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VOCABULARY FOR NOMINAL PROPERTIES AND NOMINAL EXAMINATIONS — BASIC AND GENERAL CONCEPTS AND ASSOCIATED TERMS (IFCC-IUPAC RECOMMENDATIONS 201x)

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Running title

VOCABULARY FOR NOMINAL PROPERTIES

Abstract: scientists of disciplines in clinical laboratory sciences have long recognized the need of a common language for efficient and safe request of investigations, report of results, and communication of experience and scientific achievements. Widening the scope, most scientific disciplines, not only clinical laboratory sciences, rely to some extent on various nominal examinations in addition to measurements. The "International vocabulary of metrology — Basic and general concepts and associated terms" (VIM) is designed for metrology, the science of measurement. The aim of the proposed vocabulary is to suggest definitions and explanations of concepts and terms related to nominal properties, i.e. properties that can be compared for identity with other properties of the same kind-of-property, but have no magnitude.

Key words: vocabulary; nominal property; nominal examination; concept; term.

INTRODUCTION

In a world of increased communication of examination results mediated by information technology, there is a need for a common vocabulary.

The 'International vocabulary of metrology – Basic and general concepts and associated terms (VIM)' deals with metrology, defined as the science of measurement and its application. According to VIM3 [1] in 2.1, note 1, "Measurement does not apply to nominal properties" so

they cannot be a subject for metrology. However, most scientific disciplines, not only clinical laboratory sciences, rely also, some predominantly, on description of properties without magnitude. Typical cases are several recommendations and technical reports in Pure and Applied Chemistry (PAC) authored by the Committee on Nomenclature for Properties and Units (C-NPU) [2, 3, 4, 5, 6] that rely heavily on nominal kinds-of-property, such as "taxon" or "sequence variation". Some of the concepts have been covered earlier [7] but a vocabulary for nominal properties is needed providing a complement vocabulary to the VIM3.

It is believed that the concepts for non-measurable properties should be useful for practitioners and the scientific community in disciplines such as general chemistry, health science, clinical laboratory sciences, biology, engineering, biochemistry, food science, molecular biology, and physics..

The starting point and basis of this work have been the VIM3, the definitions of which have been widely applied or adapted to nominal properties. However, a few concepts have a different definition from that given in VIM3.

The authors of this paper have a clinical laboratory sciences background, including several specialities. The examples therefore deal mostly with this discipline. Experts from other scientific background are most welcome to provide examples from other disciplines..

An earlier version of this document has been published [8] to which valuable comments have been received. Compared with the earlier version of the document several basic concepts have been converted to non defined 'primitives', without reducing the understanding for laboratory practitioners, while several of the remaining definitions have been corrected and improved. More examples to illustrate the concepts have been added. The concepts have been reordered and divided in three new sections.

CONVENTIONS

Terminology Rules

The definitions and terms given in this vocabulary, as well as their formats, comply as far as possible with the rules of terminology work, as outlined in ISO 704 [9], ISO 1087-1 [10] and ISO 10241 [11]. In particular, the substitution principle applies; that is, it is possible in any definition to replace a term, referring to a concept defined elsewhere in this vocabulary, by the definition corresponding to that term, without introducing contradiction or circularity.

Format in this document

The format of this document is as follows:

N Entry number
term

proposed definition

EXAMPLE(S)

    NOTE(S) to example(s)

NOTE(S) to definition

    EXAMPLE(S) to note(s)

Document structure

The concepts have been divided into three sections : basic concepts of nominal examinations, characteristics of nominal examination results, and references for nominal examination results.

Quotation marks

In this document, single quotation marks ('…') surround a term representing a concept unless the concept is in bold. Double quotation marks ("…") are used when only the term is considered, or for a quotation.

Curly brackets

The possible values in a set are separated by commas and surrounded by curly brackets ({…}).

Bold face

The recommended term for a concept defined in a given entry is printed in bold face below the entry number. Terms for concepts defined elsewhere in the document are also printed in bold face at the first appearance in an entry.

SCOPE

As previously stated, this vocabulary is designed as a complementary document to VIM3. Like VIM, it does not include definition of all primitives nor superordinates to the concepts herein defined.

Superordinates such as 'kind-of-property', 'dedicated kind-of-property', 'examinand', 'examination', 'property value', 'examined property value', 'property value set', 'static examination', 'dynamic examination', examining system', 'examination uncertainty' and 'examination procedure' are considered beyond the scope of this vocabulary. Superordinates which encompass the fields of both VIM (quantities) and the present vocabulary (nominal properties), and should be more properly defined in a third document, encompassing both fields.

Some basic concepts are used without definition. These "primitives" include body, code, classification, collection, component, device, feature, instrument, magnitude, material, object, phenomenon, property, reference, set, substance, system, validation, value, and verification.

Besides the scientific community previously cited, this vocabulary is designed to be a common reference for accreditation bodies, professional societies, trade associations, manufacturers, regulators, and governmental and intergovernmental bodies.

This document, being authored by a group of Clinical Laboratory scientists, encompasses a limited scientific field and, according to IFCC-IUPAC review systems, it is expected that widening to other fields will provide input from these fields, notably examples.

I) basic concepts of nominal examinations

1
nominal property

property, described by an examination procedure, of a phenomenon, body, substance, state, process, or system where the property has no magnitude

EXAMPLES

1 The colour of a sample of spinal fluid from the patient X.Y. taken at 2006-06-18T22:15, as observed visually by the laboratory professional.

