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Building information modelling and other digital processes used in construction — Methodology to describe, author and maintain properties in interconnected data dictionaries

Modélisation des informations de la construction et autres processus numériques utilisés en construction — Méthodologie de description, de création et de gestion des propriétés dans les dictionnaires de données interconnectés

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Introduction

In the digital built environment, there will not be a single data dictionary which comprises all the definitions which are needed in all BIM domains. Different groups, possibly in different countries, will create or have created separate data dictionaries, specialized for their needs, based on the legislation and culture. We are, and will be faced with, various separated data dictionaries. They may even reside on the same platform yet logically they are detached.

For the future of BIM, it is important to ensure that these data dictionaries can be interoperable in tools and applications.

— The elements of the data dictionaries need to be described by the same attributes. If this is agreed and done by all data dictionary providers, it becomes possible to map properties in one data dictionary to properties in other data dictionaries. This can lead to reuse of properties and to the harmonization of properties across data dictionaries. In addition, this is an important step to allow BIM applications to use multiple data dictionaries consistently.

— The governance of the data dictionaries needs to follow the same rules with respect to the building and development of the data dictionaries' content.

The assumption is that the data dictionaries are independent from each other, they are connected in a coordinated network of data dictionaries (again, there may exist several of these networks). Within the network, the data dictionaries are related, which is visible, for instance, using a specific attribute which maps properties and groups of properties of different data dictionaries to each other. Any data dictionary in the network of coordinated data dictionaries is independent, i.e. it has its own processes and committees to control the development and evolution of the data dictionary; meanwhile, they all follow the same description and governance rules described in this document.

This document specifies the attributes to define properties and groups of properties of a single data dictionary as well as the processes and commissions/roles for the governance of a single data dictionary in a network of coordinated data dictionaries. In the governance processes, it is described how the single data dictionary deals with queries and change requests and the extension of queries to other connected data dictionaries; information of other connected data dictionaries regarding change is an integral part of this process.

This document contributes to ensuring the quality and the unicity of property descriptions and avoiding the creation of duplicates.

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Building information modelling and other digital processes used in construction — Methodology to describe, author and maintain properties in interconnected data dictionaries

1 Scope

This document establishes the rules for defining properties used in construction and a methodology for authoring and maintaining them, for a confident and seamless digital share among stakeholders following a BIM process.

Regarding the definition of properties and groups of properties, this document provides:

— definitions of properties and groups of properties as a list of attributes;

— definitions of all the provided attributes.

Regarding the authoring and maintaining process, this document provides:

— definitions and roles of applicants;

— definitions and roles of experts and the commission of experts;

— definitions of request's attributes;

— definitions of expert's attributes;

— requirements to establish the management rules to interconnect data dictionaries through the mapping process for properties and groups of properties.

To apply the methodology of this document, it is presupposed that the following are in place:

— an established governance model for a data dictionary;

— a framework for a network of data dictionaries.

It is not in the scope of this document to provide the content of the interconnected data dictionaries.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 639-1, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 3166-2, *Codes for the representation of names of countries and their subdivisions — Part 2: Country subdivision code*

ISO 4217, *Codes for the representation of currencies*

ISO 8601 (all parts), *Date and time — Representations for information interchange*

ISO/IEC 11404, *Information technology — General-Purpose Datatypes (GPD)*

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ISO 12006-3, *Building construction — Organization of information about construction works — Part 3: Framework for object-oriented information*

ISO 80000 (all parts), *Quantities and units*

IETF https://www.ietf.org/

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
alternative use
category of *group of properties* (3.14) not corresponding to *class* (3.7), *domain* (3.11), *reference document* (3.18) or *composed property* (3.8)

Note 1 to entry: This category of group of properties shall be used only after having considered the possible use of all the other categories.

3.2
applicant
user (3.21) formulating a request for the creation, modification or deactivation of a *property* (3.17) or a *group of properties* (3.14)

3.3
area of competence
area of an *expert*'s (3.12) proficiency and knowledge associated to one or several *groups of properties* (3.14)

EXAMPLE An area of competence could be:

— *domain* (3.11);

— *class* (3.7);

— *reference document* (3.18).

3.4
attribute
data element for the computer-sensible description of a *property* (3.17), a *group of properties* (3.14), etc.

Note 1 to entry: An attribute describes only one single detail of a property or a group of properties.

