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COUNCIL DIRECTIVE

of 18 October 1971

on the approximation of the laws of the Member States relating to units of measurement

(71/354/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof;

Having regard to the proposal from the Commission;

Having regard to the Opinion of the European Parliament[1];

Having regard to the Opinion of the Economic and Social Committee[2];

Whereas the laws which regulate the use of units of measurement in the Member States differ from one Member State to another and therefore hinder trade; whereas application of the rules relating to measuring instruments is closely linked to the use of units of measurement in the metrological system; whereas, in these circumstances and having regard to the interdependence of the rules concerning units of measurement and those concerning measuring instruments, it is necessary to harmonise laws, regulations and administrative provisions to ensure harmonious application of existing and future Community directives relating to measuring instruments and methods of metrological control;

Whereas units of measurement are the subject of international resolutions adopted by the General Conference of Weights and Measures (CGPM) set up by the Metre Convention signed in Paris on 20 May 1875, to which all the Member States adhere; whereas, however, units of measurement, and in particular their names, symbols and use are not identical in the Member countries;

HAS ADOPTED THIS DIRECTIVE:

Article 1

1. Member States shall make the provisions of Chapter 1 of the Annex binding within five years of the date of entry into force of this Directive.

2. Member States shall, with effect from 31 December 1977 at the latest, prohibit the use of the units of measurement listed in Chapter III of the Annex.

3. The units of measurement temporarily retained in accordance with the provisions of Chapter II or Chapter III of the Annex may not be brought into compulsory use by the Member States where they are not authorised at the date when this Directive enters into force.

Article 2

The obligations arising under Article 1 relate to measuring instruments used, measurements made and indications of quantity expressed in units, whether for economic, public health, public safety or administrative purposes.

Article 3

This Directive shall not affect the use of units which it does not prescribe but which have been laid down by international intergovernmental conventions or agreements in the field of air and sea transport and rail traffic.

[1] OJ No C 78, 2.8.1971, p. 53.
[2] OJ No C 93, 21.9.1971, p. 18.

Article 4

1. Member States shall put into force the laws, regulations and administrative provisions needed in order to comply with this Directive within eighteen months of its notification and shall forthwith inform the Commission thereof.

2. Member States shall ensure that the texts of the main provisions of national law which they adopt in the field covered by this Directive are communicated to the Commission.

Article 5

This Directive is addressed to the Member States.

Done at Luxembourg, 18 October 1971.

For the Council

The President

A. MORO

ANNEX

CHAPTER I

UNITS OF MEASUREMENT WHICH ARE DEFINITIVELY AUTHORISED

1. SI UNITS AND THEIR DECIMAL MULTIPLES AND SUBMULTIPLES

1.1. **SI base units**

Quantity	Unit	
	Name	Symbol
length	metre	m
mass	kilogramme	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
luminous intensity	candela	cd
amount of substance	mole[1]	mol

[1] SI base unit adopted by the International Committee of Weights and Measures (CIPM) on 7 October 1969 for approval by the next General Conference of Weights and Measures (CGPM).

Definitions of SI base units:

Unit of length

The metre is the length equal to 1 650 763·73 wavelengths in vacuum of the radiation corresponding to the transition between the levels $2p_{10}$ and $5d_5$ of the krypton-86 atom. (Eleventh CPGM (1960), Resolution 6).

Unit of mass

The kilogramme is equal to the mass of the international prototype of the kilogramme. (Third CGPM (1901), p. 62 of the Conference Report).

Unit of time

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom. (Thirteenth CGPM (1967), Resolution 1).

Unit of electric current

The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section and placed 1 metre apart in a vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length. (CIPM (1946), Resolution 2 approved by the Ninth CGPM (1948)).

Unit of thermodynamic temperature

The kelvin is the fraction 1/273·16 of the thermodynamic temperature of the triple point of water. (Thirteenth CGPM (1967), Resolution 4).

Unit of luminous intensity

The candela is the luminous intensity, in the perpendicular direction, of a surface of 1/600 000 square metre of a black body at the temperature of freezing platinum under a pressure of 101 325 newtons per square metre. (Thirteenth CGPM (1967), Resolution 5).

Unit of amount of substance

The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0·012 kilogramme of carbon-12.

Note: When the mole is used the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles or specified groups of such particles.

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

Quantity	Unit		
	Name	Symbol	Value
Celsius temperature	degree Celsius	°C	1 °C = 1 K

Celsius temperature t is defined as the difference $t = T - T_0$ between the two thermodynamic temperatures T and T_0 where $T_0 = 273{\cdot}15$ K.