2 The sequence variation of the gene FXN in DNA from patient A.B, as determined by pyrosequencing.

3 The species of the bacterium in the expectorate from the patient D.E. submitted at 2006-06-23T08:30, as determined by Phadebact coagglutination test.

NOTES

1 The definition of this concept is analogous to that in [7], which has the advantage, compared to the VIM3 definition, of not using only a negative statement.

2 A nominal property cannot enter into algebraic equations and is not related to a quantity dimension or a measurement unit.

3 In clinical laboratory reports, individual nominal properties may be described according to an internationally recommended NPU syntax from IFCC-IUPAC [12]. The examples above can be written as follows (omitting patient identity and time):

Patient—Spinal fluid; colour(visual) = reddish

DNA(Leukocytes)—FXN gene; sequence variation(pyrosequencing) = (GAA)n expansion

Expectorate—Bacterium; taxon(Phadebact coagglutination test)= *Mycobacterium tuberculosis*

4 Patients' names (or other identifiers) and date and time of taking or obtaining samples of the system under consideration should always be given in the clinical laboratory report.

5 The term "attribute" has sometimes been used to designate 'nominal property', but not here.

6 The term "qualitative property" has also been used, but is ambiguous because 'ordinal quantity' is often included under that term.

7 'Nominal property' is sometimes termed "nameable property", but not here.

8 A nominal property has a 'nominal property value', which can be expressed in words, by alphanumerical codes, or by other means (see VIM3, 1.30, note 1).

9 'Nominal properties' can have numerical or alphabetical codes which can be ordered, but not by magnitude.

    EXAMPLES

    1. The numbering of chromosomes.

    2. Zoological and botanical classifications of species.

    3 The alphabetical list of country codes.

10 The terms "nominal (quantity) value" and "nominal (indication) interval" are terms used in VIM3 to indicate concepts concerning rounded or approximate quantity values.

2
nominal kind-of-property

aspect common to mutually comparable **nominal properties**

EXAMPLES

taxon, colour.

NOTES

1 The definition of this concept is taken from [7, 13].

2 'Nominal kind-of-property' is sometimes termed "attribute", but not here.

3
dedicated nominal kind-of-property

nominal kind-of-property with given sort of system and any pertinent sort of component

EXAMPLES
 1 Blood—Plasma; colour({milky, red, yellow}).
 2 Erythrocytes(Blood)—Erythrocyte antigen; taxon({A, B, AB, O}).

4
nominal property value

inherent feature of a **nominal property** used in comparing it with other nominal properties of the same **nominal kind-of-property**

EXAMPLES
 1 reddish is a nominal property value of the taxon red colours.
 2 (GAA)n expansion (for a class of objects which has the sequence variation (GAA)n expansion).
 3 *Mycobacterium tuberculosis* is a nominal property value of the taxon *Mycobacterium*.

NOTE
 Nominal property values are either international symbols, such as the name of blood group antigens, or consist of language dependent terms.

5
nominal property value set

set of all possible values of a given **nominal property**

EXAMPLES
 1 A set of colours ({milky, red, yellow}).
 2 A set of blood group antigen ({A, B, AB, O}).

NOTES
 1 The concept 'scale' in 'quantity value scale' (VIM3, 1.27) is not applicable to **nominal property values,** where no magnitude is involved, and is here replaced by set.
 2 A value set with nominal property values can be ordered by convention, but not by magnitude.

6
reference nominal property value

nominal property value used as a basis for comparison with nominal property values of the same **nominal kind-of-property**

NOTES
 1 A reference nominal property value can be a **true nominal property value** of a **nominal examinand**, in which case it is unknown, or a **conventional nominal property value**, in which case it is known.

2 The definition and note 1 of this concept are analogous to those of 'reference quantity value' in VIM3, 5.18.

7
nominal examination

process of experimentally obtaining one or more **nominal property values** that can reasonably be attributed to a **nominal property**

EXAMPLES
   1 Determination of genotype by e.g. pyrosequencing or melting point analysis.
   2 Erythrocyte antigen determined by agglutination reactions with known antibodies.

NOTES
   1 The definition of this concept is analogous to that of 'measurement' in VIM3, 2.1.
   2 The outcome of a nominal examination is an **examined nominal property value** with associated **nominal examination uncertainty**.
   3 The activity of nominal examination essentially consists in comparing the nominal property considered, i.e. the **nominal examinand**, by way of a **nominal examining system**, with a 'reference' of similar nature to obtain an examined nominal property value with associated **nominal examination uncertainty**. Such a reference may be personal and subjective, such as a person's memory of a colour, or the reference may be objective, as a **nominal reference material**.

8
nominal examinand

nominal property intended to be examined

NOTES
   1 The **nominal property value** of the nominal examinand may be different from that of the nominal property actually being examined due to changes of the system bearing the nominal property during the examination.
   EXAMPLE : 1 the morphology of blood cells as studied in a dried sample.
   EXAMPLE 2: the study of Entamoeba in faeces.
   2 The **examined nominal property value** may be obtained indirectly through examinations of other properties giving the examined nominal property value by using an algorithm: measurements as well as **nominal examinations** can be used to obtain an examined nominal property value, involving quantities and **nominal properties** all together.
   EXAMPLE: the species of the bacteria is E. coli, as determined by the appearance and behavior during culture (to be modified and corrected by Urban).
   3 The definition for this concept is analogous to that of 'measurand' in VIM3, 2.3.

