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Veličine in enote - 2. del: Matematika (ISO/DIS 80000-2:2016)

Quantities and units - Part 2: Mathematics (ISO/DIS 80000-2:2016)

Größen und Einheiten - Teil 2: Mathematik (ISO/DIS 80000-2:2016)

Grandeurs et unités - Partie 2: Mathématiques (ISO/DIS 80000-2:2016)

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Quantities and units —

Part 2:
Mathematics

Grandeurs et unités —

Partie 2: Mathématiques

ICS: 01.060

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 12, Quantities and units.

This second edition cancels and replaces the first edition of ISO 80000-10:2009.

ISO 80000 consists of the following parts, under the general title *Quantities and units*:

— *Part 1: General*
— *Part 2: Mathematics*
— *Part 3: Space and time*
— *Part 4: Mechanics*
— *Part 5: Thermodynamics*
— *Part 7: Light and Radiation*
— *Part 8: Acoustics*
— *Part 9: Physical chemistry and molecular physics*
— *Part 10: Atomic and nuclear physics*
— *Part 11: Characteristic numbers*
— *Part 12: Condensed matter physics*

IEC 80000 consists of the following parts (in collaboration with IEC/TC 25), under the general title *Quantities and units*:

— *Part 6: Electromagnetism*

— *Part 13: Information science and technology*

— *Part 14: Telebiometrics related to human physiology*

Introduction

Arrangement of the tables

The first column “Item No.” of the tables contains the number of the item.

The second column “Symbol, expression” gives the symbol under consideration, usually in the context of a typical expression. If more than one symbol or expression is given for the same item, they are on an equal footing. In some cases, e.g. for exponentiation, there is only a typical expression and no symbol.

The third column “Meaning, verbal equivalent” gives a hint on the meaning or how the expression may be read. This is for the identification of the concept and is not intended to be a complete mathematical definition.

The fourth column “Remarks and examples” gives further information. Definitions are given if they are short enough to fit into the column. Definitions need not be mathematically complete.

The arrangement of the table in Clause 16 “Coordinate systems” is somewhat different.

Quantities and units — Part 2: Mathematics

1 Scope

ISO 80000-2 gives general information about mathematical symbols, their meanings, verbal equivalents and applications.

The recommendations in ISO 80000-2 are intended mainly for use in the natural sciences and technology, but also apply to other areas where mathematics is used.

2 Normative references

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

ISO 80000-1:2009, *Quantities and units — Part 1: General*

3 Variables, functions and operators

It is customary to use different sorts of letters for different sorts of entities, e.g. *x*, *y*, … for numbers or elements of some given set, *f*, *g* for functions etc. This makes formulas more readable and helps in setting up an appropriate context.

There are – in mathematics – no strict rules for the use of letter fonts, which should be explained if necessary. However – in quantity calculus – there are rules depending on the field of application. Many mathematical concepts, discussed in this standard ISO 80000-2, apply not only to numbers and to functions having numbers as values, but also to scalars (i.e. numbers multiplied by a unit) and to scalar quantities (which are functions having scalars as values). In quantity calculus – instead of the letters *x*, *y* (for numbers) or *f*, *g* (for number valued functions) – the appropriate letters given in the parts of ISO/IEC 80000 are to be used, e.g. *s* or *l* for length, *t* for duration, *m* for mass.

Variables such as *x*, *y*, etc., and running numbers, such as *i* in $\sum_i x_i$ are printed in italic (sloping) type. Parameters, such as *a*, *b*, etc., which may be considered as constant in a particular context, are printed in italic (sloping) type. The same applies to functions in general, e.g. *f*, *g*.

An explicitly defined function not depending on the context is, however, printed in Roman (upright) type, e.g. sin, exp, ln, Γ. Mathematical constants, the values of which never change, are printed in Roman (upright) type, e.g. e = 2,718 281 828 …; π = 3,141 592 …; $i^2 = -1$. Well-defined operators are also printed in Roman (upright) style, e.g. div, δ in δ*x* and each d in d*f*/d*x*. Some transforms use special capital letters (see section 18).