1.2. **Other SI units**

1.2.1. **Derived SI units**

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

1.2.2. **SI units having special names and symbols**

Quantity	SI Unit		
	Name	Symbol	Derivation
plane angle	radian	rad	m/m
solid angle	steradian	sr	m^2/m^2
frequency	hertz	Hz	s^{-1}
force	newton	N	$m \cdot kg \cdot s^{-2}$
pressure, stress	pascal[1]	Pa	$m^{-1} \cdot kg \cdot s^{-2}$
energy, work, quantity of heat	joule	J	$m^2 \cdot kg \cdot s^{-2}$
power	watt	W	$m^2 \cdot kg \cdot s^{-3}$
quantity of electricity, electric charge	coulomb	C	$A \cdot s$
electric tension, electric potential, electromotive force	volt	V	$m^2 \cdot kg \cdot s^{-3} \cdot A^{-1}$
electric resistance	ohm	Ω	$m^2 \cdot kg \cdot s^{-3} \cdot A^{-2}$
electric conductance	siemens[1]	S	$m^{-2} \cdot kg^{-1} \cdot s^3 \cdot A^2$
electric capacitance	farad	F	$m^{-2} \cdot kg^{-1} \cdot s^4 \cdot A^2$
electric inductance	henry	H	$m^2 \cdot kg \cdot s^{-2} \cdot A^{-2}$
magnetic flux	weber	Wb	$m^2 \cdot kg \cdot s^{-2} \cdot A^{-1}$
magnetic flux density	tesla	T	$kg \cdot s^{-2} \cdot A^{-1}$
luminous flux	lumen	lm	$cd \cdot sr$
illuminance	lux	lx	$m^{-2} \cdot cd \cdot sr$

[1] Proposed by the CIPM for approval by the next CGPM.

Units derived from SI base units may be expressed in terms of the units listed in Chapters I and II, and of those listed in Chapter III so long as these remain in use.

In particular, derived SI units may be expressed in terms of the special names and symbols in the above table. For example: the SI unit of dynamic viscosity may be expressed as $m^{-1} \cdot kg \cdot s^{-1}$ or $N \cdot s/m^2$ or $Pa \cdot s$.

The SI unit of power may be called 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.

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

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

The names and symbols of the decimal multiples and submultiples of the unit of mass are formed by attaching prefixes to the word 'gramme' 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 authorised names and symbols**

1.4.1. **Special names and symbols of decimal multiples and submultiples of SI units**

Quantity	Unit		
	Name	Symbol	Value
Volume	litre	l	$1\ l = 1\ dm^3 = 10^{-3}\ m^3$
Mass	tonne	t	$1\ t = 1\ Mg = 10^3\ kg$
Pressure, stress	bar	bar	$1\ bar = 10^5\ Pa$

1.4.2. **Special names and symbols of decimal multiples and submultiples of SI units which may be used only in specialised fields**

Quantity — Size	Unit		
	Name	Symbol	Value
Area of farmland and building land	are	a	$1\ a = 10^2\ m^2$
Mass per unit length of textile yarns and threads	tex*[1]	tex*[1]	$1\ tex = 10^{-6}\ kg/m$

1. The character * after a unit name or symbol indicates that these have not yet appeared in the lists drawn up by the CGPM or CIPM.

Note: The prefixes listed in item 1.3 may be used in conjunction with the units contained in the tables of items 1.4.1 and 1.4.2.
The multiple 10^2 a is, however, called a 'hectare'.

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*	1	1 revolution = 2π rad
	grade* or gon*[2]	g* gon*	1^g or 1 gon = $\frac{\pi}{200}$ rad
	degree*	o*	$1^o = \frac{\pi}{180}$ rad
	minute of angle*	'*	$1' = \frac{\pi}{10\,800}$ rad
	second of angle*	"*	$1'' = \frac{\pi}{648\,000}$ rad
Time	minute*	min*	1 min = 60 s
	hour	h	1 h = 3 600 s
	day*	d*	1 d = 86 400 s

[1] No international symbol exists at present although there are national symbols and abbreviations, such as tr, ag.

[2] The symbol g should disappear in favour of gon. The matter will be reviewed by 31 December 1977.

Note: The prefixes listed in item 1.3 may only be used in conjunction with the names grade and gon and the symbols only with the symbol gon.

3. UNITS DEFINED INDEPENDENTLY OF THE SEVEN SI BASE UNITS

The unified atomic mass unit is 1/12 of the mass of an atom of the nuclide ^{12}C.

