

COMMISSION OF THE EUROPEAN COMMUNITIES

COM(79)89 final

Brussels, 27 february 1979

Proposal for a new

COUNCIL DIRECTIVE (EEC)

on the approximation of the laws of the Member States relating to units of measurement and repealing Council Directive of 18 October 1971 (71/354/EEC) as modified since then.

(submitted to the Council by the Commission)

COM(79)89 final

EXPLANATORY MEMORANDUM

I. INTRODUCTION

This Council Directive is based on Article 100 of the Treaty establishing the European Economic Community and falls within the context of the Council Directive of 26 July 1971 on the approximation of the laws of the Member States relating to common provisions for both measuring instruments and methods of metrological control (71/316/EEC), and more particularly within the field of the Council Directive of 19 October 1971 on the approximation of the laws of the Member States relating to units of measurement (71/354/78), as last amended by the Council Directive of 27 July 1976 (76/770/EEC).

The principal aims of this Directive are to remove barriers to intra-Community trade which still exist where the use of units of measurement is governed by legislation in Member States and, at the same time, to promote the use of a single system of units of measurement throughout the Community.

Such action at Community level is desirable since the concrete result would be to do away with all conversion operations which still have to be effected between the different systems of units of measurement. The consumer's life is made much easier when the information supplied to him is furnished in accordance with a single system, thus enabling him to make proper comparisons between different sets of data. For economic operators and for government authorities, the use of a single system of units of measurement makes for substantial savings and for better understanding by all concerned, thus reducing the possibility of errors.

All Community provisions relating to units of measurement have been incorporated in this Directive so that the preceding Directive can simply be repealed. Thus, once this Directive has been adopted it will no longer be necessary to refer to scattered texts.

II. BACKGROUND

On 18 October 1971 the Council adopted the first Community Directive on the use of units of measurement in the Community (71/354/EEC). This text is based on two mutually complementary principles: the desirability of imposing as quickly as possible the use of a single system of units of measurement; the desirability of prohibiting as quickly as possible the use of any unit which does not form part of the system chosen.

There was never any question of the Community's inventing its own system of units of measurement. Directive 71/354/EEC lays down definitively the use of a system of units comprising the international system of units (the so-called SI system, adopted by the General Conference of Weights and Measures (CGPM) set up by the International Metre Convention signed in Paris on 20 May 1875, to which all Member States of the Community are contracting parties), together with certain units which are used with the international system.

This system of units of measurement is recognized almost throughout the world, and where a State now wishes to impose the use of a single system in its territory it is the SI system that is chosen. Hence the Community is demonstrating its will to follow up at European level the work which has been carried out at international level in a much wider context.

It is not reasonable to suppose that a given system of units can be imposed overnight or that the use of a traditional system of units which is firmly rooted in the customs of a country can be proscribed. That is why, even in the first Directive, the Council provided for transitional periods both for the imposition of the system of units ultimately to be used (this transitional period ended on 21 April 1978 for all Member States) and for the phasing-out of the various units of measurement that do not appear in this system. In the latter case, the transitional periods vary according to the units of measurement in question. Some of these units of measurement presented such difficulties that the decision as to the date when they should disappear was postponed.

When the Community was enlarged in 1973, account had to be taken of the very special problem of the Imperial system of units. Since none of the original six Member States used Imperial units as legal units of measurement, their existence had been totally ignored in Directive 71/354/EEC. On 1 January 1973, however, the Community suddenly found itself faced with two Member States in which the use of the Imperial units of measurement was mandatory. It was therefore necessary to adopt appropriate provisions in the Acts relating to accession.

Thus under the terms of the Acts of Accession the Directive acquired an Annex II comprising a list of Imperial units which were to be dealt with in the context of the Community provisions. A paragraph 4 concerning these units was likewise added to Article 1 of the Directive: "The classification in Annex I of the units of measurement listed in Annex II shall be decided on 31 August 1976 at the latest. The units of measurement concerning which no decision has been made on 31 August 1976 at the latest shall disappear on 31 December 1979 at the latest. An appropriate extension of this time limit may be decided for certain of these units of measurement if it should be justified for special reasons."

