Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) and Department of Agriculture.

This standard has been technically prepared in accordance with PNS 01-4:1998 (ISO/IEC Directives Part 3:1997) – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that certain course of action is preferred but not necessarily required.

In the preparation of this standard, the following documents/publications were considered:

American Society of Agricultural Engineers (ASAE) Standard EP285.6:1986 – Use of SI (Metric) Units.

Metrication Handbook. *A Guide to Understanding Metric Conversion and Using the Modern Metric System.* Ministry of Trade and Industry.1982.

Batas Pambansa Bilang 8. An Act Defining the Metric System and its Units, Providing for its Implementation and for Other Purposes, 1978.

General – Metrication Guidelines

1 Scope

This standard establishes guidelines in the use of the International System (SI) Units.

2 References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this National Standard:

ISO 1000 – SI Units and Recommendations for the Use of their Multiples and of Certain Other Units

ANSI/ASTM E380-76 – Metric Practice

ASAE S209 – Agricultural Tractor Test Code

3 Definitions

For the purpose of this standard, the following definitions shall apply:

3.1
ampere (A)
base unit used to measure electric current

3.2
candela (cd)
base unit used to measure luminous intensity

3.3
coulomb (C)
derived unit used to measure quantity of electricity

3.4
farad (F)
derived unit used to measure electric capacitance

3.5
henry (H)
derived unit used to measure electric inductance

3.6
hertz (Hz)
derived unit used to measure frequency

3.7
joule (J)
derived unit used to measure energy or work

3.8
kelvin (K)
base unit used to measure thermodynamic temperature

3.9
kilogram (kg)
base unit used to measure mass

3.10
lumen (lm)
derived unit used to measure luminous flux

3.11
lux (lx)
derived unit used to measure illuminance

3.12
meter (m)
base unit used to measure length

3.13
mole (mol)
base unit used to measure the amount of a substance

3.14
newton (N)
derived unit used to measure force

3.15
ohm (Ω)
derived unit used to measure electric resistance

3.16
pascal (Pa)
derived unit used to measure pressure or stress

3.17
radian (rad)
supplementary unit used to measure plane angle

3.18
second (s)
base unit used to measure time

3.19
steradian (sr)
supplementary unit used to measure solid angle

3.20
tesla (T)
derived unit used to measure density of magnetic flux and magnetic induction

3.21
volt (V)
derived unit used to measure potential difference and electromagnetic force

3.22
watt (W)
derived unit used to measure power

3.23
weber (Wb)
derived unit used to measure magnetic flux

4 SI Units of Measure

SI consists of seven base units, two supplementary units and a series of derived units consistent with the base and supplementary units. There is also a series of approved prefixes for the formation of multiples and submultiples of the various units. A number of derived units are discussed in subclause 4.1.3. Additional derived units without special names are formed as needed from base units or other derived units, or both.

4.1.1 Base and Supplementary Units (Table 1)

Table 1 – SI Base and Supplementary Units and their Symbols

Quantity	Unit	Symbol of SI Unit
Base Units:		
1. length	meter	m
2. mass	kilogram	kg
3. time	second	s
4. electric current	ampere	A
5. thermodynamic temperature	kelvin	K
6. amount of substance	mole	mol
7. luminous intensity	candela	cd
Supplementary units:		
1. plane angle	radian	rad
2. solid angle	steradian	sr

4.1.2 SI Unit Prefixes and Symbols (see Table 2)

Table 2 – SI Unit Prefixes, Symbols and their Multiples and Submultiples

Prefix	SI Symbol	Multiples and Submultiples	Meaning (No. of times multiplied)
exa*	E	10^{18}	1 000 000 000 000 000 000
peta*	P	10^{15}	1 000 000 000 000 000
tera*	T	10^{12}	1 000 000 000 000
giga	G	10^{9}	1 000 000 000
mega	M	10^{6}	1 000 000
kilo	k	10^{3}	1 000
hecto**	h	10^{2}	100
deca**	da	10^{1}	10
deci**	d	10^{-1}	0.1
centi	c	10^{-2}	0.01
milli	m	10^{-3}	0.001
micro	µ	10^{-6}	0.000 001
nano*	n	10^{-9}	0.000 000 001
pico*	p	10^{-12}	0.000 000 000 001
femto*	f	10^{-15}	0.000 000 000 000 001
atto*	a	10^{-18}	0.000 000 000 000 000 001

* Rarely used, mostly in highly scientific work
** Not preferred

4.1.3 Derived units are combinations of basic units or other derived units as needed to describe physical properties. Some derived units are given special names; others are expressed in the appropriate combination of SI units. Some currently defined derived units are shown in Table 3.

