# INTERNATIONAL STANDARD 

## Quantities and units -

Part 1:
Space and time
iTeh STANDARD PREVIEW
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Partie 1: Espace et temps
ISO 31-1:1992
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9ea27ed50d0a/iso-31-1-1992

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at Jeast $75 \%$ of the member bodies casting a vote.

International Standard ISO 31-1 was preparedaby Technical Cómmitteei) ISO/TC 12, Quantities, units, symbols, conversion factors.

This second edition cancels and replaces IThe $^{31-1 \text { first }^{2}}$ edition (ISO 31-1:1978). The major technical changes from the first edition are the 2b95-4be1-a790following:

- the decision by the International Committee for Weights and Measures (Comité International des Poids et Mesures, CIPM) in 1980 concerning the status of supplementary units has been incorporated;
- units in use temporarily have been transferred to the "Conversion factors and remarks" column.

The scope of Technical Committee ISO/TC 12 is standardization of units and symbols for quantities and units (and mathematical symbols) used within the different fields of science and technology, giving, where necessary, definitions of these quantities and units. Standard conversion factors for converting between the various units also come under the scope of the TC. In fulfilment of this responsibility, ISO/TC 12 has prepared ISO 31.

[^0]ISO 31 consists of the following parts, under the general title Quantities and units:

- Part 0: General principles
- Part 1: Space and time
- Part 2: Periodic and related phenomena
- Part 3: Mechanics
- Part 4: Heat
- Part 5: Electricity and magnetism
- Part 6: Light and related electromagnetic radiations
- Part 7: Acoustics
- Part 8: Physical chemistry and molecular physics
- Part 9: Atomic and nuclear physics
- Part 10: Nuclear reactions and ionizing radiations
- Part 11: Mathematical signs and symbols for use in the physical

( - Part 12: Characteristic numbers
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- Part 13: Solid state physics

Annexes $A$ and $B$ of this part of ISO 31 are for information only.
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## Introduction

### 0.1 Arrangement of the tables

The tables of quantities and units in ISO 31 are arranged so that the quantities are presented on the left-hand pages and the units on the corresponding right-hand pages.

All units between two full lines belong to the quantities between the corresponding full lines on the left-hand pages.

Where the numbering of an item has been changed in the revision of a part of ISO 31, the number in the preceding edition is shown in parentheses on the left-hand page under the new number for the quantity; a dash is used to indicate that the item in question did not appear in the preceding edition.

### 0.2 Tables of quantities

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The most important quantities within the field of this document are given together with their symbols and, in most cases, definitions, These defi-2b95-4bel-a790nitions are given merely for identification; they are not intended to be complete.

The vectorial character of some quantities is pointed out, especially when this is needed for the definitions, but no attempt is made to be complete or consistent.

In most cases only one name and only one symbol for the quantity are given; where two or more names or two or more symbols are given for one quantity and no special distinction is made, they are on an equal footing. When two types of italic (sloping) letter exist (for example as with $\vartheta, \theta ; \varphi, \phi ; g, g$ ) only one of these is given. This does not mean that the other is not equally acceptable. In general it is recommended that such variants should not be given different meanings. A symbol within parentheses implies that it is a "reserve symbol", to be used when, in a particular context, the main symbol is in use with a different meaning.

### 0.3 Tables of units

### 0.3.1 General

Units for the corresponding quantities are given together with the international symbols and the definitions. For further information, see ISO 31-0.

The units are arranged in the following way:
a) The names of the SI units are given in large print (larger than text size). The SI units have been adopted by the General Conference on Weights and Measures (Conférence Générale des Poids et Mesures, CGPM).

The SI units and their decimal multiples and sub-multiples are recommended, although the decimal multiples and sub-multiples are not explicitly mentioned.
b) The names of non-SI units which may be used together with SI units because of their practical importance or because of their use in specialized fields are given in normal print (text size).

These units are separated by a broken line from the SI units for the quantities concerned.
c) The names of non-SI units which may be used temporarily together with SI units are given in small print (smaller than text size) in the "Conversion factors and remarks" column.
d) The names of non-SI units which should not be combined with SI units are given only in annexes in some parts of ISO 31. These annexes are informative and not integral parts of the standard. They are arranged in three groups:

1) special names of units in the CGS system;
2) names of units based on the foot, pound and second and some other related units;
3) names of other units.