Numbers expressed in the form of digits are always printed in Roman (upright) style, e.g. 351 204; 1,32; 7/8.

The argument of a function is written in parentheses after the symbol for the function, without a space between the symbol for the function and the first parenthesis, e.g. $f(x)$, $\cos(\omega t + \varphi)$. If the symbol for the

function consists of two or more letters and the argument contains no operation symbol, such as +, −, ×, · or / , the parentheses around the argument may be omitted. In these cases, there should be a thin space between the symbol for the function and the argument, e.g. int 2,4; sin $n\pi$; arcosh 2A; Ei x.

If there is any risk of confusion, parentheses should always be inserted. For example, write $\cos(x) + y$; do not write $\cos x + y$, which could be mistaken for $\cos(x + y)$.

A comma, semicolon or other appropriate symbol can be used as a separator between numbers or expressions. The comma is generally preferred, except when numbers with a decimal comma are used.

If an expression or equation must be split into two or more lines, the following method shall be used:

— Place the line breaks immediately before one of the symbols =, +, −, ± or ∓, or, if necessary, immediately before one of the symbols ×, ·, or /.

The symbol shall not be given twice around the line break; two minus signs could for example give rise to sign errors. If possible, the line break should not be inside of an expression in parentheses.

4 Mathematical logic

Item No.	Symbol, expression	Meaning, verbal equivalent	Remarks and examples
2-4.1	$p \wedge q$	conjunction of p and q, p and q	
2-4.2	$p \vee q$	disjunction of p and q, p or q	This "or" is inclusive, i.e. $p \vee q$ is true, if either p or q, or both are true.
2-4.3	$\neg\, p$	negation of p, not p	
2-4.4	$p \Rightarrow q$	p implies q, if p, then q	$q \Leftarrow p$ has the same meaning as $p \Rightarrow q$. $\Rightarrow$ is the implication symbol. $\rightarrow$ is also used als implication symbol.
2-4.5	$p \Leftrightarrow q$	p is equivalent to q	$(p \Rightarrow q) \wedge (q \Rightarrow p)$ has the same meaning as $p \Leftrightarrow q$. $\Leftrightarrow$ is the equivalence symbol. $\leftrightarrow$ is also used als implication symbol.
2-4.6	$\forall x \in A \quad p(x)$	for every x belonging to A, the proposition $p(x)$ is true	If it is clear from the context which set A is considered, the notation $\forall x\ p(x)$ can be used. $\forall$ is the universal quantifier. For $x \in A$, see 2-5.1.
2-4.7	$\exists x \in A \quad p(x)$	there exists an x belonging to A for which $p(x)$ is true	If it is clear from the context which set A is considered, the notation $\exists x\, p(x)$ can be used. $\exists$ is the existential quantifier. For $x \in A$, see 2-5.1. $\exists^1 x\ p(x)$ is used to indicate that there is exactly one element for which $p(x)$ is true. $\exists!$ is also used for $\exists^1$.

