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**Mednarodna terminologija meroslovja (VIM)**

International vocabulary of metrology (VIM)

Vocabulaire international de métrologie (VIM)

**Ta slovenski standard je istoveten z: ISO/IEC DGuide 99**

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17.020	Meroslovje in merjenje na splošno	Metrology and measurement in general

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# DRAFT Guide

## ISO/IEC DGuide 99

### International vocabulary of metrology (VIM)

*Vocabulaire international de métrologie (VIM)*

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### Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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 document 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](http://www.iso.org/directives) or [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs)).

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This document was prepared by Working Group 2 of the Joint Committee for Guides in Metrology (as JCGM 200:2026) and was adopted by the national bodies of ISO and IEC.

This second edition cancels and replaces the first edition (ISO/IEC Guide 99:2007), which has been technically revised.

The main changes are as follows:

— **xxx xxxxxxxx xxx xxx**

Given that ISO/IEC Guide 99 is identical in content to JCGM 200:2026, the decimal symbol is a point on the line in the English version and a comma on the line in the French version.

Annex ZZ has been appended to provide a list of corresponding ISO/IEC Guides and JCGM guidance documents for which equivalents are not given in the text.

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](http://www.iso.org/members.html) and [www.iec.ch/national-committees](http://www.iec.ch/national-committees).

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# Foreword

Since its foundation, in 1997, the Joint Committee for Guides in Metrology (JCGM) has the purpose to develop and maintain, at the international level, guidance documents addressing the general metrological needs of science and technology, to consider arrangements for their dissemination, and to promote worldwide adoption and implementation of the results of its work.

Eight international organizations currently form the JCGM:

- the two inter-governmental organizations concerned with metrology: the Bureau International des Poids et Mesures (BIPM) and the Organisation Internationale de Métrologie Légale (OIML);
- the two principal international standardization organizations: the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC);
- three international science unions: the International Union of Pure and Applied Chemistry (IUPAC), the International Union of Pure and Applied Physics (IUPAP), and the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC);
- one international accreditation organization: the International Laboratory Accreditation Cooperation (ILAC).

The JCGM has two Working Groups, JCGM-WG2:VIM, responsible for the International Vocabulary of Metrology (the VIM), and JCGM-WG1:GUM, responsible for the Guide to the Expression of Uncertainty in Measurement (the GUM). This document was developed and prepared for publication by JCGM-WG2:VIM, and approved for release following the procedures of the JCGM and its Member Organizations.

This fourth edition of the International Vocabulary of Metrology cancels and replaces the third edition.

A list of the principal changes in this edition can be found in the Annex on Significant Changes.

# Introduction

The International Vocabulary of Metrology (“the VIM”) is a JCGM guidance document intended to support worldwide harmonization of the fundamental terminology related to metrology. It constitutes a recommendation on terminology that JCGM Member Organizations are encouraged to implement, each according to its own purposes and in reference to its own scope.

The third edition of the VIM (denoted herein as the “VIM3”) was published by the JCGM in 2008, and republished with minor corrections in 2012. Since then, interest in the topic of nominal properties has increased substantially in the metrology community, with the recognition that metrology is often important in the examination of nominal properties. The International System of Units (SI) was revised in 2019, and a new, ninth, edition of the SI Brochure [1] has been published. There is greater interest in digitalization, placing heavier demands on precise vocabulary for machine readability and actionability. JCGM Member Organizations have requested simplification of the language in VIM definitions, to facilitate wider understanding and translation. JCGM-WG2 has also published an electronic “annotated VIM”, containing additional explanatory material which had not been incorporated in a formal release of the VIM.

This fourth edition of the VIM (VIM4) has been designed to address these issues. To meet the needs for new terminology to accommodate metrology related to nominal properties, a new chapter, containing new entries related to nominal properties and their examination, has been introduced into the VIM4. These new entries have mainly been taken from the Vocabulary on nominal property, examination, and related concepts for clinical laboratory sciences [47], adapted for consistency with other VIM terms and definitions. To address the revision of the SI, relevant entries have been revised for consistency with the new approach, in which all the SI units are individual quantities defined by reference to fundamental constants. The VIM4 also follows the SI Brochure in the treatment of quantities that are counted and quantities defined as ratios; the VIM4 refers to these as “quantities with the unit one”, as in the SI Brochure. Finally, a large part of the text has been revised to improve readability, to add further clarifications through new Notes and Examples, and to incorporate many of the annotations to the VIM3 in the electronic “annotated VIM”.

