often called weight)	gram	g	heaviness of a large-sized paper clip
volume (also see 5.1)	liter	L*	1 quart plus ¼ cup
time	second	s	same second now used

* The capital el (L) is preferred as the symbol for liter in the USA; however, the lower-case el (1) is also correct and is used in many metric countries. The liter is not strictly SI but is accepted for use in the SI; its size is equal to 1 cubic decimeter (1 dm^3).

The kilopascal is a commonly used unit for measuring the pressure in tires, pressure cookers, etc. It is based on the stem unit, pascal, which indicates such a tiny pressure that the prefix, kilo, is added to it to make 1000 pascals:

Type of Measurement	Unit	Symbol	Size
pressure	kilopascal	kPa	replaces pounds-force per square inch [7 kPa = about 1 pound-force per square inch]

2.2 Commonly Used Prefixes

There are only 4 commonly used prefixes. However, a large number of prefixes are available for technical and scientific use, and are given in the *Metric Technical Data* section (Table 4).

Prefix Name	Prefix Symbol	Prefix Value	Pronunciation
milli	m	$^1/_{1000}$ or 0.001	as in military
centi	c	$^1/_{100}$ or 0.01	as in centipede
kilo	k	1000	KILL-oh
mega	M	1 million	as in megaphone

2.3 Metric (Everyday) Temperature Unit

Temperature is measured in degrees Celsius (°C). This unit was formerly called centigrade.

Water freezes	0 °C	32 °F
Water boils (at sea level)	100 °C	212 °F
Normal body temperature	37 °C	98.6 °F
Comfortable room temperature	20 °C to 25 °C	68 °F to 77 °F

For a more precise reading (e.g., for body temperature), Celsius degrees may be stated in tenths, hundredths, etc. of a degree: for example, 37.4 °C.

2.4 Structuring Metric Units

Additional units are formed from stem units by adding a prefix. Table 1 gives examples of how commonly used units are increased or decreased in value by addition of a prefix, and also gives tips on remembering the sizes of the units.

Table 1. Forming Different Sizes of Metric Units

Prefix	Added to this Stem Unit	Results in	Its Symbol is	Frame-of-Reference Tip (approximate)
milli	meter	millimeter	mm [1/1000th of a meter]	thickness of a dime
centi	meter	centimeter	cm [1/100th of a meter]	one-half inch
kilo	meter	kilometer	km [1000 meters]	half a mile
mega	meter	megameter	Mm [a million meters]	more than 1 million yards or about 600 miles
milli	gram	milligram	mg [1/1000th of a gram]	a few grains of salt
centi	gram	centigram	cg [1/100th of a gram]	[seldom used]* about 0.04 of an ounce
kilo	gram	kilogram	kg [1000 grams]	2.2 pounds
mega	gram	megagram	Mg [a million grams or a metric ton]	2200 pounds

*The "seldom used" unit is included to show the progression values of the prefixes (from milli to centi to kilo to mega).

2.5 Inch-Pound Unit Replacements

Appendix A in this style guide provides a table that lists some of the most common inch-pound units and shows the SI units that replace them, plus applicable conversion factors.

2.6 Remembering Sizes of Metric System Units

Becoming familiar with the commonly used metric units is not difficult if you relate the size of a familiar object with each metric unit. First, find a familiar object that is about the size of each metric unit you want to remember. Then practice until, each time a metric unit is mentioned, you get a mental picture of the familiar object that is about the size of that unit. Table 2 provides a quick guide for sizes of commonly used metric system units. Figure 1 contains some familiar-item examples that will help in remembering the metric units.

Table 2. Quick Reference Guide for Everyday Metric Units

Type of Measurement	SI Metric Unit	Symbol (short form)	Approx Size of Unit it Replaces	To Remember SI Unit's Size, Visualize this Item
length & distance	meter centimeter millimeter kilometer	m cm mm km	1.1 yard 0.4 (4/10) in. 4/100th inch 6/10th mile	a yardstick plus 3 ½ inches approx width of small fingernail thickness of a dime a little over ½ mile
mass (often called weight)	gram kilogram	g kg	1/28th oz 2.2 pounds	a packet of sugar substitute 2 & 1/5 lbs of butter
volume (liquid contents)	milliliter liter	mL or ml L or 1*	1/5 teaspoon 1.06 quart	scant ¼ tsp of water a quart carton of milk plus ¼ cup of milk
temperature	degrees Celsius	°C	1.8 times °C + 32 = °F	20 °C = comfortable room temperature 0 °C = freezing (32 °F) 35 °C = beach weather (95 °F) 37 °C = normal body temperature (98.6 °F)
length/width/height/girth (for body measurements, cooking utensils, linens, etc.)	centimeter	cm	a little less than 1/2 inch	approximately the width of your smallest finger or fingernail
pressure (for tires, pressure cookers, etc.)	kilopascal	kPa	0.145 psi (pound-force per square inch)	approximately 7 kPa for each pound-force per square inch
energy (as in dieting)	kilojoule	kJ	0.239 Calories	multiply the number of Calories by 4 for approximate number of kilojoules

*L or 1 for liter: In the United States, Canada, and Australia, the capital el (L) is used as the symbol for liter; however, in many countries, the lowercase el (l) is used. Both are correct, but the capital el is preferred in the US