5 Sets

Item No.	Symbol, expression	Meaning, verbal equivalent	Remarks and examples
2-5.1	$x \in A$	x belongs to A, x is an element of the set A	$A \ni x$ has the same meaning as $x \in A$.
2-5.2	$y \notin A$	y does not belong to A, y is not an element of the set A	$A \not\ni y$ has the same meaning as $y \notin A$. The negating stroke may also be vertical.
2-5.3	$\{x_1, x_2, \ldots, x_n\}$	set with elements $x_1, x_2, \ldots, x_n$	Also $\{x_i \mid i \in I\}$, where I denotes a set of subscripts.
2-5.4	$\{x \in A \mid p(x)\}$	set of those elements of A for which the proposition $p(x)$ is true	EXAMPLE $\{x \in \mathbf{R} \mid x \geq 5\}$ If it is clear from the context which set A is considered, the notation $\{x \mid p(x)\}$ can be used (for example $\{x \mid x \geq 5\}$, if it is clear that real numbers are considered). Instead of the vertical line often a colon is used as separator: $\{x \in A : p(x)\}$.
2-5.5	card A $\lvert A \rvert$	number of elements in A, cardinality of A	The cardinality can be a transfinite number. The symbol $\lvert\ \rvert$ is also used for absolute value of a real number (see 2-9.16), modulus of a complex number (see 2-14.4) and magnitude of a vector (see 2-17.4).
2-5.6	$\emptyset$	the empty set	
2-5.7	$B \subseteq A$	B is included in A, B is a subset of A	Every element of B belongs to A. $\subset$ is also used, but see remark to 2-5.8. $A \supseteq B$ has the same meaning as $B \subseteq A$.
2-5.8	$B \subset A$	B is properly included in A, B is a proper subset of A	Every element of B belongs to A, but at least one element of A does not belong to B. If $\subset$ is used for 2-5.7, then $\subsetneq$ shall be used for 2-5.8. $A \supset B$ has the same meaning as $B \subset A$.
2-5.9	$A \cup B$	union of A and B	The set of elements which belong to at least one of the sets A and B. $A \cup B = \{x \mid x \in A \vee x \in B\}$
2-5.10	$A \cap B$	intersection of A and B	The set of elements which belong to both sets A and B. $A \cap B = \{x \mid x \in A \wedge x \in B\}$

Item No.	Symbol, expression	Meaning, verbal equivalent	Remarks and examples
2-5.11	$\bigcup_{i=1}^{n} A_i$ $A_1 \cup A_2 \cup \ldots \cup A_n$	union of the sets $A_1, A_2, \ldots, A_n$	The set of elements belonging to at least one of the sets $A_1, A_2, \ldots, A_n$ $\bigcup_{i=1}^{n}$, $\bigcup_{i \in I}$ and $\bigcup_{i \in I}$ are also used, where I denotes a set of subscripts.
2-5.12	$\bigcap_{i=1}^{n} A_i$ $A_1 \cap A_2 \cap \ldots \cap A_n$	intersection of the sets $A_1, A_2, \ldots, A_n$	The set of elements belonging to all sets $A_1, A_2, \ldots, A_n$ $\bigcap_{i=1}^{n}$, $\bigcap_{i \in I}$ and $\bigcap_{i \in I}$ are also used, where I denotes a set of subscripts.
2-5.13	$A \setminus B$	difference of A and B, A minus B	The set of elements which belong to A but not to B. $A \setminus B = \{x \mid x \in A \wedge x \notin B\}$ $A - B$ should not be used. $\complement_A B$ is also used. $\complement_A B$ is mainly used when B is a subset of A, and the symbol A may be omitted if it is clear from the context which set A is considered.
2-5.14	(a, b)	ordered pair a, b, couple a, b	$(a, b) = (c, d)$ if and only if $a = c$ and $b = d$. If the comma can be mistaken as the decimal sign, then the semicolon (;) or a stroke (|) may be used as separator.
2-5.15	$(a_1, a_2, \ldots, a_n)$	ordered n-tuple	See remark to 2-5.14.
2-5.16	$A \times B$	Cartesian product of the sets A and B	The set of ordered pairs (a, b) such that $a \in A$ and $b \in B$. $A \times B = \{(x, y) \mid x \in A \wedge y \in B\}$
2-5.17	$\prod_{i=1}^{n} A_i$ $A_1 \times A_2 \times \ldots \times A_n$	Cartesian product of the sets $A_1, A_2, \ldots, A_n$	The set of ordered n-tuples $(x_1, x_2, \ldots, x_n)$ such that $x_1 \in A_1, x_2 \in A_2, \ldots, x_n \in A_n$. $A \times A \times \ldots \times A$ is denoted by A_n, where n is the number of factors in the product.
2-5.18	id_A	identity relation on A, diagonal of $A \times A$	idA is the set of all pairs (x, x) where $x \in A$. If the set A is clear from the context, the subscript A can be omitted.