Table 3 – Derived Units

Quantity	Unit	SI Symbol	Formula
acceleration	meter per second squared	-	m/s^2
Activity (of a radioactive source)	disintegration per second	-	(disintegration)/s
Angular acceleration	radian per second squared	-	rad/s^2
Angular velocity	radian per second	-	rad/s
Area	square meter	-	m^2
Density	kilogram per cubic meter	-	kg/m^3
electrical capacitance	farad	F	A·s/V
electrical conductance	siemens	S	A/V
electrical field strength	volt per meter	-	V/m
electrical inductance	henry	H	V·s/A
electrical potential difference	volt	V	W/A
electrical resistance	ohm	Ω	V/A
electromotive force	volt	V	W/A
energy	joule	J	N·m

Quantity	Unit	SI Symbol	Formula
entropy	joule per kelvin	-	J/K
force	newton	N	$kg{\cdot}m/s^2$
frequency	hertz	Hz	(cycle)/s
illuminance	lux	lx	lm/m^2
luminance	candela per square meter	-	cd/m^2
luminous flux	lumen	lm	cd·sr
magnetic field strength	ampere per meter	-	A/m
magnetic flux	weber	Wb	V·s
magnetic flux density	tesla	T	Wb/m^2
magnetomotive force	ampere	A	-
Power	watt	W	J/s
pressure	pascal	Pa	N/m^2
quantity of electricity	coulomb	C	A·s
quantity of heat	joule	J	N·m
radiant intensity	watt per steradian	-	W/sr
specific heat	joule per kilogram-kelvin	-	J/kg·K
Stress	pascal	Pa	N/m^2
thermal conductivity	watt per meter-kelvin	-	W/m·K
velocity	meter per second	-	m/s
viscosity, dynamic	pascal-second	-	Pa·s
viscosity, kinematic	square meter per second	-	m^2/s
voltage	volt	V	W/A
volume	cubic meter	-	m^3
wavenumber	reciprocal meter	-	(wave)/m
work	joule	J	N·m

5 Rules for SI Usage

5.1 General

The established SI units (base, supplementary, derived and combinations thereof with appropriate multiple or submultiple prefixes) shall be used as indicated in this section.

5.2 Application of Prefixes

5.2.1 The prefixes shall be used to indicate orders of magnitude, thus eliminating insignificant digits and decimals, and providing a convenient substitute for writing powers of 10 as generally preferred in computation.

EXAMPLES: 12 300 m OR 12.3×10^3 m BECOMES 12.3 km
15 100 g OR 15.1×10^3 g BECOMES 15.1 kg
0.020 L OR 20.0×10^{-3} L BECOMES 20 mL
0.0123 mA OR 12.3×10^{-6} A BECOMES 12.3 µA

5.2.2 The prefix is not separated but combined with the parent unit (root word) to form one word.

EXAMPLES:	centimeter	NOT	centi meter	NOR	centi-meter
	kilogram	NOT	kilo gram	NOR	kilo-gram
	milliliter	NOT	milli liter	NOR	milli-liter

5.2.3 Not more than one prefix should be included in any unit. Double prefixes and hyphenated prefixes shall not be used.

EXAMPLES:	nanometer (nm)	NOT	millimicrometer (nμm)
	millimeter per second (m/s)	NOT	millimeter per microsecond (mm/μs)

5.2.4 When a unit is expressed in the form of a product or quotient, the prefixed unit, if any, should be the first occurring unit.

EXAMPLES:	millinewton meter (mN·m)	NOT	Newton millimeter (N·mm)
	millimeter per second (mm/s)	NOT	meter per millisecond (m/ms)

5.2.5 The only base unit that contains a prefix is the kilogram. Multiples and submultiples of a derived unit containing kilogram are formed by addition of prefixes to the term "gram". If kilogram is not the first term, then two prefixes may appear in the derived units.

EXAMPLES:	kg/m^3	AND HENCE	g/m^3	AND	mg/m^3
	J/kg	AND HENCE	kJ/kg	AND	MJ/kg

5.2.6 As much as possible, prefixes shall not be used in the denominator except for kilogram which is a base unit.

EXAMPLES:

Correct Symbol	Not Correct
50 000 J/s	50 J/ms
25 000 m/s	25 N/ms

5.2.7 With SI units of higher order such as m^2 or m^3, the prefix is also raised to the same order.

EXAMPLES: **Correct Symbols**

square millimeter
- mm^2
- $(10^{-3}\ m)^2$
- $10^{-6}\ m^2$

cubic milliliter
- mL^3
- $(10^{-3}\ L)^3$
- $10^{-9}\ m^3$

5.2.8 The only prefix that should be used for liter is milli.

5.3 Selection of Appropriate Units and Prefixes

5.3.1 When expressing a quantity by a numerical value and a unit, a prefix should be chosen so that the numerical value preferably lies between 0.1 and 1000, except where certain multiples and submultiples have been agreed for particular use. The same unit, multiple or submultiple should be used in tables even though the series may exceed the preferred range of 0.1 to 1000.

EXAMPLES:	Correct Symbols	Incorrect Symbols
	8.613 m	0.008 613 km
	861.3 km	861 300.0 m
	500 kPa or 0.5 MPa	500 000 Pa

5.4 Capitalization

All unit symbols are written in lower case (small) letters except for SI units derived from a proper name (see Table 4). The "liter" symbol shall be capitalized (L) to avoid confusion with the "figure 1". Unabbreviated units are not capitalized; for example kelvin, joule, newton, etc except for Celsius which is always written with a capital C. Numerical prefixes and their symbols are not capitalized; except for the symbols M (mega), G (giga), T (tera), P (peta) and E (exa).