EXAMPLE The name of a property, the definition of a group of properties.

[SOURCE: ISO 13584-42:2010, 3.3, modified — In the definition and Note 1 to entry, references to "a relation or a class" have been replaced with "a group of properties"; the EXAMPLE has been updated.]

3.5
base quantity
quantity in a conventionally chosen subset of a given system of quantities, where no *quantity* (3.16) in the subset can be expressed in terms of the other quantities within that subset

[SOURCE: ISO 80000-1:2009, 3.4, modified — NOTEs 1 to 4 have been removed.]

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3.6
building information modelling
BIM
use of a shared digital representation of an asset to facilitate design, construction and operation processes to form a reliable basis for decisions

[SOURCE: ISO 19650-1:2018, 3.3.14, modified — The wording "a built asset" has been changed to "an asset"; Note 1 to entry has been removed.]

3.7
class
description of a set of objects that share the same characteristics

Note 1 to entry: The characteristics may be embodied by the use of properties, operations, methods, relations, semantics, etc.

Note 2 to entry: Each class is a hierarchical element of a classification.

[SOURCE: ISO 22274:2013, 3.4, modified — Note 2 to entry has been added.]

3.8
composed property
category of *group of properties* (3.14) corresponding to a feature needing multiple properties to be defined

Note 1 to entry: Using this category of group of properties requires to fill all the properties part of the composed property. There is no *value* (3.20) attached to the group of properties.

EXAMPLE To describe the characteristic “concrete facing quality” it is mandatory to describe 3 properties: concrete planarity, concrete hue, concrete texture.

3.9
data dictionary
centralized repository of information about data such as meaning, relationships to other data, origin, usage and format

Note 1 to entry: The definition is from IBM Dictionary of Computing[15].

3.10
derived quantity
quantity (3.16), in a system of quantities, defined in terms of the *base quantities* (3.5) of that system

EXAMPLE In a system of quantities having the base quantities length and mass, mass density is a derived quantity defined as the quotient of mass and volume (length to the power three).

[SOURCE: ISO 80000-1:2009, 3.5, modified — The NOTE has been removed.]

3.11
domain
area of activity covering a science, a technique, a material, etc.

Note 1 to entry: A domain can be associated with a group to which the *property* (3.17) applies.

3.12
expert
person who, through knowledge or experience, has competence to give an opinion in the fields about which he/she is consulted

[SOURCE: ISO 13302:2003, 3.10, modified — The domain "<general sense>" has been removed; the NOTE has been removed.]

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3.13
globally unique identifier
GUID
unique identifier generated using an algorithm

Note 1 to entry: In ISO 16739-1 and ISO 12006-3 the compressed version of GUID is used.

3.14
group of properties
collection enabling the *properties* (3.17) to be prearranged or organized

Note 1 to entry: A Property Set as defined in ISO 16739-1 is a group of properties, but a group of properties is not necessarily a Property Set.

Note 2 to entry: There are five categories of possible groups of properties: *class* (3.7), *domain* (3.11), *reference document* (3.18), *composed property* (3.8), *alternative use* (3.1).

Note 3 to entry: The category of group of properties alternative use shall be used only after having considered the possible use of all the other categories.

Note 4 to entry: A *property* (3.17) can be member of several groups of properties. A property cannot be member of several Property Sets as defined in ISO 16739-1.

3.15
interconnected data dictionaries
set of *data dictionaries* (3.9) following this document and connected using specific *attributes* (3.4)

3.16
quantity
property (3.17) of a phenomenon, body, or substance, where the property has a magnitude that can be expressed by means of a number and a reference

Note 1 to entry: Quantities can appear as *base quantities* (3.5) or *derived quantities* (3.10).

EXAMPLE 1 Length, mass, electric current (ISQ base quantities).

EXAMPLE 2 Plane angle, force, power (derived quantities).

[SOURCE: ISO 80000-1:2009, 3.1, modified — NOTEs 1 to 6 have been removed; new Note 1 to entry and two EXAMPLEs have been added.]

3.17
property
inherent or acquired feature of an item

EXAMPLE Thermal efficiency, heat flow, sound reduction index, sound power level, colour.

[SOURCE: ISO 6707-1:2017, 3.7.1.3, modified — The EXAMPLE has been added.]

