United States Department of Commerce
Technology Administration
National Institute of Standards and Technology

NIST Special Publication 814
1998 Edition

Interpretation of the SI for the United States and Federal Government Metric Conversion Policy

Barry N. Taylor, Editor

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[1] At Boulder, CO 80303.
[2] Some elements at Boulder, CO.

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U.S. Department of Commerce
William M. Daley, Secretary

Technology Administration
Gary R. Bachula, Acting Under Secretary for Technology

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Introduction

The International System of Units, universally abbreviated SI (from the French *Le Système International d'Unités),* is the modern metric system of measurement. Long the dominant system of measurement used in science, the SI is rapidly becoming the dominant system used in international commerce.

The first edition of this National Institute of Standards and Technology Special Publication, NIST SP 814, was published in 1991 and replaced Letter Circular LC1132 published in 1982 by NIST's predecessor, the National Bureau of Standards (NBS). It reprinted the department of Commerce, NIST, Federal Register notice of December 20, 1990 entitled "Metric System of Measurement: Interpretation of the International System of Units for the United States"; the Department of Commerce, Office of the Secretary, Federal Register notice of January 2, 1991 entitled "Metric Conversion Policy for Federal agencies"; and Executive Order 12770 issued by the President of the United States on July 25, 1991 entitled "Metric Usage in Federal Government Programs."

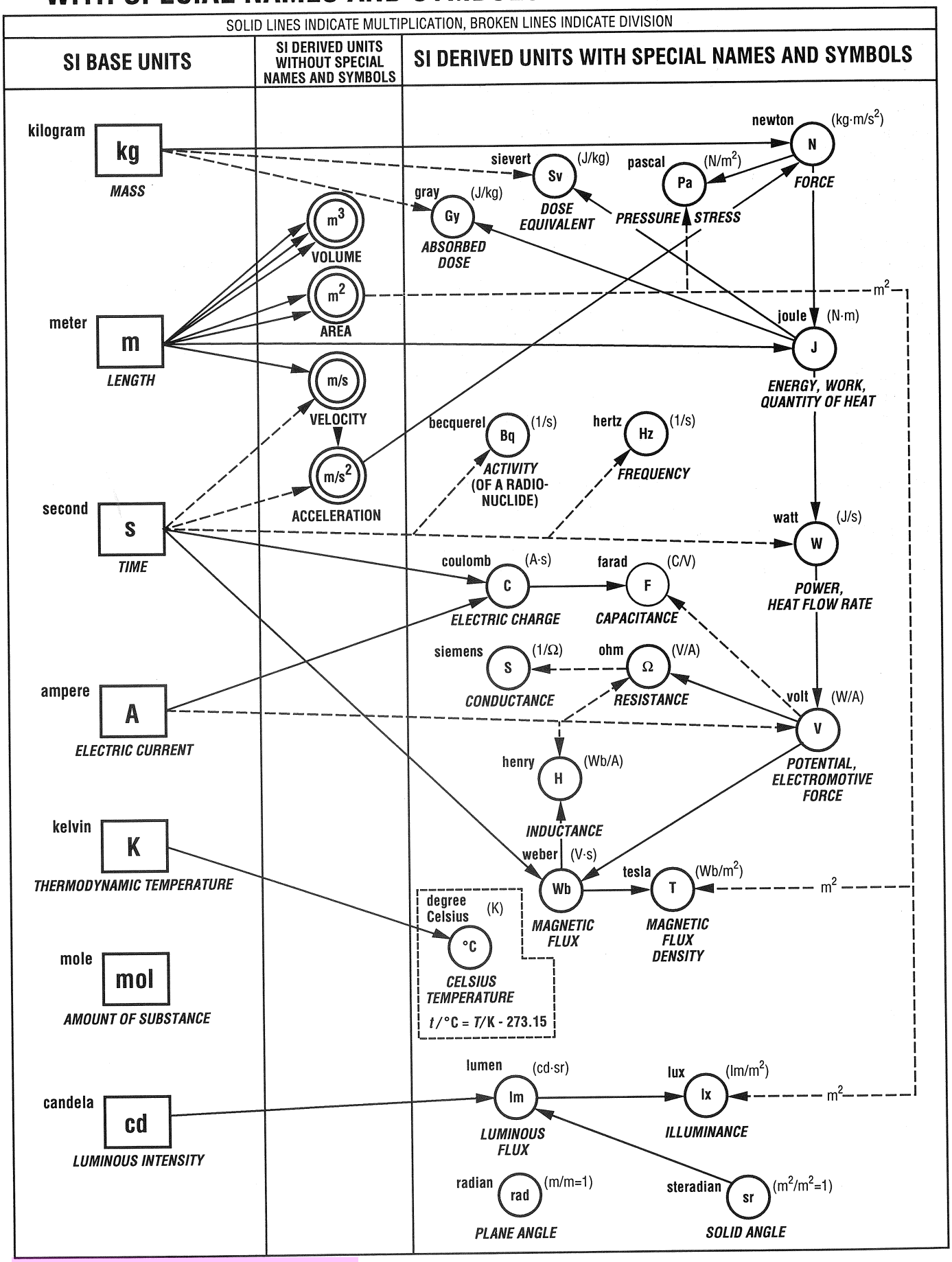
The first Federal Register notice restated the interpretation by the Department of Commerce of the International System of Units for use in the United States that was last published by the Department in 1982; the second revised the Code of Federal Regulations (CFR) to remove the voluntary aspect of the conversion to the metric system of measurement for Federal agencies; and the Executive Order provided Presidential authority and direction for the use of the metric system of measurement by Federal departments and agencies in their programs. The 1991 edition of NIST SP 814 also included a diagram with accompanying text that showed graphically how the SI derived units with special names and symbols were related to the seven SI base units.

Since the publication of NIST SP 814 in 1991, the international bodies that are responsible for the SI made some changes to it. It therefore became necessary to set forth a new interpretation of the SI for the United States that reflected those changes. This was done in a Department of Commerce, NIST, Federal Register notice of July 28, 1998, also entitled "Metric System of Measurement: Interpretation of the International System of Units for the United States." Further, the changes made to the SI by the responsible international bodies altered the number of SI units with special names and symbols. It is therefore deemed appropriate to publish this 1998 edition of NIST SP 814 with the new Federal Register notice of July 28, 1998 in place of the old notice of December 20, 1990, and a revised diagram and accompanying text showing how the SI derived units with special names and symbols are related to the seven SI base units. Further, to make the 1998 edition of NIST SP 814 more complete, the Metric Conversion Act of 1975, as amended in 1988, 1995, and 1996, is included. To reflect this additional information on U.S. Government metric policy, the title of this Special Publication has been changed from *Interpretation of the SI for the United States and Metric Conversion Policy for Federal Agencies* to *Interpretation of the SI for the United States and Federal Government Metric Conversion Policy*.

Because of the importance of the SI to science, technology, and commerce, and because (i) NIST coordinates the Federal Government policy on the conversion to the SI by Federal agencies and on the use of the SI by U.S. industry, (ii) NIST provides official U.S. representation in the various international bodies established by the Meter Convention that are now responsible for the SI, and (iii) the Secretary of Commerce has delegated his authority to interpret or modify the SI for use in the United States to the NIST Director, NIST provides for those who use the International System many other sources of information on the SI in addition to NIST SP 814. These include NIST SP 811, *Guide for the Use of the International System of Units (SI),* by Barry N. Taylor; and NIST SP 330, *The International system of Units (SI)*, Barry N. Taylor, Editor. This latter document is the United States version of the English translation of the definitive international reference on the SI published in French by the International Bureau of Weights and Measures (BIPM, *Bureau International des Poids et Mesures).*

NIST SP 811, NIST SP 330, the July 28, 1998 Federal Register notice, the "essentials" of the SI together with useful background information, and links to the Web sites of other organizations involved with the SI (for example, the NIST Metric Program and the BIPM itself), are all available on the Web site entitled "NIST Reference on Constants, Units, and Uncertainty" at URL `http://physics.nist.gov/cuu`. Users of this NIST publication are encouraged to take advantage of these other sources of information on the SI.

RELATIONSHIPS OF THE SI DERIVED UNITS WITH SPECIAL NAMES AND SYMBOLS AND THE SI BASE UNITS



Graphic Superseded: NIST SP 811: 2008

The diagram at the left shows graphically how the 21 SI derived units with special names and symbols are related to the seven SI base units. In the first column, the symbols of the SI base units are shown in rectangles, with the name of the unit shown toward the upper left of the rectangle and the name of the associated base quantity shown in italic type below the rectangle. In the third column the symbols of the SI derived units with special names and symbols are shown in solid circles, with the name of the unit shown toward the upper left of the circle, the name of the associated derived quantity shown in italic type below the circle, and an expression for the derived unit in terms of other units shown toward the upper right in parentheses. In the second column are shown those derived units without special names and symbols that are used in the derivation of the derived units with special names and symbols [the cubic meter (m^3) excepted]. In the diagram, the derivation of each derived unit is indicated by arrows that bring in units in the numerator (solid lines) and units in the denominator (broken lines), as appropriate.