9
nominal examination result

nominal property value set being attributed to a **nominal examinand** together with any other available relevant information

NOTES

1 A nominal examination result sometimes contains "relevant information" about the set of nominal property values, such that some may be more representative of the nominal examinand than others.

2 A nominal examination result may be expressed as a single **examined nominal property value** and a **nominal examination uncertainty**. If the nominal examination uncertainty can be expressed numerically and is considered to be negligible for a specified purpose, the nominal examination result may be expressed as a single examined nominal property value. In many fields, this is the common way of expressing a nominal examination result.

EXAMPLE: The gene for hemochromatosis (HFE) has been investigated for a possible mutation at c.187 from C to G. The result is C/C. What is the uncertainty or the possible sources of error for this result?

3 The definition and notes 1 and 2 for this concept are analogous to those of 'measurement result' in VIM3, 2.9.

10
examined nominal property value

nominal property value representing a **nominal examination result**

NOTES

1 The definition of this concept is analogous to that of 'measured quantity value' in VIM3, 2.10.

2 The term "observed value" is sometimes used for 'examined nominal property value', but not here.

11
nominal examination system

set of one or more devices, including any reagent and supply, assembled and adapted to give information used to generate **examined nominal property values** from a set of possible values for **nominal properties** of a specified **nominal kind-of-property**

EXAMPLE

1. Culture medium, human eye, and microscope are examining devices together making a nominal examining system for identifying *Candida albicans* in a biological fluid.
2. Mass spectrometer which identify molecular species after chromatographic separation.
3. Polymerase chain reaction - restriction fragment length polymorphism (PCR-RFLP) used for genotyping

NOTES

1 A nominal examining system may consist of only one examining instrument.

2 The definition and note 1 for this concept are analogous to those of 'measuring system' in VIM3, 3.2.

12
influence nominal property

property that, in a **nominal examination**, does not affect the **nominal property** that is actually examined, but affects the relation between the reading on the **nominal examination system** and the **nominal examination result**

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EXAMPLE
Contaminating microbiological species may influence the reading of a nominal property related to the examined species.

NOTES
1 The definition of this concept is analogous to that of 'influence quantity' in VIM3, 2.52.
2 A quantity might also influence a nominal property.

13
taxon

nominal kind-of-property indicating a classification of properties according to **nominal property value**s of a given **nominal property value set**

EXAMPLES
Staphylococcus aureus (as a species in the genus *Staphylococcus*), blood group (within a system of blood groups), chemical element.

NOTES
1 Taxonomy is the science of classification and its applications. Taxonomy uses taxonomic denominations, known as taxa (singular taxon).
2 Taxon is primarily used for hierarchical ordering in biology, chemistry, and biochemistry.
3 The definition is modified from [6].

14
nominal examination principle

law of nature as a basis of a **nominal examination**

EXAMPLE
1 When using a wash pan to identify a grain of gold, we use the gravitational law.
2 Classification of a bird, seen and heard, into a species of the Linnean system is done on audiovisual principles
  NOTE: a scientific "principle" (latin: princeps) is an abstraction of the human mind and can generally not be observed. It should not be confused with observed phenomena, such as gravity or weight, which are consequences of such principles.

15
nominal examination method

generic description of a logical organization of operations used in a **nominal examination**

EXAMPLES: polymerase chain reaction (PCR), restriction fragment length polymorphism (RFLP), infra red spectrometry

NOTES
1 The definition of this concept is analogous to that of 'measurement method' in VIM3, 2.5.
2 A nominal examination method is based on one or more **nominal examination principles**.
3 The laconic description in a nominal examination method is insufficient to allow a nominal examination with prescribed **nominal examination uncertainty**, but aids in formulating one or more **nominal examination procedures**.

16

nominal examination procedure

detailed description of a **nominal examination** according to one or more **nominal examination principles** and to a given **nominal examination method**, based on a nominal examination model and including any transformation to obtain a **nominal examination result**

NOTES

1 A nominal examination procedure specifies the **dedicated nominal kind-of-property** involved, any sampling, **nominal examining system**, and reference material(s) needed, and the **nominal property-value set** used. The nominal examination procedure also specifies how many **examined nominal property values** must be obtained to evaluate a nominal examination result and how to estimate the expected **nominal examination uncertainty**.

2 The information presented in a nominal examination procedure is intended to be operational and should be sufficient for a trained operator to perform a nominal examination satisfactorily.

3 A nominal examination procedure can include a statement concerning a **target nominal examination uncertainty**.

4 A nominal examination procedure may be termed "working instructions" or "standard operating procedure", abbreviated SOP.

5 The definition and notes 2, 3 and 4 for this concept are analogous to those of 'measurement procedure' in VIM3, 2.6.

17

true nominal property value

nominal property value consistent with the definition of a **nominal property**

NOTE

The definition of this concept is analogous to that of 'true quantity value' in VIM3, 2.11.

18

conventional nominal property value

nominal property value attributed by agreement to a **nominal property** for a given purpose

EXAMPLES

1 Colour of oxygenated blood = red, colour of deoxygenated blood = dark red.

2 Colour of faeces = putty colour (in some liver diseases) or chamois colour (in some gut diseases).

3 Colour of ascites = lemon colour.

4 Species of bacteria = *Mycobacterium tuberculosis*

5 The CYP2D6 genotype = *1/*1

NOTE

The definition of this concept is analogous to that of 'conventional quantity value' in VIM3, 2.12.