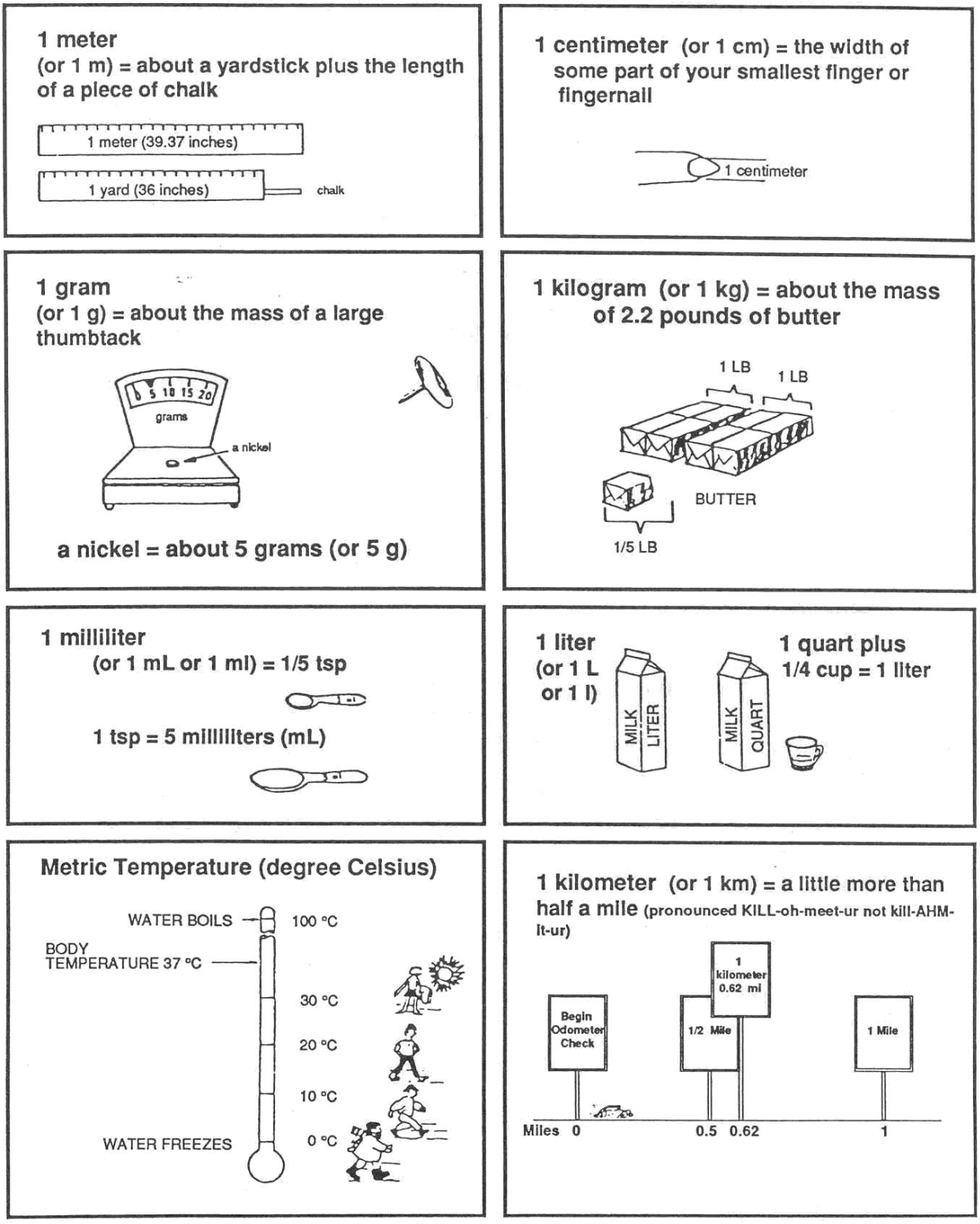


Figure 1. Antoine Frame-of-Reference Items for Remembering Metric Units

3 RULES AND CONVENTIONS FOR USING THE METRIC SYSTEM

3.1 Capitals

a. Metric unit *names* (whether stem units or preceded by prefixes) are treated as common nouns. They are capitalized at the beginning of a sentence, and may be given in all-capital letters in a title.

EXAMPLES: The centimeter replaces the inch.
Centimeters are used to measure small items.
USE OF THE CENTIMETER

Exception: The letter C, in degree Celsius, is always capitalized.

b. Metric unit *symbols* are only capitalized when they have been named after a person.

EXAMPLES: g for gram
Pa for pascal (named after Blaise Pascal)

NOTE: There is one exception to this rule. The symbol for liter may be either a capital el (L) or lowercase el (l), but the capital el is preferred in the US

c. Metric prefix symbols are capitalized only when they indicate a quantity of one million or more.

EXAMPLES: centi (meaning $^{1}/_{100}$) with the symbol: c
mega (meaning 1 million) with the symbol: M
giga (meaning 1 billion) with the symbol: G

d. Where all-capital letters must be used in a title or in other text, SI symbols should *not* be changed to all-capital letters because the meaning of the symbol might be changed. In this case, the *spelled-out* name of the unit should be used (and may be given in all-capital letters).

EXAMPLE: 100 mm should be written as 100 MILLIMETERS if all uppercase letters are used (*not* 100 MM).

3.2 Plurals

a. Metric unit *names* are pluralized only when they indicate a quantity of more than one.

EXAMPLES: 10 meters 3 liters **BUT** 1 centimeter 0.5 liter

NOTE: The *names* of a few (technical) metric units are written the same whether they are singular or plural. These are: lux, hertz, siemens.

b. Metric *symbols* are never pluralized.

EXAMPLES: 1 m 25 m 1 L 250 L 1 mm 25 mm 1 km 5 km

3.3 Periods

a. Periods are not used after metric system symbols unless the symbol occurs at the end of a sentence.

EXAMPLES: The 30 m strip is too long.
The strip measures 30 m.

b. Periods are not used in the abbreviation for the modernized version of the metric system:

SI **NOT** S.I.

3.4 Spacing

A space must always be left between a metric unit or symbol and any numbers preceding the unit or symbol.

EXAMPLES: It is 250 millimeters wide. **OR** It is 250 mm wide.
It is 20 degrees Celsius. **OR** It is 20 °C.

3.5 Symbol Usage

a. Symbols should be given exactly as shown in this guide. It is incorrect to change a capital letter into a lowercase letter in a symbol because the meaning of the symbol could be changed.

EXAMPLES: mm = a length of $^{1}/_{1000}$ meter (about equal to the thickness of a dime)
Mm = a large distance which spans over a million yards
MM = mega mega (this consists of 2 prefixes, indicating million million which is not used in SI)

b. A metric *symbol* should never be used without a preceding number (except when it heads a column).

EXAMPLES: Correct usage: It is 10 m long.
It is many meters long.
Incorrect usage: It is many m long.

3.6 Pronunciation

Metric system unit names are preferably pronounced with the accent on the *first* syllable:

meter	MEET-ur
millimeter	MILL-i-meet-ur
micrometer	MIKE-roh-meet-ur
kilogram	KILL-oh-gram
kilometer	KILL-oh-meet-ur
liter	LEE-tur

Two exceptions are the pronunciations of the technical units, candela and steradian. They are pronounced with the accent on the second syllable: can-DELL-uh, stair-RAID-ee-un.

3.7 Superscripts

To state the symbol for squaring or cubing of a metric system unit, a superscript is used.

EXAMPLES: for square meter: m^2
for cubic centimeter: cm^3

3.8 Mixing Metric and Inch-Pound System Terms

It is incorrect to use the abbreviations, sq or cu, in stating metric units or symbols.

EXAMPLES:

Correct: 12 square meters or 12 m^2
50 cubic centimeters or 50 cm^3

Incorrect: 12 sq m or 12 sq meters
50 cu cm or 50 cu centimeters

3.9 Spelling Out Numbers with SI Units/Symbols

It is recommended, in stating quantities with SI units and symbols, that Arabic numbers be used instead of spelling out the names of the numbers.

It was 5 g. **OR** It was 5 grams. **NOT** It was five g.

3.10 Stating of Ranges for SI Units/Symbols

To ensure clarity in writing SI units or symbols, use the word "to" instead of a hyphen or dash in stating a range of values:

1 gram to 10 grams	**NOT**	1 gram–10 grams
20 mm to 45 mm	**NOT**	20 mm - 45 mm
5 °C to 15 °C	**NOT**	5 °C – 15 °C

NOTE: The hyphen or dash could be mistaken for a minus sign.

3.11 Approved Non-Metric Units

Several units that are not metric units (because they do not conform with SI rules and requirements) are approved for use in SI. Most of these are technical units, but there are a few everyday units in this category. They are the minute, hour, and day.

NOTE: The second is also used, but it is a recognized SI unit.

3.12 Conversion Factors

Although it is not recommended that metric unit sizes be determined by converting back and forth from inch-pound units to metric units, there will be times when it will be necessary to make approximate conversions between the units. Table 3 provides conversion factors which give the approximate equivalents for some commonly used metric units.