Two SI derived units with special names and symbols, the radian, symbol rad, and the steradian, symbol sr (bottom of the third column of the diagram), are shown without any connections to SI base units—either direct or through other SI derived units. The reason is that in the SI, the quantities plane angle and solid angle are defined in such a way that their dimension is one—they are so-called dimensionless quantities. This means that the coherent SI derived unit for each of these quantities is the number one, symbol 1. That is, because plane angle is expressed as the ratio of two lengths, and solid angle as the ratio of an area and the square of a length, the SI derived unit for plane angle is $m/m = 1$, and the SI derived unit for solid angle is $m^2/m^2 = 1$. To aid understanding, the special name radian with symbol rad is given to the number 1 for use in expressing values of plane angle; and the special name steradian with symbol sr is given to the number 1 for use in expressing values of solid angle. However, one has the option of using or not using these names and symbols in expressions for other SI derived units, as is convenient.

The unit "degree Celsius," which is equal in magnitude to the unit "kelvin," is used to express Celsius temperature t. In this case, "degree Celsius" is a special name used in place of "kelvin." This equality is indicated in the diagram by the symbol K in parentheses toward the upper right of the °C circle. The equation below *CELSIUS TEMPERATURE* relates Celsius temperature t to thermodynamic temperature T. An interval or difference of Celsius temperature can, however, be expressed in kelvins as well as in degrees Celsius.

federal register

Tuesday
July 28, 1998

Part II

Department of Commerce

National Institute of Standards and Technology

Metric System of Measurement: Interpretation of the International System of Units for the United States; Notice

DEPARTMENT OF COMMERCE

National Institute of Standards and Technology

[Docket No. 980430113–8113–01]

Metric System of Measurement: Interpretation of the International System of Units for the United States

AGENCY: National Institute of Standards and Technology, Commerce.

ACTION: Notice.

SUMMARY: This notice restates the interpretation of the International System of Units (SI) for the United States by the Department of Commerce. This interpretation was last published by the Department of Commerce in the **Federal Register** on December 20, 1990 (55 FR 52242–52245). Since the publication of that notice, the international bodies that are responsible for the SI have made some changes to it. It has therefore become necessary to set forth a new interpretation of the SI for the United States that reflects these changes.

FOR FURTHER INFORMATION CONTACT: For information regarding the International System of Units, contact Dr. Barry N. Taylor, Building 225, Room B161, National Institute of Standards and Technology, Gaithersburg, MD 20899–0001, telephone number (301) 975–4220. For information regarding the Federal Government's efforts to coordinate the transition of the United States to the International System of Units, contact Mr. James B. McCracken, Metric Program, Building 820, Room 306, National Institute of Standards and Technology, Gaithersburg, MD 20899–0001, telephone number (301) 975–3690, email: metric_prg@nist.gov

SUPPLEMENTARY INFORMATION: Section 5164 of Public Law 100–418, the Omnibus Trade and Competitiveness Act of 1988, amended Public Law 94–168, the Metric Conversion Act of 1975. In particular, section 3 of the Metric Conversion Act (codified as amended 15 U.S.C. 205b) reads as follows:

"Sec. 3. It is therefore the declared policy of the United States—

"(1) to designate the metric system of measurement as the preferred system of weights and measures for United States trade and commerce;

"(2) to require that each Federal agency, by a date certain and to the extent economically feasible by the end of the fiscal year 1992, use the metric system of measurement in its procurements, grants, and other business related activities, except to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms, such as when foreign competitors are producing competing products in non-metric units;

"(3) to seek out ways to increase understanding of the metric system of measurement through educational information and guidance and in Government publications; and

"(4) to permit the continued use of traditional systems of weights and measures in nonbusiness activities."

In the Metric Conversion Act of 1975, the "metric system of measurement" is defined as the International System of Units as established in 1960 by the General Conference of Weights and Measures (abbreviated CGPM after the French *Conférence Général des Poids et Mesures*) and interpreted or modified for the United States by the Secretary of Commerce (15 U.S.C. 205c). The Secretary has delegated this authority to the Director of the National Institute of Standards and Technology. In implementation of this authority, tables and associated text were published in the **Federal Register** of December 20, 1990 (55 FR 52242–52245), setting forth the interpretation for the United States of the International System of Units (abbreviated SI in all languages after the French *Systéme International d'Unités*).

The CGPM is an intergovernmental organization established by the Meter Convention (*Convention du Métre*), which was signed by the United States and 16 other countries in Paris in 1875 (nearly 50 countries are now members of the Convention). One of the responsibilities of the CGPM is to ensure that the SI reflects the latest advances in science and technology. Since the publication of the 1990 **Federal Register** notice, the CGPM has made two significant changes to the SI. These are (1) the addition of four new SI prefixes to form decimal multiples and submultiples of SI units; and (2) the elimination of the class of supplementary units (the radian and the steradian) as a separate class in the SI. Further, the International Committee for Weights and Measures (abbreviated CIPM after the French *Comité International des Poids et Mesures*), which comes under the authority of the CGPM, has made some new recommendations regarding units not part of the SI that may be used with the SI. It is therefore necessary to issue new tables and associated text that reflect these changes and which set forth a new interpretation of the SI for the United States. Thus this **Federal Register** notice supersedes the previous interpretation published in the **Federal Register** on December 20, 1990 (55 FR 52242–52245).

Classes of SI Units

There are now only two classes of units in the International System of Units: *base units* and *derived units*. The units of these two classes form a *coherent* set of units and are designated by the name "SI units." Here, the term coherent is used to mean a unit system where all derived units are obtained from the base units by the rules of multiplication and division with no numerical factor other than the number 1 ever occurring in the expressions for the derived units in terms of the base units. The SI also includes *prefixes* to form decimal multiples and submultiples of SI units. Because units formed with SI prefixes are not coherent with SI units, the units so formed are designated by their complete name "decimal multiples and submultiples of SI units" in order to make a distinction between them and the coherent set of SI units proper. The SI units and their decimal multiples and submultiples together are often called "units of the SI."

SI Base Units

The SI is founded on seven SI *base units* for seven *base quantities* assumed to be mutually independent. These units and quantities are given in Table 1.

Table 1. SI base units

Base quantity	SI base unit	
	Name	Symbol
length	meter	m
mass[1]	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

[1] "Weight" in common parlance is often used to mean mass.

SI Derived Units

Other quantities, called *derived quantities,* are defined in terms of these seven base quantities through a system of quantity equations. SI *derived units* for these derived quantities are obtained from this system of equations and the seven SI base units in a coherent manner, which means, in keeping with the above discussion of the term coherent, that they are formed as products of powers (both positive and negative) of the SI base units corresponding to the base quantities concerned without numerical factors. Table 2 gives some examples of SI derived units.

Table 2. Examples of SI derived units

Derived quantity	SI derived unit	
	Name	Symbol
area	square meter	m^2
volume	cubic meter	m^3
speed, velocity	meter per second	m/s
acceleration	meter per second squared	m/s^2
wave number	reciprocal meter	m^{-1}
mass density (density)	kilogram per cubic meter	kg/m^3
specific volume	cubic meter per kilogram	m^3/kg
current density	ampere per square meter	A/m^2
magnetic field strength	ampere per meter	A/m
amount-of-substance concentration (concentration)	mole per cubic meter	mol/m^3
luminance	candela per square meter	cd/m^2
mass fraction	kilogram per kilogram, which may be represented by the number 1	kg/kg = 1

Quantities of Dimension 1

The last entry of Table 2, mass fraction, is an example of certain derived quantities that are defined as the ratio of two mutually comparable quantities, that is, two quantities of the same kind. Since the coherent SI derived unit of such a derived quantity is the ratio of two identical SI units, that unit may also be expressed by the number one, symbol 1. Such quantities are called *quantities of dimension* 1, or *dimensionless quantities,* and the SI unit of all such quantities is the number 1. Examples of other derived quantities of dimension 1, and thus with a coherent SI derived unit that may be expressed by the number 1, are relative permeability, dynamic friction factor, refractive index, characteristic numbers such as the Mach number, and numbers that represent a count, such as a number of molecules. However, the number 1 is generally not explicitly shown in the expression for the value of a quantity of dimension 1. For example, the value of the refractive index of a given medium is expressed as $n = 1.51$ rather than as $n = 1.51 \times 1$. In a few cases a special name and symbol are given to the number 1 to aid understanding. The radian, unit symbol rad, and steradian, unit symbol sr, which are given in Table 3 and are discussed in connection with Table 4, are two such examples.

SI Derived Units With Special Names and Symbols

For ease of understanding and convenience, 21 SI derived units have been given special names and symbols. These are listed in Table 3, where it should be noted that the last three units of Table 3, the becquerel, unit symbol Bq, the gray, unit symbol Gy, and the sievert, unit symbol Sv, were specifically introduced by the CGPM with a view to safeguarding human health.