The Act of Accession to the Communities consequently did not alter the positions of principle previously adopted in Directive 71/354/EEC. On the contrary, enlargement confirmed these principles to some extent with regard to the Imperial system. It is perhaps worth pointing out that there was no need to negotiate the actual principle of the adoption of the SI system with the acceding countries, since they had shown themselves to be in favour of the eventual adoption of the SI system throughout the Community as the only legal system of measurements. (The United Kingdom, for example, had decided to adopt this system well before its accession to the Communities.)

After enlargement, therefore, there were certain decisions regarding Imperial units of measurement which had to be taken before 31 August 1976 if these units were not to disappear automatically on 31 December 1979. It was also necessary to re-examine before 31 December 1977 the fate of the units of measurement referred to in Chapter II of Directive 71/354/EEC and to ascertain whether certain units mentioned in Chapter III could not be made to disappear before 1 December 1979.

The Commission presented the Council with a single proposal for amendment in order to settle all these questions and the Council adopted this amendment on 27 July 1976 (76/770/EEC). The basic principles remained unchanged. The SI system was still the only system that would be authorized in the long term. It is set out in Chapter A of Directive 76/770/EEC. This chapter includes some up-dated points in accordance with developments at international level with respect to Chapter I of Directive 71/354/EEC. The units of measurement not definitively adopted must eventually disappear, but the timetable for their disappearance has been slightly changed and is broken down according to three categories:

- (a) the units which must disappear by 31 December 1977 (Chapter B);
- (b) the units which must disappear by 31 December 1979 (Chapter C);
- (c) those units which must disappear and the date of whose disappearance has to be decided before 31 December 1979 (Chapter D). It did not appear advisable in 1977 to take a final decision on these units.

III. THE PRESENT PROPOSAL FOR A DIRECTIVE

This Directive pursues the same aims as the preceding one and is based on the same principles. Its lay-out is a little different because, for the first time, the concept of "legal units of measurement" has been introduced at Community level. This is now possible because the SI units of measurement, together with certain units which are used with this system, have been legal units of measurement throughout the Community since 21 April 1978. Any reference to units of measurement, and particularly to the requirements regarding their use, therefore becomes much more straightforward because in future it will suffice to refer merely to the legal units of measurement.

The Annex is set out in the same way as before. Chapter I lists the legal units of measurement which have been definitively adopted and Chapters II and III set out the units of measurement which are still legally authorized under certain specific conditions and until the dates laid down in Article 1.

Chapter I has undergone hardly any substantial amendments since the adoption of Directive 76/770/EEC. The few changes which have been made merely reflect the developments that have taken place at international level as regards units of measurement, more particularly as a result of the work of the General Conference on Weights and Measures. The most significant addition is the adoption of the new derived unit, the sievert, to express the equivalent absorbed dose of ionizing radiation. This was proposed by the International Committee of Weights and Measures for adoption by the next General Conference on Weights and Measures, which will be held in 1979. The Council will therefore be able to act in the full knowledge of facts.

Article 1(b) lays down that the units of measurement, names and symbols which appear in Chapter II of the Annex may remain legal in the various Member States until 31 December 1985. Member States may, however, cease to recognize their legal character before that date if they so desire, subject to the provisions of Article 3 of this Directive. As regards radiological units of measurement, the Commission has heeded the resolutions of the international organization which is most competent in the field of radiology. The World Health Organization has expressed a wish to have the millimeter of mercury retained for a further period as an authorized unit of measurement in order to help the medical profession to adapt smoothly to SI units. This unit, which was to have disappeared by 31 December 1979 at the latest, in accordance with Directive 76/770/EEC, is therefore retained in Chapter II.