3.18
reference document
publication that is consulted to find specific information, particularly in a technical or scientific *domain* (3.11)

Note 1 to entry: A reference document can be associated with any data present in a *data dictionary* (3.9).

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3.19
unit
unit of measurement
measurement unit
real scalar quantity, defined and adopted by convention, with which any other quantity of the same kind can be compared to express the ratio of the second quantity to the first one as a number

[SOURCE: ISO 80000-1:2009, 3.9, modified — NOTEs 1 to 5 have been removed; "unit" has been changed to be a preferred term and "unit of measurement" an admitted term.]

3.20
value
quantity value
value of a quantity
number and reference together expressing magnitude of a quantity

EXAMPLE 1 Length of a given rod: 5,34 m or 534 cm.

EXAMPLE 2 Mass of a given body: 0,152 kg or 152 g.

EXAMPLE 3 Curvature of a given arc: 112 m^{-1}.

EXAMPLE 4 Celsius temperature of a given sample: −5 °C.

EXAMPLE 5 Electric impedance of a given circuit element at a given frequency, where j is the imaginary *unit* (3.19): (7 + 3j) Ω.

EXAMPLE 6 Refractive index of a given sample of glass: 1,32.

EXAMPLE 7 Rockwell C hardness of a given sample (150 kg load): 43,5 HRC (150 kg).

EXAMPLE 8 Mass fraction of cadmium in a given sample of copper: 3 µg/kg or 3×10^{-9}.

EXAMPLE 9 Molality of Pb2+ in a given sample of water: 1,76 µmol/kg.

EXAMPLE 10 Amount-of-substance concentration of lutropin in a given sample of plasma (WHO international standard 80/552): 5,0 IU/l (WHO International Units per litre).

[SOURCE: ISO 80000-1:2009, 3.19, modified — NOTEs 1 to 5 have been removed; "value" has been changed to be a preferred term and "quantity value" an admitted term.]

3.21
user
person or legal entity that interacts with the *interconnected data dictionaries* (3.15) via an interface providing access to the network of *data dictionaries* (3.9)

4 Rules to define properties and groups of properties

4.1 General

To be non-ambiguous, machine-readable as well as human-understandable, properties and groups of properties shall be defined by a set of attributes. Some attributes are mandatory, and others are optional.

For a property to be human-understandable, any application following this document may be able to display the value of many attributes defining this property, for example name, name of the reference document, test method, unit, etc.

4.2 Property

A property shall be defined using the set of attributes as listed in Table 1.

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4.3 Group of properties

A group of properties shall be defined using the set of attributes as listed in Table 2.

Applicants can propose a group of properties as appropriate for their needs.

The different categories of a group of properties are (exhaustive list):

— alternative use;

— class;

— composed property;

— domain;

— reference document.

Groups of properties can be organised in tree structures. Any property attached to a group of properties is inherited by the sub-group(s) of properties.

Any property may be included in several groups of properties.

EXAMPLE

— class: Panel (class corresponding to a family of products in a classification);

— class: ifcWall;

— domain: Acoustic (domain corresponding to a scientific discipline), architecture, economy;

— composed property: "concrete facing quality" is a group of properties linking 3 properties (concrete planarity, concrete hue, concrete texture).

4.4 Attributes list

4.4.1 Attributes of a property

Table 1 provides an exhaustive list of attributes used to manage a property within a data dictionary.

Table 1 contains 8 columns:

— Code: code that can be used to identify the attribute;

— Name: name of the attribute;

— Description: description of the attribute, and how it shall be used;

— Example: some examples of possible values for the attribute;

— Interconnected data dictionaries management rule: rule that defines if it is mandatory or not to provide a value for the attribute. When "calculated" is noticed, this means that the value of the attribute is provided by the system managing a data dictionary, not by a user (i.e. when a request has been validated, the system shall change the property's attribute "status" to "active");

— Request form management rule: rule that defines if it is mandatory or not relevant to provide a value for the attribute in a request form to interact with the data dictionary;

— Type: datatype of the attribute;

— List of values: list of possible values for the attribute.