Table 4 – Symbols for Units Derived from Proper Names

Units derived from proper name	Symbols
watt	W
volt	V
newton	N
pascal	Pa
coulomb	C
farad	F
siemens	S
weber	Wb
tesla	T
henry	H
becquerel	Bq
degree Celsius	°C
joule	J
hertz	Hz
ampere	A

5.5 Singular and Plural Form

Unabbreviated SI units form their plurals in the usual manner by adding s at the end of the word. Exceptions are “siemens”, “hertz” and “lux” which stand for both singular and plural form. SI symbols are always written in singular form.

EXAMPLES:	**Correct Symbol**	**Not Correct**
50 newtons	50 N	50 Ns
25 millimeters	25 mm	25 mms
4 grams	4 g	4 gs
15 kilometers	15 km	15 kms

5.6 Punctuation

5.6.1 A symbol is not an abbreviation of the name of the unit or quantity; therefore periods shall not be used after any SI unit symbol, unless the symbol occurs at the end of a sentence.

EXAMPLES:			
	3 kg	not	3 kg**.**
	m^2	not	m**.**^{2}

5.6.2 No abbreviation shall be used in SI.

EXAMPLES:	**For Unit:**	**Use this Symbol**	**Not the Abbreviation**
	1. cubic meter	m^3	cu**.**m ; cu m
	2. gram	g	gm**.** ; gm
	3. minute	min	min**.**

5.6.3 When symbols are used in an adjectival sense, a hyphen may or may not be used between the symbol and the number.

EXAMPLES:	**Correct (hypen may/may not be used)**	**Not Correct**
16 mm film	16-mm film	16 mm-film
3 tonne truck	3-tonne truck	3 tonne-truck

5.7 Spacing

5.7.1 Unit names and symbols are separated from the numerical value by a space, except in the case of degree (°), minute (′) and second (″); e.g. 37°C and 28°50′24″.

EXAMPLES:			
	21 km	NOT	21km
	15 kg	NOT	15kg

5.7.2 A space shall be provide between the numbers and signs for multiplications, division, addition and subtraction.

EXAMPLES:	4 m x 3 m	NOT	4 mx 3m
	6 mm – 3 mm	NOT	6 mm –3 mm
	5 cm + 4 cm	NOT	5 cm +4 mm

5.8 Spelling

5.8.1 The spelling of SI units used in this standard are in accordance with the International System of Units except for a few cases where other, current spellings are allowed in the meantime to enable people to get used to and increasingly use the SI spelling. Since SI is the international language of measurement, it is advisable to adhere as closely and promptly as possible to the SI rules of usage for better word understanding.

5.8.2 The following international spellings of SI units are much preferred: “metre”, “tonne” and “litre” but “meter”, “ton” and liter are permissible in the meantime.

5.8.3 When referring to the instrument or device and for the verb form, the spelling “meter” is to be used as in “speedometer”, “electric meter”, “taxi meter” and “metered”.

5.9 Derived Units

5.9.1 The product of two or more units in symbolic form is preferably indicated by a dot midway in relation to unit symbol height. The dot may be dispensed with when there is no risk of confusion with another unit symbol.

EXAMPLES:	100 N·m	OR	100 N m	NOT	100 mN
	1 V·s	OR	1 V s	NOT	1 sV
	100 kW·h	OR	100 kW h	NOT	100 hkW

5.9.2 A solidus (oblique stroke, /), a horizontal line or negative powers may be used to express a derived unit formed from two others by division.

EXAMPLES:

	Correct
15 meters per second	▪ 15 m/s ▪ 15 $\frac{m}{s}$ ▪ 15 $m \cdot s^{-1}$
35 newtons per square meter	▪ 35 N/m^2 ▪ 15 $\frac{N}{m^2}$ ▪ 15 $N \cdot m^{-2}$
746 joules per second	▪ 746 J/s ▪ 746 $\frac{J}{s}$ ▪ 746 $m \cdot s^{-1}$

5.9.3 Names and symbols are not to be mixed within the same unit expression. For consistency, wither all words in the metric name or description, or all symbols should be used.

EXAMPLES:

Correct	**Incorrect**
▪ 9 meters per second ▪ 9 m/s	▪ 9 m per s ▪ 9 m per second ▪ 9 meter per s ▪ 9 meter/second
▪ 10 joules per second ▪ 10 J/s	▪ 10 J per s ▪ 10 J per second ▪ 10 joules per s ▪ 10 joules/second

5.10 Use of Decimals and Grouping of Numbers

5.10.1 Whenever a numerical value is less than one, a zero should precede the decimal point.

EXAMPLES:

Correct	**Incorrect**
0.7 mL	.7 mL
0.1 kg	.1 kg

5.10.2 In European countries like France, comma is used as a decimal marker instead of period or point.

EXAMPLES:

	Correct
In the Philippines:	70.7 km
In France:	7,7 km

5.10.3 Decimals should be used as much as possible instead of common fractions, which should be avoided. Decimals are also preferred for computer applications as common fractions introduce complications in key punching and programming.