4 TECHNICAL METRIC DATA

SI Units are divided into two classes:

- *base* units
- *derived* units

4.1 SI Base Units

The foundation for SI consists of 7 base units. Some of these are used mainly in technical and scientific work. These are the 7 base units:

second (s) — The same unit of time now used. 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 cesium-133 atom

meter (m) — Defined as taking the fixed numerical value of the speed of light in a vacuum to be 299 792 458 meters per second

kilogram (kg) — Measures mass and is defined by taking the fixed numerical value of the Planck constant to be $6.626\ 070\ 15 \times 10^{-34}$ when expressed in the unit J•s

Table 3. Approximate Conversion Factors for Inch-Pound and Metric Units

To convert from this Unit (col 1)	To This Unit (col 2)	Multiply by
inch	millimeter	25.4*
inch	centimeter	2.54*
foot	meter	0.3048*
yard	meter	0.9144*
mile	kilometer	1.6
millimeter	inch	0.039
centimeter	inch	0.394
centimeter	foot	0.0328
meter	foot	3.28
meter	yard	1.09
kilometer	mile	0.62
square inch	square centimeter	6.45
square foot	square meter	0.093
square yard	square meter	0.836
square mile	square kilometer	2.59
acre (US survey)	square hectometer (hectare)	0.405
square centimeter	square inch	0.155
square meter	square yard	1.196
square kilometer	square mile	0.386
square hectometer (hectare)	acre (US survey)	2.47
ounce (avoirdupois)	gram	28.35
pound (avoirdupois)	kilogram	0.45
ton (2000 pound)	kilogram	907.18
ton (2000 pound)	megagram (metric ton)	0.9
gram	ounce (avoirdupois)	0.035
kilogram	pound (avoirdupois)	2.2
megagram	ton (2000 pound)	1.102
mile per hour	kilometer per hour	1.6
ounce (US liquid)	milliliter	30
teaspoon	milliliter	5
tablespoon	milliliter	15
cup	milliliter	237
cup	liter	0.24
gallon (US liquid)	liter	3.8
quart (US liquid)	liter	0.95
pint (US liquid)	liter	0.47
milliliter	ounce (US liquid)	0.034
liter	gallon (US liquid)	0.264
liter	quart (US liquid)	1.057
pounds-force per square inch	kilopascal	6.9
degrees Fahrenheit	degrees Celsius	(°F minus 32) divided by 1.8*
degrees Celsius	degrees Fahrenheit	(°C times 1.8) plus 32*

*These items are exact conversion factors for the units [the others give approximate conversions].

NOTE: To convert units given in **(col 2)** to the units given in **(col 1)**, *divide* by the conversion factor.

ampere (A) — Measures electric current. Defined by taking the fixed numerical value of the elementary charge to be $1.602\ 176\ 634 \times 10^{-19}$ when expressed in the unit C, which is equal to A•s

kelvin (K) — The unit of thermodynamic temperature. Defined by taking the fixed numerical value of the Boltzmann constant to be $1.380\ 649 \times 10^{-23}$ when expressed in the unit $J \bullet K^{-1}$ [the degree Celsius temperature unit is also used in technical and scientific work]

mole (mol) — Indicates the amount of a substance which contains exactly $6.022\ 140\ 76 \times 10^{23}$ elementary entities

candela (cd) — Measures luminous intensity, in a given direction, of a source emitting monochromatic radiation of frequency 540×10^{12} Hz, and that has a radiant intensity (in that direction) of 1/683 watt per steradian [replaces the inch-pound system candlepower or candle]

4.2 Derived Units

Metric system derived units are formed by combining base units or other derived units. These combinations are structured by multiplying or dividing the applicable units.

EXAMPLE: The derived unit for speed or velocity is meter per second (m/s) which indicates the distance in meters traveled, divided by the number of seconds required to travel that distance. [It combines the metric unit, meter, with the unit, second.]

In measuring plane angles and solid angles, two derived units are used. They are the radian (RAID-ee-un) and steradian (stair-RAID-ee-un) shown in Figure 2.

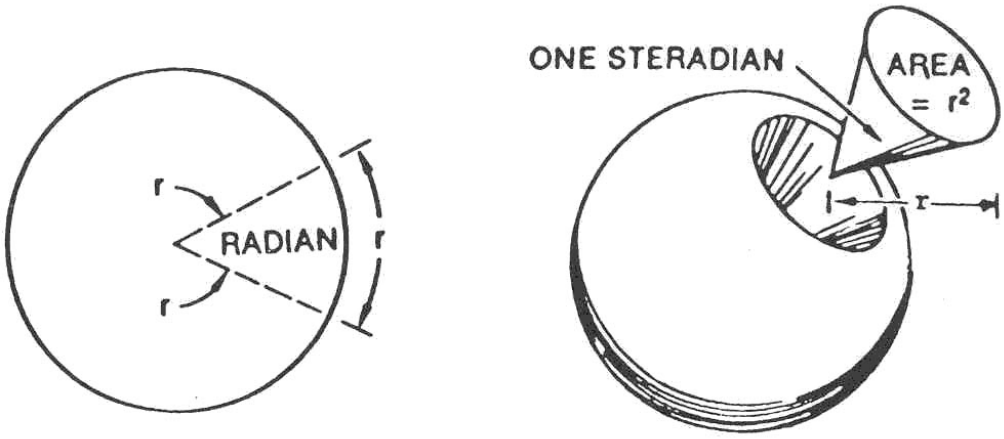


Figure 2. Radian and Steradian Measurement Illustration

radian (rad) — Measures plane angles. Defined as the plane angle between two radii of circle which cut off on the circumference an arc equal in length to the radius

steradian (sr) — Measures solid angles. Defined as the solid angle which, having its vertex in the center of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere

4.3 Derived Unit Names

In many cases, the name of a derived unit consists of the actual names of the metric units that are multiplied or divided to make the derived unit.

EXAMPLES: kilogram per cubic meter (kg/m^3) square meter (m^2) kilometer per hour (km/h)

In some cases, derived units are given special names.

EXAMPLES:	Special Name	Its Form, via Base or Other Derived Units
	volt	watt per ampere
	watt	joule per second
	pascal	newton per square meter

Some of the most commonly used derived units are given in Appendix A.

4.4 Metric Unit Prefixes

A metric stem unit may be made to indicate larger or smaller quantities of that stem unit by affixing a prefix to the stem unit. These prefixes, their values, and their symbols are given in Table 4. Keep in mind that some of the prefixes listed are seldom used. They are listed because the decimal nature of the metric system requires incrementing the prefixes by powers of 10.

4.5 Prefix Rules

a. No space should be left between a prefix and the stem unit.

EXAMPLES: kilogram (kg) microsecond (μs) gigameter (Gm)

b. No more than one prefix should be used in forming a metric unit.