Table 3. SI derived units with special names and symbols

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

Degree Celsius

The derived unit in Table 3 with special name degree Celsius and special symbol °C deserves comment. Because of the way temperature scales used to be defined, it remains common practice to express a thermodynamic temperature, symbol T, in terms of its difference from the reference temperature $T_0 = 273.15$ K, the ice point. This temperature difference is called Celsius temperature, symbol t, and is defined by the quantity equation $t = T - T_0$. The unit of Celsius temperature is the degree Celsius, symbol °C. The numerical value of a Celsius temperature t expressed in degrees Celsius is given by

$$\frac{t}{°C} = \frac{T}{K} - 273.15 .$$

It follows from the definition of t that the degree Celsius is equal in magnitude to the kelvin, which in turn implies that the numerical value of a given temperature difference or temperature interval whose value is expressed in the unit degree Celsius (°C) is equal to the numerical value of the same difference or interval when its value is expressed in the unit kelvin (K). Thus temperature differences or temperature intervals may be expressed in either the degree Celsius or the kelvin using the same numerical value. For example, the Celsius temperature difference Δt and the thermodynamic temperature difference ΔT between the melting point of gallium and the triple point of water may be written as $\Delta t = 29.7546$ °C $= \Delta T = 29.7546$ K. (Note that the centigrade temperature scale is obsolete; the unit name degree centigrade should no longer be used.)

Use of SI Derived Units With Special Names and Symbols

The special names and symbols of the 21 SI derived units with special names and symbols given in Table 3 may themselves be included in the names and symbols of other SI derived units. This use is shown in Table 4. All of the SI derived units in Table 4, like those in Table 3, have been obtained from the SI base units in the same coherent manner discussed above.

Table 4. Examples of SI derived units whose names and symbols include SI derived units with special names and symbols

Derived quantity	SI derived unit		
	Name	Symbol	Expression in terms of SI base units
dynamic viscosity	pascal second	Pa · s	$m^{-1} \cdot kg \cdot s^{-1}$
moment of force	newton meter	N · m	$m^2 \cdot kg \cdot s^{-2}$
surface tension	newton per meter	N/m	$kg \cdot s^{-2}$
angular velocity	radian per second	rad/s	$m \cdot m^{-1} \cdot s^{-1} = s^{-1}$
angular acceleration	radian per second squared	rad/s^2	$m \cdot m^{-1} \cdot s^{-2} = s^{-2}$
heat flux density, irradiance	watt per square meter	W/m^2	$kg \cdot s^{-3}$
heat capacity, entropy	joule per kelvin	J/K	$m^2 \cdot kg \cdot s^{-2} \cdot K^{-1}$
specific heat capacity, specific entropy	joule per kilogram kelvin	J/(kg · K)	$m^2 \cdot s^{-2} \cdot K^{-1}$
specific energy	joule per kilogram	J/kg	$m^2 \cdot s^{-2}$
thermal conductivity	watt per meter kelvin	W/(m · K)	$m \cdot kg \cdot s^{-3} \cdot K^{-1}$
energy density	joule per cubic meter	J/m^3	$m^{-1} \cdot kg \cdot s^{-2}$
electric field strength	volt per meter	V/m	$m \cdot kg \cdot s^{-3} \cdot A^{-1}$
electric charge density	coulomb per cubic meter	C/m^3	$m^{-3} \cdot s \cdot A$
electric flux density	coulomb per square meter	C/m^2	$m^{-2} \cdot s \cdot A$
permittivity	farad per meter	F/m	$m^{-3} \cdot kg^{-1} \cdot s^4 \cdot A^2$
permeability	henry per meter	H/m	$m \cdot kg \cdot s^{-2} \cdot A^{-2}$
molar energy	joule per mole	J/mol	$m^2 \cdot kg \cdot s^{-2} \cdot mol^{-1}$
molar entropy, molar heat capacity	joule per mole kelvin	J/(mol · K)	$m^2 \cdot kg \cdot s^{-2} \cdot K^{-1} \cdot mol^{-1}$
exposure (x and γ rays)	coulomb per kilogram	C/kg	$kg^{-1} \cdot s \cdot A$
absorbed dose rate	gray per second	Gy/s	$m^2 \cdot s^{-3}$
radiant intensity	watt per steradian	W/sr	$m^4 \cdot m^{-2} \cdot kg \cdot s^{-3} = m^2 \cdot kg \cdot s^{-3}$
radiance	watt per square meter steradian	$W/(m^2 \cdot sr)$	$m^2 \cdot m^{-2} kg \cdot s^{-3} = kg \cdot s^{-3}$

Radian and Steradian

As indicated in Table 3, the radian, unit symbol rad, and steradian, unit symbol sr, are the special names and symbols for the derived units of plane angle and solid angle, respectively. These units may be used or not in expressions for derived units as is convenient in order to distinguish between derived quantities that are not of the same kind but are of the same dimension (that is, derived quantities whose units when expressed in SI base units are the same). Table 4 includes some examples of derived units that use the radian and steradian.

SI Prefixes

Table 5 gives the 20 SI prefixes used to form decimal multiples and submultiples of SI units. It is important to note that the kilogram is the only SI unit with a prefix as part of its name and symbol. Because multiple prefixes may not be used, in the case of the kilogram the prefix names of Table 5 are used with the unit name "gram" and the prefix symbols are used with the unit symbol "g." With this exception, any SI prefix may be used with any SI unit, including the degree Celsius and its symbol °C.

Table 5. SI prefixes

Factor	Name	Symbol	Factor	Name	Symbol
$10^{24} = (10^3)^8$	yotta	Y	10^{-1}	deci	d
$10^{21} = (10^3)^7$	zetta	Z	10^{-2}	centi	c
$10^{18} = (10^3)^6$	exa	E	$10^{-3} = (10^3)^{-1}$	milli	m
$10^{15} = (10^3)^5$	peta	P	$10^{-6} = (10^3)^{-2}$	micro	μ
$10^{12} = (10^3)^4$	tera	T	$10^{-9} = (10^3)^{-3}$	nano	n
$10^9 = (10^3)^3$	giga	G	$10^{-12} = (10^3)^{-4}$	pico	p
$10^6 = (10^3)^2$	mega	M	$10^{-15} = (10^3)^{-5}$	femto	f
$10^3 = (10^3)^1$	kilo	k	$10^{-18} = (10^3)^{-6}$	atto	a
10^2	hecto	h	$10^{-21} = (10^3)^{-7}$	zepto	z
10^1	deka	da	$10^{-24} = (10^3)^{-8}$	yocto	y

Because the SI prefixes strictly represent powers of 10, it is inappropriate to use them to represent powers of 2. Thus 1 kbit = 10^3 bit = 1000 bit and *not* 2^{10} = 1024 bit, where 1 kbit is one kilobit.

Units Outside the SI

Certain units are not part of the International System of Units, that is, they are outside the SI, but are important and widely used. Consistent with the recommendations of the CIPM, the units in this category that are accepted for use in the United States with the SI are given in Tables 6 and 7.

Table 6. Units outside the SI that are accepted for use with the SI

Name		Symbol	Value in SI units
minute	time	min	1 min = 60 s
hour	time	h	1 h = 60 min = 3600 s
day	time	d	1 d = 24 h = 86 400 s
degree	plane angle	°	1° = (π/180) rad
minute	plane angle	′	1′ = (1/60)° = (π/10 800) rad
second	plane angle	″	1″ = (1/60)′ = (π/648 000) rad
liter		L	1 L = 1 $dm^3 = 10^{-3}$ m^3
metric ton		t	1 t = 10^3 kg
neper		Np	1 Np = 1
bel		B	1 B = (1/2) ln 10 Np[1]

[1] Although the neper is coherent with SI units and is accepted by the CIPM, it has not been adopted by the CGPM and is thus not an SI unit.

Liter and Metric Ton

The units liter and metric ton in Table 6 deserve comment. The liter and its symbol l were adopted by the CIPM in 1879. The alternative symbol for the liter, L, was adopted by the CGPM in 1979 in order to avoid the risk of confusion between the letter l and the number 1. Thus, although *both* l and L are internationally accepted symbols for the liter, to avoid this risk the preferred symbol for use in the United States is L. Neither a lowercase script letter l nor an uppercase script letter l are approved symbols for the liter. With regard to the metric ton, this is the name to be used in the United States for the unit with symbol t and defined according to 1 t = 10^3 kg. (The name "metric ton" is also used in some other English speaking countries, but the name "tonne" is used in many countries.)

Table 7. Units outside the SI that are accepted for use with the SI, but whose values in SI units are obtained experimentally

Name	Symbol	Value in SI units[1]
electronvolt[2]	eV	$1\ eV = 1.602\ 177\ 33(49) \times 10^{-19}\ J$
unified atomic mass unit[3]	u	$1\ u = 1.660\ 540\ 2(10) \times 10^{-27}\ kg$
astronomical unit[4]	ua	$1\ ua = 1.495\ 978\ 70(30) \times 10^{11}\ m$

[1] The combined standard uncertainty (that is, estimated standard deviation) of the last two figures is shown in parentheses.
[2] The electronvolt is the kinetic energy acquired by an electron in passing through a potential difference of 1 V in vacuum.
[3] The unified atomic mass unit is equal to 1/12 of the mass of an unbound atom of the nuclide ^{12}C at rest and in its ground state.
[4] The astronomical unit is a unit of length approximately equal to the mean Earth-Sun distance. Its value is such that, when used to describe the motion of bodies in the solar system, the heliocentric gravitation constant is $(0.017\ 207\ 098\ 95)^2\ ua^3 \cdot d^{-2}$.