EXAMPLES:

Correct	**Incorrect**
0.75 L	¾ L
1.5 m	1 ½ m

5.10.4 In SI, to facilitate reading, numbers which have four or more digits shall be arranged in groups of three, separated by a space instead of comma, counting from the decimal position or marker with a space or gap between groups. This is to avoid confusion since some European countries use the comma as decimal marker.

EXAMPLES:

Correct	Incorrect
983 769.816 34	986 769.81634
1 532	1,532

5.10.5 In the Philippines, the use of comma as thousand separator or marker is allowed.

EXAMPLES:

	Correct	
	In the Philippines	In France
1.	9,494 m	9 494 m
2.	10,666.25 L	10 666.25 L

6 Non-SI Units

6.1 Certain units outside the SI are recognized by ISO because of their practical importance in specialized fields. These include units for temperature, time and angle. Also included are names for some multiples of units such as “liter” (L) for volume, “hectare” (ha) for land measure and “metric ton” (t) for mass.

6.2 Temperature

The SI base unit for thermodynamic temperature is kelvin (K). Because of the wide usage of the degree Celsius, particularly in engineering and nonscientific areas, the Celsius scale (formerly called the centigrade scale) may be used when expressing temperature. The Celsius scale is related directly to the kelvin scale as follows:

$$t = T - 273.15$$

where t is the temperature in kelvin
T is the temperature in celsius

6.3 Time

The SI unit for time is the second. This unit is preferred and should be used when technical calculations are involved. In other cases use of the minute (min), hour (h), day (d), etc., is permissible.

6.4 Angles

The SI unit for plane angle is the radian. The use of arc degrees (°) and its decimal or minute (′), second (″) submultiple is permissible when the radian is not a convenient unit. Solid angles should be expressed in steradians.

7 Preferred Units and Conversion Factors

Preferred units for expressing physical quantities commonly encountered in agricultural engineering work are shown in Table 5. These are presented as an aid to selecting proper units for given applications and to promote consistency where interpretation of the general rules of SI may not produce consistent results. Factors for conversion from old units to SI units are also included in Table 5.

Table 5 – Preferred Units for Expressing Physical Quantities

Quantity	Application	From: Old Units	To: SI units	Multiply By:
Acceleration, angular	General	rad/s^2	rad/s^2	
Acceleration, linear	Vehicle	(mile/h)/s	(km/h)/s	1.609 344*
	General (includes acceleration of gravity)#	ft/s^2	m/s^2	0.304 8*
Angle, plane	Rotational calculations	r (revolutions)	r (revolutions)	
		rad	rad	
	Geometric and general	° (degree)	°	
		′ (min)	° (decimalized)	1/60*
		′ (min)	′	
		″ (sec)	° (decimalized)	1/3600*
		″ (sec)	″	
Angle, solid	Illumination calculations	sr	sr	
Area	Cargo platforms, roof and floor area, frontal areas, fabrics, general	in.^{2}	m^2	0.000 645 16*
		ft^2	m^2	0.092 903 04*
	Pipe, conduit	in.^{2}	mm^2	645.16*
		in.^{2}	cm^2	6.451 6*
		ft^2	m^2	0.092 903 04*
	Small areas, orifices, cross section area of structural shapes	in.^{2}	mm^2	645.16*
	Brake & clutch contact area, glass, radiators, feed opening	in.^{2}	cm^2	6.451 6*
	Land, pond, lake, reservoir, open water channel			
	Small	ft^2	m^2	0.092 903 04*
	Large	acre	ha	0.404 687 3(d)
	Very large	mile^2	km^2	2.589 998
Area per time	Field operations	acre/h	ha/h	0.404 687 3
	Auger sweeps, silo unloader	ft^2/s	m^2/s	0.092 903 04*
Bending momet	(see moment of force)			
Capacitance, electric	Capacitors	μF	μF	
Capacity, electric	Battery rating	A·h	A·h	
Capacity, heat	General	Btu/°F	kJ/K †	1.899 101