## iT Telh 0.3.2 Remark on units for quantities of/dimension one

The coherent unit for any quantity of dimension one is the number one (1). When the value of such a quantity is expressed, the unit 1 is generally not written out explicitly. Prefixes shall not be used to form multiples or submultiples of this unit. Instead of prefixes, powers of 10 may be used.
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Refractive index $n=1,53 \times 1=1,53$
Reynolds number $\operatorname{Re}=1,32 \times 10^{3}$
Considering that plane angle is generally expressed as the ratio between two lengths, and solid angle as the ratio between an area and the square of a length, the CIPM specified in 1980 that, in the International System of Units, the radian and steradian are dimensionless derived units. This implies that the quantities plane angle and solid angle are considered as dimensionless derived quantities. The units radian and steradian may be used in expressions for derived units to facilitate distinction between quantities of different nature but having the same dimension.

### 0.4 Numerical statements

All numbers in the "Definition" column are exact.
When numbers in the "Conversion factors and remarks" column are exact, the word "exactly" is added in parentheses after the number.

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## Quantities and units

## Part 1: <br> Space and time

## 1 Scope

This part of ISO 31 gives names and symbols for quantities and units of space and time. Where appropriate, conversion factors are also given.

## 2 Normative reference

The following standard contains provisions which through reference in this text, constitute provisions of this part of ISO 31. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this
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part of ISO 31 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.
mats - Information interchange - Representation of dates and times.

## 3 Names and symbols

The names and symbols for quantities and units of space and time are given on the following pages.

SPACE AND TIME
Quantities

| Item No. | Quantity | Symbol | Definition | Remarks |
| :---: | :---: | :---: | :---: | :---: |
| 1-1 | angle, <br> (plane angle) | $\alpha, \beta, \gamma, \vartheta, \varphi$ | The angle between two half-lines terminating at the same point is defined as the ratio of the length of the included arc of the circle (with its centre at that point) to the radius of that circle | Other symbols are also used. |
| 1-2 | solid angle | $\begin{array}{\|l\|} \hline \Omega^{\text {IIUNI }} \mathrm{S} \\ \text { https:/standards. its } \end{array}$ | The solid angle of a cone is defined ass the cratio of the aldea cut ơyt on a spherical surface (with its centre at the apex of that cone) to the square of the radius of the sphere 9ea27ed50d0a/iso-31-1-1992 | 1-a790- |
| 1-3.1 | length <br> breadth | $\begin{aligned} & l, L \\ & b \end{aligned}$ |  | Length is one of the base quantities on which the SI is based. |
| 1-3.3 | height | $h$ |  |  |
| 1-3.4 | thickness | $d, \delta$ |  |  |
| 1-3.5 | radius |  |  |  |
| 1-3.6 | diameter | $d, D$ |  |  |
| 1-3.7 | length of path |  |  |  |
| $\begin{aligned} & \left.\begin{array}{l} 1-3.8 \\ (-) \end{array}\right) \end{aligned}$ | distance | $d, r$ |  |  |
| $\begin{aligned} & \left.\begin{array}{l} 1-3.9 \\ -1 \end{array}\right) \end{aligned}$ | cartesian coordinates | $x, y, z$ |  |  |
| $\begin{aligned} & \begin{array}{l} 1-3.10 \\ (-) \end{array} \end{aligned}$ | radius of curvature | $\varrho$ |  |  |


| Units |  |  |  | SPACE AND TIME |
| :---: | :---: | :---: | :---: | :---: |
| Item No. | Name of unit | International symbol for unit | Definition | Conversion factors and remarks |
| 1-1.a | radian | rad | $1 \mathrm{rad}=1 \mathrm{~m} / \mathrm{m}=1$ | See the introduction, subclause 0.3.2. <br> The radian is the angle between two radii of a circle which cut off on the circumference an arc equal in length to the radius. |
| $\begin{aligned} & 1-1 . b \\ & 1-1 . c \\ & 1-1 . d \end{aligned}$ | degree <br> minute <br> second | " | $\begin{aligned} & 1^{\circ}=\frac{\pi}{180} \mathrm{rad} \\ & 1^{\prime}=(1 / 60)^{\circ} \\ & 1^{\prime \prime}=(1 / 60)^{\prime} \end{aligned}$ | $1^{\circ}=0,0174533 \mathrm{rad}$ <br> There shall be no space between a numerical value and any of these superscript-type unit symbols. The degree should preferably be subdivided decimally. The unit symbol shall then be placed after the number. <br> EXAMPLE <br> Write $17,25^{\circ}$ rather than $17^{\circ} 15^{\prime}$. |
| 1-2.a | steradian | sr <br> (stan <br> /standards.iteh.ai/catalc 9ea27 | $1 \mathrm{sr}=1 \mathrm{~m}^{2} / \mathrm{m}^{2}=1$ lards.iteh.ail) <br> ISO 31-1:1992 <br> g/standards/sist/e17ad3a8-2b95-4 d50d0a/iso-31-1-1992 | See the introduction, subclause 0.3.2. <br> The steradian is the solid angle of a cone which, having its vertex in the centre of a sphere, cuts off on the surface of the sphere an area equal to that of a square with sides of length equal to the radius of the sphere. |
| 1-3.a | metre | m | The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792458 of a second | ångström ( $\AA$ ), $1 \AA=10^{-10} \mathrm{~m}$ (exactly) <br> nautical mile, 1 nautical mile $=$ 1852 m (exactly) <br> This definition was adopted by the First International Extraordinary Hydrographic Conference, in 1929. |