These changes, together with the opportunity for improvement presented by the revision of the VIM, stimulated further consideration of other key concepts. In particular:

- The treatment of values of quantities, as appearing in basic relations like ( $m_A = 0.1234 \text{ kg}$ ), has been improved. This relation is now more explicitly interpreted as an equation stating that the individual quantity identified as the mass  $m$  of a given object  $A$ , and the individual quantity identified as 0.1234 times the kilogram, are the same mass. As a consequence, the presentation and definitions for concepts such as ‘quantity’, ‘value of a quantity’ and ‘true value of a quantity’ have been significantly amended in this edition. These changes and their rationale are discussed in more detail in the Annex on “Significant changes”.
- The systematic revision of the entries related to properties, including those about units, scales, and values, has led to focusing on the ambiguity of the term “quantity”. This term is used to refer to both quantities in the general sense, such as length and mass, and to individual quantities, such as lengths and masses of particular objects. These cases are not distinguished by separate terms and definitions in this Vocabulary, but new explanatory notes and examples are provided for clarification.

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- The use of the term “magnitude” was reviewed. In the previous edition of the VIM, ‘quantity’ was defined as a property that has a magnitude. In some contexts, however, “quantity” and “magnitude” are considered synonyms. Further, “magnitude” is not easy to translate into some other languages. Hence, “magnitude” is not used in this Vocabulary. Quantities are, instead, operationally defined according to the nature of possible comparisons (ratio, difference etc.) between them.
- Following the more extensive treatment of nominal properties, the definitions of ‘measurement’ and ‘metrology’ were also reviewed. Following inquiry among JCGM Member Organizations, the existing definitions have been retained for this edition. However, new Notes on these, and related, terms acknowledge the increased importance of nominal properties and their examinations.
- The inclusion of additional terms for nominal properties, for which no ordering relation is defined, stimulated further consideration of the related topic of ordinal properties. These can be ordered meaningfully, but differences and ratios are not defined for them. The third edition of the VIM described these as quantities despite the absence of difference and ratio operations. After careful analysis, it was decided to minimize changes on this matter with respect to the VIM3. This edition therefore maintains the position that ordinal properties are quantities and measurement applies to them.
- Concepts for characterization of the quality of measurement and its results, including ‘measurement error’, ‘measurement accuracy’, and ‘measurement trueness’, have been defined for greater generality than in previous editions. These terms are variously used in metrology to describe both measured values and differences and parameters in statistical models. To accommodate these uses, the VIM4 has adopted more general definitions, phrased in terms of reference values, of which true values are specific cases. This approach provides flexibility for the differing perspectives on the use of “true value”.
- The organization of terms into chapters has been revised; in particular, terms related to metrological traceability and calibration are now grouped with terms related to measurement standards (Chapter 5).

Finally, for transparency and to support users in the transition from the VIM3 to the VIM4, all changes that are considered significant are presented and justified in an Annex of this Vocabulary.

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# Conventions

The definitions and terms given in this fourth edition of the VIM, as well as their formats, comply as far as possible with the rules of terminology, as outlined in ISO 704 [11], ISO 1087 [12], and ISO 10241-1 [18]. In particular, the substitution principle applies: that is, it is possible in any definition to replace a term for a concept defined elsewhere in this Vocabulary by the definition corresponding to that term, without introducing contradiction or circularity.

Entries – each with a number, the entry numbers from earlier editions when existing, a preferred term and possibly one or more admitted terms, a definition, and possibly notes and examples – are listed in six chapters and in conceptual order, to the extent practical, in each chapter.

In some definitions, the use of non-defined concepts (also called “primitives”) is unavoidable. In this Vocabulary such non-defined concepts include: object, system, component, property, feature, comparison (among objects and properties), attribute, reference, experiment, material, device, and signal.