Quantity	Application	From: Old Units	To: SI units	Multiply By:
Capacity, heat, specific	General	Btu/(lb·°F)	kJ/(kg·K) †	4.186 8*
Capacity, volume	(see volume)			
Coefficient of heat transfer	General	Btu/(h·ft^2 ·°F)	W/(m^2·K) †	5.678 263
Coefficient of linear expansion	Shrink fit, general	°F^{-1}, (1/°F)	K^{-1}, (1/K) †	1.8*
Conductance, electric	General	mho	S	1*
Conductance, thermal	(see coefficient of heat transfer)			
Conductivity, electric	Material property	mho/ft	S/m	3.280 840
Conductivity, thermal	General	Btu·ft/(h·ft^2 ·°F)	W/(m·K) †	1.730 735
Consumption, fuel	Off highway vehicles (see also Efficiency, fuel)	gal/h	L/h	3.785 412
Consumption, oil	Vehicle performance testing	qt/(1000 miles)	L/(1000 km)	0.588 036 4
Comsumption, specific, oil	Engine Testing	lb/(hp·h)	g/(kW·h)	608.277 4
		lb/(hp·h)	g/MJ	168.965 9
Current, electric	General	A	A	
Density, current	General	A/in.^{2}	kA/m^2	1.550 003
		A/ft^2	A/m^2	10.763 91
Density, magnetic flux	General	kilogauss	T	0.1*
Density, mass	Solid, general; agricultural products, soil, building materials	lb/yd^3	kg/m^3	0.593 276 3
		lb/in.^{3}	kg/m^3	27 679.90
		lb/ft^3	kg/m^3	16.018 46
	Liquid	lb/gal	kg/L	0.119 826 4
	Gas	lb/ft^3	kg/m^3	16.018 46
	Solution concentration		g/m^3, mg/L	
Density of heat flow rate	Irradiance, general	Btu/(h·ft^2)	W/m^2	3.154 591 ††
Consumption, fuel	(see Flow, volume)			
Consumption, specific fuel	(see Efficiency, fuel)			
Drag	(see Force)			
Economy, fuel	(see Efficiency, fuel)			
Efficiency, fuel	Highway vehicles			
	Economy	Mile/gal	km/L	0.415 143 7
	Consumption		L/(100 km)	§
	Specific fuel consumption	lb/(hp·h)	g/MJ	168.965 9
	Off-highway vehicles			
	Economy	h·ph/gal	kW·h/L	0.196 993 1
	Specific fuel consumption	lb/(hp·h)	g/MJ	168.965 9
	Specific fuel consumption	lb/(hp·h)	kg/(kW·h)§§	0.608 277 4
Energy, work, enthalpy, quantity of heat	Impact strength	ft·lbf	J	1.355 818
	Heat	Btu	kJ	1.055 056
		Kcal	kJ	4.186 8*
	Energy usage, electrical	kW·h	kW·h	

Quantity	Application	From: Old Units	To: SI units	Multiply By:
		kW·h	MJ	3.6
	Mechanical, hydraulic, general	ft·lbf	J	1.355 818
		ft·pdl	J	0.042 140 11
		hp·h	MJ	2.684 520
		hp·h	kW·h	0.745 699 9
Energy per area	Solar radiation	Btu/ft^2	MJ/m^2	0.011 356 528
Energy, specific	General	cal/g ‡	J/g	4.186 8*
		Btu/lb	kJ/kg	2.326*
Enthalpy	(see Energy)			
Entropy	(see Capacity, heat)			
Entropy, specific	(see Capacity, heat, specific)			
Floor loading	(see Mass per area)			
Flow, heat, rate	(see Power)			
Flow, mass, rate	Gas, liquid	lb/min	kg/min	0.453 592 4
		lb/s	kg/s	0.453 592 4
	Dust flow	g/min	g/min	
	Machine work capacity, harvesting, materials handling	ton (short)/h	t/h, Mg/h**	0.907 184 7
Flow, volume	Air, gas, general	ft^3/s	m^3/s	0.028 316 85
		ft^3/s	m^3/min	1.699 011
	Liquid flow, general	gal/s (gps)	L/s	3.785 412
		gal/s (gps)	m^3/s	0.003 785 412
		gal/min (gpm)	L/min	3.785 412
	Seal and packaging leakage, sprayer flow	oz/s	mL/s	29.573 53
		oz/min	mL/min	29.573 53
	Fuel consumption	gal/h	L/h	3.785 412
	Pump capacity, coolant flow, oil flow	gal/min (gpm)	L/min	3.785 412
	Irrigation sprinkler, small pipe flow	gal/min (gpm)	L/s	0.063 090 20
	River and channel flow	ft^3/s	m^3/s	0.028 316 85
Flux, luminous	Light bulbs	lm	Lm	
Flux, magnetic	Coil rating	maxwell	Wb	0.000 000 01*
Force, thrust, drag	Pedal, spring, belt, hand lever, general	lbf	N	4.448 222
		ozf	N	0.278 013 9
		pdl	N	0.138 255 0
		kgf	N	9.806 650
		dyne	N	0.000 01*
	Drawbar, breakout, rim pull, winch line pull, general	lbf	kN	0.004 448 222
Force per length	Beam loading	lbf/ft	N/m	14.593 90
	Spring rate	lbf/in.	N/mm	0.175 126 8
Frequency	System, sound and electrical	Mc/s	MHz	1*
		kc/s	kHz	1*
		Hz, c/s	Hz	1*
	Mechanical events, rotational	r/s (rps)	s^{-1}, r/s	1*