Chapter III of the Annex is reserved more particularly for certain Imperial units of measurement which are most commonly used and therefore die the hardest. All these units are listed in Chapter D of the Annex to the preceding Directive, indicating that it had not been possible to take a decision as to the date when they should cease to be used. The present Directive provides that the final date shall be set by the Council. Indeed the Commission did not want, of its own initiative, to impose a precise date on those Member States where the use of these units of measurement remains very generalized and which are in a better position to set this limit taking into account the economic and social consequences of this decision.

For the purposes of this Directive, these units of measurement can only be legal units of measurement in the Member States in which their use was authorized on 21 April 1973. This clause was already contained in Directive 76/770/EEC. In accordance with the provisions of Article 1(c) and Article 3, Member States which did not authorize these units on 21 April 1973 must allow these units to appear as a secondary indication until 31 December 1989 at the latest.

Article 2 of this Directive reproduces in their entirety the provisions of Articles 2 and 3 of Directive 71/354/EEC. The scope has thus remained unchanged. Hence Community provisions continue to aim at the use of units of measurement for indications appearing on measuring instruments and for the expression of the results of measurements performed by such instruments, the use of units of measurement in any operation where it is necessary to measure a particular dimension and their use whenever it is necessary to express the magnitude of dimension. These various uses are highly specific and must be interpreted very restrictively (*stricto sensu*). All these uses provided for in Article 2(a) must be related to the fields covered by the Directive and laid down in Article 2(a), that is to say to the economic field, to operations of an administrative nature and to the fields of health and public safety. The terms denoting the fields of application of this Directive have been deliberately chosen because they encompass very broad concepts, and this is wholly in accordance with the aims of the Directive.

It was, however, necessary, to provide for various exceptions to the applications of Article 2(a).

The first major exception concerns the field of international transport, where traditionally there have been many international agreements. The Member States and the Community are obliged to respect these international agreements, which frequently employ units of measurement other than the legally recognized ones. In this area, the Community cannot take a decision independently of the other signatories to such agreements.

Spare parts cause problems of quite a different nature. Very often spare parts bear dimension indications in order to show on what products and equipments, - which have been on the market and in use for long periods already - they can be fitted. Frequently these spare parts have to be specially manufactured. In these cases, if the parts have to be mounted on products or equipments which were designed in non-SI units, the spare parts must likewise be so designed. In order to enable these products and equipments to remain in use, it was necessary to provide for a derogation from the provisions of Article 2(a). This is the purpose of Article 4.

Article 5 provides for a very special exception in the case of representations of SI and other units to be used in data-processing systems involving limited sets of characters. Since the problem had already been settled at international level, a straightforward reference to the results of the work of the International Standards Organization (ISO), through a dated reference to ISO standard 2955 of 1 March 1974, seemed to be the most appropriate solution at Community level.

This directive differs widely from the earlier one as regards double indication. Directive 71/354/EEC as amended by Directive 76/770/EEC, did not make special provisions in this respect. However, practical experience has shown that it is unrealistic to expect that units of measurement which have been in use for a very long time and which in many cases have become part of the traditions of a country can be ~~done~~ away with overnight without a transitional period. What is more, experience has shown that a mere transitional period without any provision for special arrangements is insufficient to overcome the difficulties.

Consequently, this Directive provides not only for transitional periods in respect of the units of measurement appearing in Chapters II and III to the Annex, but also for double indication during a fixed period specified in Article 1.

In order to be useful and effective, the provisions regarding double indication have to be clear and easy to apply. Hence the definition given in Article 3 is very simple: double indication is used where a unit of measurement which does not appear in Chapter I of the Annex accompanies a unit from Chapter I. By way of explanation, therefore, a unit from Chapter I of the Annex may be accompanied by any other unit of measurement which does not appear in that same Chapter I. The second unit of measurement need not even appear in the Annex to this Directive.

Double indication in this form may be used until 31 December 1985. This time limit is extended until 31 December 1989 in the case of Imperial units of measurement appearing in Chapter III to the Annex.