Other Units Outside the SI

Other units outside the SI that are currently accepted for use with the SI in the United States are given in Table 8. These units, which are subject to future review by the NIST Director on behalf of the Secretary of Commerce, should be defined in relation to the SI in every document in which they are used; their continued use is not encouraged. The CIPM currently accepts the use of all of the units given in Table 8 with the SI except for the curie, roentgen, rad, and rem. Because of the continued wide use of these units in the United States, especially in regulatory documents dealing with health and safety, this interpretation of the SI for the United States accepts their use with the SI. Nevertheless, use of the corresponding SI units is encouraged whenever possible, with values given in terms of the older units in parentheses if necessary.

Table 8. Other units outside the SI that are currently accepted for use with the SI, subject to future review

Name	Symbol	Value in SI units
nautical mile		1 nautical mile = 1852 m
knot		1 nautical mile per hour = (1852/3600) m/s
are[1]	a	$1\ a = 1\ dam^2 = 10^2\ m^2$
hectare[1]	ha	$1\ ha = 1\ hm^2 = 10^4\ m^2$
bar	bar	$1\ bar = 0.1\ MPa = 100\ kPa = 1000\ hPa = 10^5\ Pa$
ångström	Å	$1\ Å = 0.1\ nm = 10^{-10}\ m$
barn	b	$1\ b = 100\ fm^2 = 10^{-28}\ m^2$
curie	Ci	$1\ Ci = 3.7 \times 10^{10}\ Bq$
roentgen	R	$1\ R = 2.58 \times 10^{-4}\ C/kg$
rad	rad[2]	$1\ rad = 1\ cGy = 10^{-2}\ Gy$
rem	rem	$1\ rem = 1\ cSv = 10^{-2}\ Sv$

[1] This unit and its symbol are used to express areas of land.
[2] When there is risk of confusion with the symbol for the radian, rd may be used as the symbol for rad.

Use of SI Prefixes With Units Outside the SI

Some SI prefixes are used with some of the units given in Tables 6, 7, and 8. For example, prefixes for both positive and negative powers of ten are used with the liter, the electronvolt, the unified atomic mass unit, the bar, and the barn. Prefixes for positive powers of ten are used with the metric ton, and prefixes for negative powers of ten are used with the neper and the bel, although the bel is most commonly used in the form of the decibel: 1 dB = 0.1 B.

Rules and Style Conventions

A number of rules and style conventions have been adopted internationally for the use of the SI to ensure that scientific and technical communication is not hindered by ambiguity. The most important of these are as follows:

1. Unit symbols are printed in roman (upright) type regardless of the type used in the surrounding text.

2. Unit symbols are printed in lower-case letters except that:

(a) the symbol or the first letter of the symbol is an upper-case letter when the name of the unit is derived from the name of a person; and

(b) the preferred symbol for the liter in the United States is L.

3. When the name of a unit is spelled out, it is always written with a lower-case initial letter unless it begins a sentence.

4. Unit symbols are unaltered in the plural.

5. Unit symbols are not followed by a period unless at the end of a sentence.

6. Symbols for units formed from other units by multiplication are indicated by means of a half-high (that is, centered) dot or space.

Example: N•m or N m

7. Symbols for units formed from other units by division are indicated by means of a solidus (oblique stroke,/), a horizontal line, or negative exponents.

Example: m/s, $\frac{m}{s}$, or $m \cdot s^{-1}$

However, to avoid ambiguity, the solidus must not be repeated on the same line unless parentheses are used.

Examples:

m/s^2 or $m \cdot s^{-2}$ *but not:* m/s/s

$m \cdot kg/(s^3 \cdot A)$ or $m \cdot kg \cdot s^{-3} \cdot A^{-1}$ *but not:* $m \cdot kg/s^3/A$

Negative exponents should be used in complicated cases.

8. Prefix symbols are printed in roman (upright) type regardless of the type used in the surrounding text, and are attached to unit symbols without a space between the prefix symbol and the unit symbol. This last rule also applies to prefix names attached to unit names.

Examples:

1 mL (one milliliter)

1 pm (one picometer)

1 GΩ (one gigaohm)

1 THz (one terahertz)

9. The dgrouping formed by a prefix symbol attached to a unit sybmbol constitutes a new inseparable symbol (forming a multiple or submultiple of the unit concerned) which can be raised to a positive or negative power and which can be combined with other unit symbols to form compound unit symbols.

Examples:

$2.3\ cm^3 = 2.3\ (cm)^3 = 2.3\ (10^{-2}\ m)^3 = 2.3 \times 10^{-6}\ m^3$

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

$5000\ \mu s^{-1} = 5000\ (\mu s)^{-1} = 5000\ (10^{-6}\ s)^{-1} = 5000 \times 10^6\ s^{-1} = 5 \times 10^9\ s^{-1}$

Prefix names are also inseparable form the unit names to which they are attached. Thus, for example, millimeter, micropascal, and meganewton are single words.

10. Compound prefix symbols, that is, prefix symbols formed by the juxtaposition of two or more prefix symbols, are not permitted. This rule also applies to compound prefix names.

Example: 1 nm (one nanometer) *but not:* 1 mμm (one millimicrometer)

11. An SI prefix symbol (and name) cannot stand alone, but must always be attached to a unit symbol (or name).

Example: $5 \times 10^6/m^3$ *but not:* $5M/m^3$

12. In the expression for the value of a quantity, the unit symbol is placed after the numerical value and a space is left between the numerical value and the unit symbol. The only exceptions to this rule are for the unit symbols for degree, minute, and second for plane angle: °, ′, and ″, respectively (see Table 6), in which case no space is left between the numerical value and the unit symbol.

Example: α = 30°22′8″

This rule means that:

(a) The symbol °C for the degree Celsius is preceded by a space when one expresses the values of Celsius temperatures.

Example: *t* = 30.2 °C *but not:* *t* = 30.2°C or *t* = 30.2° C

(b) Even when the value of a quantity is used in an adjectival sense, a space is left between the numerical value and the unit symbol. (This rule recognizes that unit symbols are not like ordinary words or abbreviations but are mathematical entities, and that the value of a quantity should be expressed in a way that is as independent of language as possible.)

Examples:

a 1 m end gauge *but not:* a 1-m end gage

a 10 kΩ resistance *but not:* a 10-kΩ resistance

However, if there is any ambiguity, the words should be rearranged accordingly. For example, the statement "the samples were placed in 22 mL vials" should be replaced with the statement "the samples were placed in vials of volume 22 mL, " or "the samples were placed in 22 vials of volume 1 mL," whichever was meant.

Note: When unit names are spelled out as is often the case in nontechnical writing, the normal rules of English apply. Thus, for example, "a roll of 35-millimeter film" is acceptable.

Obsolete Units

As stated in the 1990 **Federal Register** notice, metric units, symbols, and terms that are not in accordance with the foregoing interpretation are not accepted for continued use in the United States with the International System of Units. Accordingly, the following units and terms listed in the table of metric units in section 2 of the Act of July 28, 1866 (15 U.S.C. 205) that legalized the metric system of weights and measures in the United States are not accepted for use in the United States:

myriameter

stere

millier or tonneau

quintal

myriagram

kilo (for kilogram).

Additional Information on the SI

Additional information on the SI may be found in NIST Special Publication (SP) 811, *Guide for the Use of the International System of Units (SI),* by Barry N. Taylor. This publication is for sale by the Superintendent of Documents, but is also available online (as will be this notice) at URL http://physics.nist.gov/cuu. (Although the 1995 edition of SP 811 is the edition currently available in print and online, a new edition that fully reflects the contents of this notice is under preparation and will replace the 1995 edition.)

Although there is no formal comment period, public comments are welcome on a continuing basis. Comments should be submitted to Dr. Barry N. Taylor at the above address.

Dated: June 19, 1998.

Robert E. Hebner,

Acting Deputy Director.

[FR Doc. 98–16965 Filed 7–27–98; 8:45 am]

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METRIC CONVERSION ACT

Public Law 94-168
December 23, 1975

As Amended by Public Laws
100-418, August 23, 1988
104-66, December 21, 1995
104-289, October 11, 1996

Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled, That this Act may be cited as the "Metric Conversion Act of 1975".

SEC. 2. The Congress finds as follows:

(1) The United States was an original signatory party to the 1875 Treaty of the Meter (20 Stat. 709), which established the General Conference of Weights and Measures, the International Committee of Weights and Measures and the International Bureau of Weights and Measures.

(2) Although the use of metric measurement standards in the United States has been authorized by law since 1866 (Act of July 28 1866; 14 Stat. 339), this Nation today is the only industrially developed nation which has not established a national policy of committing itself and taking steps to facilitate conversion to the metric system.