Quantity	Application	From: Old Units	To: SI units	Multiply By:
		r/min (rpm)	min^{-1}, r/min	1*
	Engine, power-take-ff shaft, gear speed	r/min (rpm)	min^{-1}, r/min	1*
	Rotational dynamics	rad/s	rad/s	
Hardness	Conventional hardness numbers, BHN, R, etc., not affected by change to SI.			
Heat	(see Energy)			
Heat capacity	(see Capacity, heat)			
Heat capacity, specific	(see Capacity, heat, specific)			
Heat flow rate	(see Power)			
Heat flow - density of	(see Density of heat flow)			
Heat, specific	General	cal/g·°C	kJ/kg·K	4.186 8*
		Btu/lb·°F	kJ/kg·K	4.186 8*
Heat transfer coefficient	(see Coefficient of heat transfer)			
Illuminance, illumination	General	fc	lx	10.763 91
Impact strength	(see Strength, impact)			
Impedance, mechanical	Damping coefficient	lbf·s/ft	N·s/m	14.593.90
Inductance, electric	Filters and chokes, permeance	H	H	
Intensity, luminous	Light bulbs	candlepower	cd	1*
Intensity, radiant	General	W/sr	W/sr	
Leakage	(see Flow, volume)			
Length	Land distance, maps, odometers	mile	km	1.609 344*‖
	Field size, turning circle, braking distance, cargo platforms, rolling circumference, water depth, land leveling (cut and fill)	rod	m	5.029 210 ‖
		yd	m	0.914 4
		ft	m	0.304 8*
	Row spacing	in.	cm	2.54*
	Engineering drawings, product specifications, vehicle dimensions, width of cut, shipping dimensions, digging depth, cross section of lumber, radius of gyration, deflection	in.	mm	25.4*
	Precipitation, liquid, daily and seasonal, field drainage (runoff), evaporation and irrigation depth	in.	mm	25.4*
	Precipitation, snow depth	in.	cm	2.54*
	Coating thickness, filter particle size	mile	µm	25.4*
		µin.	µm	0.025 4*
		micron	µm	1*
	Surface texture			
	Roughness, average	µin.	µm	0.025 4*

Quantity	Application	From: Old Units	To: SI units	Multiply By:
	Roughness sampling length, waviness height and spacing	in.	mm	25.4 *
	Radiation wavelengths, optical measurements (interference)	μin.	nm	25.4*
Lengh per time	Precipitation, liquid per hour	in./h	mm/h	25.4*
	Precipitation, snow depth per hour	in./h	cm/h	2.54*
Load	(see Mass)			
Luminance	Brightness	footlambert	cd/m^2	3.426 259
Magnetization	Coil field stength	A/in.	A/m	39.370 08
Mass	Vehicle mass, axle rating, rated load, tire load, lifting capacity ‡‡, tipping load, load, quantity of crop, counter mass, body mass, general	ton (long)	t, Mg**	1.016 047
		ton (short)	t, Mg**	0.907 184 7
		lb	kg	0.453 592 4
		slug	kg	14.593 90
	Small mass	oz	g	28.349 52
Mass per area	Fabric, surface coatings	oz/yd^2	g/m^2	33.905 75
		lb/ft^2	kg/m^2	4.882 428
		oz/ft^2	g/m^2	305.151 7
	Floor loading	lb/ft^2	kg/m^2	4.882 428
	Application rate, fertilizer, pesticide	lb/acre	kg/ha	1.120 851
	Crop yield, soil erosion	ton (short)/acre	t/ha**	2.241 702
Mass per length	General, structural members	lb/ft	kg/m	1.488 164
		lb/yd	kg/m	0.496 054 7
Mass per time	Machine work capacity, harvesting, materials handling	ton (short)/h	t/h, Mg/h**	0.907 184 7
Modulus of elasticity	General	$lbf/in.^2$	MPa	0.006 894 757
Modulus of rigidity	(see Modulus of elasticity)			
Modulus, section	General	$in.^3$	mm^3	16 387.06
		$in.^3$	cm^3	16.387 06
Modulus, bulk	System fluid compression	psi	kPa	6.894 757
Moment, bending	(see Moment of force)			
Moment of are, second	General	$in.^4$	mm^4	416 231.4
		$in.^4$	cm^4	41.623 14
Moment of force, torque, bending moment	General, engine torque, fasteners, steering torque, gear torque, shaft torque	lbf·in.	N·m	0.112 984 8
		lbf·ft	N·m	1.355 818
		kgf·cm	N·m	0.098 066 5*
	Locks, light torque	ozf·in.	mN·m	7.061 552
Moment of inertia, mass	Flywheel, general	$lb·ft^2$	$kg·m^2$	0.042 140 11
Moment of mass	Unbalance	oz·in.	g·m	0.720 077 8
Moment of momentum	(see Momentum, angular)			
Moment of section	(see Moment of area, second)			
Momentum, linear	General	lb·ft/s	kg·m/s	0.138 255 0
Momentum, angular	Torsional vibration	$lb·ft^2/s$	$kg·m^2/s$	0.042 140 11
Permeability	Magnetic core properties	H/ft	H/m	3.280 840