| SPACE AND TIME (continued) |  |  |  | Quantities |
| :---: | :---: | :---: | :---: | :---: |
| Item No. | Quantity | Symbol | Definition | Remarks |
| $\begin{aligned} & 1-4 \\ & (-) \end{aligned}$ | curvature | $\varkappa$ | $\boldsymbol{x}=1 / \mathrm{e}$ |  |
| $\begin{aligned} & 1-5 \\ & (1-4.1) \end{aligned}$ | area | A, (S) | $A=\iint \mathrm{d} x \mathrm{~d} y$ <br> where $x$ and $y$ are cartesian coordinates | For an element of area, $\mathrm{d} \sigma$ is sometimes used. |
| $\begin{aligned} & 1-6 \\ & (1-5.1) \end{aligned}$ | volume | v | $V=\iiint \mathrm{d} x \mathrm{~d} y \mathrm{~d} z$ <br> where $x, y$ and $z$ are cartesian coordinates <br> \$TANDARID PREVI (standards.iteh.ai) <br> ISO 31-1:1992 | For an element of volume, $\mathrm{d} \tau$ is sometimes used. <br> W |
| $\begin{aligned} & 1-7 \\ & (1-6.1) \end{aligned}$ | time, time interval, duration | $t$ | 9ea27ed50d0a/iso-31-1-1992 | Time is one of the base quantities on which the SI is based. |
| $\begin{aligned} & 1-8 \\ & (1-7.1) \end{aligned}$ | angular velocity | $\omega$ | $\omega=\frac{\mathrm{d} \varphi}{\mathrm{~d} t}$ |  |
| $\begin{aligned} & 1-9 \\ & (1-8.1) \end{aligned}$ | angular acceleration | $\alpha$ | $\alpha=\frac{\mathrm{d} \omega}{\mathrm{~d} t}$ | This equation applies to rotation about a fixed axis. It may also be applied generally, provided that both $\omega$ and $\alpha$ are regarded as vectors. |


| Units |  |  |  | SPACE AND TIME (continued) |
| :---: | :---: | :---: | :---: | :---: |
| Item No. | Name of unit | International symbol for unit | Definition | Conversion factors and remarks |
| 1-4.a | reciprocal metre, metre to the power minus one | $\mathrm{m}^{-1}$ |  |  |
| 1-5.a | square metre | $\mathrm{m}^{2}$ |  | The unit are, symbol a, (and its multiple hectare, symbol ha) are used to express agrarian areas, $1 \mathrm{a}=100 \mathrm{~m}^{2}$ (exactly). |
| 1-6.a | cubic metre | $\mathrm{m}^{3}$ |  |  |
| 1-6.b | litre | I, L <br> iTeh STA <br> (star | $1 \mathrm{I}=1 \mathrm{dm}^{3}$ <br> NDARD PREV dards.iteh.ai) <br> ISO 31-1:1992 | $1 \mathrm{I}=10^{-3} \mathrm{~m}^{3} \text { (exactly) }$ <br> In 1964 the 12th CGPM redefined the litre as $1 \mathrm{I}=1 \mathrm{dm}^{3}$. According to the older definition the litre was equal to $1,000028 \mathrm{dm}^{3}$. <br> The two symbols for the litre are on an equal footing. The CGPM will later consider the possibility of retaining only one of the symbols. |
| 1-7.a | second | s <br> 9 ea2 | The second is the duration of 9192631770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom | tocr-atsu- |
| $\begin{aligned} & 1-7 . b \\ & 1-7 . c \\ & 1-7 . d \end{aligned}$ | minute <br> hour <br> day | $\begin{aligned} & \text { min } \\ & h \\ & d \end{aligned}$ | $\begin{aligned} & 1 \mathrm{~min}=60 \mathrm{~s} \\ & 1 \mathrm{~h}=60 \mathrm{~min}=3600 \mathrm{~s} \\ & 1 \mathrm{~d}=24 \mathrm{~h}=86400 \mathrm{~s} \end{aligned}$ | For representations of time of day, see ISO 8601. |
| 1-8.a | radian per second | $\mathrm{rad} / \mathrm{s}$ |  | For other units, see 1-1.b...d. |
| 1-9.a | radian per second squared | $\mathrm{rad} / \mathrm{s}^{2}$ |  | For other units, see 1-1.b...d. |


[^0]:    - ISO 1992

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