Council Directive of 20 December 1979 on the approximation of the laws of the Member States relating to units of measurement and on the repeal of Directive 71/354/EEC (80/181/EEC)

[X1ANNEX

Editorial Information

X1 Substituted by Corrigendum to Council Directive 80/181/EEC of 20 December 1979 on the aproximation of the laws of the Member States relating to units of measurement and on the repeal of Directive 71/354/EEC (Official Journal of the European Communities No L 39 of 15 February 1980).

CHAPTER I

LEGAL UNITS OF MEASUREMENT REFERRED TO IN ARTICLE 1 (a)

1. SI UNITS AND THEIR DECIMAL MULTIPLES AND SUBMULTIPLES

[F1 1.1. SI base units

Quantity	Unit	
	Name	**Symbol**
Time	second	s
Length	metre	m
Mass	kilogram	kg
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Definitions of SI base units:

Unit of time

The second, symbol s, is the SI unit of time. It is defined by taking the fixed numerical value of the caesium frequency Δv_{Cs}, the unperturbed ground-state hyperfine transition frequency of the caesium 133 atom, to be 9 192 631 770 when expressed in the unit Hz, which is equal to s^{-1}.

Unit of length

The metre, symbol m, is the SI unit of length. It is defined by taking the fixed numerical value of the speed of light in vacuum c to be 299 792 458 when expressed in the unit m/s, where the second is defined in terms of Δv_{Cs}.

Unit of mass

The kilogram, symbol kg, is the SI unit of mass. It is defined by taking the fixed numerical value of the Planck constant h to be $6{,}626\ 070\ 15 \times 10^{-34}$ when expressed in the unit J s, which is equal to kg m^2 s^{-1}, where the metre and the second are defined in terms of c and Δv_{Cs}.

Unit of electric current

The ampere, symbol A, is the SI unit of electric current. It is defined by taking the fixed numerical value of the elementary charge e to be 1,602 176 634 × 10^{-19} when expressed in the unit C, which is equal to A s, where the second is defined in terms of Δv_{Cs}.

Unit of thermodynamic temperature

The kelvin, symbol K, is the SI unit of thermodynamic temperature. It is defined by taking the fixed numerical value of the Boltzmann constant k to be 1,380 649 × 10^{-23} when expressed in the unit J K^{-1}, which is equal to kg m^2 s^{-2} K^{-1}, where the kilogram, metre and second are defined in terms of h, c and Δv_{Cs}.

Unit of amount of substance

The mole, symbol mol, is the SI unit of amount of substance. One mole contains exactly 6,022 140 76 × 10^{23} elementary entities. This number is the fixed numerical value of the Avogadro constant, N_A, when expressed in the unit mol^{-1} and is called the Avogadro number.

The amount of substance, symbol n, of a system is a measure of the number of specified elementary entities. An elementary entity may be an atom, a molecule, an ion, an electron, any other particle or specified group of particles.

Unit of luminous intensity

The candela, symbol cd, is the SI unit of luminous intensity in a given direction. It is defined by taking the fixed numerical value of the luminous efficacy of monochromatic radiation of frequency 540 × 10^{12} Hz, K_{cd}, to be 683 when expressed in the unit lm W^{-1}, which is equal to cd sr W^{-1}, or cd sr kg^{-1} m^{-2} s^3, where the kilogram, metre and second are defined in terms of h, c and Δv_{Cs}.

1.1.1. **Special name and symbol of the SI derived unit of temperature for expressing Celsius temperature**

Quantity	**Unit**	
	Name	**Symbol**
Celsius temperature	degree Celsius	°C

Celsius temperature t is defined as the difference $t = T - T_0$ between the two thermodynamic temperatures T and T_0 where T_0 = 273,15 K. An interval or difference of temperature may be expressed either in kelvins or in degrees Celsius. The unit ‘degree Celsius’ is equal to the unit ‘kelvin’.**]**

Textual Amendments

F1 Substituted by Commission Directive (EU) 2019/1258 of 23 July 2019 amending, for the purpose of its adaptation to technical progress, the Annex to Council Directive 80/181/EEC as regards the definitions of SI base units (Text with EEA relevance).

[[F2]1.2. SI derived units**]**

[F3]1.2.1. SI supplementary units

[F3

F3 . . . . . .]