19

 blank nominal property value

nominal property value provided by a **nominal examination system** from a phenomenon, body, or substance similar to the one under investigation, except that the **nominal property** of interest is supposed not to be present, or is not contributing to the nominal property value

EXAMPLES

1 The blank control examination which is performed by examining a serum containing polyclonal immunoglobulins, when searching for monoclonal immunoglobulins.

2 Blood—Erythrocytes; morphology(list; proc.)

While searching for sickle cells in drepanocytosis (sickle cell anemia), the blank nominal property value is provided by observing red blood cells where the cause of abnormality, Haemoglobin S, is not present.

NOTES

1 The definition of this concept is analogous to that of 'blank indication' in VIM3, 4.2.

2 That a nominal property is "not present" shall not be confused with the question whether its presence is above a detection limit, which is an ordinal quantity

3 A blank nominal property value is provided by a blank control nominal examination.

4 A blank control nominal examination is necessary for quality assessment in some **nominal examination procedures**.

II) Characteristics of nominal examination results

20

 nominal coverage set

nominal property value set of a **nominal examinand** containing all the **true nominal property values** with a stated probability, based on the information available

EXAMPLES

1 {*Escherichia* sp.} that is {one or more species of genus *Escherichia}*, as the result of a screening procedure for bacteria, with a probability of >99%.

2 {*1/*1} as the result of a test of the genotype for CYP2D6, with a probability of > 99%.

NOTE

The definition of this concept is analogous to that of 'coverage interval' in VIM3, 2.36.

21

coverage probability of a nominal property value

probability that the set of **true nominal property values** of a **nominal examinand** is contained within a specified **nominal coverage set**

EXAMPLES

The coverage probability of a value after blood grouping in the system A, B, O is 100 %, because there is no other possibility to find another group in this system.

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NOTE

The definition of this concept is analogous to that of 'coverage probability' in VIM3, 2.37.
within a specified nominal coverage set

22
nominal examination trueness

degree of agreement between the most frequent **examined nominal property value** of an infinite
number of replicate examined nominal property values and the corresponding **reference nominal
property value**

NOTES

1 Nominal examination trueness cannot be expressed numerically, because calculations are not
possible with "infinite".

EXAMPLES

1. During restauration of a supposedly Veronese painting, the painter team chooses
several green, intended to reproduce the "Veronese green". They try a hundred "greens", but none
of them fit the green appearing on their reference true Veronese painting. Their nominal
examination has a bad trueness (the degree of agreement is null).

2. To identify a mushroom, a person consults a number of non-specialists. 10 % of the
non-specialists say it is a *boletus*, 90 % say it is a "cep". As a specialist consulted to give a final
identification say that "cep" is synonym of *boletus*, and thus agrees with all non-specialists, the
trueness is excellent (the degree of agreement is complete).

3. In a wine contest, 60 persons identify a wine as being a 2005 blend, 40 persons identify
the same wine as being a 2002 blend. It is in fact a 2005 blend: the trueness of the contest
(examination) is fairly good (the degree of agreement is partial).

4. One thousand media around the world provided a weather forecast for town X and for
yesterday morning, as such : 100 say "partly cloudy, 100 say "partly sunny", 800 say "dry and
sunny". Today, it happened to be "dry and mostly sunny" this morning. The trueness of the results
of the weather forecast (the property) observation (kind-of-property) was globally fairly good (the
degree of agreement is highly acceptable).

NOTE

1 For this example, it is assumed that the 1000 number of replicates represents the infinite
replicates.

2 Nominal examination trueness is inversely related to **systematic nominal examination
error**.

3 The term "nominal examination trueness" should not be used for **nominal examination
accuracy** and *vice versa*.

4 Nominal examination trueness is a property of a **nominal examining system** used with
specified **nominal examination procedure**.

5 The definition and notes 1-3 are analogous to those of 'measurement trueness' in VIM3 2.14.

23
nominal examination uncertainty

description characterizing the diversity of the **nominal property values** being attributed to a
nominal examinand, based on the information used

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NOTES

1 The definition of this concept is analogous to that of 'measurement uncertainty' in VIM3 2.26.

2 A nominal examination uncertainty is part of a **nominal examination result**.

3 The expression of nominal examination uncertainty may be numerical.

EXAMPLE: The uncertainty may be expressed by a probability distribution for examined nominal property values.

4 Some nominal property values must have a **target nominal examination uncertainty** equalling zero, e.g. blood group values.

24
nominal examination error

disagreement between an **examined nominal property value** and a **reference nominal property value**

EXAMPLES

1 Reference nominal property value of **'**System X—Component Y; colour' = red
Examined nominal property value of 'System X—Component Y; colour' = pink
Narrative expression**:** examined nominal property value is in error.
2 Reference nominal property value of 'System X—Component Y; taxon' = A, B, C, D
Examined nominal property value of 'System X—Component Y; taxon' = B, D, E
Narrative expression: examined nominal property value is in error.

NOTES

1 Nominal examination error may be expressed by a binary (dichotomous) variable representing presence or absence of this error.

2 Nominal examination error should not be confused with production error or mistake. This note is analogous to that of 'measurement error' in VIM3, 2.16, note 2.

3 Nominal examination error is a **property** of an examined nominal property value, but not of a **nominal examining system**.