(3) World trade is increasingly geared towards the metric system of measurement.

(4) Industry in the United States is often at a competitive disadvantage when dealing in international markets because of its nonstandard measurement system, and is sometimes excluded when it is unable to deliver goods which are measured in metric terms.

(5) The inherent simplicity of the metric system of measurement and standardization of weights and measures has led to major cost savings in certain industries which have converted to that system.

(6) The Federal Government has a responsibility to develop procedures and techniques to assist industry, especially small business, as it voluntarily converts to the metric system of measurement.

(7) The metric system of measurement can provide substantial advantages to the Federal Government in its own operations.

SEC. 3. It is therefore the declared policy of the United States --

(1) to designate the metric system of measurement as the preferred system of weights and measures for United States trade and commerce;

(2) to require that each Federal agency, by a date certain and to the extent economically feasible by the end of the fiscal year 1992, use the metric system of measurement in its procurements, grants, and other business-related activities, except to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United

States firms, such as when foreign competitors are producing competing products in non-metric units;
(3) to seek out ways to increase understanding of the metric system of measurement through educational information and guidance and in Government publications; and
(4) to permit the continued use of traditional systems of weights and measures in nonbusiness activities.

SEC. 4. As used in this Act, the term-
(1) "Board" means the United States Metric Board, established under section 5 of this Act;
(2) "engineering standard" means a standard which prescribes (A) a concise set of conditions and requirements that must be satisfied by a material, product, process, procedure, convention, or test method; and (B) the physical, functional, performance and/or conformance characteristics thereof;
(3) "international standard or recommendation" means an engineering standard or recommendation which is (A) formulated and promulgated by an international organization and (B) recommended for adoption by individual nations as a national standard;
(4) "metric system of measurement" means the International System of Units as established by the General Conference of Weights and Measures in 1960 and as interpreted or modified for the United States by the Secretary of Commerce;
(5) "full and open competition" has the same meaning as defined in section 403(6) of title 41, United States Code;
(6) "total installed price" means the price of purchasing a product or material, trimming or otherwise altering some or all of that product or material, if necessary to fit with other building components, and then installing that product or material into a Federal facility;
(7) "hard-metric" means measurement, design, and manufacture using the metric system of measurement, but does not include measurement, design, and manufacture using English system measurement units which are subsequently reexpressed in the metric system of measurement;
(8) "cost or pricing data or price analysis" has the meaning given such terms in section 304A of the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 254b); and
(9) "Federal facility" means any public building (as defined under section 13 of the Public Buildings Act of 1959 (40 U.S.C. 612) and shall include any Federal building or construction project--

(A) on lands in the public domain;

(B) on lands used in connection with Federal programs for agriculture research, recreation, and conservation programs;

(C) on or used in connection with river, harbor, flood control, reclamation, or power projects;

(D) on or used in connection with housing and residential projects;

(E) on military installations (including any fort, camp, post, naval training station, airfield, proving ground, military supply depot, military school, or any similar facility of the Department of Defense);

(F) on installations of the Department of Veteran Affairs used for hospital or domiciliary purposes; or

(G) on lands used in connection with Federal prisons, but does not include (i) any Federal Building or construction project the exclusion of which the President deems to be justified in the public interest, or (ii) any construction project or building owned or controlled by a State government, local government, Indian tribe, or any private entity.

SEC. 5. (a) There is established, in accordance with this section, an independent instrumentality to be known as a United States Metric Board.

(b) The Board shall consist of 17 individuals, as follows:

(1) the Chairman, a qualified individual who shall be appointed by the President, by and with the advice and consent of the Senate;

(2) sixteen members who shall be appointed by the President, by and with the advice and consent of the Senate, on the following basis-

(A) one to be selected from lists of qualified individuals recommended by engineers and organizations representative of engineering interests;

(B) one to be selected from lists of qualified individuals recommended by scientists, the scientific and technical community, and organizations representative of scientists and technicians;

(C) one to be selected from a list of qualified individuals recommended by the National Association of Manufacturers or its successor;

(D) one to be selected from lists of qualified individuals recommended by the United States Chamber of Commerce, or its successor, retailers, and other commercial organizations;

(E) two to be selected from lists of qualified individuals recommended by the American Federation of Labor and Congress of Industrial Organizations or its successor, who are representative of workers directly affected by metric conversion, and by other organizations representing labor;

(F) one to be selected from a list of qualified individuals recommended by the National Governors Conference, the National Council of State legislatures, and organizations representative of State and local government;

(G) two to be selected from lists of qualified individuals recommended by organizations representative of small business;

(H) one to be selected from lists of qualified individuals representative of the construction industry;

(I) one to be selected from a list of qualified individuals recommended by the National Conference on Weights and Measures and standards making organizations;

(J) one to be selected from lists of qualified individuals recommended by educators, the educational community, and organizations representative of educational interests; and

(K) four at-large members to represent consumers and other interests deemed suitable by the President and who shall be qualified individuals.

As used in this subsection, each "list" shall include the names of at least three individuals for each applicable vacancy. The terms of office of the members of the Board first taking office shall expire as designated by the President at the time of nomination; five at the end of the 2nd year; five at the end of the 4th year; and six at the end of the 6th year. The term of office of the Chairman of such Board shall be 6 years. Members, including the Chairman, may be appointed to an additional term of 6 years, in the same manner as the original appointment. Successors to members of such Board shall be appointed in the same manner as the original members and shall have terms of office expiring 6 years from the date of expiration of the terms for which their predecessors were appointed. Any individual appointed to fill a vacancy occurring prior to the expiration of any term of office shall be appointed for the remainder of that term. Beginning 45 days after the date of incorporation of the Board, six members of such Board shall constitute a quorum for the transaction of any function of the Board.

(c) Unless otherwise provided by the Congress, the Board shall have no compulsory powers.

(d) The Board shall cease to exist when the Congress, by law, determines that its mission has been accomplished.

SEC. 6. It shall be the function of the Board to devise and carry out a broad program of planning, coordination, and public education, consistent with other national policy and interests, with the aim of implementing the policy set forth in this Act. In carrying out this program, the Board shall--

(1) consult with and take into account the interests, views, and conversion costs of United States commerce and industry, including small business; science; engineering; labor; education; consumers; government agencies at the Federal, State, and local level; nationally recognized standards developing and coordinating organizations; metric conversion planning and coordinating groups; and such other individuals or groups as are considered appropriate by the Board to the carrying out of the purposes of this Act. The Board shall take into account activities underway in the private and public sectors, so as not to duplicate unnecessarily such activities;

(2) provide for appropriate procedures whereby various groups, under the auspices of the Board, may formulate, and recommend or suggest, to the Board specific programs for coordinating conversion in each industry and segment thereof and specific dimensions and configurations in the metric system and in other measurements for general use. Such programs, dimensions, and configurations shall be consistent with (A) the needs, interests, and capabilities of manufacturers (large and small), suppliers, labor, consumers, educators, and other interested groups, and (B) the national interest;

(3) publicize, in an appropriate manner, proposed programs and provide an opportunity for interested groups or individuals to submit comments on such programs. At the request of interested parties, the Board, in its discretion, may hold hearings with regard to such programs. Such comments and hearings may be considered by the Board;

(4) encourage activities of standardization organizations to develop or revise, as rapidly as practicable, engineering standards on a metric measurement basis, and to take advantage

of opportunities to promote (A) rationalization or simplification of relationships, (B) improvements of design, (C) reduction of size variations, (D) increases in economy, and (E) where feasible, the efficient use of energy and the conservation of natural resources;
(5) encourage the retention, in new metric language standards, of those United States engineering designs, practices, and conventions that are internationally accepted or that embody superior technology;
(6) consult and cooperate with foreign governments, and intergovernmental organizations, in collaboration with the Department of State, and, through appropriate member bodies, with private international organizations, which are or become concerned with the encouragement and coordination of increased use of metric measurement units or engineering standards based on such units, or both. Such consultation shall include efforts, where appropriate, to gain international recognition for metric standards proposed by the United States, and, during the United States conversion, to encourage retention of equivalent customary units, usually by way of dual dimensions, in international standards or recommendations;
(7) assist the public through information and education programs, to become familiar with the meaning and applicability of metric terms and measures in daily life. Such programs shall include--

(A) public information programs conducted by the Board, through the use of newspapers, magazines, radio, television, and other media, and through talks before appropriate citizens' groups, and trade and public organizations;
(B) counseling and consultation by the Secretary of Education; the Secretary of Labor; the Administrator of the Small Business Administration; and the Director of the National Science Foundation, with educational associations, State and local educational agencies, labor education committees, apprentice training committees, and other interested groups, in order to assure (i) that the metric system of measurement is included in the curriculum of the Nation's educational institutions, and (ii) that teachers and other appropriate personnel are properly trained to teach the metric system of measurement;
(C) consultation by the Secretary of Commerce with the National Conference of Weights and Measures in order to assure that State and local weights and measures officials are (i) appropriately involved in metric conversion activities and (ii) assisted in their efforts to bring about timely amendments to weights and measures laws; and
(D) such other public information activities, by any Federal agency in support of this Act, as relate to the mission of such agency;

