SECTION A4

METRIC SYSTEM

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A4.0.0 METRIC SYSTEM

A4.1.0 Introduction

The purpose of this section is to acquaint the reader with the metric system and its advantages over the English system. This section also presents definitions, symbols, and conversion tables.

Units of length, mass, and time are basic to both the English System and to the Metric System. In the English System these are: length, the foot; mass, the pound; and time, the second. Note that the second, based on the sexagesimal system, is common to both the English System and the Metric System.

A4.2.0 The International System of Units (SI)

The International System of Units, or Système Internationale (SI), is sometimes referred to, in less precise terms, as the Meter-Kilogram-Second-Ampere (MKSA) system. The SI, therefore, should be considered as the definitive metric system, although it is much broader in scope and purpose than any previous system.

A4.2.1 Advantages of SI

The use of SI has significant advantages in all phases of research and development work relating to space technology. For instance, the use of SI will tend to eliminate wasted time and costly errors in computations now involving varied terms derived from a multiplicity of sources. The

utilization of a uniform system of measurement such as the SI thus simplifies the exchange of in-house data among NASA centers and installations and will do so, eventually, among associated contractors and space-oriented organizations throughout the world.

A4.3.0 Basic SI Units

The name, International System of Units, has been recommended by the Conférence Générale des Poids et Mesures in 1960 for the following basic units:

meter	m	ampere	A
kilogram	kg	degree Kelvin	^{o}K
second	s	candela	cd

In addition, it was also determined that the amount of substance would be treated as a basic quantity. The recommended basic unit is the mole, symbol: mol. The mole (mol), a unit of quantity in chemistry, is defined as the amount of a substance in grams (gram mole; gram molecular weight; or pound mole, or pound molecular weight) which corresponds to the sum of the atomic weights of all the atoms constituting the molecule. These atomic weights are based upon Carbon 12.

A4.4.0 International Symbols for Units, SI

In order that SI may be in fact an international system, it was necessary to reach agreement on the symbols, names, and abbreviations.

A4.4.1 CGS System

In the field of mechanics, the following units of this system have special names and symbols which have been approved by the General Conference on Weights and Measures:

l, b, h	centimeter	cm
t	second	s
m	gram	g
f, ν	hertz (= s^{-1})	Hz
F	dyne (= g· cm/s^2)	dyn
E, U, W, A	erg (= g· cm^2/s^2)	erg
p	microbar (= dyn/cm^2)	μ bar
μ	poise (= dyn· s/cm^2)	p

A4.4.2 Giorgi System

The MKSA system or m-kg-s-A system is a coherent system of units for mechanics, electricity, and magnetism, based on four basic quantities: length, mass, time, and electric current intensity.

meter	m
kilogram	kg
second	s
ampere	A

The system based on these four units was given the name "Giorgi system" by the International Electrotechnical Committee in 1958. The mechanical system, which is based on the first three units only, has the name MKS system.

The MKSA system of units forms a coherent system of units in the four-dimensional system of equations previously mentioned, and is most commonly used together with these equations.

A4.4.3 Incoherent Units

l	ångström	Å
σ	barn (= 10^{-24} cm^2)	b
V	liter (= 1 dm^3)	l
t, τ	minute	min
t, τ	hour	h
t, τ	day	d
t, τ	year	a
p	atmosphere	atm
p	kilowatt-hour	kWh
Q	calorie	cal
Q	kilocalorie	kcal
E, Q	electronvolt	eV
m	ton (= 1000kg)	t
M_a, m	(unified) atomic mass unit	u
p	bar (= 10^6 dyn/cm^2) (= 10^5 N/m^2)	bar

A4.5.0 Physical Quantities

The symbol for a physical quantity (French: 'grandeur physique'; German: 'physikalische Grosse'; English, sometimes: 'physical magnitude') is equivalent to the product of the numerical value (or the measure, a pure number) and a unit, i.e., physical quantity = numerical value x unit.

A4.5.1 Dimensionless Physical Quantities

For dimensionless physical quantities the unit often has no name or symbol and is not explicitly indicated.

Examples: E = 200 erg $\quad n_{qu} = 1.55$

F = 27 N $\quad \nu = 3 \times 10^8\ s^{-1}$

A4.6.0 Other SI Symbols

The following units of the MKSA system have special names and symbols which have been approved by the General Conference on Weights and Measures:

I	ampere	A
Q	coulomb (= A· s)	C
C	farad (= C/V)	F
L	henry (= Vs/A)	H
E	joule (=kg. m^2/s^2)	J
m	kilogram	kg
l, b, h	meter	m
F	newton (=kg. m/s^2)	N
R	ohm (= V/A)	Ω
B	tesla (= Wb/m^2)	T
V	volt (= W/A)	V
P	watt (= J/s)	W
Φ	weber (= V· s)	Wb

A4.6.1 Photometric Units

In the field of photometry an additional basic unit is introduced corresponding to the basic quantity, luminous intensity. This unit is the candela, symbol: cd. Special names for units in this field are:

I	candela (candle)	cd
Φ	lumen	lm
E	lux (= lm/m^2)	lx

A4.6.2 Rules for Notation

a. Symbols for units of physical quantities shall be printed in Roman upright type.

b. Symbols for units shall not contain a final full stop (a period), and shall remain unaltered in the plural, e.g.: 7cm, not 7 cms.

c. Symbols for units shall be printed in lower case Roman upright type. However, the symbol for a unit derived from a proper name shall start with a capital Roman letter, e.g.: m (meter); A (ampere); Wb (weber); Hz (hertz).

d. The following prefixes shall be used to indicate decimal fractions or multiples of a unit.

Prefix	Equiv	Symbol
deci	(10^{-1})	d
centi	(10^{-2})	c
milli	(10^{-3})	m
micro	(10^{-6})	μ
nano	(10^{-9})	n
pico	(10^{-12})	p
femto	(10^{-15})	f
atto	(10^{-18})	a
deka	(10^{1})	da
hecto	(10^{2})	h
kilo	(10^{3})	k
mega	(10^{6})	M
giga	(10^{9})	G
tera	(10^{12})	T

e. The use of double prefixes shall be avoided when single prefixes are available.

Not: m μ s, but: ns (nanosecond)

Not: kMW, but: GW (gigawatt)

Not: μ μ F, but: pF (picofarad)

f. When a prefix symbol is placed before a unit symbol, the combination shall be considered as a new symbol, which can be squared or cubed without using brackets.

Examples: cm^2, mA^2, μs^2

A numerical prefix shall never be used before a unit symbol which is squared, thus, cm^2 is never written, and never means , 0.01 (m^2) but always means $(0.01m)^2$.

g. No periods or hyphens shall be used with SI abbreviations, symbols, or prefixes. Prefixes are joined directly to units, as in the following examples:

MN	mN
kV	kHz
MV	mA
GHz	cm

A4.7.0 SI Units on Drawings and in Analyses

The following paragraphs describe general techniques for using SI units on drawings and in analyses.

A4.7.1 Dual Units

When SI units are specified for use on a drawing or in an analysis, the non-SI units of measure shall be used parenthetically to facilitate

comprehension of the drawing or analysis. Non-SI units shall never be omitted on the assumption that users are familiar with the SI units.