25
nominal examination accuracy

degree of agreement between an **examined nominal property value** and a **true nominal property value** of a **nominal examinand**

EXAMPLES

1 True nominal property value = red
Examined nominal property value 1 = pink
Examined nominal property value 2 = green
Narrative expression: examined nominal property value 1 is more accurate than examined nominal property value 2

2 True nominal property value = A, B, C, D
Examined nominal property value 1 = B, D

Examined nominal property value 2 = A, B, D
Examined nominal property value 3 = B, D, E
Examined nominal property value 4 = A, D, E, F

Narrative expression: **nominal examination result** 2 is more accurate than nominal examination result 1.

Nominal examination result 1 is more accurate than examination result 3.

Nominal examination result 4 is less accurate than examination result 1.

NOTES

1 Nominal examination accuracy is not a quantity and is not given a numerical value. A **nominal examination** is said to be more accurate when it offers a smaller **nominal examination error**.

2 If the nominal examination error is expressed by a binary variable (see nominal examination error) the examined nominal property value is either accurate or inaccurate."

3 Nominal examination accuracy is a property of a single examined nominal property value, but not of a **nominal examining system**.

EXAMPLE: when determining the species of a tree, 29 persons conclude that they have a cork-oak, *Quercus suber* in front of them and 1 person concludes that it is an oak *Quercus rober*. The accuracy obtained (good – if the true nominal property value is *Q. suber*) is not that of the group of persons (the nominal examining system), but that of the "cork-oak" value.

3 The definition and note 1 for this concept are analogous to those of 'measurement accuracy' in VIM3 2.13.

26

nominal examination precision

degree of agreement between readings on a **nominal examination system** or **examined nominal property values** obtained by replicated **nominal examinations** on the same or similar objects under specified nominal examination conditions

EXAMPLES

1 **Nominal examinations** of the **nominal property** 'System X—Component Y; taxon' with two different **nominal examining system**s (1 and 2), used with respective specified **nominal examination procedures** under the same specified nominal examination conditions.

Examined nominal property values from nominal examining system 1	Examined nominal property values from nominal examining system 2
A	A
A	A
B	B
A	A
A	A
A	A
A	C
A	B
D	D
A	A

Narrative expression: Nominal examining system 1 is more precise than nominal examining

system 2.

2 Nominal examinations of the nominal property 'System X—Component Y; taxon' with two different nominal examining systems (1 and 2), used with respective specified examination procedures under specified examination conditions.

Examined nominal property values from nominal examining system 1	Examined nominal property values from nominal examining system 2
A, B, C, D	A, B, C, D
A, B, C	A, B, C
A, D	A, B, D
A, B, C, D	A, B, C, D
A, B, C, D	A, B, C, D
A, B	A, B
A, D	A, D
A, B, C, D	A, B, C, D
A, B, C, D	A, B, C, D
A, C, D	A, B, C, D

Narrative expression: Nominal examining system 2 is more precise than nominal examining system 1.

NOTES

1 Nominal examination precision is an ordinal quantity and is not given a numerical value.

2 The 'specified nominal examination conditions' can be **repeatability condition of nominal examination**, **intermediate precision condition of nominal examination**, or **reproducibility condition of nominal examination**.

3 Nominal examination precision is used to define **repeatability conditions of nominal examination**, **intermediate nominal examination precision**, and **nominal examination reproducibility**

4. Nominal examination precision is a property of a nominal examining system used with a specified nominal examination procedure.

5 The definition and notes 2 and 3 for this concept are analogous to those of 'measurement precision' in VIM3 2.15.

6 The mode is the most frequent value of a set of examined nominal property values.

27

nominal examination imprecision

numerical expression of **nominal examination precision**

EXAMPLES

1 **Nominal examinations** of the **nominal property** 'System X—Component Y; taxon' with two different **nominal examining system**s (1 and 2), used with specified **nominal examination procedures** under specified nominal examination conditions.

Examined nominal property values from nominal examining system 1	Examined nominal property values from nominal examining system 2
A	A
A	A
B	B
A	A
A	A
A	A
A	C
A	B
D	D
A	A

Narrative numerical expression: If "A" is the expected examined nominal examination value the nominal examination imprecision of nominal examining system 1 is 20 % and the nominal examination imprecision of nominal examining system 2 is 40 % or, alternatively, examined nominal property values obtained with examining system 1 show a 20 % of disagreement and examined nominal property values obtained with nominal examining system 2 show 40 % of disagreement.

2 Nominal examinations of the nominal property 'System X—Component Y; taxon' with two different nominal examining systems (1 and 2), used with specified nominal examination procedures under specified nominal examination conditions.

Examined nominal property values from nominal examining system 1	Examined nominal property values from nominal examining system 2
A, B, C, D	A, B, C, D
A, B, C	A, B, C
A, D	A, B, D
A, B, C, D	A, B, C, D
A, B, C, D	A, B, C, D
A, B	A, B
A, D	A, B, C, D
A, B, C, D	A, B, C, D
A, B, C, D	A, B, C, D
A, C, D	A, B, C, D

Narrative numerical expression: If "A, B, C, D" is the expected set of examined nominal property values, the nominal examination imprecision obtained with nominal examining system 1 is 50 % and the nominal examination imprecision obtained with examining system 2 is 30 % or, alternatively, examined nominal property values obtained with examining system 1 shows a 50 % of disagreement and examined nominal property values obtained with examining system 2 shows a 30 % of disagreement.

NOTES

1 Nominal examination imprecision can be expressed as percent of disagreement between **nominal examination values** under specified nominal examination conditions.