(8) collect, analyze, and publish information about the extent of usage of metric measurements; evaluate the costs and benefits of metric usage; and make efforts to minimize any adverse effects resulting from increasing metric usage;
(9) conduct research, including appropriate surveys; publish the results of such research; and recommend to the Congress and to the President such action as may be appropriate to deal with any unresolved problems, issues, and questions associated with metric conversion, or usage, such problems, issues, and questions may include, but are not limited to, the impact on workers (such as costs of tools and training) and on different

occupations and industries, possible increased costs to consumers, the impact on society and the economy, effects on small business, the impact on the international trade position of the United States, the appropriateness of and methods for using procurement by the Federal Government as a means to effect conversion to the metric system, the proper conversion or transition period in particular sectors of society, and consequences for national defense;

(10) submit annually to the Congress and to the President a report on its activities. Each such report shall include a status report on the conversion process as well as projections for the conversion process. Such report may include recommendations covering any legislation or executive action needed to implement the programs of conversion accepted by the Board. The Board may also submit such other reports and recommendations as it deems necessary; and

(11) submit to the Congress and to the President, not later than 1 year after the date of enactment of the Act making appropriations for carrying out this Act, a report on the need to provide an effective structural mechanism for converting customary units to metric units in statutes, regulations, and other laws at all levels of government, on a coordinated and timely basis, in response to voluntary conversion programs adopted and implemented by various sectors of society under the auspices and with the approval of the Board. If the Board determines that such a need exists, such report shall include recommendations as to appropriate and effective means for establishing and implementing such a mechanism.

SEC. 7. In carrying out its duties under this Act, the Board may

(1) establish an Executive Committee, and such other committees as it deems desirable;

(2) establish such committees and advisory panels as it deems necessary to work with the various sectors of the Nation's economy and with Federal and State governmental agencies in the development and implementation of detailed conversion plans for those sectors. The Board may reimburse, to the extent authorized by law, the members of such committees;

(3) conduct hearings at such times and places as it deems appropriate;

(4) enter into contracts, in accordance with the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C. 471 et seq.), with Federal or State agencies, private firms, institutions, and individuals for the conduct of research or surveys, the preparation of reports, and other activities necessary to the discharge of its duties;

(5) delegate to the Executive Director such authority as it deems advisable; and

(6) perform such other acts as may be necessary to carry out the duties prescribed by this Act.

SEC. 8. (a) The Board may accept, hold, administer, and utilize gifts, donations, and bequests of property, both real and personal, and personal services, for the purpose of aiding or facilitating the work of the Board. Gifts and bequests of money, and the proceeds from the sale of any other property received as gifts or requests, shall be deposited in the Treasury in a separate fund and shall be disbursed upon order of the Board.

(b) For purpose of Federal income, estate, and gift taxation, property accepted under subsection (a) of this section shall be considered as a gift or bequest to or for the use of the United States.

(c) Upon the request of the Board, the Secretary of the Treasury may invest and reinvest, in securities of the United States, any moneys contained in the fund authorized in subsection (a) of this section. Income accruing from such securities, and from any other property accepted to the credit of such fund, shall be dispersed upon the order of the Board.

(d) Funds not expended by the Board as of the date when it ceases to exist, in accordance with section 5(d) of this Act, shall revert to the Treasury of the United States as of such date,

SEC. 9. Members of the Board who are not in the regular full-time employ of the United States shall, while attending meetings or conferences of the Board or while otherwise engaged in the business of the Board, be entitled to receive compensation at a rate not to exceed the daily rate currently being paid grade 18 of the General Schedule (under section 5332 of title 5), including travel time. While so serving, on the business of the Board away from their homes or regular places of business, members of the Board may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, for persons employed intermittently in the Government service. Payments under this section shall not render members of the Board employees or officials of the United States for any purpose. Members of the Board who are in the employ of the United States shall be entitled to travel expenses when traveling on the business of the Board.

SEC. 10. (a) The Board shall appoint a qualified individual to serve as the Executive Director of the Board at the pleasure of the Board. The Executive Director, subject to the direction of the Board, shall be responsible to the Board and shall carry out the metric conversion program, pursuant to the provisions of this Act and the policies established by the Board.

(b) The Executive Director of the Board shall serve full time and be subject to the provisions of chapter 51 and subchapter III of chapter 53 of title 5. The annual salary of the Executive Director shall not exceed level III of the Executive Schedule under section 5314 of such title.

(c) The Board may appoint and fix the compensation of such staff personnel as may be necessary to carry out the provisions of this Act in accordance with the provisions of chapter 51 and subchapter III of chapter 53 of title 5.

(d) The Board may (1) employ experts and consultants or organizations thereof, as authorized by section 3109 of title 5; (2) compensate individuals so employed at rates not in excess of the rate currently being paid grade 18 of the General Schedule under section 5332 of such title, including travel-time; and (3) may allow such individuals, while away from their homes or regular places of business, travel expenses (including per diem in lieu of subsistence) as authorized by section 5703 of such title 5 for persons in the Government service employed intermittently: *Provided, however* That contracts for such temporary employment may be renewed annually.

SEC. 11. Financial and administrative services, including those related to budgeting, accounting, financial reporting, personnel, and procurement, and such other staff services as may be needed by the Board, may be obtained by the Board from the Secretary of Commerce or other appropriate sources in the Federal Government. Payment for such services shall be made by the Board, in advance or by reimbursement, from funds of the Board in such amounts as may be agreed upon by the Chairman of the Board and by the source of the services being rendered.

SEC. 12. DELETED

SEC. 13.(formerly SEC. 12) There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this Act. Appropriations to carry out the provisions of this Act may remain available for obligation and expenditure for such period or periods as may be specified in the Acts making such appropriations.

SEC. 14. (a) Construction services and materials for Federal facilities shall be procured in accordance with the policies and procedures set forth in chapter 137 of title 10, United States Code, section 2377 of title 10, United States Code, title III of the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 251 et seq.), and section 3(2) of this Act. Determination of a design method shall be based upon preliminary market research as required under section 2377(c) of title 10, United States Code, and section 314B(c) of the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 264b(c)). If the requirements of this Act conflict with the provisions of section 2377 of title 10, United States Code, or section 314B of the Federal Property and Administrative Services Act of 1949, then the provisions of 2377 or 314B shall take precedence.

(b) In carrying out the policy set forth in section 3 (with particular emphasis on the policy set forth in paragraph (2) of that section) a Federal agency may require that specifications for the acquisition of structures or systems of concrete masonry be expressed under the metric system of measurement, but may not incorporate specifications, that can only be satisfied by hard-metric versions of concrete masonry units, in a solicitation for design or construction of a Federal facility within the United States or its territories, or a portion of said Federal facility, unless the head of the agency determines in writing that--

(1) hard-metric specifications are necessary in a contract for the repair or replacement of parts of Federal facilities in existence or under construction upon the effective date of the Savings in Construction Act of 1996; or

(2) the following 2 criteria are met:

(A) the application requires hard-metric concrete masonry units to coordinate dimensionally into 100 millimeter building modules; and

(B) the total installed price of hard-metric concrete masonry units is estimated to be equal to or less than the total installed price of using non-hard-metric concrete masonry units. Total installed price estimates shall be based, to the extent available, on cost or pricing data or price analysis, using actual hard-metric and non-hard-metric offers received for comparable existing projects. The head of the agency shall include

in the writing required in this subsection an explanation of the factors used to develop the price estimates.

(c) In carrying out the policy set forth in section 3 (with particular emphasis on the policy set forth in paragraph (2) of that section) a Federal agency may require that specifications for the acquisition of structures or systems of recessed lighting fixtures be expressed under the metric system of measurement, but may not incorporate specifications, that can only be satisfied by hard-metric versions of recessed lighting fixtures, in a solicitation for design or construction of a Federal facility within the United States or its territories unless the head of the agency determines in writing that--

(1) the predominant voluntary industry consensus standards include the use of hard-metric for the items specified; or

(2) hard-metric specifications are necessary in a contract for the repair or replacement of parts of Federal facilities in existence or under construction upon the effective date of the Savings in Construction Act of 1996; or

(3) the following 2 criteria are met:

(A) the application requires hard-metric recessed lighting fixtures to coordinate dimensionally into 100 millimeter building modules; and

(B) the total installed price of hard-metric recessed lighting fixtures is estimated to be equal to or less than the total installed price of using non-hard-metric recessed lighting fixtures. Total installed price estimates shall be based, to the extent available, on cost or pricing data or price analysis, using actual hard-metric and non-hard-metric offers received for comparable existing projects. The head of the agency shall include in the writing required in this subsection an explanation of the factors used to develop the price estimates.

(d) The provisions of subsections (b) and (c) of this section shall not apply to Federal contracts to acquire construction products for the construction of facilities outside of the United States and its territories.

(e) The provisions contained in subsections (b) and (c) of this section shall expire 10 years from the effective date of the Savings in Construction Act of 1996.