The use of the double indication system is as follows: Member States must authorize or allow double indication on products and equipment until 31 December 1985. For the units listed in Chapter III, the time limit is fixed at 31 December 1989. This obligation is to some extent an obligation to ensure free movement (Article 3(c)). In all cases which are not referred to in Article 3(c) and (d), Member States are free to authorize or prohibit double indication in their territory.

The obligation to allow double indication does not apply to measuring instruments. It does not seem essential to require Member States to accept on their territory measuring instruments which bear a double indication, since in many cases Member States have already adopted rules prohibiting the appearance on measuring instruments of any unit of measurement which is not a legal unit of measurement, often for safety reasons.

Since the aim of this Directive is precisely to ensure that measuring instruments bear dimension indications solely in legal units of measurement which have been definitively adopted, it seems desirable not to go against national rules. Thus Member States are free to require that measuring instruments bear dimension indications in a single legal unit of measurement.

The last paragraph of Article 3 lays down the practical conditions under which double indication can be used. The rule is that the Chapter I units of measurement should be inscribed more conspicuously so as to avoid any possible confusion.

IV. HARMONIZATION

This Directive, like the earlier ones, has adopted the solution of "total" harmonization. Since the very purpose of the Directive is to impose, wherever possible, the use of a single system of legal units of measurement throughout the Community, total harmonization is the most efficient means of achieving this. Thus, on the expiry of the transitional periods provided for in Article 1, only the units of measurement appearing in Chapter I of the Annex may be used in the Community.

V. CONSULTATION OF PARLIAMENT AND THE ECONOMIC AND SOCIAL COMMITTEE

Under the second paragraph of Article 100 of the EEC Treaty the opinion of these two bodies is required. Implementation of the provisions of the Directive will, in some Member States, necessitate an amendment of legislation.

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 Council Directive 71/354/EEC of 18 October 1971 on the approximation of the laws of the Member States relating to units of measurement (1), as last amended by Council Directive 76/770/EEC of 27 July 1976 (2),

Having regard to the proposal from the Commission,

Having regard to the Opinion of the European Parliament,

Having regard to the Opinion of the Economic and Social Committee,

Whereas units of measurement are essential in the use of all measuring instruments, to express measurements or any indication of quantity; whereas it is necessary to ensure the greatest possible clarity in their use; whereas it is therefore necessary to make rules for their use for economic, public health, public safety or administrative purposes;

Whereas, however, international conventions or agreements exist in the field of international transport which bind the Community or the Member States; whereas these conventions or agreements have to be respected;

Whereas the laws which regulate the use of units of measurement in the Member States differ from one Member State to another and as a result hinder trade; whereas, in these circumstances, it is necessary to harmonise laws, regulations and administrative provisions in order to overcome these obstacles;

(1) O.J. N° L 243 of 29 October 1971, p. 29

(2) O.J. N° L 262 of 27 September 1976, p. 204

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 are party; whereas the "International System of Units" (S.I.) was drawn up as a result of these resolutions;

Whereas the Council adopted Directive 71/354/EEC on 18 October 1971 on the approximation of the laws of the Member States in order to overcome obstacles to trade by adopting the international system of units at Community level; whereas Directive 71/354/EEC was amended by the Act of Accession and by Council Directive 76/770/EEC; whereas these Community provisions have not overcome all the obstacles in this field; whereas Directive 76/770/EEC provides for the review before 31 December 1979 of the situation regarding units of measurement, names and symbols listed in Chapter D of the Annex; whereas it has also proved necessary to review the situation regarding various other units of measurement;

Whereas it is necessary, in order to avoid serious difficulties, to provide for a transitional period during which units of measurement which are not compatible with the international system can be phased out; whereas it is nevertheless essential to allow the Member States wishing to do so to bring into force as quickly as possible, on their territory, the provisions of Chapter I of the Annex; whereas it is therefore necessary to set a limit at Community level on the duration of this transitional period while, at the same time, leaving the Member States free to curtail that period;

