SLOVENSKI STANDARD
oSIST prEN ISO 80000-1:2022

01-april-2022

Veličine in enote - 1. del: Splošno (ISO/DIS 80000-1:2022)

Quantities and units - Part 1: General (ISO/DIS 80000-1:2022)

Größen und Einheiten – Teil 1: Allgemeines (ISO/DIS 80000-1:2022)

Grandeurs et unités - Partie 1 : Généralités (ISO/DIS 80000-1:2022)

Ta slovenski standard je istoveten z: prEN ISO 80000-1

ICS:

01.060 Veličine in enote Quantities and units

oSIST prEN ISO 80000-1:2022 **en,fr,de**

DRAFT INTERNATIONAL STANDARD
ISO/DIS 80000-1

ISO/TC **12** Secretariat: **SIS**

Voting begins on: **2022-01-28** Voting terminates on: **2022-04-22**

Quantities and units —

Part 1: **General**

Grandeurs et unités —

Partie 1: Généralités

ICS: 01.060

This document is circulated as received from the committee secretariat.

This draft is submitted to a parallel vote in ISO and in IEC.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/DIS 80000-1:2022(E)

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 12, *Quantities and units* in co-operation with IEC/TC 25, *Quantities and units*.

This second edition cancels the first edition (ISO 80000-1:2009), which has been technically revised.

The main changes are as follows:

— More focus on concepts and terminology based on a system of quantities, particularly following the recent major revision of the International System of Units (SI) and the proposed revisions of the International vocabulary of metrology (VIM).

— At the same time, sections of previous editions of this Standard which essentially reproduced content from other sources – particularly metrological vocabulary, descriptions of SI units and compilations of fundamental constants – have been substantially removed from the present edition, in accord with an ISO/TC 12 CIB 2020.

A list of all parts in the ISO 80000 and IEC 80000 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

0 Introduction

0.1 Quantities

Systems of quantities – as defined in the ISO/IEC Guide 99 (VIM) – can be treated in many consistent, but different, ways. Which treatment to use is partly a matter of convention.

The quantities and relations among the quantities used here are those almost universally accepted for use throughout the physical sciences. They are presented in the majority of scientific textbooks today and are familiar to all scientists and technologists.

The quantities and the relations among them are essentially infinite in number and are continually evolving as new fields of science and technology are developed. Thus, it is not possible to list all these quantities and relations in this International Standard; instead, a selection of the more commonly used quantities and the relations among them is presented.

It is inevitable that some readers working in particular specialized fields may find that the quantities they are interested in using may not be listed in this International Standard or in another International Standard. However, provided that they can relate their quantities to more familiar examples that are listed, this will not prevent them from defining units for their quantities.

The system of quantities presented in this International Standard is named the *International System of Quantities*, denoted “ISQ”, in all languages. This name was not used in ISO 31, from which the present harmonized series has evolved. However, the ISQ does appear in ISO/IEC Guide 99 and is the system of quantities underlying the International System of Units, denoted “SI”, in all languages. It should be realized that the ISQ is an essentially infinite and continually evolving and expanding system of quantities and equations on which all of modern science and technology rests.

0.2 Arrangement of the tables

In parts 3 to 14 of this International Standard, the quantities and relations among them, which are a subset of the ISQ, are given and the units of the SI[1] (and some other units) are given in tables. Some additional quantities and units are also given. The item numbers of quantities are written pp-nn.s (pp, part number; nn, running number in the part, respectively; s, sub-number).

Quantities and units —

Part 1:
General

1 Scope

This document gives general information and definitions concerning quantities, systems of quantities, units, quantity and unit symbols, and coherent unit systems, especially the International System of Quantities, ISQ.

The principles laid down in ISO 80000-1 are intended for general use within the various fields of science and technology, and as an introduction to other parts of this International Standard.

The ISO 80000 series does not, as yet, cover ordinal quantities and nominal properties.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC Guide 99 apply.

4 Quantities

4.1 The concept of quantity

In this International Standard, it is accepted that things (including physical bodies and phenomena, substances, events, etc.) are characterized by properties, according to which things can be compared, in terms of having the same property or not, as is the case for rigid bodies about their shape and for human beings about having the same blood type or not. Some properties make things comparable also by order, so that for example winds can be compared by their strength and earthquakes can be compared by their magnitude. Finally, some properties make things comparable not only in terms of equivalence and order, but also in more complex ways, and in particular by ratio, as is the case for most physical quantities, according to which the mass or the electric charge of a body might be twice the mass or the electric charge of another body, and so on.

Not all properties, and more specifically quantities, can be compared with each other. For example, while the diameter of a cylindrical rod can be compared to the height of a block, the diameter of a rod cannot be compared to the mass of a block.

Quantities that are comparable are said to be of the same kind[2] and are instances of the same general quantity. Hence diameters and heights are quantities of the same kind, being instances of the general quantity length.

