Some significant changes

JCGM/WG2 webinar: An overview of the VIM4

Joint Committee for Guides in Metrology (JCGM)
Working Group on the International Vocabulary of Metrology (VIM) - WG2

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Some significant changes...

... from the VIM3 to the VIM4 CD

Together with many smaller or more specific changes, coordinated revision of the entries about:

1. properties, thus including quantities and nominal properties
2. measurement accuracy, error, etc
3. examination of nominal properties (→ Gunnar Nordin)

... as presented in “Significant changes of the VIM4 with respect to the VIM3”
1. Properties: general and individual

The object of measurement are properties, and more specifically quantities

The terms “quantity”, “ordinal quantity”, and “nominal property” refer to both things like length and blood group (properties in the general sense) and things like given lengths and given blood groups (individual properties)

The distinction is simple but fundamental:
• comparisons, by equivalence, order, or ratio, apply to individual properties
• measurements are about individual properties
• the distinction base vs derived quantities is about general quantities
• ...

→ individual properties are instances of general properties
The terminological choice

Introducing this distinction would make the Vocabulary clearer and more consistent, but one term “property” is used for both general and individual properties (e.g., length is a quantity; the length of this rod is a quantity).

ISO/IEC Directives: “If a term is used to define more than one concept, a separate terminological entry shall be created for each concept and the domain shall be included in angle brackets before the definition.”

1.1 quantity <general>
general quantity
quantity in the general sense
kind of quantity

property whose instances can be compared by ratio or only by order

1.2 quantity <individual>
individual quantity
instance of a general quantity
Three key benefits

**References to the concept ‘magnitude’ are avoided**

**Definitions are based on operational concepts**

**The equation**  \( \text{measurand} = \text{measured value} \)

is provided with a simple interpretation
Interpreting measurand = measured value

Given the equation \( \ell_a = 0.5 \text{ m} \) is meant that there is an individual length called “the metre” such that \( \frac{\ell_a}{\text{m}} = 0.5 \) and therefore that \( \ell_a \) and 0.5 m are the same length.

And therefore that both units of length and values of length are lengths, and therefore individual quantities.
Interpreting measurand = measured value

- the length of an object, $\ell_a$
- a unit of length, m
- a value of length, 0.5 m

and therefore

- an individual quantity
- a unit of measurement
- a value of a quantity

is an instance of

a general quantity
Consequence: some VIM4 CD definitions

1.9 **measurement unit**
unit of measurement
unit

real scalar **individual quantity**, defined and adopted by convention, with which any other quantity of the same kind can be compared by ratio, resulting in a number

1.20 **value of a quantity**
quantity value
value `<quantity>`

**individual quantity** identified as the product of a number and a measurement unit or on an ordinal scale

1.19 **measurement scale**
ordered set of **individual quantities** of the same kind, where each quantity is associated with an element of a set of ordered identifiers
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The VIM3 defines the three key features of **measurement accuracy**, **measurement trueness**, and **measurement error** according to a hybrid approach.

**measurement accuracy**
closeness of agreement between a measured quantity value and a **true quantity value** of a measurand

**measurement trueness**
closeness of agreement between the average of an **infinite number** of replicate measured quantity values and a reference quantity value

**measurement error**
measured quantity value minus a **reference quantity value**

Furthermore, the VIM3 remains silent whether these features refer to measurements, or measurement procedures, or measurement results, or measured values, or ...
An operational approach

The VIM4 acknowledges that measurement accuracy etc may be of measurement, measurement results, etc, and in some cases they \textit{may be known}, also in a quantitative sense.

Accordingly, the approach has been followed to adopt \textit{operational definitions} whenever possible, consistently in particular with the position of ISO 5725 (*)

‘measurement accuracy’ etc are defined about reference values, of which true values are specific cases.

(*) ISO 5725 Accuracy (trueness and precision) of measurement methods and results
Consequence: some updated definitions

**measurement accuracy**

closeness of agreement between a measured quantity value and a **true quantity value** of a measurand

**measurement trueness**

closeness of agreement between the **average of an infinite number of replicate measured quantity values** and a reference quantity value

**measurement error**

measured quantity value minus a reference quantity value

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**VIM3**

**measurement accuracy**

closeness of agreement between a measured value and a **reference value** of a measurand

**measurement trueness**

closeness of agreement between the **average of measured values obtained by replicate measurements** and a reference value

**measurement error**

measured value minus a reference value

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**VIM4 CD**
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