The electronvolt is the kinetic energy acquired by an electron passing in a vacuum from one point to another whose potential is 1 volt higher.

Quantity	Unit		
	Name	Symbol	Value
mass	unified atomic mass unit*	u*	. . . .
energy	electronvolt*	eV*	. . . .

The value of these units, expressed in SI units, is not exactly known.

Note: The prefixes listed in item 1.3 may be used in conjunction with these two units.

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

Quantity	Unit	
	Name	Value
vergence of optical systems	dioptre*	1 dioptre = 1 m^{-1}
mass of precious stones	metric carat	1 metric carat = $2 \cdot 10^{-4}$ kg

Note: The prefixes listed in item 1.3 may be used in conjunction with the above units.

5. COMPOUND UNITS

Compound units are formed by combining the units in Chapters I, II and III *with the exception of those listed in items 1.4.2 and 4 of Chapter I and item 8.1 of Chapter III* (units permitted in specialised fields only). The use of some of such compound units, where these are not derived SI units, will be examined by 31 December 1977 with a view to deciding whether their use should be restricted or prohibited.

CHAPTER II

UNITS OR NAMES OF UNITS, THE AUTHORISATION OF WHICH IS TO BE REVIEWED BY 31 DECEMBER 1977

6. CGS UNITS

Quantity	Unit		
	Name	Symbol	Value
force	dyne	dyn	1 dyn = 10^{-5} N
energy	erg	erg	1 erg = 10^{-7} J
dynamic viscosity	poise	P	1P = 10^{-1} Pa · s
kinematic viscosity	stokes*	St*	1 St = 10^{-4} M^2/s
acceleration due to gravity	gal*	Gal*	1 Gal = 10^{-2} m/s^2

7. OTHER UNITS

Quantity	Unit		
	Name	Symbol	Value
wavelength, atomic distances	ångström*	Å*	1 Å = 10^{-10} m
effective cross-sectional area	barn*	b*	1 b = 10^{-28} m^2
mass	quintal*	q*	1 q = 10^2 kg
pressure	standard atmosphere	atm	1 atm = 101 325 Pa
activity of a radioactive source	curie	Ci	1 Ci = $3{\cdot}7 \times 10^{10}$ s^{-1}
absorbed dose	rad*	rd*	1 rd = 10^{-2} J/kg
equivalent absorbed dose	rem*	rem*	1 rem = 1 rd
exposure to ionising radiations	röntgen*	R*	1 R = $2{\cdot}58 \times 10^{-4}$ C/kg

Note: The prefixes listed in item 1.3 may be used in conjunction with the units contained in items 6 and 7, apart from the quintal.

CHAPTER III

UNITS, NAMES AND SYMBOLS WHICH ARE TO DISAPPEAR FROM USE AS SOON AS POSSIBLE, AND AT THE LATEST BY 31 DECEMBER 1977

8. QUANTITIES, NAMES OF UNITS, SYMBOLS AND VALUES

8.1. **Volume** (forestry and timber trade)

Festmeter*	1 Fm* = 1 m^3
Raummeter* stère	1 Rm* 1 st } = 1 m^3

8.2. **Force**

kilogramme-force* kilopond*	1 kgf* 1 kp* } = 9·806 65 N

8.3. **Pressure**

torr*	1 torr* = $\frac{101\,325}{760}$ Pa
technical atmosphere*	1 at* = 98 066·5 Pa
metre of water (conventional: 1 mH_2O)	1 mH_2O* = 9 806·65 Pa
millimetre of mercury* (conventional: 1 mmHg = 13·5951 mmH_2O)	1 mmHg* = 133·322 Pa

8.4. **Power**

Pferdestärke* Paardekracht* cheval vapeur* cavallo vapore*	1 PS* 1 pk* 1 CV* 1 cv* } = 735·498 75 W

8.5. **Quantity of heat**

calorie	1 cal* = 4·186 8 J
thermie*	1 th* = 4·186 8 × 10^6 J
frigorie* (for measuring a quantity of heat withdrawn from a system)	1 fg* = 4·186 8 × 10^3 J

8.6. **Luminance**

stilb	1 sb = 10^4 cd/m^2

Note: The prefixes listed in item 1.3 may be used in conjunction with the units contained in items 8.2, 8.5 and 8.6, with the stère (item 8.1), with the torr and with the metre of water (item 8.3).

9. SPECIAL CASE WITH REGARD TO TEMPERATURE

The name 'degree Kelvin' and the symbol '°K' may be used instead of 'Kelvin' and the symbol 'K' until 31 December 1977.