2 There are other ways to express variation of examined nominal property values such as degree of dispersion, diversity or heterogeneity

3 The "specified nominal examination conditions" can be : **repeatability conditions of nominal examination**, **intermediate precision conditions of nominal examination**, or **reproducibility conditions of nominal examination.**

4 Nominal examination imprecision is used to numerically express **nominal examination repeatability**, **intermediate nominal examination precision**, and **nominal examination reproducibility**.

5 Nominal examination imprecision **under repeatability or intermediate nominal examination conditions** is a **property** of a nominal examining system used with specified nominal examination procedure.

28
systematic nominal examination error

component of **nominal examination error** that in replicate **nominal examinations** remains constant or varies in a predictable manner

EXAMPLE

Reference nominal property value of 'System X—Component Y; taxon' = A, B, C, D

10 replicated **nominal examination**s of 'System X—Component Y; taxon**'** gave the following:

Examined nominal property values
B, D, E
B, C, D
C, D
B, C
B, C, D
B, C, D, E
B, C, D, E
B, C, D
C, D, E
B, C

Narrative expression: The systematic nominal examination error is that A is constantly not found.

NOTES

1 The definition of this concept is analogous to that of 'systematic measurement error' in VIM3, 2.17.

2 The concept 'systematic nominal examination error' is usually expressed numerically by measures of **nominal examination bias**.

3 Systematic nominal examination error is a **property** of a **nominal examining system** used with specified **nominal examination procedure**.

29
nominal examination bias

estimate of a **systematic nominal examination error**

EXAMPLE

Examinations of the **nominal property** 'System X—Component Y; taxon' with a **nominal examining system**, used with a specified **nominal examination procedure** under specified nominal examination conditions.

Examined nominal property values	Reference nominal property values
A, B, C, D	A, B, C, D
A, B, C	A, B, C
A, D	A, B, D
[no value]	D
A, B	A, B
A, B	A, B
C, D	C, D
B, C, D	B, C, D
A, B, C, D	A, B, C, D
A, C, D	D

Note that each set of letters (e.g. {A,B,C,D}) is a hypothetical result in a set of nominal values.

Narrative numerical expression: The nominal examination bias of the nominal examining system is 30 % of disagreements.

The individual nominal examination biases of the nominal examining system are

For A, false positive fraction = 10 % and false negative fraction = 0 %

For B, false positive fraction = 0 % and false negative fraction = 10 %

For C, false positive fraction = 10 % and false negative fraction = 0 %

For D, false positive fraction = 0 % and false negative fraction = 10 %

NOTES

1 The definition of this concept is analogous to that of 'measurement bias' in VIM3, 2.18.

2 Nominal examination bias is usually expressed numerically by a number fraction of the sum of false positive and false negative values, derived from examined nominal property values of different **nominal examinands** and the corresponding reference nominal property value of each nominal examinand, carried out under specified nominal examination conditions.

3 Individual nominal examination bias is usually expressed numerically by a false positive fraction and a false negative fraction, derived from examined nominal property values of different nominal examinands and the corresponding reference nominal property value of each nominal examinand, carried out under specified nominal examination conditions.

4 Nominal examination bias is a property of a nominal examining system used with a specified nominal examination procedure**.**

5 In some publications on analytical chemistry, **'**nominal examination bias' is termed "lack of reliability", but this is not recommended.

30

random nominal examination error

component of **nominal examination error** that in replicated **nominal examinations** varies in an unpredictable manner

NOTES

1 The definition of this concept is analogous to that of 'random measurement error' in VIM3, 2.19.

2 The concept 'random nominal examination error' is usually expressed numerically by measures of **nominal examination imprecision**, such as percent of disagreement under the specified nominal examination conditions.

31

repeatability condition of nominal examination

condition of **nominal examination** out of a set of conditions that includes the same **nominal examination procedure**, same operators, same **nominal examination system**, same operating conditions, same location, and replicated nominal examinations on the same or similar objects over a short period of time

NOTE

The definition of this concept is analogous to that of 'repeatability condition of measurement' in VIM3, 2.20.

repeatability condition of nominal examination

condition of **nominal examination** out of a set of conditions that includes the same **nominal examination procedure**, same operators, same **nominal examination system**, same operating conditions, same location, and replicated nominal examinations on the same or similar objects over a short period of time

NOTE

The definition of this concept is analogous to that of 'repeatability condition of measurement' in VIM3, 2.20.

32

nominal examination repeatability examination repeatability

nominal examination precision under a set of **repeatability conditions of nominal examination**

NOTES

1 The definition of this concept is analogous to that of 'measurement repeatability' in VIM3, 2.21.

2 Nominal examination repeatability is a property of a **nominal examining system** used with a specified **nominal examination procedure**.

33

intermediate precision condition of nominal examination

condition of **nominal examination** out of a set of conditions that includes the same **nominal examination procedure**, same location, and replicated nominal examinations on the same or similar objects over an extended period of time, but may include other conditions involving changes

NOTE
The definition of this concept is analogous to that of 'intermediate precision condition of measurements in VIM3, 2.22.

34

intermediate nominal examination precision

nominal examination precision under a set of **intermediate precision conditions of nominal examination**

NOTES
1 The definition of this concept is analogous to that of 'intermediate measurement precision' in VIM3, 2.23.
2 Intermediate nominal examination precision is a property of a **nominal examining system** used with a specified **nominal examination procedure**.

35

reproducibility condition of nominal examination

condition of **nominal examination** out of a set of conditions that includes different locations, operators, **nominal examination systems**, and replicated nominal examinations on the same or similar objects

NOTE
The definition of this concept is analogous to that of 'reproducibility condition of measurement' in VIM3, 2.24.

