SLOVENSKI STANDARD
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SIST EN ISO 80000-11:2013

Veličine in enote - 11. del: Značilna števila (ISO 80000-11:2019)

Quantities and units - Part 11: Characteristic numbers (ISO 80000-11:2019)

Größen und Einheiten - Teil 11: Kenngrößen der Dimension Zahl (ISO 80000-11:2019)

Grandeurs et unités - Partie 11: Nombres caractéristiques (ISO 80000-11:2019)

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01.060	Veličine in enote	Quantities and units

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 80000-11

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ICS 01.060

Supersedes EN ISO 80000-11:2013

English Version

Quantities and units - Part 11: Characteristic numbers (ISO 80000-11:2019)

Grandeurs et unités - Partie 11: Nombres caractéristiques (ISO 80000-11:2019)

Größen und Einheiten - Teil 11: Kenngrößen der Dimension Zahl (ISO 80000-11:2019)

This European Standard was approved by CEN on 21 October 2020.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EN ISO 80000-11:2020 (E)

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European foreword

The text of ISO 80000-11:2019 has been prepared by Technical Committee ISO/TC 12 "Quantities and units" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 80000-11:2020 by Technical Committee CEN/SS F02 "Units and symbols" the secretariat of which is held by CCMC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2021, and conflicting national standards shall be withdrawn at the latest by April 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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The text of ISO 80000-11:2019 has been approved by CEN as EN ISO 80000-11:2020 without any modification.

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INTERNATIONAL STANDARD

ISO 80000-11

Second edition
2019-10

Quantities and units —

Part 11:
Characteristic numbers

Grandeurs et unités —

Partie 11: Nombres caractéristiques

Reference number
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ISO 80000-11:2019(E)

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).

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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 collaboration with Technical Committee IEC/TC 25, *Quantities and units*.

This second edition cancels and replaces the first edition (ISO 80000-11:2008), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the table giving the quantities and units has been simplified;

— all items have been revised in terms of the layout of the definitions, and a worded definition has been added to each item;

— the number of items has been increased from 25 to 108 (concerns all Clauses);

— item 11-9.2 (Landau-Ginzburg number) has been transferred in this document from ISO 80000-12:2009 (revised as ISO 80000-12:2019).

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

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.

Introduction

Characteristic numbers are physical quantities of unit one, although commonly and erroneously called "dimensionless" quantities. They are used in the studies of natural and technical processes, and (can) present information about the behaviour of the process, or reveal similarities between different processes.

Characteristic numbers often are described as ratios of forces in equilibrium; in some cases, however, they are ratios of energy or work, although noted as forces in the literature; sometimes they are the ratio of characteristic times.

Characteristic numbers can be defined by the same equation but carry different names if they are concerned with different kinds of processes.

Characteristic numbers can be expressed as products or fractions of other characteristic numbers if these are valid for the same kind of process. So, the clauses in this document are arranged according to some groups of processes.

As the amount of characteristic numbers is tremendous, and their use in technology and science is not uniform, only a small amount of them is given in this document, where their inclusion depends on their common use. Besides, a restriction is made on the kind of processes, which are given by the Clause headings. Nevertheless, several characteristic numbers are found in different representations of the same physical information, e.g. multiplied by a numerical factor, as the square, the square root, or the inverse of another representation. Only one of these have been included, the other ones are declared as deprecated or are mentioned in the remarks column.

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INTERNATIONAL STANDARD   **ISO 80000-11:2019(E)**

Quantities and units —

Part 11:
Characteristic numbers

1 Scope

This document gives names, symbols and definitions for characteristic numbers used in the description of transport and transfer phenomena.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

Names, symbols and definitions for characteristic numbers are given in Clauses 4 to 9.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Momentum transfer

Table 1 gives the names, symbols and definitions of characteristic numbers used to characterize processes in which momentum transfer plays a predominant role. The transfer of momentum (ISO 80000-4) basically occurs during a collision of 2 bodies, and is governed by the law of momentum conservation. Energy dissipation can occur. In a more generalized meaning momentum transfer occurs during the interaction of 2 subsystems moving with velocity v relative to each other. Typically, one of the subsystems is solid and possibly rigid, with a characteristic length, which can be a length, width, radius, etc. of a solid object, often the effective length is given by the ratio of a body's volume to the area of its surface.