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Table 1 — Property attributes

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA001	Globally unique identifier	Globally unique identifier	*936DA01F-9ABD-4D9D-80C7-02AF85C822A8*	Mandatory Calculated	Not relevant	String Single-value	
PA002	Status	Status of the property during its life cycle	*Active*	Mandatory Calculated	Not relevant	Enumeration Single-value	Active Inactive
PA003	Date of creation	Date of validation of the property creation request by experts	*2014-04-30T10:39:53Z*	Mandatory Calculated	Not relevant	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM-DDThh:mm:ssTZD	
PA004	Date of activation	Date after when the property can be used	*2014-04-30T10:39:53Z*	Mandatory if the property is validated Calculated	Not relevant	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM-DDThh:mm:ssTZD	
PA005	Date of last change	Date of validation of the last change request by experts	*2014-04-30T10:39:53Z*	Mandatory if the property has changed Calculated	Not relevant	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM-DDThh:mm:ssTZD	
PA006	Date of revision	Date of the revision	*2014-04-30T10:39:53Z*	Mandatory Calculated	Not relevant	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM-DDThh:mm:ssTZD	
PA007	Date of version	Date of the version	*2014-04-30T10:39:53Z*	Mandatory Calculated	Not relevant	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM-DDThh:mm:ssTZD	

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA008	Date of deactivation	Date as of which the property becomes obsolete; the property is maintained in the data dictionary	*2014-04-30T10:39:53Z*	Mandatory if the property is deactivated Calculated	Not relevant	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM-DDThh:mm:ssTZD	
PA009	Version number	This version number allows tracking of major changes. Experts decide if a new version number must be applied	*2*	Mandatory	Mandatory	Integer Single value	
PA010	Revision number	This revision number allows tracking of minor changes e.g. new translation, changes of typos: if the version number changes, the revision number starts again at 1 Experts decide if a new revision number can be applied or if a new revision is needed	*3*	Mandatory	Mandatory	Integer Single value	
PA011	List of replaced properties	Globally unique identifier (attribute PA001) of the replaced property (or properties)	*(946DA01F-9ABD-4D9D-80C7-02AF-85C822A8, 946DA01F-9ABD-4D9D-80C7-02AF85C822A9)*	Mandatory if the property replaces another one Calculated	Mandatory if the property replaces another one	String Multiple values	
PA012	List of replacing properties	Globally unique identifier (attribute PA001) of the replacing property (or properties)	*(935DA01F-9ABD-4D9D-80C7-02AF-85C822A8)*	Mandatory if the property is replaced Calculated	Mandatory if the property is replaced	String Multiple values	

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA013	Deprecation explanation	Sentence explaining the reason of the deprecation, which can explain how to convert values to conform to the new property; this explanation has to be written in international English (EN)		Mandatory if the property has been replaced by others	Mandatory if the property has been replaced by others	String Single value	
PA014	Relation of the property identifiers in the interconnected data dictionaries	List of pairs (property internal identifier, corresponding data dictionary identifier) This attribute should be used for compatibility between already existing properties	*(internalGUID1,* bsdd.buildingsmart.org*),* *(internalGUID2, PPBIM)*	Optional Mandatory if the property is in interconnected data dictionaries	Optional, Mandatory if the property is in interconnected data dictionaries	List of pairs Multiple values	
PA015	Creator's language	Language of the creator of the property	*en-EN* *en-GB* *IFC-IFC* *EN (for international English)*	Mandatory	Mandatory	String Single value	The language shall consist of an ISO 639-1 letter code followed by a dash and then an ISO 3166-1 alpha-2 letter code + "IFC-IFC"

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA016	Names in language N	List of pairs (name of the property and language) This attribute can be used to add synonyms for different domains	*(* *(PropertyName | en-EN),* *(Nompropriété | fr-FR),* *(IfcPropertyName | IFC)* *)*	Mandatory The minimum it shall contain is a name in international English and a name in the creator's language	Mandatory The minimum it shall contain is a name in international English and a name in the creator's language	List of pairs Multiple values	The second part of the pair shall consist of an ISO 639-1 letter code followed by a dash and then an ISO 3166-1 alpha-2 letter code + "IFC-IFC"
PA017	Definitions in language N	List of pairs (definition of the property, language)		Mandatory The minimum it shall contain is a definition in international English and a definition in the creator's language	Mandatory The minimum it shall contain is a definition in international English and a definition in the creator's language	List of pairs Multiple values	
PA018	Descriptions in language N	List of pairs (description of the property, language) This attribute is used to provide a plain language description of the property		Optional	Optional	List of pairs Multiple values	
PA019	Examples in language N	List of pairs (example values, language) This attribute can be used to illustrate the possible values of the property		Optional	Optional	List of pairs Multiple values	