EXAMPLES: nm for nanometer **NOT** mμm for nanometer
pF for picofarad **NOT** μμF for picofarad

Table 4. SI Metric Unit Prefixes

Metric System Prefixes

Prefix	Symbol	Factor	Ordinary Notation	US Name
yotta	Y	10^{24}	1 000 000 000 000 000 000 000 000	septillion
zetta	Z	10^{21}	1 000 000 000 000 000 000 000	sextillion
exa	E	10^{18}	1 000 000 000 000 000 000	quintillion
peta	P	10^{15}	1 000 000 000 000 000	quadrillion
tera	T	10^{12}	1 000 000 000 000	trillion
giga	G	10^{9}	1 000 000 000	billion
mega	M	10^{6}	1 000 000	million
kilo	k	10^{3}	1 000	thousand
hecto	h	10^{2}	100	hundred
deka	da	10^{1}	10	ten
		10^{0}	1	one
deci	d	10^{-1}	0.1	tenth
centi	c	10^{-2}	0.01	hundredth
milli	m	10^{-3}	0.001	thousandth
micro	µ	10^{-6}	0.000 001	millionth
nano	n	10^{-9}	0.000 000 001	billionth
pico	p	10^{-12}	0.000 000 000 001	trillionth
femto	f	10^{-15}	0.000 000 000 000 001	quadrillionth
atto	a	10^{-18}	0.000 000 000 000 000 001	quintillionth
zepto	z	10^{-21}	0.000 000 000 000 000 000 001	sextillionth
yocto	y	10^{-24}	0.000 000 000 000 000 000 000 001	septillionth

Etymologies

Prefix	Pronunciation	Origin
yotta	YOTE-uh or YOTT-uh	Latin: “eight” $[(10^3)^8]$
zetta	ZETT-uh	Latin: “seven” $[(10^3)^7]$
exa	EX-uh	Greek: “six” $[(10^3)^6]$
peta	PET-uh	Greek: “five” $[(10^3)^5]$
tera	TAIR-uh	Greek: “monster”
giga	GIG-uh or JIG-uh	Greek: “giant”
mega	MEG-uh	Greek: “big”
kilo	KILL-oh	Greek: “thousand”
hecto	HECK-toe	Greek: “hundred”
deka	DECK-uh	Greek: “ten”
deci	DESS-ih	Latin: “tenth”
centi	SENT-ih	Latin: “hundredth
milli	MILL-ih	Latin: “thousandth”
micro	MIKE-roe	Greek: “small”
nano	NAN-oh	Greek: “dwarf”
pico	PEEK-oh	Spanish: “tiny bit”
femto	FEM-toe	Dano-Norwegian: “fifteen”
atto	AT-toe	Dano-Norwegian: “eighteen”
zepto	ZEP-toe	Latin: “seven” $[(10^3)^{-7}]$
yocto	YOCK-toe	Latin: “eight” $[(10^3)^{-8}]$

[Developed by David Bernklau, Certified Metrication Specialist]

c. A prefix should never be used alone. It should always be used in conjunction with a stem unit, whether the unit is written out or given as a symbol.

EXAMPLES:	Correct:	a kilogram container	**OR**	a 10 kg container
	Incorrect:	a kilo container	**OR**	a 10 kilo container

4.6 Spelling

You will see the -er and -re endings for metric unit names (such as meter/liter and metre/litre). Both are correct, but, in accordance with the US government's preference, this book uses the -er spellings.

4.7 Multiples/Submultiples

Metric stem units, combined with a prefix that makes the resulting unit larger than the stem unit, are called multiples. Stem units, combined with a prefix that makes the resulting unit smaller than the stem unit, are called submultiples.

EXAMPLES: kilogram is a multiple [kilo and gram: it means 1000 grams (1000 times larger than the gram)]
millimeter is a submultiple (of "meter") [milli and meter: it means $^{1}/_{1000^{th}}$ of a meter]

4.8 Kelvin Temperature

The kelvin (K) is the SI metric unit for thermodynamic temperature, which is often used in scientific work. Kelvin temperature is not stated as a degree.

EXAMPLES: 273.15 K **NOT** 273.15 °K

Each degree Celsius is equal to 1 kelvin. The difference between the Celsius and kelvin temperature scales is the place where the zero point occurs. On the kelvin (thermodynamic) scale, zero is at absolute zero, which is the coldest temperature possible. On the Celsius scale, zero is at the freezing point of water. [The unit, kelvin, is not capitalized unless it is in a heading or the first word in a sentence; the modifier Celsius (which modifies “degree”), always begins with a capital letter.]

4.9 Italic Typeface Not Used for Metric Symbols

Metric symbols should never be given in italics because they might be misread as one of the quantity symbols for *types* of measurement.

EXAMPLES:	g is the symbol for gram	**BUT**	*g*	indicates the acceleration of gravity
	V is the symbol for volt	**BUT**	*V*	is the symbol for volume

4.10 Mixing Multiples/Submultiples in a Statement

When listing a number of metric units or symbols in a statement, it is preferable to state them using the same unit instead of using a mixture of the unit and its multiples or submultiples. [An exception is made when there is an extremely large difference in sizes between the units.]

EXAMPLES:

Correct: It is 3000 mm long, 2500 mm wide, and 1500 mm deep.
It consists of 2500 m of 5-mm diameter cord. [*example of an exception*]

Incorrect: It is 3 m long, 2500 mm wide, and 150 cm deep.
It consists of 2,500,000 mm of 5-mm diameter cord.

4.11 Showing Division with Metric Units & Symbols

When indicating division with metric *symbols*, the solidus (slash) should be used. When indicating division with metric unit *names*, the solidus must be replaced with its spelled-out form: per. It is wrong to use the solidus symbol when using the spelled-out unit names.

EXAMPLES: kilometers per hour [or km/h] **NOT** kilometers/hour [or km per h]

In writing a metric symbol, use of a double solidus is not permitted; rather parentheses (or superscripts, as applicable) should be used.

EXAMPLES: J/(mol•K*)* or m/s^2 **NOT** J/mol/K or m/s/s

4.12 Showing Multiplication with Metric Units & Symbols

a. When indicating multiplication with metric *symbols*, use a raised dot between the symbols of the units being multiplied to show a product is involved.

EXAMPLES: N•m **NOT** N x m

b. When indicating multiplication with spelled-out unit *names*, use a space (preferred) or a hyphen.

EXAMPLES: newton meter or newton-meter

4.13 Fractions

It is preferred that decimal fractions be used instead of common fractions. A zero should always precede the decimal point for values less than 1.

EXAMPLES: 0.25 **NOT** .25 or 1/4

4.14 Using Modifiers Involving Squared or Cubed Units

a. If stating powers (squared, cubed, etc.) when using unit names, the modifier should be placed after the unit which it modifies.

EXAMPLE: meter per second squared **NOT** meter per square second

b. When stating volume or area, the modifier is usually placed before the unit modified.

EXAMPLES: square millimeter cubic meter

5 GENERAL SI INFORMATION

5.1 Volume

The SI unit of volume is the cubic meter (m^3). This unit is used to express solid, liquid, or gas volume. For volumes smaller than the cubic meter, submultiples, such as cubic millimeter (mm^3), may be used. Also approved, in everyday use to show liquid volume is the liter (L), which is a special name for the cubic decimeter (dm^3). The liter is not recommended for use in high-accuracy measurements. It is not an SI unit but is approved for use in SI.

5.2 Mass and Force

A significant difference between SI metric and the inch-pound system is the use of distinctly different units for mass and force. The SI mass unit is the kilogram, and the SI force unit is the newton. However, in everyday usage, the word “weight” is frequently used when mass is meant.

5.3 Mass

Mass is defined as the quantity of matter in an object. The quantity is independent of gravity. The SI unit of mass is the kilogram (kg). In technical/scientific work, the kilogram should not be identified as the unit of weight because weight encompasses the effects of gravity on an object. [The ordinary bathroom scale is calibrated in kilograms which show the mass of the person on the scale, not the pull of the earth's gravity on the person.]

5.4 Force

The newton (N) is the SI unit for measuring force. One newton is the force required to accelerate a 1-kilogram mass at a rate of 1 meter per second squared. Force normally is measured on a scale that has been calibrated in newtons.