(f) (1) The head of each executive agency that awards construction contracts within the United States and its territories shall designate a senior agency official to serve as a construction metrication ombudsman who shall be responsible for reviewing and responding to complaints from prospective bidders, subcontractors, suppliers, or their designated representatives related to--

(A) guidance or regulations issued by the agency on the use of the metric system of measurement in contracts for the construction of Federal buildings; and

(B) the use of the metric system of measurement for services and materials required for incorporation in individual projects to construct Federal buildings. The construction metrication ombudsman shall be independent of the contracting officer for construction contracts.

(2) The ombudsman shall be responsible for ensuring that the agency is not implementing the metric system of measurement in a manner that is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms in violation of the policy

stated in section 3(2), or is otherwise inconsistent with guidance issued by the Secretary of Commerce in consultation with the Interagency Council on Metric Policy while ensuring that the goals of the Metric Conversion Act of 1975 are observed.

(3) The ombudsman shall respond to each complaint in writing within 60 days and make a recommendation to the head of the executive agency for an appropriate resolution thereto. In such a recommendation, the ombudsman shall consider--

(A) whether the agency is adequately applying the policies and procedures in this section;

(B) whether the availability of hard-metric products and services from United States firms is sufficient to ensure full and open competition; and

(C) the total installed price to the Federal Government.

(4) After the head of the agency has rendered a decision regarding a recommendation of the ombudsman, the ombudsman shall be responsible for communicating the decision to all appropriate policy, design, planning, procurement, and notifying personnel in the agency. The ombudsman shall conduct appropriate monitoring as required to ensure the decision is implemented, and may submit further recommendations, as needed. The head of the agency's decision on the ombudsman's recommendations, and any supporting documentation, shall be provided to affected parties and made available to the public in a timely manner.

(5) Nothing in this section shall be construed to supersede the bid protest process established under subchapter V of chapter 35 of title 31, United States Code.

Presidential Documents

Executive Order 12770 of July 25, 1991

Metric Usage in Federal Government Programs

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the Metric Conversion Act of 1975, Public Law 94–168 (15 U.S.C. 205a *et seq.*) ("the Metric Conversion Act"), as amended by section 5164 of the Omnibus Trade and Competitiveness Act of 1988, Public Law 100–418 ("the Trade and Competitiveness Act"), and in order to implement the congressional designation of the metric system of measurement as the preferred system of weights and measures for United States trade and commerce, it is hereby ordered as follows:

Section 1. *Coordination by the Department of Commerce.* (a) The Secretary of Commerce ("Secretary") is designated to direct and coordinate efforts by Federal departments and agencies to implement Government metric usage in accordance with section 3 of the Metric Conversion Act (15 U.S.C. 205b), as amended by section 5164(b) of the Trade and Competitiveness Act.

(b) In furtherance of his duties under this order, the Secretary is authorized:

(1) to charter an Interagency Council on Metric Policy ("ICMP"), which will assist the Secretary in coordinating Federal Government-wide implementation of this order. Conflicts and questions regarding implementation of this order shall be resolved by the ICMP. The Secretary may establish such subcommittees and subchairs within this Council as may be necessary to carry out the purposes of this order.

(2) to form such advisory committees representing other interests, including State and local governments and the business community, as may be necessary to achieve the maximum beneficial effects of this order; and

(3) to issue guidelines, to promulgate rules and regulations, and to take such actions as may be necessary to carry out the purposes of this order. Regulations promulgated by the Secretary shall function as policy guidelines for other agencies and departments.

(c) The Secretary shall report to the President annually regarding the progress made in implementing this order. The report shall include:

(1) an assessment of progress made by individual Federal agencies towards implementing the purposes underlying this order;

(2) an assessment of the effect that this order has had on achieving the national goal of establishing the metric system as the preferred system of weights and measures for United States trade and commerce; and

(3) on October 1, 1992, any recommendations which the Secretary may have for additional measures, including proposed legislation, needed to achieve the full economic benefits of metric usage.

Sec. 2. *Department and Agency Responsibilities.* All executive branch departments and agencies of the United States Government are directed to take all appropriate measures within their authority to carry out the provisions of this order. Consistent with this mission, the head of each executive department and agency shall:

(a) use, to the extent economically feasible by September 30, 1992, or by such other date or dates established by the department or agency in consultation with the Secretary of Commerce, the metric system of measurement in Federal Government procurements, grants, and other business-related activi-

ties. Other business-related activities include all use of measurement units in agency programs and functions related to trade, industry, and commerce.

(1) Metric usage shall not be required to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms.

(2) Heads of departments and agencies shall establish an effective process for a policy-level and program-level review of proposed exceptions to metric usage. Appropriate information about exceptions granted shall be included in the agency annual report along with recommendations for actions to enable future metric usage.

(b) seek out ways to increase understanding of the metric system of measurement through educational information and guidance and in Government publications. The transition to use of metric units in Government publications should be made as publications are revised on normal schedules or new publications are developed, or as metric publications are required in support of metric usage pursuant to paragraph (a) of this section.

(c) seek the appropriate aid, assistance, and cooperation of other affected parties, including other Federal, State, and local agencies and the private sector, in implementing this order. Appropriate use shall be made of governmental, trade, professional, and private sector metric coordinating groups to secure the maximum benefits of this order through proper communication among affected sectors.

(d) formulate metric transition plans for the department or agency which shall incorporate the requirements of the Metric Conversion Act and this order, and which shall be approved by the department or agency head and be in effect by November 30, 1991. Copies of approved plans shall be forwarded to the Secretary of Commerce. Such metric transition plans shall specify, among other things:

(1) the total scope of the metric transition task for that department or agency, including firm dates for all metric accomplishment milestones for the current and subsequent fiscal year;

(2) plans of the department or agency for specific initiatives to enhance cooperation with industry, especially small business, as it voluntarily converts to the metric system, and with all affected parties in undertaking the requirements of paragraph (a) of this section; and

(3) specific steps and associated schedules through which the department or agency will seek to increase understanding of the metric system through educational information and guidance, and in department or agency publications.

(e) designate a senior-level official as the Metric Executive for the department or agency to assist the head of each executive department or agency in implementing this order. The responsibilities of the Metric Executive shall include, but not be limited to:

(1) acting as the department's or agency's policy-level representative to the ICMP and as a liaison with other government agencies and private sector groups:'

(2) management oversight of department or agency outreach and response to inquiries and questions from affected parties during the transition to metric system usage; and

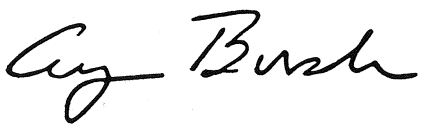
(3) management oversight of preparation of the department's or agency's metric transition plans and progress reports, including the Annual Metric Report required by 15 U.S.C. 205j and OMB Circular A–11.

(4) preparation by June 30, 1992, of an assessment of agency progress and problems, together with recommendations for steps to assure successful implementation of the Metric Conversion Act. The assessment and recommendations shall be approved by the head of the department or agency and provided

to the Secretary by June 30, 1992, for inclusion in the Secretary's October 1, 1992, report on implementation of this order.

Sec. 3. *Application of Resources.* The head of each executive department and agency shall be responsible for implementing and applying the necessary resources to accomplish the goals set forth in the Metric Conversion Act and this order.

Sec. 4. *Judicial Review.* This order is intended only to improve the internal management of the executive branch and is not intended to create any right or benefit, substantive or procedural, enforceable at law by a party against the United States, its agencies, its officers, or any other person.



THE WHITE HOUSE,
July 25, 1991.

[FR Doc. 91-18028
Filed 7-25-91; 3:06 pm]
Billing code 3195-01-M

federal register

Wednesday
January 2, 1991

Editors Note: In a Federal Register notice of August 20, 1991 (56 FR 41281-41283), 15 CFR Part 19 was redesignated 15 CFR 1170. The authority citation for Part 1170 is revised to read as follows:

Authority: 15 U.S.C. 1512 and 3710, 15 U.S.C. 205a *et seq.*, and DOO 10–17 and DOO 10–18.

The Table of contents for Part 1170 reads as follows:

Sec.

Part IV

Department of Commerce

Office of the Secretary

15 CFR Part 19

Metric Conversion Policy for Federal Agencies; Rule

DEPARTMENT OF COMMERCE

Office of the Secretary

15 CFR Part 19

[Docket No. 90913-0259]

RIN 0692-AA07

Metric Conversion Policy for Federal Agencies

AGENCY: Office of the Secretary, Under Secretary for Technology, U.S. Department of Commerce.

ACTION: Final rule.

SUMMARY: 15 CFR part 19 subpart B sets out Federal Government policy on the voluntary use of the metric system of measurement by agencies, industry and the public. In conformance with the Omnibus Trade and Competitiveness Act of 1988 (Pub. L. 100–418, section 5164), we are revising that subpart to remove the voluntary aspect of metric transition for Federal agencies. The amended subpart B provides policy direction to assist Federal agencies in their transition to use of the metric system of measurement.

EFFECTIVE DATE: February 1, 1991.