It is customary to use the same term, "quantity", to refer to both general quantities, such as length, mass, etc., and their instances, such as given lengths, given masses, etc. Accordingly, we are used to saying both that length is a quantity and that a given length is a quantity, by maintaining the specification – "general quantity" or "individual quantity" – implicit and exploiting the linguistic context to remove the ambiguity.

4.2 System of quantities ─ Base quantities and derived quantities

General quantities are related through equations that express laws of nature or define new general quantities. Each equation between quantities is called a *quantity equation*.

It is convenient to consider some quantities of different kinds as mutually independent. Such quantities are called *base quantities*. Other quantities, called *derived quantities,* are defined or expressed in terms of *base quantities* by means of equations.

It is a matter of choice how many and which quantities are considered to be base quantities. It is also a matter of choice which equations are used to define the derived quantities. Each set of non-contradictory equations between quantities is called a *system of quantities*.

4.3 Universal constants and empirical constants

Some individual quantities are considered to be constant under all circumstances. Such quantities are called *universal constants* or *fundamental physical constants*.

EXAMPLE 1 The Planck constant, $\hbar$[3].

EXAMPLE 2 The Faraday constant, F[3].

Other quantities may be constant under some circumstances but depend on others. Their values are generally obtained by measurement. They are called *empirical constants*.

EXAMPLE 3

The result of measuring at a certain station the length l and the periodic time T, for each of several particle pendulums, can be expressed by one quantity equation

$$T = C\sqrt{l}$$

where C is an empirical constant that depends on the location.

Theory shows that

$$C = \frac{2\pi}{\sqrt{g}}$$

where g is the local acceleration of free fall, which is another empirical constant.

4.4 Constant multipliers in quantity equations

Equations between quantities sometimes contain constant multipliers. These multipliers depend on the definitions chosen for the quantities occurring in the equations, i.e., on the system of quantities chosen. Such multipliers may be purely numerical and are then called *numerical factors*.

EXAMPLE 1

In a three-dimensional quantity system, where length, mass, and time are three base quantities, the kinetic energy of a particle in classical mechanics is

$$T = \frac{1}{2}mv^2$$

where T is kinetic energy, m is mass and v is speed. This equation contains the numerical factor $\frac{1}{2}$.

A multiplier may include one or more universal (or empirical) constants.

EXAMPLE 2

In the three-dimensional quantity system, the Coulomb law for electric charges is

$$F = \frac{q_1 q_2}{r^2}$$

where F is scalar force, q_1 and q_2 are two electric charges, r is distance.

For a rationalised four-dimensional quantity system, where at least one base quantity of an electrical nature is added, the expression becomes

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

where ε_0 is since the 2019 redefinition of SI base units[1], an empirical constant, i.e., the electric constant (it was formerly a universal constant).

A multiplier may also include one or more *conventional quantity values*.

Constant multipliers other than numerical factors are often called *coefficients*.

4.5 International System of Quantities, ISQ

The special choice of base quantities and quantity equations, including multipliers, given in ISO 80000 and IEC 80000 defines the *International System of Quantities*, denoted “ISQ” in all languages. Derived quantities can be defined in terms of the base units by quantity equations. There are seven base quantities in the ISQ: length, mass, time, electric current, thermodynamic temperature, amount of substance, and luminous intensity.

5 Dimensions

In the system of quantities under consideration, the relation between any general quantity Q and the base quantities can be expressed by means of an equation. The equation may include a sum of terms, each of which can be expressed as a product of powers of base quantities A, B, C, ... from a chosen set, sometimes multiplied by a numerical factor ξ, i.e., $\xi \cdot A^\alpha B^\beta C^\gamma$..., where the set of exponents α, β, γ, ... is the same for each term.

The *dimension* of the quantity Q is then expressed by the *dimensional product*

$$\dim Q = \mathrm{A}^\alpha\, \mathrm{B}^\beta\, \mathrm{C}^\gamma \ldots$$

where A, B, C, ... denote the dimensions of the base quantities A, B, C, ..., respectively, and α, β, γ, ... are called the *dimensional exponents*.

Quantities that are of the same kind (e.g., length) have the same dimension, even if they are originally expressed in different units (such as yards and metres). If quantities have different dimensions (such as length vs. mass), they are of different kinds[2,4] and cannot be compared[5].

A quantity whose dimensional exponents are all equal to zero has the dimensional product denoted $\mathrm{A}^0\mathrm{B}^0\mathrm{C}^0$... = 1, where the symbol 1 denotes the corresponding dimension. There is no agreement on how to refer to such quantities. They have been called dimensionless quantities (although this term should now be avoided), quantities with dimension one, quantities with dimension number, or quantities with the unit one. Such quantities are dimensionally simply numbers. To avoid confusion, it is helpful to use explicit units with these quantities where possible, e.g., m/m, nmol/mol, rad[1]. It is especially important to have a clear description of any such quantity when expressing a measurement result.

NOTE 1 These quantities include those defined as a quotient of two quantities of the same dimension and those defined as numbers of entities.