Definitions of SI supplementary units:

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Textual Amendments

F3 Deleted by Directive 2009/3/EC of the European Parliament and of the Council of 11 March 2009 amending Council Directive 80/181/EEC on the approximation of the laws of the Member States relating to units of measurement (Text with EEA relevance).

[F2 1.2.2. General rule for SI derived units

Units derived coherently from SI base units are given as algebraic expressions in the form of products of powers of the SI base units with a numerical factor equal to 1.

1.2.3. SI derived units with special names and symbols

Quantity	Unit		Expression	
	Name	Symbol	In terms of other SI units	In terms of SI base units
Plane angle	radian	rad		$m \cdot m^{-1}$
Solid angle	steradian	sr		$m^2 \cdot m^{-2}$
Frequency	hertz	Hz		s^{-1}
Force	newton	N		$m \cdot kg \cdot s^{-2}$
Pressure, stress	pascal	Pa	$N \cdot m^{-2}$	$m^{-1} \cdot kg \cdot s^{-2}$
Energy, work; quantity of heat	joule	J	$N \cdot m$	$m^2 \cdot kg \cdot s^{-2}$
Power[a], radiant flux	watt	W	$J \cdot s^{-1}$	$m^2 \cdot kg \cdot s^{-3}$
Quantity of electricity, electric charge	coulomb	C		$s \cdot A$
Electric potential, potential difference, electromotive force	volt	V	$W \cdot A^{-1}$	$m^2 \cdot kg \cdot s^{-3} \cdot A^{-1}$
Electric resistance	ohm	Ω	$V \cdot A^{-1}$	$m^2 \cdot kg \cdot s^{-3} \cdot A^{-2}$

a Special names for the unit of power: the name volt–ampere (symbol ‘VA’) when it is used to express the apparent power of alternating electric current, and var (symbol ‘var’) when it is used to express reactive electric power. The ‘var’ is not included in GCPM resolutions.

Conductance	siemens	S	$A \cdot V^{-1}$	$m^{-2} \cdot kg^{-1} \cdot s^3 \cdot A^2$
Capacitance	farad	F	$C \cdot V^{-1}$	$m^{-2} \cdot kg^{-1} \cdot s^4 \cdot A^2$
Magnetic flux	weber	Wb	$V \cdot s$	$m^2 \cdot kg \cdot s^{-2} \cdot A^{-1}$
Magnetic flux density	tesla	T	$Wb \cdot m^{-2}$	$kg \cdot s^{-2} \cdot A^{-1}$
Inductance	henry	H	$Wb \cdot A^{-1}$	$m^2 \cdot kg \cdot s^{-2} \cdot A^{-2}$
Luminous flux	lumen	lm	$cd \cdot sr$	cd
Illuminance	lux	lx	$lm \cdot m^{-2}$	$m^{-2} \cdot cd$
Activity (of a radionuclide)	becquerel	Bq		s^{-1}
Absorbed dose, specific energy imparted, kerma, absorbed dose index	gray	Gy	$J \cdot kg^{-1}$	$m^2 \cdot s^{-2}$
Dose equivalent	sievert	Sv	$J \cdot kg^{-1}$	$m^2 \cdot s^{-2}$
Catalytic activity	katal	kat		$mol \cdot s^{-1}$

a Special names for the unit of power: the name volt–ampere (symbol ‘VA’) when it is used to express the apparent power of alternating electric current, and var (symbol ‘var’) when it is used to express reactive electric power. The ‘var’ is not included in GCPM resolutions.

Units derived from SI base units may be expressed in terms of the units listed in Chapter I.

In particular, derived SI units may be expressed by the special names and symbols given in the above table; for example, the SI unit of dynamic viscosity may be expressed as $m^{-1} \cdot kg \cdot s^{-1}$ or $N \cdot s \cdot m^{-2}$ or $Pa \cdot s$.**]**

Textual Amendments

F2 Substituted by Directive 2009/3/EC of the European Parliament and of the Council of 11 March 2009 amending Council Directive 80/181/EEC on the approximation of the laws of the Member States relating to units of measurement (Text with EEA relevance).

1.3. Prefixes and their symbols used to designate certain decimal multiples and submultiples

[F4Factor	**Prefix**	**Symbol**
10^{24}	yotta	Y

10^{21}	zetta	Z
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	**[**^{X2}k**]**
10^{2}	hecto	**[**^{X2}h**]**
10^{1}	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	µ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a
10^{-21}	zepto	z
10^{-24}	yocto	y**]**

The names and symbols of the decimal multiples and submultiples of the unit of mass are formed by attaching prefixes to the word ‘gram’ and their symbols to the symbol ‘g’.