A4.7.2 Identification of Units

Basic units of measure used frequently on a drawing shall be identified by a note on the drawing to avoid repetition of unit names throughout the drawing. For example,

NOTE: ALL DIMENSIONS ARE IN mm (in.).

A4.7.3 Tabular Data

To provide maximum clarity of presentation, SI and non-SI units shall be placed in separate columns or in separate tables if the need is indicated.

A4.7.4 Collateral Use, SI and Non-SI Units

Place the metric units first, followed immediately by the equivalents in parentheses. In tables, other formats may be desirable, such as one unit in a row or column, followed by the other unit in another row or column. In some complex tables and drawings it may be desirable to present the equivalent units in separate tables and drawings. Figure A4-1 shows a drawing with both units given.

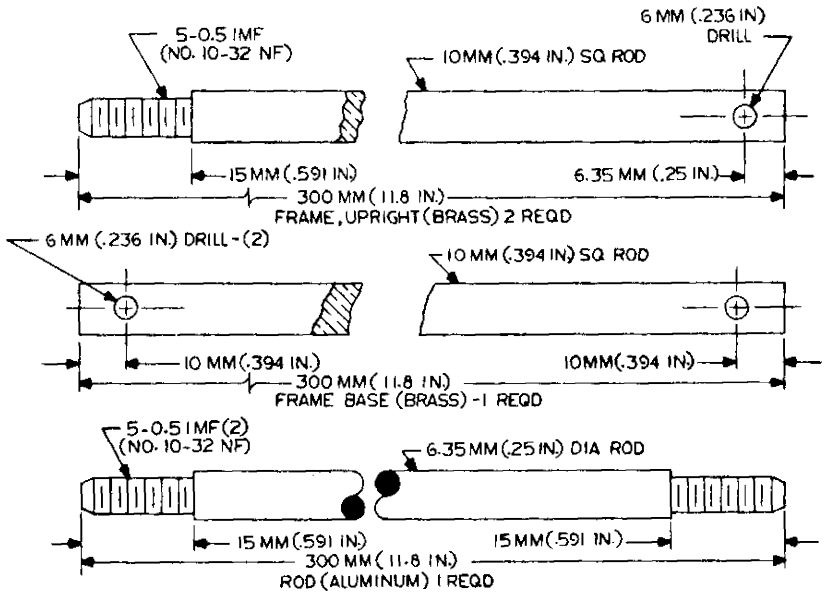

Figure A4-1. Collateral Use of Units

A4.7.5 Temperature Scales

Either the Kelvin or the Celsius temperature scale may be used as the SI unit, with the Fahrenheit scale being optional as a parenthetical non-SI unit.

A4.8.0 Transitional Indices

The following explanations indicate nomenclatures, methods, and preferred styles which are to be used during the transition from non-SI systems to SI.

A4.8.1 Mass vs Force

The term "mass" (and not weight) shall be used to specify the

quantity of matter contained in material objects.

The term "weight" shall be defined as the gravitational force acting on a material object at a specified location. Accordingly, the statement of the weight of an object should be accompanied by a statement of the corresponding location of the object or by a statement of the gravitational acceleration in m/s^2 at the location where the object was weighed or is assumed to be located.

The pound mass (lbm), defined as being exactly 0.453 592 37 kilogram by the U. S. National Bureau of Standards; the pound force (lbf), defined as being exactly 4.448 221 615 260 5 newtons by the NBS; and the pound thrust, defined as being exactly 4.448 221 615 260 5 newtons, shall be abandoned at the earliest practicable date.

During the transition period to SI units, the pound mass shall be abbreviated lbm, the pound force shall be abbreviated lbf, and the pound thrust shall be abbreviated to lbf.

The kilogram (kg), the SI unit of mass, shall not be used as a unit of force, weight, or thrust.

A4.8.2 Examples of Nomenclature

The dry mass of the S-I (first) stage of the Saturn I launch vehicle is 48 600 kg (107 139 lbm).

The weight of a man of 70.0 kg (154 lbm) mass, standing on the

surface of the moon where the gravitational acceleration is 1.62 m/s^2, is 113 newtons (25.4 lbf).

The thrust of the S-I (first) stage of the Saturn I launch vehicle is 6.689 MN (1 504 000 lbf).

The preferred unit of force, weight, and thrust is the newton.

A4.9.0 Measurement of Angles

A circle cannot be divided into a rational number of radians (rad), there being 2π radians (approximately 6.283 rad) in a circle. However, the radian, arc degree, arc minute, and arc second may all be used for the measurement of plane angles. Decimal multiples of the degree or radian are preferred.

The "grad" is a unit of angular measure wherein 100 grads constitute a right angle. This is not an SI unit, but, since it is based on decades it will be found useful for many purposes.

A4.10.0 Preferred Style

In order to ensure maximum accuracy, the following style shall be adhered to wherever practicable in engineering analysis documentation.

a. Spell out a term in full when first used, followed by the related symbol in parentheses. Thereafter, use the related symbol for measurement applications.

b. In general, state the measurement in terms of the system

of units used, followed by the applicable translated value in parentheses: for example, 48 000 kg (107 000 lbm), and 25.4 lbf (113 newtons).

c. In using numerical values involving more than three digits, place a space between each group of three digits. Such spaces shall be used to the right and left of decimal points. Commas are not used: 126 306.204 359 60.

A4.10.1 Volume

The cubic meter (m^3) should be used in preference to the liter. The liter is now defined as exactly 1 dm^3.

A4.10.2 Time

The preferred unit of time associated with time rates is the second.

A4.10.3 Energy

The preferred unit of energy (mechanical, electrical, thermal, and all other forms) is the joule (J). The Btu, calorie, and kilocalorie, although listed in this document for information, are poorly defined and should be avoided.

A4.10.4 Temperature

Either the Thermodynamic Kelvin Temperature Scale, the International Practical Kelvin Temperature Scale, or the International Practical Celsius Temperature Scale may be used. Equivalent temperatures in degrees Rankine, Fahrenheit, etc., may be included in

parentheses. Note that temperature differences expressed in Kelvin degrees (^{o}K) and in Celsius degrees ($^{o}Cels$) are numerically equal and that degrees Celsius and degrees Centigrade are identical. See Temperature Nomograph, Figure A4-2, and Table A4-15.

The International Practical Kelvin Temperature Scale of 1960, and the International Practical Celsius Temperature Scale of 1960 are defined by a set of interpolation equations based on the reference temperatures in Table A4-1.

Table A4-1. Reference Temperatures, International Practical Temperature Scale

Temperature of	^{o}K	^{o}C
Oxygen: liquid-gas equilibrium	90.18	-182.97
Water: solid-liquid equilibrium	273.15	0.00
Water: solid-liquid-gas equilibrium	273.16	0.01
Water: liquid-gas equilibrium	373.15	100.00
Zinc: solid-liquid equilibrium	692.655	419.505
Sulphur: liquid-gas equilibrium	717.75	444.6
Silver: solid-liquid equilibrium	1233.95	960.8
Gold: solid-liquid equilibrium	1336.15	1063.0

A4.10.5 Prefixes

"Coherent units" are units that can be used directly in equations without the application of numerical coefficients. The exclusive use of coherent units over the entire range of numerical values of physical quantities is highly desirable. As previously stated, the SI is the only complete system of coherent units available to meet the needs of all branches of science and technology. The full range of numerical values of physical quantities can be represented rationally and conveniently by utilizing SI units.