$1\ N = kg \bullet m/s^2$ [1 pound-force (1 lbf) equals about 4.448 newtons]

5.5 Hard versus Soft Metric Dimensions

A "hard" metric dimension is attained by designing a product (or a part or component) to SI metric dimensions. No conversion from inch-pound measurement units is involved.

A "soft" metric dimension is the result of taking a product (or a part or component) already designed and manufactured to inch-pound system dimensions and converting those dimensions to (approximately equivalent) metric dimensions.

For example, an item measuring ¾ in. by 5½ in. could result in a "soft" metric conversion yielding 19 mm by 140 mm (which includes rounding off the numbers).

5.6 Rounding Off and Tolerances in Soft Conversion

The problem involved in soft-converting to metric is in tolerancing requirements. Giving a realistic number of significant digits (to the metric equivalent of an inch) requires rounding the metric number. But this rounding can create a tighter or looser tolerance. For a detailed description of the rounding of converted values and tolerancing, consult IEEE/ASTM SI 10 (referenced in this style guide's *Major Reference Documents*, 5.13).

5.7 International Standards

The International Organization for Standardization, based in Switzerland, publishes the international standard for SI metric usage [the ISO 80000 series]. It also publishes a large number of standards for producing a variety of products, parts, and components.

> NOTE: ISO is pronounced EYE-soh. It is incorrect to state it as eye-ess-oh because it is a Greek word, meaning "that which is factual" or "uniform." Keep in mind that "ISO" is not an abbreviation or acronym for the group that publishes the ISO documents.

5.8 Metric Nation Differing Practices/Conventions

There are some practices or conventions used in various metric nations that are not currently widely used in the United States. Two major differences are (1) the use of international paper sizes, and (2) using spaces instead of commas every three numbers. However, international paper sizes are *not* part of SI rules, and using spaces every three numbers is a usage issue. Information on international paper sizes is included in Appendix B. The following is an example of the two types of digit-writing practices for the same value.

213,456,893	or	23,899.523	[USA usage]
213 456 893	or	23 899,523	[usage in many foreign countries]

> NOTE: This space-in-numbers convention is used because many foreign countries use the comma as their decimal point. It is not a USA convention. Both the comma and the decimal point are acceptable, depending on particular language and country conventions.

5.9 Automobile Fuel Consumption

A motor car's use of gasoline or other fuel is expressed as liters per 100 kilometers in many metric countries. This indicates the amount of fuel it takes for a car to travel 100 kilometers, and is expressed as L/100 km. For comparison: if you know the number of miles per gallon that your car travels, divide this number into 235.2 to obtain the approximate number of liters per hundred kilometers.

5.10 Obsolete Metric System Units & Symbols

Currently, some textbooks, dictionaries, and other materials contain metric units that come from various now-obsolete versions of the metric system. The following are some examples of commonly used unit names and symbols (from older versions of the metric system) that differ from SI metric units, and should not be used in SI.

SI Unit & Symbol	**Obsolete Unit Name or Symbol**
micrometer (μm)	micron
cubic meter (m^3)	stere
siemens (S)	mho
10 kilometers (km)	myriameter
4.184 kilojoules (kJ)	Calories
degree Celsius (°C)	degree centigrade
cubic centimeter (cm^3)	cc or c.c.
microgram (μg)	mcg or MCG
second (s)	sec

5.11 Acceptable Non-Metric (and Non-SI) Units

There are a number of non-SI units that have been designated as acceptable for use with the metric system because:

a. Some have been used worldwide for a long time. For example: hour, minute, day. This group of non-metric units will probably never be replaced.

b. Some have been used in specialized fields for such a long time that it will take longer to phase them out. These normally come from now-obsolete versions of the metric system.

Table 5 provides a list of some of the non-SI units that are either approved for use (or are temporarily acceptable for use) in the SI version of the metric system.

A list of SI units with the types of measurements they represent, their symbols, and relationships is given in Table 6.

Table 5. Non-SI Units Approved for Use (or Currently Being Used) in the SI

Some Non-SI Units That are Accepted in SI Due to Traditional Use, and Some That are Still Being Used in Certain Fields or Occupations

Approved Non-SI Unit	Symbol or Abbreviation	Remarks
hour	h	1 hour = 60 minutes = 3600 seconds [the inch-pound abbreviation, hr, should not be used]
minute (time)	min	1 minute = 60 seconds
day	d	1 day = 24 hours = 86400 seconds
(plane angle) degree*	°	[degree of arc] 1° = (π/180) radians
(plane angle) minute*	'	[minute of arc] 1' = 1/60 degree = (π/10800) radians
(plane angle) second*	"	[second of arc] 1" = 1/60 minute = (π/648000) radians
liter	L	1 L = 1 dm^3
nautical mile	nmi	1 nautical mile = 1852 meters
knot	kn or kt	Same as nautical mile per hour [1 knot = $^{1852}/_{3600}$ meters per second]
metric ton	t	1 metric ton = 1 megagram = 10^3 kg
electronvolt	eV	Kinetic energy of an electron
kilowatt hour	kW•h	Eventually to be replaced by the megajoule [1 kW•h = 3.6 MJ]
hectare	ha	Eventually to be replaced by the square kilometer or square hectometer [100 hectares = 1 square kilometer]

*When stating these non-SI plane-angle dimensions, the SI "space" rule is not used: 12°10'25"

Table 6. Relationship of SI Units & Units Approved in SI Usage (1 of 2)

Measurement Type	Unit	Symbol	Relationship
Length	kilometer	km	1 km = 1000 m
	meter	m	1 m = 100 cm
	centimeter	cm	1 cm = 10 mm
	millimeter	mm	1 mm = 1000 μm
	nautical mile*	nmi	1 nmi = 1852 m
Area	square kilometer	km^2	1 km^2 = 100 ha
	square hectometer	hm^2 [same as hectare]	1 hm^2 = 10,000 m^2
	hectare*	ha	1 ha = 10,000 m^2
	square meter	m^2	1 m^2 = 100 dm^2
	square decimeter	dm^2	1 dm^2 = 100 cm^2
	square centimeter	cm^2	1 cm^2 = 100 mm^2
	square millimeter	mm^2	
Volume	cubic meter	m^3	1 m^3 = 1000 dm^3 or 1000 L
	cubic decimeter	dm^3	1 dm^3 = 1000 cm^3 or 1000 mL
	liter*	L (or l)	1 L = 1000 mL
	cubic centimeter	cm^3	1 cm^3 = 1000 mm^3 or 1000 μL
	milliliter*	mL (or ml)	1 mL = 1000 μL
Mass (in in.-lb. system called weight)	megagram	Mg	1 Mg = 1000 kg
	metric ton*	t	1 t = 1000 kg
	kilogram	kg	1 kg = 1000 g
	gram	g	1 g = 1000 mg
	milligram	mg	1 mg = 1000 μg
Mass density	kilogram per cubic meter	kg/m^3	
Temperature	degree Celsius	°C	0 °C = 273.15 K
Temperature interval	kelvin	K	1 K = 1 °C
Time	day*	d	1 d = 24 h
	hour*	h	1 h = 60 min
	minute*	min	1 min = 60 s
	second	s	1 s = 1000 ms
	millisecond	ms	1 ms = 1000 μs
	microsecond	μs	
Plane angle	radian	rad	m/m = 1
	degree*	°	1° = 60' (pi/180) rad
	minute*	'	1' = 60"
	second*	"	
Force	kilonewton	kN	1 kN = 1000 N
	newton	N	
Energy, work, quantity of heat	megajoule	MJ	1 MJ = 1,000,000 J
	kilojoule	kJ	1 kJ = 1000 J
	joule	J	
	kilowatt hour*	kW•h	1 kW•h = 3.6 MJ