Quantity	Application	From: Old Units	To: SI units	Multiply By:
Permeance	(see Inductance)			
Potential, electric	General	V	V	
Power	General, light bulbs	W	W	
	Air conditioning, heating	Btu/min	W	17.584 27
		Btu/h	W	0.293 071 1
	Engine, alternator, drawbar, power-take-off, hydraulic and pneumatic systems, heat rejection, heat exchanger capacity, water power, electrical power, body heat loss	hp (550 ft·lbf/s)	kW	0.745 699 9
Power per area	Solar radiation	Btu/ft^2h	W/m^2	3.154 591
Pressure	All pressure except very small	$lbf/in.^2$ (psi)	kPa	6.894 757
		in.Hg (60°F)	kPa	3.376 85
		in.H_2O (60 °F)	kPa	0.248 84
		mmHg (0 °C)	kPa	0.133 322
		kgf/cm^2	kPa	98.066 5
		bar	kPa	100.0*
		lbf/ft^2	kPa	0.47 880 26
		atm (normal = 760 torr)	kPa	101.325*
	Very small pressure (high vacuum)	$lbf/in.^2$ (psi)	Pa	6 894.757
Pressure, sound level	Acoustical measurement. When weighting is specified show weighting level in parenthesis following the symbol for example db(A)	dB	dB	
Quantity of electricity	General	C	C	
Radiant intensity	(see Intensity, radiant)			
Resistance, electric	General	Ω	Ω	
Resistivity, electric	General	Ω·ft	Ω·m	0.304 8*
		Ω·ft	Ω·cm	30.48*
Sound pressure level	(see Pressure, sound level)			
Speed	(see Velocity)			
Spring rate, linear	(see Force per length)			
Spring rate, torsional	General	lbf·ft/deg	N·m/deg	1.355 818
Strength, field, electric	General	V/ft	V/m	3.280 840
Strength, field, magnetic	General	oersted	A/m	79.577 47
Strength, impact	Materials testing	ft·lbf	J	1.355 818
Stress	General	$lbf/in.^2$	Mpa	0.006 894 757
Surface tension	(see Tension, surface)			
Temperature	General use	°F	°C	$t_{°C} = (t_{°F} - 32)/1.8$*
	Absolute temperature, thermodynamics, gas cycles	°R	K	$T_K = T_{°R}/1.8$*
Temperature interval	General use	°F	K†	1 K = 1 °C = 1.8 °F *
Tension, surface	General	lbf/in.	mN/m	175 126.8

Quantity	Application	From: Old Units	To: SI units	Multiply By:
		dyne/cm	mN/m	1*
Thermal diffusivity	Heat transfer	ft^2/h	m^2/h	0.092 903 04
Thrust	(see Force)			
Time	General	s	s	
		h	h	
		min	min	
	Hydraulic cycle time	s	s	
	Hauling cycle time	min	min	
Torque	(see Moment of force)			
Toughness, fracture	Metal properties	$ksi \cdot in.^{0.5}$	$MPa \cdot m^{0.5}$	1.098 843
Vacuum	(see Pressure)			
Velocity, angular	(see Velocity, rotational)			
Velocity, linear	Vehicle	mile/h	km/h	1.609 344*
	Fluid flow, conveyor speed, lift speed, air speed	ft/s	m/s	0.304 8*
	Cylinder actuator speed	in./s	mm/s	25.4*
	General	ft/s	m/s	0.304 8*
		ft/min	m/min	0.304 8*
		in./s	mm/s	25.4*
Velocity, rotational	(see Frequency)			
Viscosity, dynamic	General liquids	centipoise	MPa·s	1*
Viscosity, kinematic	General liquids	centistokes	Mm^2/s	1*
Volume	Truck body, shipping or freight, bucket capacity, earth, gas, lumber, building, general	yd^3	m^3	0.764 554 9
		ft^3	m^3	0.028 316 85
	Combine harvester grain tank capacity	bushel	L	35.239 07
	Automobile luggage capacity	ft^3	L	28.316 85
	Gas pump displacement, air compressor, air reservoir, engine displacement			
	Large	$in.^3$	L	0.016 387 06
	Small	$in.^3$	cm^3	16.387 06
	Liquid - fuel, lubricant, coolant, liquid wheel ballast	gal	L	3.785 412
		qt	L	0.946 352 9
		pt	L	0.473 176 5
	Small quantity liquid	oz	mL	29.573 53
	Irrigation, reservoir	acre·ft	m^3	1 233.489 ‖
			dam^3	1.233 489 ‖
	Grain bins	bushel (U.S.)	m^3	0.035 239 07
Volume per area	Application rate, pesticide	gal/acre	L/ha	9.353 958
Volume per time	Fuel consumption (Also see Flow)	gal/h	L/ha	3.785 412
Weight	May mean either mass or force - avoid use of weight			
Work	(see Energy)			
Young's modulus	(see Modulus of elasticity)			

Notes:
* Indicates exact conversion factor.
† In these expressions K indicates temperature intervals. Therefore, K may be replaced with °C if desired without changing the value or affecting the conversion factor. kJ/(kg·K) = kJ/(kg·°C).
‡ Not to be confused with kcal/g. kcal often called calorie.
§ Convenient conversion: 235.215 / (mile per gal) = L/(100 km).

‖ Official use in surveys and cartography involves the U.S. survey mile based on the U.S. survey foot, which is longer than the international foot by two parts per million. The factors used in this standard for acre, acre foot, rod are based on the U.S. survey foot. Factors for all other old length units are based on the international foot. (see ANSI/ASTM Standard E380-76).
Standard acceleration of gravity is 9.806 650 m/s^2 exactly (Adopted by the General Conference on Weights and Measures).
** The symbol t is used to designate metric ton. The unit metric ton (exactly 1 Mg) is in wide use but should be limited to commercial description of vehicle mass, freight mass and agricultural commodities. No prefix is permitted.
†† Conversions of Btu are based on the International Table Btu.
‡‡ Lift capacity ratings for cranes, hoists and related components such as ropes, cable chains, etc., should be rated in mass units. Those items such as winches, which can be used for pulling as well as lifting, shall be rated in both force and mass units for safety reasons.
§§ ASAE S209 and SAE J708, specify kg/(kW·h). It should be noted that there is a trend toward use of g/MJ as specified for highway vehicles.