### Verbal forms for expressions of provisions

This Vocabulary has been written in accordance with the ISO/IEC Directives, Part 2 [32] as to the verbal forms for expressing provisions (Section 7), as follows:

- requirement: “shall” (equivalent phrase: “is required”);
- recommendation: “should” (equivalent phrase: “is recommended”);
- permission: “may” (equivalent phrase: “is permitted”);
- possibility and capability: “can” (equivalent phrases: “is able”, “is possible”).

### Synonyms

Multiple terms for the same concept are permitted. If more than one term is given, the first term is the preferred one, and it is used in context whenever it may help avoiding ambiguities. The shorter terms are sometimes used for the sake of simplicity.

### Bold face

In any entry, terms for concepts defined elsewhere in this Vocabulary are printed in bold face the first time they appear.

### Quotation marks

Single quotation marks (‘...’) surround the term representing a concept unless it is in bold. Double quotation marks (“...”) are used when only the term is considered, or for a quote.

### Names of quantities and nominal properties

With the aim of improving the readability of the text, the names of quantities or nominal properties are sometimes written in italics.

### Decimal marker

The decimal marker in the text is the point on the line.

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# Scope

This Vocabulary provides a set of definitions and associated terms for a system of basic and general concepts used in metrology, including nominal properties and their examination.

This Vocabulary is applicable to all fields of metrology, including physical, chemical and biological measurement, irrespective of the level of measurement uncertainty. It can also be used as a resource for teaching, and as a reference for governmental and inter-governmental bodies, trade associations, accreditation bodies, regulators, and professional societies.

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# 1 Quantities and units

## 1.1 [VIM3: 1.1; VIM2: 1.1; VIM1: 1.01]

### quantity

property for which comparison by ratio, or by difference, or by order applies

NOTE 1 The same term “quantity” is commonly used to refer to both quantities in the general sense, such as length and mass, and individual quantities, such as any given length and any given mass. This has been acknowledged for a long time [37], and the context is usually sufficient to understand whether the term “quantity” refers to either a general or an individual quantity: for the sake of simplicity this linguistic custom is maintained in this Vocabulary. Furthermore, an individual quantity can be identified as the property of a given object or as a **value of a quantity**. For example, a given length could be identified as the length of a given rod or as the value 1.234 5 m, i.e., 1.234 5 times the length that is the metre. The following Table exemplifies the distinction between general quantities and individual quantities identified as properties of given objects or values of quantities.

General quantity	Individual quantity, identified as	
	property of a given object	value of a quantity
length, $l$	length of rod A, $l_A$	1.234 5 m
kinetic energy, $T$	kinetic energy of a gas molecule $i$ at room temperature, $T_i$	$6.2 \times 10^{-21}$ J
electric charge, $Q$	electric charge of the proton, $e$	$1.602 \times 10^{-19}$ C
electric resistance, $R$	electric resistance of resistor $i$ , $R_i$	1.001 k $\Omega$
mass fraction, $w$	mass fraction of lead in a soil sample $w(\text{Pb})$	23 mg/kg
number concentration, $C$	number concentration of erythrocytes in blood sample $B_i$ , $C(\text{Erys}; B_i)$	$5.2 \times 10^{12} \text{L}^{-1}$
Rockwell C hardness, $H$	Rockwell C hardness of steel sample $i$ , $H_i$	55 HRC

NOTE 2 Any individual quantity is an instance (i.e., an example, a case) of a general quantity – for example the radius of cylindrical rod A is an instance of the general quantity length – and individual quantities are instances of the same general quantity if they are comparable with each other. **Measurement units, measurands, values of quantities, and measured values** are all examples of individual quantities.

NOTE 3 The comparison in the definition is such that “comparing properties of objects” and “comparing objects by their properties” are phrases referring to the same situation. Different types of comparisons are possible among comparable properties, and types of properties are specified accordingly, and in particular:

- properties that can be compared by ratio (such that for example one length may be twice another length), are **ratio quantities**;
- properties that can be compared by difference, but not by ratio (such that for example the difference between two positions in space may be twice the difference between two other positions in space), are **interval quantities**;
- properties that can be compared by order, but not by difference (such that for example one Mohs hardness may be greater than another Mohs hardness), are **ordinal quantities** (in the relevant literature ordinal properties are sometimes considered to be non-quantitative, but not in this Vocabulary);
- properties that can be compared by equivalence, but not by order (such that for example one shape may be equivalent to another shape), are **nominal properties**.