FOR FURTHER INFORMATION CONTACT: A. S. Whelihan, Office of Metric Programs, Room 4845, U.S. Department of Commerce, Washington, DC 20230; Phone (202) 377–0944.

SUPPLEMENTARY INFORMATION:

Background

The Omnibus Trade and Competitiveness Act of 1988 (Pub. L. 100–418, section 5164) declares the metric system to be the "preferred measurement system for U.S. trade and commerce." Federal agencies are also now required to use the metric system in procurement, grants and other business-related activities, by a date certain and to the extent economically feasible by the end of fiscal year 1992, except to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms, such as when foreign competitors are producing competing products in non-metric units.

These declarations and the accompanying report of the Congressional conferees require this updating of the existing Federal policy document. The policy set out below was issued as a proposed rule: "Metric Conversion Policy for Federal Agencies," 54 FR 41848, October 12, 1989, which updated the policy stated in a prior notice: "Metric Conversion Policy for Federal Agencies," 50 FR 27577, July 5, 1985. The updated policy has been taken directly from the 1985 notice. However, this rule amends the earlier policy to bring the references and text up-to-date. The policy clarifies and strengthens Federal program requirements. Implementing agency initiatives are expected.

The current text reflects comments received from the public (1 comment) as well as from the Federal Metrication Operating Committee (MOC.) The text of the policy has been approved by the Federal Interagency Council on Metric Policy (ICMP.) Recommended changes from the representatives of the ICMP/MOC included updating the **Federal Register** notice defining the "metric system," clarifying the term "other business-related activities," and adding agency reporting requirements. These changes were made and are incorporated in the rule.

The only private sector response was from the American Petroleum Institute (API.) The API commented on: (1) Section 19.23(a), encouraging DoC to continue to coordinate federal agency metrication activities. That section was modified in the final, although it never mentioned DoC. However 19.22(a) refers to the Department's coordination role; (2) section 19.23(b), asking for a clarification of "areas where metrication is dependent on agency initiatives." That language was clarified and became § 19.23(c); and (3) section 19.23(d) pointing out that the American National Metric Council and the U.S. Metric Association are good sources for agencies seeking information on private sector metrication efforts. Section 19.24(d) recommends that agencies "maintain liaison with private sector groups (such as the American National Metric Council and the U.S. Metric Association) that are involved in planning for or coordinating National transition to the metric system."

Rulemaking Requirement

Under Executive Order 12291 the Department must judge whether a regulation is major within the meaning of section 1 of the Order and, therefore, subject to the requirement that a Regulatory Impact Analysis be prepared. This policy statement is not a major rule because it is not likely to result in (1) an annual effect on the economy of $100,000,000 or more; (2) a major increase in costs or prices for consumers, individual industries, Federal, state or local government agencies, or geographic regions; or (3) significant adverse effects on competition, employment, investment, productivity, innovation, or in the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets. Therefore, a Regulatory Impact Analysis will not be prepared.

This policy statement contains no policies with Federalism implications sufficient to warrant preparation of a Federalism assessment under Executive Order 12612.

This action is exempt from the analysis requirements of the Regulatory Flexibility Act because notice and opportunity for comment are not required for this policy statement by section 553 of the Administrative Procedure Act or any other law. Therefore, no initial or final regulatory flexibility analysis was prepared.

This policy statement does not contain a collection of information for purposes of the Paperwork Reduction Act.

List of Subjects in 15 CFR Part 19

Science and technology, Metric system.

For the reasons set out in the preamble part 19 of title 15 of the Code of Federal Regulations is amended as follows:

1. The authority citation for 15 CFR part 19 is revised to read as follows:

Authority: 15 U.S.C. 1512 and 3710, 15 U.S.C. 205a *et seq.* and DOO 10–17.

2. Subpart B is revised to read as follows:

Subpart B—Metric Conversion Policy for Federal Agencies

Sec.
19.20 Purpose.
19.21 Definition.
19.22 General Policy.
19.23 Guidelines.
19.24 Recommendations for Agency Organizations.
19.25 Reporting Requirement.
19.26 thru 19.199 reserved.

Subpart B—Metric Conversion Policy for Federal Agencies

§ 19.20 Purpose.

To provide policy direction for Federal agencies in their transition to use of the metric system of measurement.

§ 19.21 Definition.

Metric system means the International System of Units (SI) established by the General Conference of Weights and Measures in 1960, as interpreted or modified from time to time for the United States by the Secretary of Commerce under the authority of the Metric Conversion Act of 1975 and the Metric Education Act of 1978.

Other business-related activities means measurement sensitive commerical or business directed transactions or programs, i.e., standard or specification development, publications, or agency statements of general applicability and future effect designed to implement, interpret, or prescribe law or policy or describing the procedure or practice requirements of an agency. "Measurement sensitive" means the choice of measurement unit is a critical component of the activity, i.e., an agency rule/regulation to collect samples or measure something at specific distances or to specific depths, specifications requiring intake or discharge of a product to certain volumes or flow rates, guidelines for clearances between objects for safety, security or environmental purposes, etc.

§ 19.22 General Policy.

The Omnibus Trade and Competitiveness Act of 1988 (Pub. L. 100–418, section 5164) amended the Metric Conversion Act of 1975 to, among other things, require that each Federal agency, by a date certain and to the extent economically feasible by the end of the fiscal year 1992, use the metric system of measurement in its procurements, grants, and other business-related activities, except to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United States firms, such as when foreign competitors are producting competing products in non-metric units.

(a) The Secretary of Commerce will appoint a Commerce Department Under Secretary to assist in coordinating the efforts of Federal agencies in meeting their obligations under the Metric Conversion Act, as amended.

(b) Federal agencies shall coordinate and plan for the use of the metric system in their procurements, grants and other business-related activities consistent with the requirements of the Metric Conversion Act, as amended. Federal agencies shall encourage and support an environment which will facilitate the transition process. When taking initiatives, they shall give due consideration to known effects of their actions on State and local governments and the private sector, paying particular attention to effects on small business.

(c) Each Federal agency shall be responsible for developing plans, establishing necessary organizational structure, and allocating appropriate resources to carry out this policy.

§ 19.23 Guidelines.

Each agency shall:

(a) Establish plans and dates for use of the metric system in procurements, grants and other business-related activities;

(b) Coordinate metric transition plans with other Federal agencies, State and local governments and the private sector;

(c) Require maximum practical use of metric in areas where Federal procurement and activity represents a predominant influence on industry standards (e.g.: weapon systems or space exploration). Strongly encourage metrication in industry standards where Federal procurement and activity is not the predominant influence, consistent with the legal status of the metric system as *the preferred system of weights and measures for United States trade and commerce*;

(d) Assist in resolving metric-related problems brought to the attention of the agency that are associated with agency actions, activities or programs undertaken in compliance with these guidelines or other laws or regulations;

(e) Identify measurement-sensitive agency policies and procedures and ensure that regulations, standards, specifications, procurement policies and appropriate legislative proposals are updated to remove barriers to transition to the metric system;

(f) Consider cost effects of metric use in setting agency policies, programs and actions and determine criteria for the assessment of their economic feasibility. Such criteria should appropriately weigh both agency costs and national economic benefits related to changing to the use of metric;

(g) Provide for full public involvement and timely information about significant metrication policies, programs and actions;

(h) Seek out ways to increase understanding of the metric system of measurement through educational information and guidance and in agency publications;

(i) Consider, particularly, the effects of agency metric policies and practices on small business; and

(j) Consistent with the Federal Acquisition Regulation System (48 CFR), accept, without prejudice, products and services dimensioned in metric when they are offered at competitive prices and meet the needs of the Government, and ensure that acquisition planning considers metric requirements.

§ 19.24 Recommendations for Agency Organization.

Each agency shall:

(a) Participate, as appropriate, in the Interagency Council on Metric Policy (ICMP), and/or its working committee, the Metrication Operating Committee (MOC), in coordinating and providing policy guidance for the U.S. Government's transtion to use of the metric system.

(b) Designate a senior policy official to be responsible for agency metric policy and to represent the agency on the ICMP.

(c) Designate an appropriate official to represent the agency on the Metrication Operating Committee (MOC), an interagency committee reporting to the ICMP.

(d) Maintain liaison with private sector groups (such as the American National Metric Council and the U.S Metric Association) that are involved in planning for or coordinating National transition to the metric system.

(e) Provide for internal guidelines, training and documentation to assure employee awareness and understanding of agency metric policies and programs.

§ 19.25 Reporting Requirement.

Each Federal agency shall, as part of its annual budget submission each fiscal year, report to the Congress on the metric implementation actions it has taken during the previous fiscal year. The report will include the agency's implementation plans, with a current timetable for the agency's transition to the metric system, as well as actions planned for the budget year involved to implement fully the metric system, in accordance with this policy. Reporting shall cease for an agency in the fiscal year after it has fully implemented metric usage, as prescribed by the Metric Conversion Act (15 U.S.C. 205b(2).)

§§ 19.26 thru 19.199 [Reserved]

Dated: December 19, 1990.

Robert M. White,

Under Secretary for Technology.

[FR Doc. 90–30566 Filed 12–31–90; 8:45 am]

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