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA020	Connected properties	List of the globally unique identifier of the connected properties (attribute PA001); the value of one property is related to the values of the other ones. For example, a sound absorption coefficient is given for a specific frequency, in this case sound absorption and frequency are connected properties	*(945DA01F-9BBD-4D9D-80C7-02AF-85C822A8,* *945DA01F-9BBD-4D9D-80C7-02AF85C822A7)*	Optional	Optional	List of GUIDs Multiple values	
PA021	Group(s) of properties	List of globally unique identifiers of groups of properties (attribute GA001) to which the property is attached	*(945DA01F-9BBD-4D9D-80C7-02AF-85C822A8,* *945DA01F-9BBD-4D9D-80C7-02AF85C822A7)*	Mandatory	Mandatory	List of GUIDs Multiple values	List of all the groups.
PA022	Symbols of the property in a given property group	List of pairs (symbol of the property, globally unique identifier of the group of properties (attribute GA001))	*(λ, 936DA01F-9ABD-4B6D-80C7-03BF-85C822A8)*	Optional	Optional	Unicode, text Multiple values	
PA023	Visual representation	Visual representation of the property through sketches, photos, videos or other multimedia objects		Optional	Optional	Multiple values It can be a URL code	

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA024	Country of use	Country (group of countries, continent) in which the property is relevant for the market the stakeholders operate in For example: ISOLE (The "ISOLE" usage profile is designed to make it easier to express of the suitability of insulation products relative to the needs of users, and as set out in a number of codified texts) has a country of use: Europe	*(FR, US, NO)*	Mandatory	Mandatory	Choose Multiple values	In accordance with ISO 3166-1
PA025	Subdivision of use	Documented geographical region of use of the property	*(US-MT)*	Optional Depending on country of use	Optional Depending on country of use	Choose Multiple values	In accordance with ISO 3166-2, and other subdivisions (thermal regulation "RT 2012" zones, seismic zones fixed by decree etc.)
PA026	Country of origin	Country from where the requirement for this property originated	*FR*	Optional	Optional	String Single value	In accordance with ISO 3166-1

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA027	Physical quantity	List of pairs (physical quantity | language) Physical quantities are expressed in International System (SI) units Non-physical quantities such as text are expressed with the value "without" This is equivalent to a measure in ISO 16739-1 and ISO 10303 Only one physical quantity can be attached to a property. This attribute is used to provide the quantity in plain text with all the needed translations	*(* *(Mass | en-EN),* *(Masse | fr-FR)* *)*	Mandatory	Mandatory	String Multiple values	First part of the pair in accordance with ISO 80000 (all parts) -- or "without"

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA028	Dimension	In case of a physical quantity, dimension according to ISO 80000 (all parts) This attribute allows the dimension to be machine readable; as all physical quantities are derived from 7 base quantities, it is provided with the power (as a rational number) attached to a basic dimension in the following order and with one space between each Examples of dimensions are provided in Annex C L M T I θ N J	*For acceleration ($L\ T^{-2}$) the value to provide is* *1 0 −2 0 0 0 0* *For capacitance ($L^{-2}\ M^{-1} T^{4}\ I^{2}$) the value to provide is* *−2 −1 4 2 0 0 0*	Mandatory if physical quantity	Mandatory if physical quantity	String	In accordance with ISO 80000 (all parts)
PA029	Method of measurement	Evaluation of construction products to ensure their fitness according to requirements in harmonised technical specifications	*Type of specimen according to EN 771-2* *Thermal transmittance according to ISO 10077-1*	Optional	Optional	String, single value	

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA030	Data type	Format for expressing the value of the property This can be understood as the storage type from a software perspective In case of a dynamic property the value of this attribute is the datatype of the result of the calculation by the formula	*(numerical, numerical)* *real* *integer* *array (1..m) of integer* *array (1..2) of integer* *array (1..m , 1..n) of real*	Mandatory Derived from attribute "Physical quantity"	Mandatory	String Single value	In accordance with ISO/IEC 11404
PA031	Dynamic property	If this is a dynamic property, the value is dependent on the parameters provided in the attribute PA032	*No*	Mandatory	Mandatory	String Single value	Yes No
PA032	Parameters of the dynamic property	List of GUIDS of properties which are parameters of the function for a dynamic property		Optional Mandatory if dynamic property = yes	Optional Mandatory if dynamic property = yes	List of GUID	
PA033	Units	A unit to represent a scale that enables a value to be measured It is possible to use this attribute to explain there is no unit attached to the property by using "unitless"	*(m^2)* *(mm , m)* *(kg)* *(unitless)*	Optional Consistent with "physical quantity"	Optional Consistent with "physical quantity"	String Multiple values	In accordance with ISO 80000 (all parts)-- or ISO 4217 or ISO 8601 (all parts)