Differently from nominal properties and ordinal quantities, both ratio and interval quantities can be characterized as having a measurement unit.

The list above is not complete, as other types are known. In particular, cyclic / modular quantities like wind direction, for which comparability by ratio modulo  $2\pi$  applies, would need a more developed treatment.

NOTE 4 As defined here, quantities are scalar, i.e., unidimensional, properties. Properties with more than one

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dimension, such as vectors and tensors, are considered quantities in a broader sense and called “vector quantities” and “tensor quantities” accordingly, if their components are (scalar) **quantities of the same kind**.

NOTE 5 Quantities can be classified as, for example, physical quantities, chemical quantities, and biological quantities, or as **base quantities** and **derived quantities** in a given **system of quantities**.

NOTE 6 A general quantity can admit some more specific general quantities, such as wavelength with respect to length and kinetic energy with respect to energy, so that for example wavelengths are lengths but not all lengths are wavelengths, and kinetic energies are energies but not all energies are kinetic energies.

NOTE 7 Symbols for quantities are given in the ISO 80000 and IEC 80000 series of International Standards *Quantities and units* [31] and other International Standards. The symbols for quantities are written in italics (an exception is “pH”, written in roman), irrespective of the type used in the rest of the text. A given symbol can indicate different quantities.

NOTE 8 The preferred IUPAC and IFCC format to refer to quantities in laboratory medicine is “System–Component; kind of quantity” (see [44]).

EXAMPLE The amount-of-substance concentration of glucose in blood plasma in a given person at a given time could be described as Plasma(Blood)–Glucose; amount-of-substance concentration = 5.1 mmol/L.

### 1.2 [new]

#### quantities of the same kind

**quantities** that can be compared with each other

NOTE 1 Two individual quantities are of the same kind if there exists a general quantity of which both are instances. Quantities that are identified as properties of given objects are comparable by empirical means; quantities that are identified as **values** of properties are comparable by mathematical means.

EXAMPLE The radius of a given circle and the wavelength of the sodium D radiation are quantities of the same kind: being properties of given objects, they can be compared by empirical means. 0.123 4 m and 589 nm are also quantities of the same kind: being values of quantities, they can be compared by mathematical means.

NOTE 2 The condition of comparability in the definition is such that “comparing properties of objects” and “comparing objects by their properties” are phrases referring to the same situation. Hence it is not the same as **metrological comparability of measurement results**.

NOTE 3 The expression “of the same kind” is sometimes also used for general quantities, though the condition of comparability in the definition does not apply to general quantities. Two general quantities are said to be of the same kind if their instances are comparable.

EXAMPLE Radius and wavelength are, in this sense, general quantities of the same kind, because radii and wavelengths are comparable with each other.

NOTE 4 Quantities of the same kind have the same **dimension** in a given **system of quantities**. However, quantities of the same dimension are not necessarily of the same kind.

EXAMPLES Moment of force and energy are not regarded as being of the same kind, although they have the same dimension. Similarly for heat capacity and entropy, as well as for number of entities, relative permeability, and mass fraction.

NOTE 5 Similar expressions, such as “quantities of different kinds” and “quantities of a given kind”, are also used.

### 1.3 [new]

#### ratio quantity

**quantity** for which comparison by ratio applies

NOTE 1 The quantity mentioned in the definition is a general quantity. Any individual quantity that is an instance of that general quantity inherits the feature of being a ratio quantity.

EXAMPLE Length, mass, etc. are ratio quantities, and therefore any given length, any given mass, etc. is also a ratio quantity.

NOTE 2 The comparison in the definition is such that “comparing properties of objects” and “comparing objects by their properties” are phrases referring to the same situation.

NOTE 3 A ratio quantity has an intrinsic (i.e., non-conventional) **reference quantity** (e.g., a zero quantity), the difference between any pairs of its instances is defined, and its instances are ordered. Hence, ratios of instances of ratio quantities have empirical meaning.