To facilitate this, either a power of ten is employed, or an approved prefix representing a power of ten is placed before an SI unit (or before any combination of SI units).

Only previously listed prefixes shall be used to indicate decimal fractions or multiples of an SI unit.

A4.11.0 Conversion Factors

Measurements in units other than those of the SI are preferably converted by the application of approved numerical conversion factors.

The number of decimal places should be governed by the purpose to which the information is to be put and by the degree of accuracy attainable with applicable measuring instruments and methods. These conversion factors have been tabulated according to physical quantity.

A4.11.1 Basic Linear Unit

The basic unit of measurement is the meter. Prefixes shall be used in accordance with A4.6.2(d). Once a prefix is chosen, no other prefix shall be used on a drawing or in an analysis. The inch (in.) is defined as exactly 2.54 cm.

A4.11.2 Noncritical Conversion

If dimensions are not critical, non-SI data converted to mm shall be rounded to convenient numbers and the word "nominal" appended in parentheses.

A4.11.3 Conversion to Other SI Units

Conversion to SI units other than mm shall follow the rules as herein set forth.

A4.12.0 Conversion Tables

The conversion factors given in the following tables will facilitate the conversion of most commonly used units of the English system to units of the Metric System (or conversion of non-SI units to SI units).

Table A4-2. Acceleration

To Convert	To	Symbol	Multiply by
foot/second squared	meter/second squared	m/s^2	*3.048 x 10^{-1}
galileo (gal)	meter/second squared	m/s^2	*1.000 x 10^{-2}
inch/second squared	meter/second squared	m/s^2	*2.54 x 10^{-2}

Table A4-3. Area

To Convert	To	Symbol	Multiply by
sq foot	sq meter	m^2	*9.290 304 x 10^{-2}
sq inch	sq meter	m^2	*6.451 6 x 10^{-4}
circular mil	sq meter	m^2	5.067 074 8 x 10^{-10}

Table A4-4. Density

To Convert	To	Symbol	Multiply by
gram/cu centimeter	kilogram/cu meter	kg/m^3	*1.00 x 10^3
pound mass/cu inch	kilogram/cu meter	kg/m^3	2.767 990 5 x 10^4
pound mass/cu foot	kilogram/cu meter	kg/m^3	1.601 846 3 x 10^1
slug/cu foot	kilogram/cu meter	kg/m^3	5.153 79 x 10^2

Table A4-5. Electrical

To Convert	To	Symbol	Multiply by
ampere (Int of 1948)	ampere	A	9.998 35 x 10^{-1}
ampere hour	coulomb	C = A·s	*3.60 x 10^3
coulomb (Int of 1948)	coulomb	C = A·s	9.998 35 x 10^{-1}
faraday (physical)	coulomb	C = A·s	9.652 19 x 10^4
farad (Int of 1948)	farad	F = A·s/V	9.995 05 x 10^{-1}
henry (Int of 1948)	henry	H = V·s/A	1.000 495
ohm (Int of 1948)	ohm	Ω = V/A	1.000 495
gamma	tesla	$T = Wb/m^2$	*1.00 x 10^{-9}

*Exact, as defined by the National Bureau of Standards.

Table A4-5. Electrical (Cont'd)

To Convert	To	Symbol	Multiply by
gauss	tesla	$T = Wb/m^2$	*1.00 x 10^{-4}
volt (Int of 1948)	volt	V = W/A	1.000 330
maxwell	weber	Wb = V·s	*1.00 x 10^{-8}

Table A4-6. Energy

To Convert	To	Symbol	Multiply by
Btu (mean)	joule	J=N.m	1.055 87 x 10^{3}
calorie (mean)	joule	J=N.m	4.190 02
calorie (thermochemical)	joule	J=N.m	*4.184
electron volt	joule	J=N·m	1.602 10 x 10^{-19}
erg	joule	J=N.m	*1.00 x 10^{-7}
foot pound force	joule	J=N.m	1.355 817 9
foot poundal	joule	J=N.m	4.214 011 0 x 10^{-2}
joule (Int of 1948)	joule	J=N.m	1.000 165
kilowatt hour (Int of 1948)	joule	J=N.m	3.600 59 x 10^{6}
ton (nuclear equiv of TNT)	joule	J=N·m	4.20 x 10^{9}
watt hour	joule	J=N·m	*3.60 x 10^{3}

Table A4-7. Energy/Area: Time

To Convert	To	Symbol	Multiply by
**Btu/sq foot·sec	watt/sq meter	W/m^2	1.134 893 1 x 10^{4}
**Btu/sq foot·min	watt/sq meter	W/m^2	1.891 488 5 x 10^{2}
**Btu/sq inch·sec	watt/sq meter	W/m^2	1.634 246 2 x 10^{6}
erg/sq centimeter·sec	watt/sq meter	W/m^2	*1.00 x 10^{-3}
watt/sq centimeter	watt/sq meter	W/m^2	*1.00 x 10^{4}

*Exact, as defined by the National Bureau of Standards.

**(thermochemical)

Table A4-8. Force

To Convert	To	Symbol	Multiply by
dyne	newton	$N=kg \cdot m/s^2$	$*1.00 \times 10^{-5}$
kilogram force (kgf)	newton	$N=kg \cdot m/s^2$	*9.806 65
pound force (avoirdupois)	newton	$N=kg \cdot m/s^2$	*4.448 221 615 260 5
ounce force (avoirdupois)	newton	$N=kg \cdot m/s^2$	$2.780\ 138\ 5 \times 10^{-1}$

Table A4-9. Length

To Convert	To	Symbol	Multiply by
angstrom	meter	m	$*1.00 \times 10^{-10}$
astronomical unit	meter	m	1.495×10^{11}
foot	meter	m	$*3.048 \times 10^{-1}$
foot (U. S. survey)	meter	m	*1200/3937
foot (U. S. survey)	meter	m	$3.048\ 006\ 096 \times 10^{-1}$
inch	meter	m	$*2.54 \times 10^{-2}$
light year	meter	m	$9.460\ 55 \times 10^{15}$
meter	wavelengths Kr^{86}	m	$*1.650\ 763\ 73 \times 10^{6}$
micron	meter	m	$*1.00 \times 10^{-6}$
mil	meter	m	$*2.54 \times 10^{-5}$
mile (U. S. statute)	meter	m	$*1.609\ 344 \times 10^{3}$
yard	meter	m	$*9.144 \times 10^{-1}$

Table A4-10. Mass

To Convert	To	Symbol	Multiply by
gram	kilogram	kg	$*1.00 \times 10^{-3}$
kilogram force $\cdot$ sec^2/meter (mass)	kilogram	kg	*9.806 65
kilogram mass	kilogram	kg	*1.00
pound mass (avoirdupois)	kilogram	kg	$*4.535\ 923\ 7 \times 10^{-1}$

*Exact, as defined by the National Bureau of Standards.