Whereas during the transitional period it is essential, particularly for the protection of the consumer, to maintain a clear position on the use of units of measurement in trade between the Member States; whereas the obligation on the Member States to allow double indication on products and equipment imported from other Member States during this transitional period seems to serve this purpose well;

Whereas the systematic adoption of a solution of this kind for all measuring instruments, including medical instruments, is however not necessarily desirable; whereas the Member States should therefore be able to require that, on their territory, measuring instruments bear indications of quantity in one single legal unit of measurement;

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Whereas this Directive does not affect the continued manufacture of products already on the market; whereas it does, however, affect the placing on the market and use of products and equipment bearing indications of quantity in units of measurement which are no longer legal units of measurement, when such products and equipment are necessary to supplement or replace components or parts of such products, equipment and instruments already on the market; whereas it is therefore necessary for Member States to authorize the placing on the market and the use of such products and equipment to complete and replace components, even when they bear indications of quantity in units of measurement which are no longer legal, so that the products, equipment or instruments already on the market may continue to be used;

Whereas the International Organization for Standardization (ISO) adopted an international standard on 1 March 1974 on the representation of S.I. and other units for use in systems with limited sets of symbols; whereas it is therefore advisable for the Community to adopt solutions which have already been approved on a wider international level; whereas the strict reference to the standard makes it possible to adopt the ISO Standard 2955 of 1 March 1974 at Community level;

Whereas Community provisions relating to units of measurement are to be found in various separate Community acts; whereas the question of units of measurement is so important that it is essential that reference may be made to a single Community act; whereas this Directive thereby consolidates all the Community provisions on this subject and repeals Directive 71/354/EEC of 18 October 1971,

HAS ADOPTED THIS DIRECTIVE :

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Article 1

The legal units of measurement within the meaning of this Directive which are necessary for expressing quantities shall be:

- a) those listed in Chapter I of the Annex to this Directive;
- b) until a date to be fixed by the Member States, those listed in Chapter II of the Annex; this date may not be set at later than 31 December 1985;
- c) until a date to be fixed by those Member States, those listed in Chapter III of the Annex in those Member States where they were authorized on 21 April 1973; this date may not extend beyond a date which shall be set by the Council under Article 100 of the Treaty before 31 December 1989.

Article 2

- a) 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.
- b) This Directive shall not affect the use in the field of air and sea transport and rail traffic of units which it does not prescribe but which have been laid down by international conventions or agreements binding the Community or the Member States.

Article 3

- a) There is double indication within the meaning of this Directive when an indication expressed by a unit listed in Chapter I is accompanied by a supplementary explanatory indication expressed by a unit not listed in Chapter I of this Directive.

- b) Member States may authorize, on their territory, double indication using the units of measurement listed in Chapter III until 31 December 1989, and, using other units of measurement not listed in Chapter I, until 31 December 1985.
- c) Member States shall authorize or tolerate on products and equipment double indication using the units of measurement listed in Chapter III until 31 December 1989, and, using other units of measurement not listed in Chapter I, until 31 December 1985.
- d) However, Member States may require that measuring instruments bear indications of quantity in one single legal unit of measurement.
- e) When use is made of double indication in accordance with the provisions of this Directive, the indication expressed by the unit of measurement listed in Chapter I shall be preponderant. The indications expressed by the units of measurement not listed in Chapter I of the Annex shall be expressed notably in characters at most equal in size to those of the corresponding indication in units listed in Chapter I of the Annex.

Article 4

Member States shall authorize the placing on the market and the use of products and equipment bearing indications of quantity in units of measurement which are no longer legal units of measurement, when these products and equipment are necessary to complete or replace components or parts of such products, equipment and instruments already on the market and bearing such indications.