Table 6. Relationship of SI Units & Units Approved in SI Usage (2 of 2)

Measurement Type	Unit	Symbol	Relationship
Power, heat flow rate	kilowatt	kW	1 kW = 1000 W
	watt	W	
Pressure	megapascal	MPa	1 MPa = 1,000,000 Pa
	kilopascal	kPa	1 kPa = 1000 Pa
	pascal	Pa	
	bar*	bar	1 bar = 100,000 Pa
Speed, velocity	kilometer per hour*	km/h	1 km/h = 0.2778 m/s (approx)
	meter per second	m/s	
	knot (nautical mile per hour)*	kn or kt	1 kn = 0.5144 m/s (approx) 1 kt = 0.5144 m/s (approx)
Rotational Frequency	radian per second	rad/s	
	revolution per second*	r/s	1 r/s = 2 pi rad/s
	revolution per minute*	r/min	1 r/min = (pi/30) rad/s

*Asterisked items indicate non-SI metric units that are currently approved for usage in the SI.

5.12 Technical Unit Usage

The SI has a large number of units that are used in highly technical and scientific areas. Table 6 lists some of the more common everyday and technical units, and gives the relationship between those units. A detailed construction of most SI units with special names is given in Appendix F. Further information on these units is contained in the document that US industry and the private sector use as their SI metric standard: IEEE/ASTM SI 10. The websites for ordering this document are shown below along with documents from ISO and NIST.

5.13 Major Reference Documents

American National Standard for Metric Practice, IEEE/ASTM SI 10-2016

https://standards.ieee.org/ (Institute of Electrical and Electronics Engineers)

https://www.astm.org (ASTM International)

https://webstore.ansi.org (American National Standards Institute)

Quantities And Units – Part 1: General, ISO 80000-1:2009

https://www.iso.org/standards.html (also available from IEEE and ANSI)

The following two documents from the National Institute of Standards and Technology (NIST) are available to download for free: https://www.nist.gov/publications

The International System of Units (SI), NIST Special Publication 330
Guide for the Use of the International System of Units (SI), NIST Special Publication 811

APPENDIX A. Commonly Used Non-SI Units & SI Base/Derived Unit Replacements (1 of 3)

This Non-SI Unit	Is Replaced by this SI Unit (or its applicable multiple or submultiple)	Multiply the Non-SI Unit Value by this to get a Comparable SI Unit Value
acre foot (US survey)	cubic meter (m^3)	1233.5
acre (based on US survey foot)	square meter (m^2)	4046.873
ampere hour	coulomb (C)	3600
angstrom	nanometer (nm)	0.1
atmosphere (standard)	kilopascal (kPa)	101.325
bar	kilopascal (kPa)	100
barrel (US 42 gallon)	cubic meter (m^3)	0.1589873
British thermal unit *	joule (J)	1055.056
carat (metric)	kilogram (kg)	0.0002
carat (metric)	gram (g)	0.2
cubic inch (volume)	cubic meter (m^3)	0.000016387064
cubic yard	cubic meter (m^3)	0.7645549
cup (US)	liter (L)	0.2366
cup (US)	milliliter (mL)	236.6
cycles per second	hertz (Hz)	1.00000000
degree (for angle)	radian (rad)	0.01745329
degree Fahrenheit	degree Celsius (°C)	subtract 32 & divide by 1.8
degree Fahrenheit	kelvin (K)	add 459.67 & divide by 1.8
degree Rankine	kelvin (K)	divide by 1.8
dyne	newton (N)	0.00001
electronvolt	joule (J)	1.602177 (E-19)
fluid ounce (US)	cubic meter (m^3)	0.00002957353
fluid ounce (US)	milliliter (mL)	29.57353
foot	meter (m)	0.3048
foot squared	square meter (m^2)	0.09290304
foot cubed	cubic meter (m^3)	0.02831685
foot cubed	liter (L)	28.31685
foot cubed per minute	cubic meter per second (m^3/s)	0.0004719474
foot per hour	meter per second (m/s)	0.00008466667
foot per minute	meter per second (m/s)	0.00508
foot per second	meter per second (m/s)	0.3048
footcandle	lux (lx)	10.76391
footlambert	candela per square meter (cd/m^2)	3.426259
foot pound-force	joule (J)	1.355818
foot pound-force per hour	watt (W)	0.0003766161
g (acceleration of free fall, standard)	meter per second squared (m/s^2)	9.80665

*There are many types of BTUs, which have different values. See *IEEE/ASTM SI 10*.

APPENDIX A. Commonly Used Non-SI Units & SI Base/Derived Unit Replacements (2 of 3)

This Non-SI Unit	Is Replaced by this SI Unit (or its applicable multiple or submultiple)	Multiply the Non-SI Unit Value by this to get a Comparable SI Unit Value
gallon (US dry)	cubic meter (m^3)	0.004404884
gallon (US liquid)	liter (L)	3.785412
grain	kilogram (kg)	0.00006479891
hectare	square meter (m^2)	10000
horsepower (boiler)	watt (W)	9809.50
horsepower (electric)	watt (W)	746
hour	second (s)	3600
inch	meter (m)	0.0254
inch of mercury	pascal (Pa)	3386.39
inch of mercury	kilopascal (kPa)*	3.38639
kilocalorie (thermochemical)	joule (J)	4184
kilowatt hour	joule (J)	3600000
knot	meter per second (m/s)	0.5144444
micron (use micrometer)	meter (m)	0.000001
mil (0.001 in.)	millimeter (mm)	0.0254
mile (international) (5280 ft)	meter (m)	1609.344
mile (US nautical)	meter (m)	1852
mile per hour	meter per second (m/s)	0.44704
mile per hour	kilometer per hour (km/h)	1.609344
millibars	pascal (Pa)	100
minute (angle or arc)	radian (rad)	0.0002908882
minute (time)	second (s)	60
ounce (avoirdupois)	kilogram (kg)	0.02834952
ounce (avoirdupois)	gram (g)	28.34952
ounce (US fluid)	cubic meter (m^3)	0.00002957353
ounce (US fluid)	milliliter (mL)	29.57353
pint (US dry)	cubic meter (m^3)	0.0005506105
pint (US liquid)	cubic meter (m^3)	0.0004731765
pint (US liquid)	liter (L)	0.473176
pound (avoirdupois)	kilogram (kg)	0.45359237
pound-force	newton (N)	4.448222
pound-force per square inch	kilopascal (kPa)	6.894757
quart (US dry)	cubic meter (m^3)	0.001101221
quart (US liquid)	cubic meter (m^3)	0.0009463529
quart (US liquid)	liter (L)	0.9463529
revolution per minute	radian per second (rad/s)	0.1047198
second (angle)	radian (rad)	0.000004848137