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA034	Names of the defining values	In case of an array, this attribute provides the names of the column headers defined as a list of pairs (name, language)	*In case of array (3, 2)* *(* *(frequency|en-EN), (fréquence|fr-FR)* *)* *In case of array (3, 3)* *(* *(* *(temperature|en-EN),* *(température|fr-FR)* *),* *(* *(air flow|en-EN),* *(flux d'air|fr-FR)* *)* *)*	Optional Mandatory if datatype is an array	Optional Mandatory if datatype is an array	List of pairs of string	
PA035	Defining values	In case of an array, this attribute provides the defining values when applicable, the datatype is given by the attribute PA030	*In case of array (3, 2)* *(* *(25, 50, 75),* *(0.4,0.5,06)* *)*	Optional	Optional	List	

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Table 1 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request from management rule	Type	List of values
PA036	Tolerance	For numerical values; the total amount that a specific unit is permitted to vary; it is the difference between the maximum and the minimum limits for the unit		Optional	Optional	Multiple values Real	
PA037	Digital format	Pair for digital text type (precision, unit) Precision is the number of significant digits	*(1E-2, W/m^2. K)*	Optional Derived from "units"	Optional Derived from "units"	Multiple values	
PA038	Text format	Pair for text type (encoding, number of characters) The encoding is set according to "Name of encoding standard" of IANA, RFC 2978	*(UTF-8, 32)*	Optional	Optional Mandatory if data type is a string	Single value	
PA039	List of possible values in language N	List of pairs (possible value for the property and language) Values can be string or numbers	*((Yes | en-EN),* *(No| en-EN)* *(Not Applicable | en-EN))*	Optional	Optional	List of pairs Multiple values	The second part of the pair shall consist of an ISO 639-1 letter code followed by a dash and then an ISO 3166-1 alpha-2 letter code + "IFC-IFC"
PA040	Boundary values	Pair (list of boundary intervals of possible values for the property, unit)	*({(⁻15,⁻10),(⁻5,15)},°C)*	Optional	Optional		

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4.4.2 Attributes of a group of properties

Table 2 provides an exhaustive list of attributes used to manage a group of properties within a data dictionary.

Table 2 contains 8 columns:

— Code: code that can be used to identify the attribute;

— Name: name of the attribute;

— Description: description of the attribute, and how it shall be used;

— Example: some examples of possible values for the attribute;

— Interconnected data dictionaries management rule: rule that defines if it is mandatory or not to provide a value for the attribute. When “calculated” is noticed, this means that the value of the attribute is provided by the system managing a data dictionary, not by a user (i.e. when a request has been validated, the system shall change the group of properties attribute “status” to “active”);

— Request form management rule: rule that defines if it is mandatory or not relevant to provide a value for the attribute in a request form to interact with the data dictionary;

— Type: datatype of the attribute;

— List of values: List of possible values for the attribute.

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Table 2 — Group of properties attributes

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request form management rule	Type	List of values
GA001	Globally unique identifier	Globally unique identifier	*936DA01F-9ABD-4D9D-80C7-02AF85C822A8*	Mandatory Calculated	Not needed	String Single value	
GA002	Status	Status of the group of properties during its life cycle		Mandatory Calculated	Not needed	Enumeration Single value	Active Inactive
GA003	Date of creation	Date of validation of the group of properties creation request by experts	*2014-04-30T10:39:53Z*	Mandatory Calculated	Not needed	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM -DDThh:mm: ssTZD	
GA004	Date of activation	Date after when the group of properties can be used	*2014-04-30T10:39:53Z*	Mandatory if the group of properties is validated Calculated	Not needed	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM -DDThh:mm: ssTZD	
GA005	Date of last change	Date of validation of the last change request by experts	*2014-04-30T10:39:53Z*	Mandatory Calculated	Not needed	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM -DDThh:mm: ssTZD	