36

nominal examination reproducibility

nominal examination precision under a set of **reproducibility conditions of nominal examination**

NOTES
1 The definition of this concept is analogous to that of 'measurement reproducibilty' in VIM3, 2.25.
2 Nominal examination reproducibility is a property of a set of **examined nominal property values**.

37

definitional nominal examination uncertainty

component of **nominal examination uncertainty** resulting from the finite amount of detail in the definition of a **nominal examinand**

NOTE

    The definition of this concept is analogous to that of 'definitional uncertainty' in VIM3, 2.27.

38

type A evaluation of nominal examination uncertainty

evaluation of a component of **nominal examination uncertainty** by a statistical analysis of **examined nominal property values** obtained under defined nominal examination conditions

NOTES

    1 For various types of nominal examination condition, see **repeatability condition of nominal examination**, **intermediate precision condition of nominal examination**, and **reproducibility condition of nominal examination**.

    2 The definition and note 1 for this concept are analogous to those of 'Type A evaluation of measurement uncertainty' in VIM3, 2.28.

39

type B evaluation of nominal examination uncertainty

evaluation of a component of **nominal examination uncertainty** determined by means other than a **Type A evaluation of nominal examination uncertainty**

EXAMPLES

    1 Identification based on information associated with authoritative published **nominal property value**s: iron (Fe) as defined in the IUPAC Periodic Table of the Elements.

    2 Identification based on information associated with the **nominal property value** of a certified reference material.

    3 Identification based on information obtained from limits deduced through personal acquired experience.

NOTE

    The definition of this concept is analogous to that of 'Type B evaluation of measurement uncertainty' in VIM3, 2.29.

40

nominal examination uncertainty budget

statement of a **nominal examination uncertainty** and of the components of that nominal examination uncertainty, and of their combination

NOTES

    1 A nominal examination uncertainty budget should include the **Type (A** and/or **B) of evaluation of nominal examination uncertainty**, the **definitional nominal examination uncertainty**, the **target nominal examination uncertainty**, and the **coverage set**.

2 The definition and note 1 for this concept are analogous to those of 'uncertainty budget' in VIM3, 2.33.

41

target nominal examination uncertainty

nominal examination uncertainty specified as an acceptable limit and decided on the basis of the intended use of **nominal examination results**

NOTES

1 The intended use of some **examined nominal property values**, such as erythrocyte antigen values, requires a target nominal examination uncertainty of zero.

2 The definition of this concept is analogous to that of 'target measurement uncertainty' in VIM3, 2.34.

III) References for nominal examination results

42
nominal examination standard

realization of the definition of a given **nominal property**, with stated **nominal property value** and associated **nominal examination uncertainty**, used as a reference

EXAMPLE

A given **examined nominal property value** for a bacterial taxon can be compared for identity with a nominal examination standard in the form of the nominal property values of a collection of typical bacteria of various species.

NOTES

1 A "realization of the definition of a given nominal property" can be provided by a **nominal examining system** or a **nominal reference material**.

2 The definition and note 1 of this concept are analogous to those of 'measurement standard' in VIM3, 5.1.

43
nominal reference material

material, sufficiently homogeneous and stable with reference to specified **nominal properties**, that has been established to be fit for its intended use in a **nominal examination**

EXAMPLES

1 Colour chart with one or more specified colours.
2 DNA compound containing a specified nucleotide sequence.

NOTES

1 The definition of this concept and related examples are analogous to those of 'reference material' in VIM3, 5.13, where the superordinate of both nominal reference material and measurement reference material is defined.

2 Nominal reference materials with or without assigned **nominal property value**s can be used for **nominal examination precision** control, whereas only nominal reference materials with assigned **nominal property value** can be used for the control of **nominal examination calibration** or **nominal examination trueness**.

44

commutability of a nominal reference material

property of a **nominal reference material**, demonstrated by the degree of agreement between the relation among the **nominal examination results** for a stated **nominal property** in this material, obtained according to two given **nominal examination procedure**s, and the relation obtained among the nominal examination results for specified materials

NOTE

The definition of this concept is analogous to that of 'commutability of a reference material' in VIM3, 5.15.

45

nominal examination calibration

process that confers to a person or to a device the capacity to perform specified **nominal examinations** after having examined **nominal examination standards**

EXAMPLE

Identifying a bird with the help of certified specimens (pictures, sounds).

46

reference nominal examination procedure

nominal examination procedure accepted as providing **nominal examination results** fit for their intended use in assessing **nominal examination trueness** of **examined nominal property values** obtained from other nominal examination procedures for **nominal properties** of the same **nominal kind-of-property**, in **nominal examination calibration**, or in characterizing reference materials

EXAMPLES

1 A reference procedure provided by a famous perfume firm to identify smells.

2 The official procedure for car technical control (involving both measurements and nominal examinations).

NOTE

The definition of this concept is analogous to that of 'reference measurement procedure' in VIM3, 2.7.

47

primary reference nominal examination procedure

reference nominal examination procedure used to obtain a **nominal examination result** without relation to a **nominal examination standard** for a **nominal property** of the same **nominal kind-of-property**

NOTE

The definition of this concept is analogous to that of 'primary reference measurement procedure' in VIM3, 2.8.

48

nominal examinational traceability

property of a **nominal examination result** whereby it can be related to a reference through a documented unbroken chain of **nominal examination calibrations**, each contributing to the **nominal examination uncertainty**

NOTE

The definition of this concept is analogous to that of 'metrological traceability' in VIM3, 2.41.