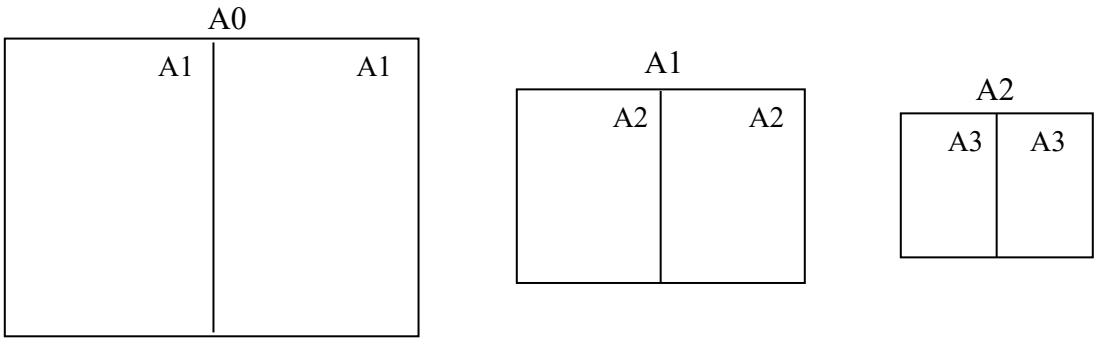
*The World Meteorological Organization (WMO) has recommended that the hectopascal (hPa) be used for atmospheric pressures. 1 kilopascal (kPa) = 10 hectopascals (hPa)

APPENDIX A. Commonly Used Non-SI Units & SI Base/Derived Unit Replacements (3 of 3)

This Non-SI Unit	Is Replaced by this SI Unit (or its applicable multiple or submultiple)	Multiply the Non-SI Unit Value by this to get a Comparable SI Unit Value
square inch	square meter (m^2)	0.00064516
square yard	square meter (m^2)	0.8361274
tablespoon	milliliter (mL)	14.79
teaspoon	milliliter (mL)	4.929
therm (US)	joule (J)	1.054804 (E+08)
ton (long, 2240 lb)	kilogram (kg)	1016.047
ton (short, 2000 lb)	kilogram (kg)	907.1847
ton (metric)	kilogram (kg)	1000
watt hour	joule (J)	3600
yard	meter (m)	0.9144

APPENDIX B. ISO International Paper Sizes

The ISO paper size system is used in most countries and is considered the international standard for paper. The main ISO paper-size series is called the "A" series. It begins with the A0 size (a piece of paper that is 841 mm by 1189 mm, and having an area of 1 square meter). The following illustration shows how each "A" series size is divided in two to attain the next smaller size.



As shown in the illustration, the A0 size is divided into two equal pieces (cutting it parallel to its shorter side) to make two pieces of the A1 size paper. The A1 size paper is divided in half in the same manner, yielding two pieces of the A2 size paper, etc. The following list shows the sizes of ISO "A" series paper, all of which are obtained by dividing the previous size in half.

Dimensions of Some ISO Standard Paper Sizes

ISO Paper Size Designation	ISO Paper Dimensions	Approx Equivalent in Inch-Pound Measurements
A0	841 mm by 1189 mm	33.1 by 46.8 inches
A1	594 mm by 841 mm	23.4 by 33.1 inches
A2	420 mm by 594 mm	16.5 by 23.4 inches
A3	297 mm by 420 mm	11.7 by 16.5 inches
A4*	210 mm by 297 mm	8.3 by 11.7 inches
A5	148 mm by 210 mm	5.8 by 8.3 inches
A6	105 mm by 148 mm	4.1 by 5.8 inches
A7	74 mm by 105 mm	2.9 by 4.1 inches
A8	52 mm by 74 mm	2 by 2.9 inches

* The A4 size of paper stock is the *international standard letterhead* size. This size is slightly narrower than the currently used 8½ by 11 inch letterhead and a little over half an inch longer.

Where the ISO A paper series does not furnish the particular required size, ISO also has a "B" series of paper sizes that give additional sizes. In addition, ISO has a "C" series that pertains to envelope sizes. For information on ISO international paper and envelope sizes, contact: International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401-1214 Vernier, Geneva, Switzerland. Telephone +41 22 749 01 11; FAX: +41 22 733 34 30; email: customerservice@iso.org

NOTE: Keep in mind that international paper sizes are *not* part of using SI.

APPENDIX C. Commonly Used Metric Unit Conversion Factors

[inch-pound units to metric units, and vice versa]

Quantity	Convert from	To	Multiply by	Quantity	Convert from	To	Multiply by
LENGTH	inch	millimeter (mm)	25.4*	MASS	grain	milligram (mg)	64.798 9
	inch	centimeter (cm)	2.54*		ounce (avoirdupois)	gram (g)	28.349 5
	foot	meter (m)	0.304 8*		pound (avoirdupois)	kilogram (kg)	0.453 592
	yard	meter	0.914 4*		ton (short, 2000 lb)	kilogram	907.184 7
	chain	meter	20.116 8*		ton (short, 2000 lb)	megagram (Mg)	0.907 185
	mile (statute)	kilometer (km)	1.609 344*		ton (long, 2240 lb)	kilogram	1 016.047
	mile (nautical)	kilometer	1.852*		ounce (troy, apoth)	gram	31.103 48
	millimeter (mm)	inch	0.039 370		pound (troy, apoth)	kilogram	0.373 24
	centimeter	foot	0.032 808		slug	kilogram	14.593 9
	meter	foot	3.280 840		milligram	grain	0.015 432 3
	meter	yard	1.093 613		gram	ounce (avoirdupois)	0.035 274
	kilometer	mile (statute)	0.621 371		kilogram	pound (avoirdupois)	2.204 62
VOLUME	ounce (US liquid)	milliliter (mL)	29.573 53		megagram**	pound (avoirdupois)	2 204.62
	cubic inch	cubic centimeter (cm^3)	16.387 06	AREA	square inch	square centimeter (cm^2)	6.451 600*
	cubic foot	cubic meter (m^3)	0.028 317		square foot	square meter (m^2)	0.092 903
	cubic yard	cubic meter	0.764 555		square yard	square meter	0.836 127
	quart (US liquid)	liter (L)	0.946 353		square mile	square kilometer (km^2)	2.589 988
	gallon (US liquid)	liter	3.785 412		acre (US survey)	hectare (ha)	0.404 687
	quart (US dry)	liter	1.101 221		square centimeter	square inch	0.155 000
	gallon (Canadian liquid)	liter	4.546 090		square meter	square foot	10.763 91
	quart (Canadian liquid)	liter	1.136 522		square meter	square yard	1.195 99
	bushel	liter	35.239 07		square kilometer	square mile	0.386 102
	barrel (oil, 42 gal)	cubic meter	0.158 987		hectare	acre (US survey)	2.471 044
	board foot	cubic decimeter (dm^3)	2.359 737	SPEED	mile per hour	kilometer per hour (km/h)	1.609 344*
	cubic centimeter	cubic inch	0.061 024		mile per hour	meter per second (m/s)	0.447 040
	cubic meter	cubic foot	35.314 66		knot	meter per second	0.514 444
	cubic meter	cubic yard	1.307 951		knot	kilometer per hour	1.852*
	1000 board feet	cubic meter	2.359 737				
	cord	cubic meter	3.624 556				
	acre foot (US survey)	cubic meter	1 233.489				
	liter	gallon (US liquid)	0.264 172				

*indicates exact value

**the megagram is also known as the metric ton

MASS DENSITY is measured in kg/m^3

TEMPERATURE: °F minus 32 divided by 1.8 = degree Celsius (°C)

°C times 1.8 plus 32 = degree Fahrenheit (°F)

APPENDIX D. Metric System Equivalents for Some Unusual Units

Because there are a number of not too commonly used units that might require conversion to SI units, the following table is supplied.