Table A4-10. Mass (Cont'd)

To Convert	To	Symbol	Multiply by
ounce mass (avoirdupois)	kilogram	kg	*2.834 952 312 5 x 10^{-2}
ounce mass (troy or apothecary)	kilogram	kg	*3.110 347 68 x 10^{-2}
pound mass (troy or apothecary)	kilogram	kg	*3.732 417 216 x 10^{-1}
slug	kilogram	kg	1.459 390 29 x 10^{1}
ton (short, 2000 pound)	kilogram	kg	*9.071 847 4 x 10^{2}

Table A4-11. Miscellaneous

To Convert	To	Symbol	Multiply by
degree (angle)	radian	rad	1.745 329 251 994 3 x 10^{-2}
minute (angle)	radian	rad	2.908 882 086 66 x 10^{-4}
second (angle)	radian	rad	4.848 136 811 x 10^{-6}
cu foot/second	cu meter/second	m^3/s	*2.831 684 659 2 x 10^{-2}
cu foot/minute	cu meter/second	m^3/s	4.719 474 4 x 10^{-4}
**Btu/pound mass °F	joule/kilogram °C	J/kg°C	*4.184 x 10^{3}
**Kilocalorie/kg °C	joule/kilogram °C	J/kg°C	*4.184 x 10^{3}
**Btu/pound mass	joule/kilogram	J/kg	2.324 444 4 x 10^{3}
Rad (radiation dose absorbed)	joule/kilogram	J/kg	*1.00 x 10^{-2}
roentgen	coulomb/kilogram	A·s/kg	*2.579 76 x 10^{-4}
curie	disintegration/second	1/s	*3.70 x 10^{10}

Table A4-12. Power

To Convert	To	Symbol	Multiply by
**Btu/second	watt	W= J/s	1.054 350 264 488 888 x 10^{3}
**Btu/minute	watt	W= J/s	1.757 250 4 x 10^{1}
**calorie/second	watt	W= J/s	*4.184
**calorie/minute	watt	W= J/s	6.973 333 3 x 10^{-2}
foot pound force/second	watt	W= J/s	1.355 817 9

* Exact, as defined by the National Bureau of Standards
** (thermochemical)

Table A4-12. Power (Cont'd)

To Convert	To	Symbol	Multiply by
foot pound force/minute	watt	W= J/s	$2.259\ 696\ 6 \times 10^{-2}$
foot pound force/hour	watt	W= J/s	$3.766\ 161\ 0 \times 10^{-4}$
horsepower (550 ft lb force/sec)	watt	W= J/s	$7.456\ 998\ 7 \times 10^{2}$
horsepower (electric)	watt	W= J/s	$*7.46 \times 10^{2}$
**kilocalorie/sec	watt	W= J/s	$*4.184 \times 10^{3}$
**kilocalorie/min	watt	W= J/s	$6.973\ 333\ 3 \times 10^{1}$
watt (Int of 1948)	watt	W= J/s	1.000 165

Table A4-13. Pressure

To Convert	To	Symbol	Multiply by
atmosphere	newton/sq meter	N/m^2	$*1.013\ 25 \times 10^{5}$
centimeter of mercury (0°C)	newton/sq meter	N/m^2	$1.333\ 22 \times 10^{3}$
centimeter of water (4°C)	newton/sq meter	N/m^2	$9.806\ 38 \times 10^{1}$
dyne/sq centimeter	newton/sq meter	N/m^2	$*1.00 \times 10^{-1}$
foot of water (39.2°F)	newton/sq meter	N/m^2	$2.988\ 98 \times 10^{3}$
inch of mercury (60°F)	newton/sq meter	N/m^2	$3.376\ 85 \times 10^{3}$
inch of water (60°F)	newton/sq meter	N/m^2	$2.488\ 4 \times 10^{2}$
kilogram force/sq centimeter	newton/sq meter	N/m^2	$*9.806\ 65 \times 10^{4}$
kilogram force/sq meter	newton/sq meter	N/m^2	$*9.806\ 65$
pound force/sq inch (psi)	newton/sq meter	N/m^2	$6.894\ 757\ 2 \times 10^{3}$
pound force/sq foot	newton/sq meter	N/m^2	$4.788\ 025\ 8 \times 10^{1}$
millimeter of mercury (0°C)	newton/sq meter	N/m^2	$1.333\ 224 \times 10^{2}$
torr (0°C)	newton/sq meter	N/m^2	$1.333\ 22 \times 10^{2}$

*Exact, as defined by the National Bureau of Standards

**(thermochemical)

Table A4-14. Speed

To Convert	To	Symbol	Multiply by
foot/second	meter/second	m/s	*3.048 x 10^{-1}
foot/minute	meter/second	m/s	*5.08 x 10^{-3}
foot/hour	meter/second	m/s	8.466 666 6 x 10^{-5}
inch/second	meter/second	m/s	*2.54 x 10^{-2}
kilometer/hour	meter/second	m/s	2.777 777 8 x 10^{-1}
mile/second (U.S. statute)	meter/second	m/s	*1.609 344 x 10^{3}
mile/minute (U.S. statute)	meter/second	m/s	*2.682 24 x 10^{1}
mile/hour (U.S. statute)	meter/second	m/s	*4.470 4 x 10^{-1}

Table A4-15. Temperature

To Convert	Symbol	To	Symbol	Computation
°Celsius	°Cels.	°Centigrade	°C	°Cels. = °C
°Fahrenheit	°F	°Centigrade	°C	°C = 5/9 (°F-32)
°Rankine	°R	°Centigrade	°C	°C = 5/9 (°R-491.69)
°Reaumur	°Re	°Centigrade	°C	°C = 5/4 °Re
°Fahrenheit	°F	°Celsius	°Cels.	°Cels. = 5/9 (°F-32)
°Fahrenheit	°F	°Reaumur	°Re	°Re = 4/9 (°F-32)
°Fahrenheit	°F	°Rankine	°R	°R = °F + 459.69
°Rankine	°R	°Celsius	°Cels.	°Cels.= 5/9 (°R-491.69)
°Rankine	°R	°Reaumur	°Re	°Re = 4/9 (°R-491.69)
°Reaumur	°Re	°Celsius	°Cels.	°Cels. = 5/4 °Re
°Centigrade	°C	°Kelvin	°K	°K = °C + 273.16

Table A4-16. Thermal Conductivity

To Convert	To	Symbol	Multiply by
Btu·inch/sq foot·second·°F	joule/meter·second·°Kelvin	J/m·s·°K	5.188 731 5 x 10^{2}

*Exact, as defined by the National Bureau of Standards.