49

comparability of nominal examination results

property of **nominal examination results** whereby they may be intercompared, for **nominal properties** of a given **nominal kind-of-property** that have **nominal examinational traceability** to the same reference

EXAMPLE

Nominal examination results for the colours of two different biological fluids are comparable when they are both traceable to the same colour chart.

50

compatibilty of nominal examination results

property of a set of **nominal examination results** for a specified **nominal examinand** of a given **nominal kind-of-property** that have overlapping **nominal coverage sets**

NOTE

Two compatible nominal examination results can be identical.

EXAMPLE

Let the nominal coverage set for Patient—Urine; colour(proc.) be {red, dark red}. "Red" is a compatible nominal examination result with the nominal coverage set. "Black" and "white" are not compatible as they do not belong to the nominal coverage set.

51

international nominal examination standard

nominal examination standard recognized by signatories to an international agreement and intended to serve worldwide

EXAMPLE
    The WHO 1st international genetic reference panel for Factor V Leiden, Human gDNA: 03/254, 03/260, 03/248 [14].

NOTE
    The definition of this concept is analogous to that of 'international measurement standard' in VIM3, 5.2.

52

national nominal examination standard

nominal examination standard recognized by national authority to serve in a state or economy as the basis for assigning **nominal property values** to other **nominal examination standards** for the **nominal kind-of--property** concerned

EXAMPLE
    The **nominal examinand** HLA specific allo-antibodies in human blood plasma is detected and identified according to nationally agreed procedure and reference material, e.g. NIBSC (National Institute for Biological Standards and Control, UK) 02/282 [15].

NOTE
    The definition of this concept is analogous to that of 'national measurement standard' in VIM3, 5.3.

53

primary nominal examination standard

nominal examination standard established using a **primary reference nominal examination procedure**, or created as an artifact, chosen by convention

NOTE
    The definition of this concept is analogous to that of 'primary measurement standard' in VIM3, 5.4.

54

secondary nominal examination standard

nominal examination standard established through **nominal examination calibration** with respect to a **primary nominal examination standard** for a **nominal property** of the same **nominal kind-of-property**

NOTE

The definition of this concept is analogous to that of 'secondary measurement standard' in VIM3, 5.5.

55
reference nominal examination standard

nominal examination standard designated for the **nominal examination calibration** of other nominal examination standards for **nominal properties** of a given **nominal kind-of-property** in a given organization or a given location

NOTE

The definition of this concept is analogous to that of 'reference measurement standard' in VIM3, 5.6.

56
working nominal examination standard

nominal examination standard that is used routinely to calibrate or verify **nominal examination systems**

NOTES

1 A working nominal examination standard is usually calibrated with respect to a **reference nominal examination standard**.

2 The definition and note 1 for this concept are analogous to those of 'working measurement standard' in VIM3, 5.7.

57
travelling nominal examination standard

nominal examination standard, sometimes of special construction, intended for transport between different locations

EXAMPLE
Material certified for DNA sequence by IRMM [16] as 609 bp DNA fragment from human prothrombin gene (point mutation G20210A)

NOTE

The definition of this concept is analogous to that of 'travelling measurement standard' in VIM3, 5.8.

58
transfer nominal examination device

device used as an intermediary to compare **nominal examination standard**s

NOTES

   1 Sometimes, **nominal examination standards** are used as transfer devices.

   2 The definition and note 1 for this concept are analogous to those of 'transfer measurement device' in VIM3, 5.9.

59

 intrinsic nominal examination standard

nominal examination standard based on a reproducible **nominal property** of a phenomenon or substance

EXAMPLE

   For tridimensional shape, a crystal obtained from a solution of a pure compound.

NOTES

   1 A **nominal property value** of an intrinsic nominal examination standard is assigned by consensus and does not need to be established by relating it to another **nominal examination standard** of the same type.

   2 The definition and note 1 for this concept are analogous to those of 'intrinsic measurement standard' in VIM3, 5.10.

60

conservation of a nominal examination standard

set of operations necessary to preserve the properties of a **nominal examination standard** within stated limits

NOTES

   1 Conservation commonly includes periodic **verification** of predefined **nominal propertie**s or **nominal examination calibration**, storage under suitable conditions, and specified care in use.

   2 The definition and note 1 for this concept are analogous to those of 'conservation of a measurement standard' in VIM3, 5.11.

61

nominal examination calibrator

nominal examination standard used in **nominal examination calibration**

NOTE

   The definition of this concept is analogous to that of 'calibrator' in VIM3, 5.12.

62

certified nominal reference material

nominal reference material accompanied by documentation issued by an authoritative body and providing one or more specified **nominal property values** with **nominal examination uncertainties** and **nominal examinational traceabilities** using valid procedures

NOTE

The definition of this concept is analogous to that of 'certified reference material' in VIM3, 5.14.

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ABBREVIATIONS

IEC - International Electrotechnical Commission

IFCC - International Federation of Clinical Chemistry and Laboratory Medicine*

IUPAC - International Union of Pure and Applied Chemistry

JCGM - Joint Committee for Guides in Metrology

VIM3 - International Vocabulary of Metrology — Basic and General Concepts and Associated Terms, Vocabulaire international de métrologie — Concepts fondamentaux et généraux et termes associés (2007) VIM, 3rd edition

WHO - World Health Organization

* Formerly: International Federation of Clinical Chemistry.