Article 5

ISO Standard 2955 of 1 March 1974, "Information processing - Representations of S.I. and other units for use in systems with limited character sets" applies in the field covered by its paragraph 1.

Article 6

Council Directive 71/354/EEC of 18 October 1971, as amended by the Acts concerning the Accession to the European Communities and most recently amended by Council Directive 76/770/EEC of 27 July 1976, shall stand repealed on 1 October 1981.

Article 7

- a) Member States shall adopt and publish before 1 July 1981 the laws, regulations and administrative provisions necessary in order to comply with this Directive, which shall enter into force on 1 October 1981 and shall inform the Commission thereof.
- b) Once this Directive has been notified, Member States shall also ensure that the Commission is informed, in sufficient time to enable it to submit its comments, of any draft laws, regulations or administrative provisions which they intend to adopt in the field covered by this Directive.

Article 8

This Directive is addressed to the Member States.

ANNEX

CHAPTER I

LEGAL UNITS OF MEASUREMENT REFERRED TO IN ARTICLE 1 a

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
Amount of substance	mole	mol
Luminous intensity	candela	cd

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 CGPM (1960), resolution 6).

Unit of mass

The kilogramme is the unit of mass; it is equal to the mass of the international prototype of the kilogramme.

(Third CGPM (1901), page 70 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 one 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, unit of thermodynamic temperature, is the fraction 1/273·16 of the thermodynamic temperature of the triple point of water.

(Thirteenth CGPM (1967), resolution 4).

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 kg of carbon 12.

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.

(Fourteenth CGPM (1971), resolution 3).

Unit of luminous intensity

The candela is the luminous intensity, in the perpendicular direction, of a surface of 1/600 000 m² of a black body at the temperature of freezing platinum under a pressure of 101 325 newtons/m².

(Thirteenth CGPM (1967), resolution 5).

1.1.1. Special name and symbol of the SI 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 kelvins. An interval of or difference in temperature may be expressed either in kelvins or in degrees Celsius. The unit of 'degree Celsius' is equal to the unit 'kelvin'.

1.2. Other SI units

1.2.1. Supplementary SI units

Quantity	Unit	
	Name	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

(Eleventh CGPM, 1960, resolution 12).

Definitions of supplementary SI units:

Plane angle unit

The radian is the plane angle between two radii which, on the circumference of a circle, cut an arc equal in length to the radius.

(International standard ISO 31 - I).

Solid angle unit

The steradian is the solid angle which has its apex at the centre of a sphere and which describes on the surface of the sphere an area equal to that of a square having as its side the radius of the sphere.

(International standard ISO 31 - I).

1.2.2. Derived SI units

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

1.2.3. Derived SI units having names and symbols

Quantity	Unit		Expression	
	Name	Symbol	In other SI units	In terms of base or supplementary SI units
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⁽¹⁾, 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	$V \cdot A^{-1}$	$m^2 \cdot kg \cdot s^{-3} \cdot A^{-2}$
Conductance	siemens	S	$A \cdot V^{-1}$	$m^{-2} \cdot kg^{-1} \cdot s^4 \cdot A^2$
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		$cd \cdot sr$
Illuminance	lux	lx	$lm \cdot m^{-2}$	$m^{-2} \cdot cd \cdot sr$
Activity (of a radio-nuclide)	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, dose equivalent index	sievert	Sv	$J \cdot kg^{-1}$	$m^2 \cdot s^{-2}$

⁽¹⁾ 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 CGPM resolutions.

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

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 $Pa \cdot s$.

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

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10^{18}	exa	E	10^{-1}	deci	d
10^{15}	peta	P	10^{-2}	centi	c
10^{12}	tera	T	10^{-3}	milli	m
10^9	giga	G	10^{-6}	micro	μ
10^6	mega	M	10^{-9}	nano	n
10^3	kilo	k	10^{-12}	pico	p
10^2	hecto	h	10^{-15}	femto	f
10^1	deca	da	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 authorized 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⁾	1 l = 1 dm ³ = 10 ⁻³ m ³
Mass	metric ton	t	1 t = 1 Mg = 10 ³ kg
Pressure, stress	bar	bar	1 bar = 10 ⁵ Pa

(1) For the symbol for litre, where there is a risk of confusion between the letter l and the number 1, one may use the abbreviation "ltr" or write "litre" in full (CIPM, 1976).