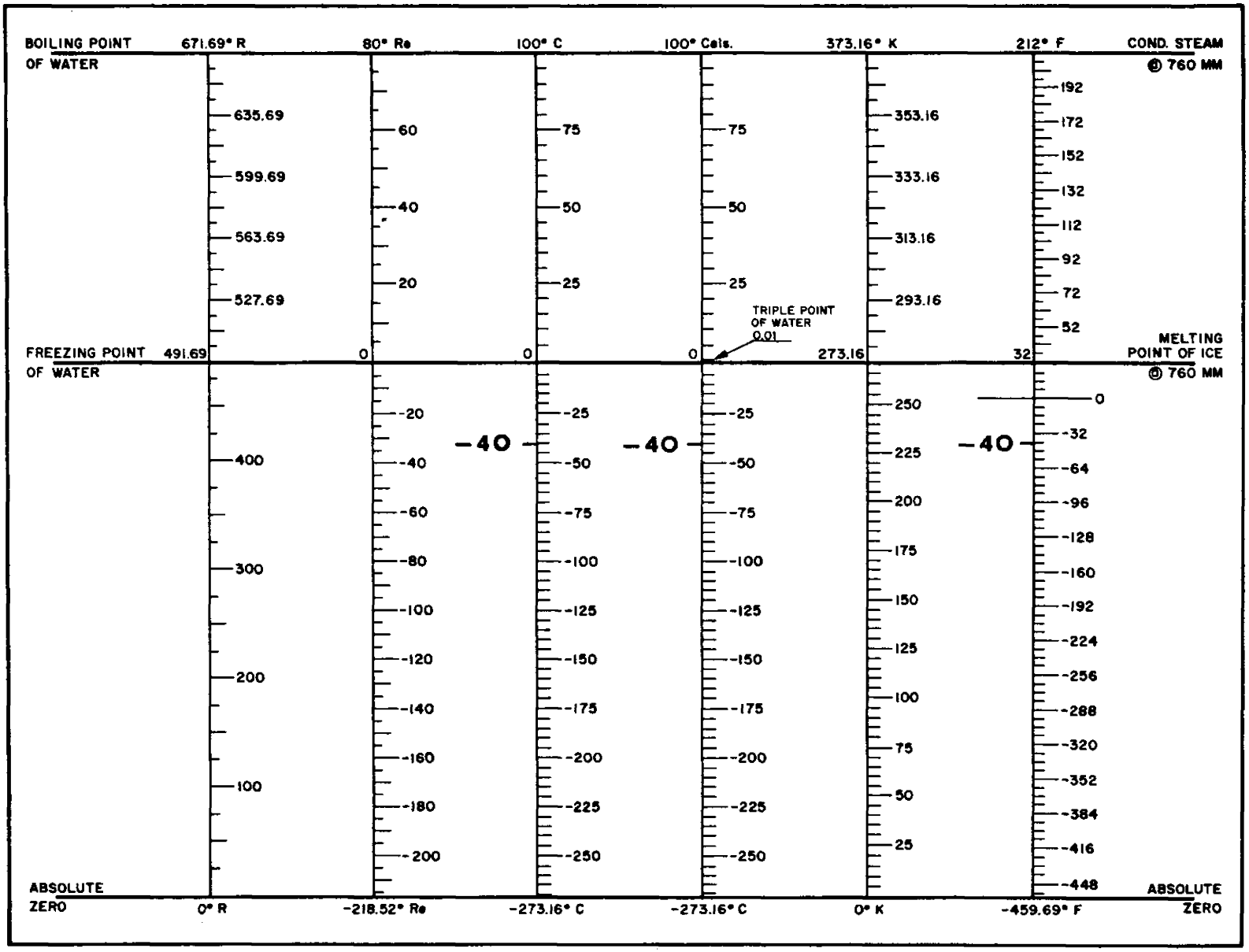

Figure A4-2. Temperature Nomograph

Table A4-17. Time

To Convert	To	Multiply by
day (mean solar)	second (mean solar)	*8.64 x 10^4
day (sidereal)	second (mean solar)	8.616 409 0 x 10^4
hour (mean solar)	second (mean solar)	*3.60 x 10^3
hour (sidereal)	second (mean solar)	3.590 170 4 x 10^3
minute (mean solar)	second (mean solar)	*6.00 x 10^1
minute (sidereal)	second (mean solar)	5.983 617 4 x 10^1
month (mean calendar)	second (mean solar)	*2.628 x 10^6
second (mean solar)	second (ephemeris)	Use equation of time
second (sidereal)	second (mean solar)	9.972 695 7 x 10^{-1}
tropical year 1900, Jan, day 0, hour 12	second (ephemeris)	*3.155 692 597 47 x 10^7
year (calendar)	second (mean solar)	*3.153 6 x 10^7
year (sidereal)	second (mean solar)	3.155 815 0 x 10^7
year (tropical)	second (mean solar)	3.155 692 6 x 10^7

Table A4-18. Viscosity

To Convert	To	Symbol	Multiply by
sq foot/second	sq meter/second	m^2/s	*9.290 304 x 10^{-2}
centipoise	newton·second/sq meter	$N \cdot s/m^2$	*1.00 x 10^{-3}
pound mass/foot·second	newton·second/sq meter	$N \cdot s/m^2$	1.488 163 9
pound force·second/sq foot	newton·second/sq meter	$N \cdot s/m^2$	4.788 025 8 x 10^1
poise	newton·second/sq meter	$N \cdot s/m^2$	*1.00 x 10^{-1}
poundal·second/sq foot	newton·second/sq meter	$N \cdot s/m^2$	1.488 163 9
slug/foot·second	newton·second/sq meter	$N \cdot s/m^2$	4.788 025 8 x 10^1

* Exact, as defined by the National Bureau of Standards.

Table A4-19. Volume

To Convert	To	Symbol	Multiply by
fluid ounce (U.S.)	cu meter	m^3	*2.957 352 956 25 x 10^{-5}
cu foot	cu meter	m^3	*2.831 684 659 2 x 10^{-2}
gallon (U.S. liquid)	cu meter	m^3	*3.785 411 784 x 10^{-3}
cu inch	cu meter	m^3	*1.638 706 4 x 10^{-5}
liter	cu meter	m^3	1.000 000 x 10^{-3}
pint (U.S. liquid)	cu meter	m^3	*4.731 764 73 x 10^{-4}
quart (U.S. liquid)	cu meter	m^3	9.463 529 5 x 10^{-4}
ton (register)	cu meter	m^3	*2.831 684 659 2

Table A4-20. Alphabetical Listing of Conversion Factors

To Convert	To	Symbol	Multiply by
abampere	ampere	A	*1.00 x 10^{1}
abcoulomb	coulomb	C= A·s	*1.00 x 10^{1}
abfarad	farad	F= A·s/V	*1.00 x 10^{9}
abhenry	henry	H= V·s/A	*1.00 x 10^{-9}
abmho	mho		*1.00 x 10^{9}
abohm	ohm	Ω = V/A	*1.00 x 10^{-9}
abvolt	volt	V= W/A	*1.00 x 10^{-8}
acre	sq meter	m^2	*4.046 856 422 4 x 10^{3}
ampere (Int of 1948)	ampere	A	9.998 35 x 10^{-1}
angstrom	meter	m	*1.00 x 10^{-10}
are	sq meter	m^2	*1.00 x 10^{2}
astronomical unit	meter	m	1.495 98 x 10^{11}
atmosphere	newton/sq meter	N/m^2	*1.013 25 x 10^{5}
bar	newton/sq meter	N/m^2	*1.00 x 10^{5}
barn	sq meter	m^2	*1.00 x 10^{-28}

* Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
barye	newton/sq meter	N/m^2	$*1.00 \times 10^{-1}$
Btu (Int Steam Table)	joule	J= N·m	$1.055\ 04 \times 10^{3}$
Btu (mean)	joule	J= N·m	$1.055\ 87 \times 10^{3}$
Btu (thermochemical)	joule	J= N·m	$1.054\ 350\ 264\ 488\ 888 \times 10^{3}$
Btu (39°F)	joule	J= N·m	$1.059\ 67 \times 10^{3}$
Btu (60°F)	joule	J= N·m	$1.054\ 68 \times 10^{3}$
bushel (U.S.)	cu meter	m^3	$*3.523\ 907\ 016\ 688 \times 10^{-2}$
cable	meter	m	$*2.194\ 56 \times 10^{2}$
caliber	meter	m	$*2.54 \times 10^{-4}$
calorie (Int Steam Table)	joule	J= N·m	4.186 8
calorie (mean)	joule	J= N·m	4.190 02
calorie (thermochemical)	joule	J= N·m	*4.184
calorie (15°C)	joule	J= N·m	4.185 80
calorie (20°C)	joule	J= N·m	4.181 90
calorie (kilogram, Int Steam Table)	joule	J= N·m	$4.186\ 8 \times 10^{3}$
calorie (kilogram, mean)	joule	J= N·m	$4.190\ 02 \times 10^{3}$
calorie (kilogram, thermochemical)	joule	J= N·m	$*4.184 \times 10^{3}$
carat (metric)	kilogram	kg	$*2.00 \times 10^{-4}$
°Celsius (temperature)	°Kelvin	°K	°K= °C + 273.16
centimeter of mercury (0°C)	newton/sq meter	N/m^2	$1.333\ 22 \times 10^{3}$
centimeter of water (4°C)	newton/sq meter	N/m^2	$9.806\ 38 \times 10^{1}$
chain (surveyor or gunter)	meter	m	$*2.011\ 68 \times 10^{1}$
chain (engineer or ramden)	meter	m	$*3.048 \times 10^{1}$
circular mil	sq meter	m^2	$5.067\ 074\ 8 \times 10^{-10}$
cord	cu meter	m^3	3.624 556 3

*Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
coulomb (Int of 1948)	coulomb	C= A·s	$9.998\ 35 \times 10^{-1}$
cubit	meter	m	$*4.572 \times 10^{-1}$
cup	cu meter	m^3	$*2.365\ 882\ 365 \times 10^{-4}$
curie	disintegration/second	1/s	$*3.70 \times 10^{10}$
day (mean solar)	second (mean solar)		$*8.64 \times 10^{4}$
day (sidereal)	second (mean solar)		$8.616\ 409\ 0 \times 10^{4}$
degree (angle)	radian	rad	$1.745\ 329\ 251\ 994\ 3 \times 10^{-2}$
denier (International)	kilogram/meter	kg/m	$*1.00 \times 10^{-7}$
dram (avoirdupois)	kilogram	kg	$*1.771\ 845\ 195\ 312\ 5 \times 10^{-3}$
dram (troy or apothecary)	kilogram	kg	$*3.887\ 934\ 6 \times 10^{-3}$
dram (U.S. fluid)	cu meter	m^3	$*3.696\ 691\ 195\ 312\ 5 \times 10^{-6}$
dyne	newton	N= kg·m/s^2	$*1.00 \times 10^{-5}$
electron volt	joule	J= N·m	$1.602\ 10 \times 10^{-19}$
erg	joule	J= N·m	$*1.00 \times 10^{-7}$
°Fahrenheit (temperature)	°Celsius	°C	°C = 5/9 (°F - 32)
°Fahrenheit (temperature)	°Kelvin	°K	°K = 5/9 (°F + 459.69)
farad (Int of 1948)	farad	F= A·s/V	$9.995\ 05 \times 10^{-1}$
faraday (based on carbon 12)	coulomb	C= A·s	$9.648\ 70 \times 10^{4}$
faraday (chemical)	coulomb	C= A·s	$9.649\ 57 \times 10^{4}$
faraday (physical)	coulomb	C= A·s	$9.652\ 19 \times 10^{4}$
fathom	meter	m	$*1.828\ 8$
fermi	meter	m	$*1.00 \times 10^{-15}$
fluid ounce (U.S.)	cu meter	m^3	$*2.957\ 352\ 956\ 25 \times 10^{-5}$
foot	meter	m	$*3.048 \times 10^{-1}$
foot (U.S. survey)	meter	m	*1200/3937

*Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
foot (U.S. survey)	meter	m	$3.048\ 006\ 096 \times 10^{-1}$
foot of water (39.2°F)	newton/sq meter	N/m^2	$2.988\ 98 \times 10^{3}$
foot-candle	lumen/sq meter	lm/m^2	$1.076\ 391\ 0 \times 10^{1}$
furlong	meter	m	$*2.011\ 68 \times 10^{2}$
gal	meter/second squared	m/s^2	$*1.00 \times 10^{-2}$
gallon (British)	cu meter	m^3	$4.546\ 087 \times 10^{-3}$
gallon (U.S. dry)	cu meter	m^3	$*4.404\ 883\ 770\ 86 \times 10^{-3}$
gallon (U.S. liquid)	cu meter	m^3	$*3.785\ 411\ 784 \times 10^{-3}$
gamma	tesla	$T = Wb/m^2$	$*1.00 \times 10^{-9}$
gauss	tesla	$T = Wb/m^2$	$*1.00 \times 10^{-4}$
gilbert	ampere turn		$7.957\ 747\ 2 \times 10^{-1}$
gill (British)	cu meter	m^3	$1.420\ 652 \times 10^{-4}$
gill (U.S.)	cu meter	m^3	$1.182\ 941\ 2 \times 10^{-4}$
grad	degree (angular)	1°	$*9.00 \times 10^{-1}$
grad	radian	rad	$1.570\ 796\ 3 \times 10^{-2}$
grain	kilogram	kg	$*6.479\ 891 \times 10^{-5}$
gram	kilogram	kg	$*1.00 \times 10^{-3}$
hand	meter	m	$*1.016 \times 10^{-1}$
hectare	sq meter	m^2	$*1.00 \times 10^{4}$
henry (Int of 1948)	henry	H = V·s/A	1.000 495
hogshead (U.S.)	cu meter	m^3	$*2.384\ 809\ 423\ 92 \times 10^{1}$
horsepower (550 foot lbf/second)	watt	W = J/s	$7.456\ 998\ 7 \times 10^{2}$
horsepower (boiler)	watt	W = J/s	$9.809\ 50 \times 10^{3}$
horsepower (electric)	watt	W = J/s	$*7.46 \times 10^{2}$
horsepower (metric)	watt	W = J/s	$7.354\ 99 \times 10^{2}$

*Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
horsepower (water)	watt	W= J/s	$7.460\ 43 \times 10^{2}$
hour (mean solar)	second (mean solar)		$*3.60 \times 10^{2}$
hour (sidereal)	second (mean solar)		$3.590\ 170\ 4 \times 10^{3}$
hundredweight (long)	kilogram	kg	$*5.080\ 234\ 544 \times 10^{1}$
hundredweight (short)	kilogram	kg	$*4.535\ 923\ 7 \times 10^{1}$
inch	meter	m	$*2.54 \times 10^{-2}$
inch of mercury (32°F)	newton/sq meter	N/m^2	$3.386\ 389 \times 10^{3}$
inch of mercury (60°F)	newton/sq meter	N/m^2	$3.376\ 85 \times 10^{3}$
inch of water (39.2°F)	newton/sq meter	N/m^2	$2.490\ 82 \times 10^{2}$
inch of water (60°F)	newton/sq meter	N/m^2	$2.488\ 4 \times 10^{2}$
joule (Int of 1948)	joule	J= N·m	1.000 165
kayser	1/meter	1/m	$*1.00 \times 10^{2}$
°Kelvin (temperature)	°Celsius	°C	°C= °K - 273.16
kilocalorie (Int Steam Table)	joule	J= N·m	$4.186\ 74 \times 10^{3}$
kilocalorie (mean)	joule	J= N·m	$4.190\ 02 \times 10^{3}$
kilocalorie (thermochemical)	joule	J= N·m	$*4.184 \times 10^{3}$
kilogram mass	kilogram	kg	*1.00
kilogram force	newton	N= kg·m/s²	*9.806 65
kilopond force	newton	N= kg·m/s²	*9.806 65
kip	newton	N= kg·m/s²	$*4.448\ 221\ 615\ 260\ 5 \times 10^{3}$
knot (International)	meter/second	m/s	$5.144\ 444\ 444 \times 10^{-1}$
lambert	candela/sq meter	cd/m^2	$*1/pi \times 10^{4}$
lambert	candela/sq meter	cd/m^2	$3.183\ 098\ 8 \times 10^{3}$
langley	joule/sq meter	J/m^2	$*4.184 \times 10^{4}$
lbf (pound force, avoirdupois)	newton	N= kg·m/s²	*4.448 221 615 260 5

* Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
lbm (pound mass, avoirdupois)	kilogram	kg	*4.535 923 7 x 10^{-1}
league (British nautical)	meter	m	*5.559 552 x 10^{3}
league (Int nautical)	meter	m	*5.556 x 10^{3}
league (statute)	meter	m	*4.828 032 x 10^{3}
light-year	meter	m	9.460 55 x 10^{15}
link (surveyor or gunter)	meter	m	*2.011 68 x 10^{-1}
link (engineer or ramden)	meter	m	*3.048 x 10^{-1}
liter	cu meter	m^3	1.000 000 x 10^{-3}
lux	lumen/sq meter	lm/m^2	1.00
maxwell	weber	Wb= V·s	*1.00 x 10^{-8}
meter	wavelengths Kr^{86}		*1.650 763 73 x 10^{6}
micron	meter	m	*1.00 x 10^{-6}
mil	meter	m	*2.54 x 10^{-5}
mile (U.S. statute)	meter	m	*1.609 344 x 10^{3}
mile (British nautical)	meter	m	*1.853 184 x 10^{3}
mile (Int nautical)	meter	m	*1.852 x 10^{3}
mile (U.S. nautical)	meter	m	*1.852 x 10^{3}
millimeter of mercury (0°C)	newton/sq meter	N/m^2	1.333 224 x 10^{2}
millibar	newton/sq meter	N/m^2	*1.00 x 10^{2}
minute (angle)	radian	rad	2.908 882 086 66 x 10^{-4}
minute (mean solar)	second (mean solar)		*6.00 x 10^{1}
minute (sidereal)	second (mean solar)		5.983 617 4 x 10^{1}
month (mean calendar)	second (mean solar)		*2.628 x 10^{6}
oersted	ampere/meter	A/m	7.957 747 2 x 10^{1}
ohm (Int of 1948)	ohm	Ω = V/A	1.000 495

*Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
ounce mass (avoirdupois)	kilogram	kg	*2.834 952 312 5 x 10^{-2}
ounce force (avoirdupois)	newton	N= kg·m/s^2	2.780 138 5 x 10^{-1}
ounce mass (troy or apothecary)	kilogram	kg	*3.110 347 68 x 10^{-2}
ounce (U.S. fluid)	cu meter	m^3	*2.957 352 956 25 x 10^{-5}
pace	meter	m	*7.62 x 10^{-1}
parsec	meter	m	3.083 74 x 10^{16}
pascal	newton/sq meter	N/m^2	*1.00
peck (U.S.)	cu meter	m^3	*8.809 767 541 72 x 10^{-3}
pennyweight	kilogram	kg	*1.555 173 84 x 10^{-3}
perch	meter	m	*5.029 2
phot	lumen/sq meter	lm/m^2	1.00 x 10^4
pica (printers')	meter	m	*4.217 517 6 x 10^{-3}
pint (U.S. dry)	cu meter	m^3	*5.506 104 713 575 x 10^{-4}
pint (U.S. liquid)	cu meter	m^3	*4.731 764 73 x 10^{-4}
point (printers')	meter	m	*3.514 598 x 10^{-4}
poise	newton·second/sq meter	N·s/m^2	*1.00 x 10^{-1}
pole	meter	m	*5.029 2
pound mass (lbm, avoirdupois)	kilogram	kg	*4.535 923 7 x 10^{-1}
pound force (lbf, avoirdupois)	newton	N = kg·m/s^2	*4.448 221 615 260 5
pound mass (troy or apothecary)	kilogram	kg	*3.732 417 216 x 10^{-1}
poundal	newton	N = kg·m/s^2	*1.382 549 543 76 x 10^{-1}
quart (U.S. dry)	cu meter	m^3	*1.101 220 942 715 x 10^{-3}
quart (U.S. liquid)	cu meter	m^3	9.463 529 5 x 10^{-4}
Rad (radiation dose absorbed)	joule/kilogram	J/kg	*1.00 x 10^{-2}
°Reaumur (temperature)	°Centigrade	°C	°C = 5/4 °Re

*Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
rhe	sq meter/newton·second	$m^2/N \cdot s$	$*1.00 \times 10^{1}$
rod	meter	m	*5.029 2
roentgen	coulomb/kilogram	C/kg	$*2.579\ 76 \times 10^{-4}$
second (angle)	radian	rad	$4.848\ 136\ 811 \times 10^{-6}$
second (mean solar)	second (ephemeris)		Use equation of time.
second (sidereal)	second (mean solar)		$9.972\ 695\ 7 \times 10^{-1}$
section	sq meter	m^2	$*2.589\ 988\ 110\ 336 \times 10^{6}$
scruple (apothecary)	kilogram	kg	$*1.295\ 978\ 2 \times 10^{-3}$
shake	second	s	1.00×10^{-8}
skein	meter	m	$*1.097\ 28 \times 10^{2}$
slug	kilogram	kg	$1.459\ 390\ 29 \times 10^{1}$
span	meter	m	$*2.286 \times 10^{-1}$
statampere	ampere	A	$3.335\ 640 \times 10^{-10}$
statcoulomb	coulomb	$C = A \cdot s$	$3.335\ 640 \times 10^{-10}$
statfarad	farad	$F = A \cdot s/V$	$1.112\ 650 \times 10^{-12}$
stathenry	henry	$H = V \cdot s/A$	$8.987\ 554 \times 10^{11}$
statmho	mho		$1.112\ 650 \times 10^{-12}$
statohm	ohm	$\Omega = V/A$	$8.987\ 554 \times 10^{11}$
statvolt	volt	$V = W/A$	$2.997\ 925 \times 10^{2}$
stere	cu meter	m^3	*1.00
stilb	candela/sq meter	cd/m^2	1.00×10^{4}
stoke	sq meter/second	m^2/s	$*1.00 \times 10^{-4}$
tablespoon	cu meter	m^3	$*1.478\ 676\ 478\ 125 \times 10^{-5}$
teaspoon	cu meter	m^3	$*4.928\ 921\ 593\ 75 \times 10^{-6}$

*Exact, as defined by the National Bureau of Standards.