8 Conversion Techniques

8.1 Conversion of quantities between systems of units involves careful determination of the number of significant digits to be retained. To convert “1 quart of oil” to “0.946 352 9 liter of oil” is, of course, unrealistic because the intended accuracy of the value does not warrant expressing the conversion in this fashion.

8.2 All conversions, to be logically established, must depend upon an intended precision of the original quantity – either implied by a specific tolerance, or by the nature of the quantity. The first step in conversion is to establish this precision.

8.3 The implied precision of a value should relate to the number of significant digits shown. The implied precision is plus or minus one-half unit of the last significant digit in which the value is stated. This is true because it may be assumed to have been rounded from a greater number of digits, and one-half unit of the last significant digit retained is the limit of error resulting from rounding. For example, the number 2.14 may have been rounded from any number between 2.135 and 2.145. Whether rounded or not, a quantity should always be expressed with this implication of precision in mind. For instance, 2.14 in., implies a precision of ± 0.005 in., since the last significant digit is in units of 0.01 in.

8.4 Quantities should be expressed in digits which are intended to be significant. The dimension 1.1875 in. may be a very accurate one in which the digit in the fourth place is significant, or it may in some cases be an exact decimalization of a fractional dimension, 1-3/16 in., in which case the dimension is given with too many decimal places relative to its intended precision.

EXAMPLE 1: Convert the height of 5 feet 6 inches to metric unit. Using the exact conversion factor (1 foot = 30.48 cm), the height in metric is exactly 167.64 cm. However, for the practical purpose at hand, it is sufficient to convert the height to only 3 significant digits, or 168, as rounded off.

8.5 Quantities should not be expressed with significant zeros omitted. The dimension 2 in. may mean "about 2 in.", or it may, in fact, mean a very accurate expression which should be written 2.0000 in. In the latter case, while the added zeros are not significant in establishing the value, they are very significant in expressing the proper intended precision.

9 Rules for Rounding Off

9.1 Where feasible, the rounding of SI equivalents should be in reasonable, convenient, whole units.

9.2 Interchangeability of parts, functionally, physically, or both, is dependent upon the degree of round-off accuracy used in the conversion of the U.S. customary to SI value.

9.3 Rounding off numerical values

When a number is to be rounded to fewer decimal places, the procedure shall be as follows:

9.3.1 When the first digit discarded is less than 5 (i.e. 0, 1, 2, 3 and 4), the last digit retained shall not be changed. If the digit to be discarded is a whole number, it is replaced by zero so that the remaining digits will retain their place values.

EXAMPLES:	**Round off values**
Decimal	
67.482 31, if rounded off to two decimal places	67.48
3.463 25, if rounded off to three decimal places	3.463
Whole Number	
6 748, if rounded off to two significant digits	6 700
3 463, if rounded off to three significant digits	3 460

9.3.2 When the first digit discarded is greater than 5 (i.e. 6, 7, 8 and 9), the last retained digit is increased by 1. If the digit to be discarded is a whole number, it is replaced by zero so that the remaining digits will retain their place values.

EXAMPLES:	**Round off values**
Decimal	
3.463 25, if rounded off to one decimal place	3.5
67.487 31, if rounded off to two decimal places	67.49
Whole Number	
6 748, if rounded off to one significant digit	7 000
3 463, if rounded off to two significant digits	3 500

9.3.3 When the first digit discarded is equal to 5 followed by zeros only or is five alone, the last retained digit is increased by one if it is odd (i.e. 1, 3, 5, 7 or 9) and it is left unchanged if it is even (i.e. 0, 2, 4, 6 or 8).

EXAMPLES:	**Round off values**
Decimal	
67.15, if rounded off to one decimal place	67.2
67.25, if rounded off to one decimal place	67.2
Whole Number	
3 500, if rounded off to the nearest thousands	4 000
6 500, if rounded off to the nearest thousands	6 000

9.3.4 When the first digit discarded is equal to 5 followed by at least one digit other than 0, the last figure retained shall be increased by one.

EXAMPLES:	**Round off values**
Decimal	
67.251, if rounded off to one decimal place	67.3
8.376 52, if rounded to three decimal places	8.377
Whole Number	
4 530, if rounded off to the nearest thousands	5 000
6 510, if rounded off to the nearest thousands	7 000

9.3.5 The final rounded value shall be obtained from the most precise value available in one step only and not from a series of successive roundings.

EXAMPLES:	**Correct**	**Incorrect (successive rounding)**
Decimal		
27.46, if rounded off to a whole number	27	
27.46, if rounded off to one decimal place	27.5	
27.46 is off to one decimal place then rounded off to a whole number		28