LENGTH:		
1 cable's length (US)	219.456	meters
1 chain (surveyor's)	20.1168	meters
1 chain (engineer's)	30.48	meters
1 degree (geographical)	111.123	kilometers
1 fathom	1.8288	meters
1 furlong	201.168	meters
1 league (land)	4.828	kilometers
1 link (Gunter's or surveyor's)	0.201168	meters
1 point (typography)	0.351	millimeter
1 rod (pole or perch)	5.029	meters
AREA SURFACE:		
1 acre (based on the US survey foot)	4046.873	square meters
1 are	100.0	square meters
1 square rod (square pole or square perch)	25.293	square meters

CAPACITY/VOLUME:		
1 US bushel (struck measure)	35.239	liters
1 gill (US liquid)	0.118	liters
1 peck (US dry)	8.810	liters
MASS:		
1 assay ton	29.167	grams
1 carat	200.0	milligrams
1 dram avoirdupois	1.772	grams
1 hundredweight (gross or long)	50.802	kilograms
1 hundredweight (net or short)	45.359	kilograms
1 troy ounce	31.103	grams
1 pennyweight	1.555	grams
1 troy pound	373.242	grams

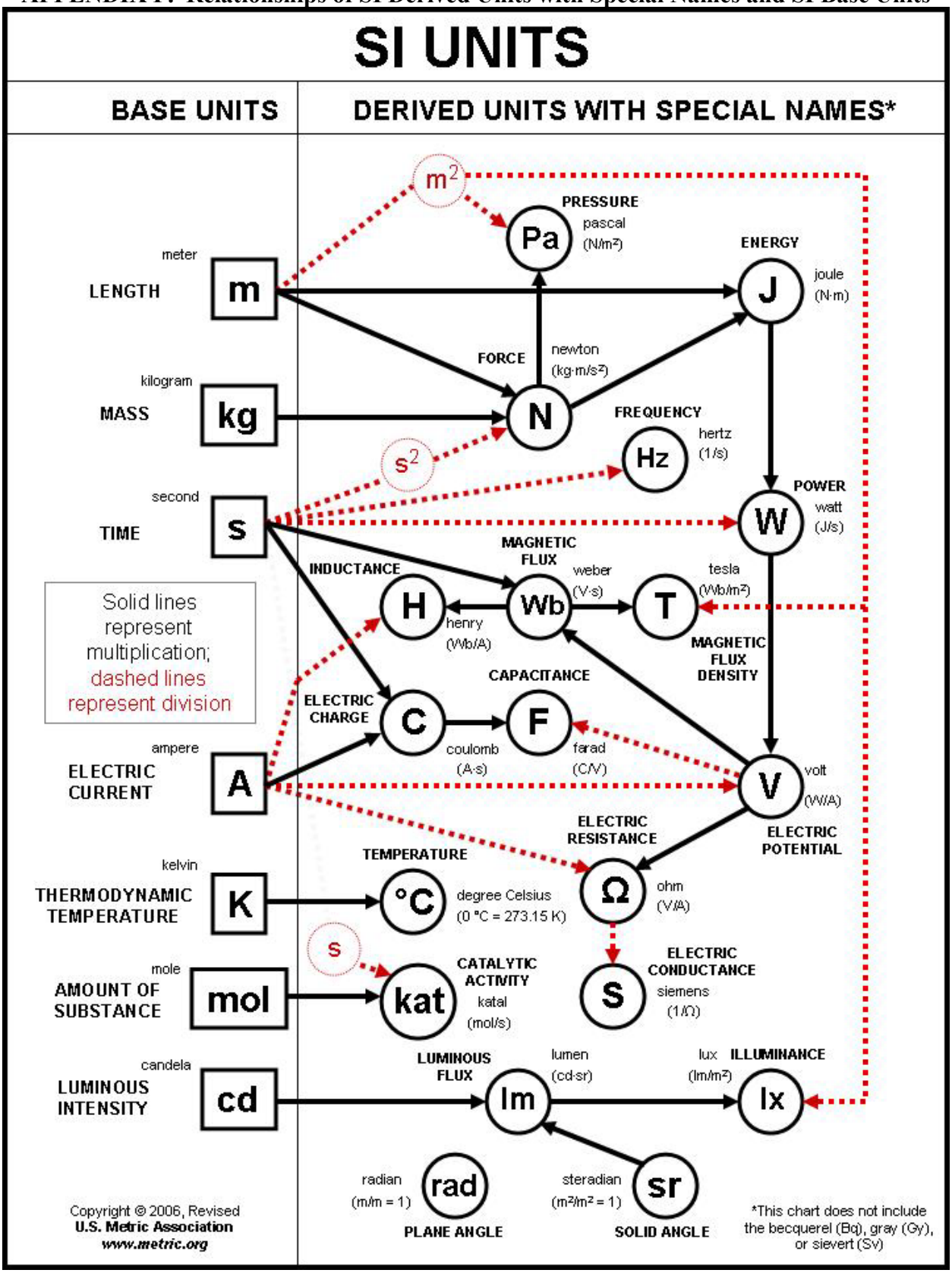
APPENDIX E. Approximate Conversions for Fractions of an Inch into Millimeters

The following table is supplied because there may occasionally be a requirement to convert fractions of inches into millimeters.

[1 inch = 25.4 millimeters exactly]

inch fraction	mm	inch fraction	mm	inch fraction	mm	inch fraction	mm	inch fraction	mm	inch fraction	mm
1/2	12.70	1/8	3.18	1/16	1.59	1/32	0.79	1/64	0.40	33/64	13.10
1/4	6.35	3/8	9.53	3/16	4.76	3/32	2.38	3/64	1.19	35/64	13.89
3/4	19.05	5/8	15.88	5/16	7.94	5/32	3.97	5/64	1.98	37/64	14.68
		7/8	22.23	7/16	11.11	7/32	5.56	7/64	2.78	39/64	15.48
				9/16	14.29	9/32	7.14	9/64	3.57	41/64	16.27
				11/16	17.46	11/32	8.73	11/64	4.37	43/64	17.07
				13/16	20.64	13/32	10.32	13/64	5.16	45/64	17.86
				15/16	23.81	15/32	11.91	15/64	5.95	47/64	18.65
						17/32	13.49	17/64	6.75	49/64	19.45
						19/32	15.08	19/64	7.54	51/64	20.24
						21/32	16.67	21/64	8.33	53/64	21.03
						23/32	18.26	23/64	9.13	55/64	21.83
						25/32	19.84	25/64	9.92	57/64	22.62
						27/32	21.43	27/64	10.72	59/64	23.42
						29/32	23.02	29/64	11.51	61/64	24.21
						31/32	24.61	31/64	12.30	63/64	25.00

APPENDIX F. Relationships of SI Derived Units with Special Names and SI Base Units



SI chart designed by Don Hillger, based on a similar but outdated chart from 1973 developed by Hans Milton (Australia) and Albert Mettler (Canada).

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