Table A4-20. Alphabetical Listing of Conversion Factors (Cont'd)

To Convert	To	Symbol	Multiply by
ton (assay)	kilogram	kg	$2.916\ 666\ 6 \times 10^{-2}$
ton (short, 2000 pound)	kilogram	kg	$*9.071\ 847\ 4 \times 10^{2}$
ton (long)	kilogram	kg	$*1.016\ 046\ 908\ 8 \times 10^{3}$
ton (metric)	kilogram	kg	$*1.00 \times 10^{3}$
ton (nuclear equiv. of TNT)	joule	J= N·m	4.20×10^{9}
ton (register)	cu meter	m^3	*2.831 684 659 2
torr (0°C)	newton/sq meter	N/m^2	$1.333\ 22 \times 10^{2}$
township	sq meter	m^2	$9.323\ 957\ 2 \times 10^{7}$
unit pole	weber	Wb= V·s	$1.256\ 637 \times 10^{-7}$
volt (Int of 1948)	volt	V= W/A	1.000 330
watt (Int of 1948)	watt	W= J/s	1.000 165
yard	meter	m	$*9.144 \times 10^{-1}$
year (calendar)	second (mean solar)		$*3.153\ 6 \times 10^{7}$
year (sidereal)	second (mean solar)		$3.155\ 815\ 0 \times 10^{7}$
year (tropical)	second (mean solar)		$3.155\ 692\ 6 \times 10^{7}$
year 1900, tropical, Jan, day 0, hour 12	second (ephemeris)	s	$*3.155\ 692\ 597\ 47 \times 10^{7}$

*Exact, as defined by the National Bureau of Standards.

Table A4-21. Decimal and Metric Equivalents of Fractions of an Inch

Inch Decimal	Inch Fraction	Millimeter (mm)	Centimeter (cm)	Meter (m)
0.015 625	1/64	0.396 87	0.039 687	0.000 396 87
0.031 25	1/32	0.793 74	0.079 374	0.000 793 74
0.046 875	3/64	1.190 61	0.119 061	0.001 190 61
0.062 5	1/16	1.587 48	0.158 748	0.001 587 48
0.078 125	5/64	1.984 35	0.198 435	0.001 984 35
0.093 75	3/32	2.381 23	0.238 123	0.002 381 23
0.109 375	7/64	2.778 09	0.277 809	0.002 778 09
0.125	1/8	3.174 97	0.317 497	0.003 174 97
0.140 625	9/64	3.571 83	0.357 183	0.003 571 83
0.156 25	5/32	3.968 71	0.396 871	0.003 968 71
0.171 875	11/64	4.365 57	0.436 557	0.004 365 57
0.187 5	3/16	4.762 45	0.476 245	0.004 762 45
0.203 125	13/64	5.159 31	0.515 931	0.005 159 31
0.218 75	7/32	5.556 20	0.555 620	0.005 556 20
0.234 375	15/64	5.953 05	0.595 305	0.005 953 05
0.25	1/4	6.349 94	0.634 994	0.006 349 94
0.265 625	17/64	6.746 79	0.674 679	0.006 746 79
0.281 25	9/32	7.143 68	0.714 368	0.007 143 68
0.296 875	19/64	7.540 53	0.754 053	0.007 540 53
0.312 5	5/16	7.937 43	0.793 743	0.007 937 43
0.328 125	21/64	8.334 27	0.833 427	0.008 334 27
0.343 75	11/32	8.731 17	0.873 117	0.008 731 17
0.359 375	23/64	9.128 01	0.912 801	0.009 128 01
0.375	3/8	9.524 91	0.952 491	0.009 524 91
0.390 625	25/64	9.921 75	0.992 175	0.009 921 75

Table A4-21. Decimal and Metric Equivalents of Fractions of an Inch (Cont'd)

Inch Decimal	Inch Fraction	Millimeter (mm)	Centimeter (cm)	Meter (m)
0.406 25	13/32	10.318 65	1.031 865	0.010 318 65
0.421 875	27/64	10.715 49	1.071 549	0.010 715 49
0.437 5	7/16	11.112 40	1.111 240	0.011 112 40
0.453 125	29/64	11.509 23	1.150 923	0.011 509 23
0.468 75	15/32	11.906 14	1.190 614	0.011 906 14
0.484 375	31/64	12.302 97	1.230 297	0.012 302 97
0.5	1/2	12.699 88	1.269 988	0.012 699 88
0.515 625	33/64	13.096 71	1.309 671	0.013 096 71
0.531 25	17/32	13.493 62	1.349 362	0.013 493 62
0.546 875	35/64	13.890 45	1.389 045	0.013 890 45
0.562 5	9/16	14.287 37	1.428 737	0.014 287 37
0.578 125	37/64	14.684 19	1.468 419	0.014 684 19
0.593 75	19/32	15.081 11	1.508 111	0.015 081 11
0.609 375	39/64	15.477 93	1.547 793	0.015 477 93
0.625	5/8	15.874 85	1.587 485	0.015 874 85
0.640 625	41/64	16.271 67	1.627 167	0.016 271 67
0.656 25	21/32	16.668 59	1.666 859	0.016 668 59
0.671 875	43/64	17.065 41	1.706 541	0.017 065 41
0.687 5	11/16	17.462 34	1.746 234	0.017 462 34
0.703 125	45/64	17.859 15	1.785 915	0.017 859 15
0.718 75	23/32	18.256 08	1.825 608	0.018 256 08
0.734 375	47/64	18.652 89	1.865 289	0.018 652 89
0.75	3/4	19.049 82	1.904 982	0.019 049 82
0.765 625	49/64	19.446 63	1.944 663	0.019 446 63
0.781 25	25/32	19.843 56	1.984 356	0.019 843 56

Table A4-21. Decimal and Metric Equivalents of Fractions of an Inch (Cont'd)

Inch Decimal	Inch Fraction	Millimeter (mm)	Centimeter (cm)	Meter (m)
0.796 875	51/64	20.240 37	2.024 037	0.020 240 37
0.812 5	13/16	20.637 31	2.063 731	0.020 637 31
0.828 125	53/64	21.034 11	2.103 411	0.021 034 11
0.843 75	27/32	21.431 05	2.143 105	0.021 431 05
0.859 375	55/64	21.827 85	2.182 785	0.021 827 85
0.875	7/8	22.224 79	2.222 479	0.022 224 79
0.890 625	57/64	22.621 59	2.262 159	0.022 621 59
0.906 25	29/32	23.018 53	2.301 853	0.023 018 53
0.921 875	59/64	23.415 33	2.341 533	0.023 415 33
0.937 5	15/16	23.812 28	2.381 228	0.023 812 28
0.953 125	61/64	24.209 07	2.420 907	0.024 209 07
0.968 75	31/32	24.606 02	2.460 602	0.024 606 02
0.984 375	63/64	25.002 81	2.500 281	0.025 002 81
1.0	1	25.4	2.54	0.025 4