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

Quantity	Unit		
	Name	Symbol	Value
Area of farmland and building land	are	a	1 a = 10 ³ m ²
Mass per unit length of textile yarns and threads	tex* ⁽¹⁾	tex*	1 tex = 10 ⁻⁶ kg · m ⁻¹

Note: The prefixes and their symbols listed in 1.3 may be used in conjunction with the units and symbols contained in Tables 1.4.1 and 1.4.2.

The multiple 10² a is, however, called a 'hectare'.

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

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* (a)		1 revolution = 2π rad
	grade* or gon*	gon *	1 gon = $\frac{\pi}{200}$ rad
	degree	°	1° = $\frac{\pi}{180}$ 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

(a) 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 symbols only with the symbol 'gon'.

3. UNITS DEFINED INDEPENDENTLY OF THE SEVEN SI BASE UNITS

The unified atomic mass unit is one-twelfth 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 one volt higher.

Quantity	Unit		
	Name	Symbol	Value
Mass	unified atomic mass unit	u	1 u $\approx 1.6605655 \times 10^{-27}$ kg
Energy	electronvolt	eV	1 eV $\approx 1.6021892 \times 10^{-19}$ J

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

The above values are taken from CODATA Bulletin No 11 of December 1973 of the International Council of Scientific Unions.

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	Value
Vergency of optical systems	dioptré*	1 dioptré = 1 m^{-1}
Mass of precious stones	metric carat	1 metric carat = 2×10^{-4} kg

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

CHAPTER II

LEGAL UNITS OF MEASUREMENT REFERRED TO IN ARTICLE 1 b

Quantities, names of units, symbols and values

Quantity	Unit		
	Name	Symbol	Value
Blood pressure	millimeter of mercury	mm Hg	1 mm Hg = 133,322 Pa
Plane angle		g [*] (1)	1 g = $\frac{\pi}{200}$ rad
Activity (of a radio-nuclide)	curie	Ci	1 Ci = 3.7×10^{10} Bq
Absorbed dose	rad	rad(2)	1 rad = 10^{-2} Gy
Equivalent dose	rem*	rem*	1 rem = 10^{-2} Sv
Exposure (X and γ rays)	röntgen	R	1 R = 2.58×10^{-4} C · kg ⁻¹

(1) Symbol for "grade".

(2) When there is risk of confusion with the symbol for radian, rd may be used as symbol for rad.

Note: The prefixes and their symbols listed in 1.3 may be used in conjunction with the units and symbols contained in this section, with the exception of 'g'.

CHAPTER III

LEGAL UNITS OF MEASUREMENT REFERRED TO IN ARTICLE 1 c

Quantities, names of units, symbols and approximate values

Length

inch	1 in = 2.54×10^{-2} m
foot	1 ft = 0.3048 m
fathom ⁽¹⁾	1 fm = 1.829 m
mile	1 mile = 1 609 m

Area

square foot	1 sq ft = 0.929×10^{-1} m ²
acre	1 ac = 4 047 m ²

Volume

fluid ounce	1 fl oz = 28.41×10^{-6} m ³
gill	1 gill = 0.1421×10^{-3} m ³
pint	1 pt = 0.5683×10^{-3} m ³
quart	1 qt = 1.137×10^{-3} m ³
gallon	1 gal = 4.546×10^{-3} m ³

Mass

ounce (avoirdupois)	1 oz = 28.35×10^{-3} kg
troy ounce	1 oz tr = 31.10×10^{-3} kg
pound	1 lb = 0.4536 kg

⁽¹⁾ For marine navigation only.