The other subsystem is a fluid, in general liquid or gaseous, with the following properties amongst others:

— mass density ρ (ISO 80000-4);

— dynamic viscosity η (ISO 80000-4);

— kinematic viscosity $v = \eta / \rho$ (ISO 80000-4), or

— pressure drop Δp (ISO 80000-4).

The field of science is mainly fluid dynamics (mechanics). Characteristic numbers of this kind allow the comparison of objects of different sizes. They also can give some estimation about the change of laminar flow to turbulent flow.

ISO 80000-11:2019(E)

Table 1 — Characteristic numbers for momentum transfer

No.	Name	Symbol	Definition	Remarks
11-4.1	Reynolds number	Re	quotient of inertial forces and viscous forces in a fluid flow, expressed by $$Re = \frac{\rho v l}{\eta} = \frac{v l}{\nu}\text{ ; where}$$ ρ is mass density (ISO 80000-4), v is speed (ISO 80000-3), l is characteristic length (ISO 80000-3), η is dynamic viscosity (ISO 80000-4), and ν is kinematic viscosity (ISO 80000-4)	The value of the Reynolds number gives an estimate on the flow state: laminar flow or turbulent flow. In rotating movement, the speed $v = \omega l$, where l is the distance from the rotation axis and ω is the angular velocity.
11-4.2	Euler number	Eu	relationship between pressure drop in a flow and the kinetic energy per volume for flow of fluids in a pipe, expressed by $$Eu = \frac{\Delta p}{\rho v^2}\text{ ; where}$$ Δp is drop of pressure (ISO 80000-4) ρ is mass density (ISO 80000-4), and v is speed (ISO 80000-3)	The Euler number is used to characterize losses in the flow. A modification of the Euler number is considering the dimensions of the containment (pipe): $$Eu' = \frac{d}{l}Eu\text{ ; where}$$ d is inner diameter (ISO 80000-3) of the pipe, and l is length (ISO 80000-3).
11-4.3	Froude number	Fr	quotient of a body's inertial forces and its gravitational forces for flow of fluids, expressed by $$Fr = \frac{v}{\sqrt{lg}}\text{ ; where}$$ v is speed (ISO 80000-3) of flow, l is characteristic length (ISO 80000-3), and g is acceleration of free fall (ISO 80000-3)	The Froude number can be modified by buoyancy. Sometimes the square and sometimes the inverse of the Froude number as defined here is wrongly used.

Table 1 *(continued)*

No.	Name	Symbol	Definition	Remarks
11-4.4	Grashof number	Gr	quotient of buoyancy forces due to thermal expansion which results in a change of mass density and viscous forces for free convection due to temperature differences, expressed by $Gr = l^3 g \alpha_V \, \Delta T / v^2$; where l is characteristic length (ISO 80000-3), g is acceleration of free fall (ISO 80000-3), α_V is thermal cubic expansion coefficient (ISO 80000-5), ΔT is difference of thermodynamic temperature T (ISO 80000-5) between surface of the body and the fluid far away from the body, and v is kinematic viscosity (ISO 80000-4)	Heating can occur near hot vertical walls, in pipes, or by a bluff body. The characteristic length can be the vertical height of a hot plate, the diameter of a pipe, or the effective length of a body. See also Rayleigh number (item 11-5.3).
11-4.5	Weber number	We	relation between inertial forces and capillary forces due to surface tension at the interface between two different fluids, expressed by $We = \rho v^2 l / \gamma$; where ρ is mass density (ISO 80000-4), v is speed (ISO 80000-3), l is characteristic length (ISO 80000-3), and γ is surface tension (ISO 80000-4)	The fluids can be gases or liquids. The different fluids often are drops moving in a gas or bubbles in a liquid. The characteristic length is commonly the diameter of bubbles or drops. The square root of the Weber number is called Rayleigh number. Sometimes the square root of the Weber number as defined here is called the Weber number. That definition is deprecated. Interfaces only exist between two fluids which are not miscible.
11-4.6	Mach number	Ma	quotient of the speed of flow and the speed of sound, expressed by $Ma = v / c$; where v is speed (ISO 80000-3) of the body, and c is speed of sound (ISO 80000-8) in the fluid	The Mach number represents the relationship of inertial forces compared to compression forces. For an ideal gas $c = \sqrt{\gamma \dfrac{p}{\rho}} = \sqrt{\gamma \dfrac{RT}{M}} = \sqrt{\gamma \dfrac{kT}{m}}$; where γ is ratio of the specific heat capacity (ISO 80000-5).