Where a derived unit is expressed as a fraction, its decimal multiples and submultiples may be designated by attaching a prefix to units in the numerator or the denominator, or in both these parts.

Compound prefixes, that is to say prefixes formed by the juxtaposition of several of the above prefixes, may not be used.

1.4. Special authorized names and symbols of decimal multiples and submultiples of SI units

Quantity	**Unit**		
	Name	**Symbol**	**Value**

a The two symbols ‘I’and ‘L’ may be used for the litre unit.
(Sixteenth CGPM (1979), resolution 6).

b Unit listed in the International Bureau of Weights and Measures booklet as among the units to be permitted temporarily.

Volume	litre	1 or L[a]	1 l = 1 dm^3 = 10^{-3} m^3
Mass	tonne	t	1 t = 1 Mg = 10^3 kg
Pressure, stress	bar	bar[b]	1 bar = 10^5 Pa

a The two symbols ‘I’and ‘L’ may be used for the litre unit.
(Sixteenth CGPM (1979), resolution 6).

b Unit listed in the International Bureau of Weights and Measures booklet as among the units to be permitted temporarily.

Note:

The prefixes and their symbols listed in 1.3 may be used in conjunction with the units and symbols contained in Table 1.4.

2. UNITS WHICH ARE DEFINED ON THE BASIS OF SI UNITS BUT ARE NOT DECIMAL MULTIPLES OR SUBMULTIPLES THEREOF

Quantity	**Unit**		
	Name	**Symbol**	**Value**
Plane angle	revolution*[ab]		1 revolution = 2 π rad
	grade* or gon*	gon*	$1\ \text{gon} = \frac{\pi}{200}\ \text{rad}$
	degree	°	$1^\circ = \frac{\pi}{180}\ \text{rad}$
	minute of angle	′	$1' = \frac{\pi}{10800}\ 10800\ \text{rad}$
	second of angle	″	$1'' = \frac{\pi}{648000}\ 648000\ \text{rad}$
Time	minute	min	1 min = 60 s
	hour	h	1 h = 3 600 s
	day	d	1 d = 86 400 s

a The character (*) after a unit name or symbol indicates that it does not appear in the lists drawn up by the CGPM, CIPM o BIPM. This applies to the whole of this Annex.

b No international symbol exists.

Note:

The prefixes listed in 1.3 may only be used in conjunction with the names ‘grade’ or ‘gon’ and the symbol ‘gon’.

[F4 3. UNITS USED WITH THE SI, WHOSE VALUES IN SI ARE OBTAINED EXPERIMENTALLY

Quantity	**Unit**		
	Name	**Symbol**	**Definition**
Energy	Electronvolt	eV	The electron volt is the kinetic energy acquired by an electron in passing through a potential

			difference of 1 volt in vaccum
Mass	Unified atomic mass unit	u	The unified atomic mass units is equal to 1/12 of the mass of an atom of the nuclide ^{12}C.

Note:

The prefixes and their symbols listed in 1.3 may be used in conjunction with these two units and with their symbols.**]**

4. UNITS AND NAMES OF UNITS PERMITTED IN SPECIALIZED FIELDS ONLY

Quantity	**Unit**		
	Name	**Symbol**	**Value**
Vergency of optical systems	dioptre*		1 dioptre = 1 m^{-1}
Mass of precious stones	metric carat		1 metric carat = 2 × 10^{-4} kg
Area of farmland and building land	are	a	1 a = 10^2 m^2
Mass per unit length of textile yarns and threads	tex*	tex*	1 tex = 10^{-6} kg · m^{-1}
[F5Blood pressure and pressure of other body fluids	Millimetre of mercury	mm Hg(*)	1 mm Hg = 133,322 Pa
Effective cross-sectional area	Barn	b	1 b = 10^{-28} m^{2}l

Note:

[F6The prefixes and their symbols listed in 1.3 may be used in conjunction with the above units and symbols, with the exception of the millimetre of mercury and its symbol. The multiple of 10^2a is, however, called a ‘hectare’.**]**

5. COMPOUND UNITS

Combinations of the units listed in Chapter I form compound units.

[F7CHAPTER II

LEGAL UNITS OF MEASUREMENT REFERRED TO IN ARTICLE 1 (b), PERMITTED FOR SPECIFIC USES ONLY

Field of application	**Unit**			
	Name	**Approximate value**		**Symbol**
Road traffic signs, distance and speed measurement	mile	1 mile =	1 609 m	mile
	yard	1 yd =	0,9144 m	yd
	foot	1 ft =	0,3048 m	ft
	inch	1 in =	$2{,}54 \times 10^{-2}$ m	in
Dispense of draught beer and cider; milk in returnable containers	pint	1 pt =	$0{,}5683 \times 10^{-3}$ m^3	pt
[F3]				
Transaction in precious metals	troy ounce	1 oz tr =	$31{,}10 \times 10^{-3}$ kg	oz tr

[F2 The units listed in this Chapter may be combined with each other or with those in Chapter I to form compound units.**]]**

Textual Amendments

F7 Substituted by Council Directive of 27 November 1989 amending Directive 80/181/EEC on the approximation of the laws of the Member States relating to units of measurement (89/617/EEC).

CHAPTER III

LEGAL UNITS OF MEASUREMENT REFERRED TO IN ARTICLE 1 (c)

QUANTITIES, NAMES OF UNITS, SYMBOLS AND APPROXIMATE VALUES		
Length		
inch	1 in	= $2{\cdot}54 \times 10^{-2}$ m
foot	1 ft	= 0·3048 m
[F8]		
mile	1 mile	= 1 609 m
yard	1 yard	= 0·9144 m
Area		
a **[F8]**		

QUANTITIES, NAMES OF UNITS, SYMBOLS AND APPROXIMATE VALUES		
square foot	1 sq ft	= $0{\cdot}929 \times 10^{-1}$ m^2
acre	1 ac	= 4 047 m^2
square yard	1 sq yd	= $0{\cdot}8361$ m^2
Volume		
fluid ounce	1 fl oz	= $28{\cdot}41 \times 10^{-6}$ m^3
gill	1 gill	= $0{\cdot}1421 \times 10^{-3}$ m^3
pint	1 pt	= $0{\cdot}5683 \times 10^{-3}$ m^3
quart	1 qt	= $1{\cdot}137 \times 10^{-3}$ m^3
gallon	1 gal	= $4{\cdot}546 \times 10^{-3}$ m^3
Mass		
ounce (avoirdupois)	1 oz	= $28{\cdot}35 \times 10^{-3}$ kg
troy ounce	1 oz tr	= $31{\cdot}10 \times 10^{-3}$ kg
pound	1 lb	= $0{\cdot}4536$ kg
Energy		
therm	1 therm	= $105{\cdot}506 \times 10^{6}$ J
a [F8]		

Textual Amendments

F8 Deleted by Council Directive of 27 November 1989 amending Directive 80/181/EEC on the approximation of the laws of the Member States relating to units of measurement (89/617/EEC).

Until the date to be fixed under Article 1 (c), the units listed in Chapter III may be combined with each other or with those in Chapter I to form compound units.**]**

[F9CHAPTER IV

LEGAL UNITS OF MEASUREMENT REFERRED TO IN ARTICLE I (d), PERMITTED IN SPECIALIZED FIELDS ONLY

Field of application	**Unit**			
	Name	**Approximate value**		**Symbol**
Marine navigation	fathom	1 fm =	1,829 m	fm
Beer, cider, waters, lemonades and fruit juices	pint	1 pt =	$0{,}5683 \times 10^{-3}$ m^3	pt
	fluid ounce	1 fl oz =	$28{,}41 \times 10^{-6}$ m^3	fl. oz

in returnable containers				
Spirit drinks	gill	1 gill =	$0{,}142 \times 10^{-3}$ m^3	gill
Goods sold loose in bulk	ounce (avoir dupois)	1 oz =	$28{,}35 \times 10^{-3}$ kg	oz
	pound	1 lb =	0,4536 kg	lb
Gas supply	therm	1 therm =	$105{,}506 \times 10^{6}$ J	therm

Until the date to be fixed under Article 1 (d), the units listed in this Chapter may be combined with each other or with those in Chapter I to form compound units.**]**

Textual Amendments

F9 Inserted by Council Directive of 27 November 1989 amending Directive 80/181/EEC on the approximation of the laws of the Member States relating to units of measurement (89/617/EEC).