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Table 2 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request form management rule	Type	List of values
GA006	Date of revision	Date of the revision	*2014-04-30T10:39:53Z*	Mandatory	Not needed	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM -DDThh:mm: ssTZD	
GA007	Date of version	Date of the version	*2014-04-30T10:39:53Z*	Mandatory	Not needed	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM -DDThh:mm: ssTZD	
GA008	Date of deactivation	Date as of which the group of properties becomes obsolete; the group of properties is maintained in the data dictionary	*2014-04-30T10:39:53Z*	Mandatory if the group of properties is deactivated Calculated	Not needed	Date In accordance with ISO 8601 (all parts) Format = YYYY-MM -DDThh:mm: ssTZD	
GA009	Version number	This version number allows tracking of major changes. It is the experts who decide if the version number has to be changed or not	*2*	Mandatory	Mandatory	Integer Single value	

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Table 2 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request form management rule	Type	List of values
GA010	Revision number	This revision number allows tracking of minor changes e.g. new translation, changes of typos; if the version number changes, the revision number starts again at 1. It is the experts who decide about the revision number change	*3*	Mandatory	Mandatory	Integer Single value	
GA011	List of replaced groups of properties	List of globally unique identifiers of the replaced groups of properties		Mandatory if the group of properties replaces another one Calculated	Optional	List of GUIDS Multiple values	
GA012	List of replacing groups of properties	List of globally unique identifiers of the replacing groups of properties		Mandatory if the group of properties is replaced Calculated	Mandatory if the group of properties is replaced	List of GUIDS Multiple values	
GA013	Deprecation explanation	Sentence explaining the reason of the deprecation, which can explain how to convert values to conform to the new group of properties; this explanation has to be written in international English		Mandatory if the group of properties has been replaced by others	Mandatory if the group of properties has been replaced by others	String Single value	
GA014	Relation of the group of properties identifiers in the interconnected data dictionaries	List of pairs (group of properties internal identifier, corresponding data dictionary identifier) This attribute should be used for compatibility between already existing groups of properties	*((internalGUID1, bsdd.buildingsmart.org),* *(internalGUID2, PPBIM))*	Optional Mandatory if the group of properties is in interconnected data dictionaries	Optional, Mandatory if the group of properties is in interconnected data dictionaries	Choose Multiple values	

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Table 2 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request form management rule	Type	List of values
GA015	Creator's language	Language of the creator of the group of properties	*en-EN* *en-GB* *IFC-IFC* *EN (for international english)*	Mandatory	Mandatory	String Single value	The language shall consist of an ISO 639-1 letter code followed by a dash and then an ISO 3166-1 alpha-2 letter code + "IFC-IFC"
GA016	Names in language N	List of pairs (name of the group of properties and language) This attribute can be used to add synonyms for different domains	*((GroupName | en-EN),* *(Nomgroupe | fr-FR))*	Mandatory The minimum it shall contain is a name in international English and a name in the creator's language	Mandatory The minimum it shall contain is a name in international English and a name in the creator's language	List of pairs Multiple values	
GA017	Definitions in language N	List of pairs (definition of the group of properties, language)		Mandatory The minimum it shall contain is a definition in international English and a definition in the creator's language	Mandatory The minimum it shall contain is a definition in international English and a definition in the creator's language	List of pairs Multiple values	
GA018	Visual representation	Visual representation of the group of properties through sketches, photos, videos or other multimedia objects		Optional	Optional	Multiple values It can be a URL code	
GA019	Country of use	Country in which the group of properties is used	*(FR, US)*	Mandatory	Mandatory	Choose Multiple values	In accordance with ISO 3166-1

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Table 2 *(continued)*

Code	Name	Description	Example	Interconnected data dictionaries management rule	Request form management rule	Type	List of values
GA020	Subdivision of use	Documented geographical region of use of the group of properties	*(US-MT)*	Optional Depending on country of use	Optional Depending on country of use	Choose Multiple values	In accordance with ISO 3166-2, and other subdivisions *(thermal regulation "RT 2012" zones, seismic zones fixed by decree etc.)*
GA021	Country of origin	Country from where the requirement for this group of properties originated	*FR* *UK*	Optional	Optional	String Single value	In accordance with ISO 3166-1
GA022	Category of group of properties	Indicates the category of the group of properties created		Mandatory	Mandatory	Choose Single value	List of categories of group of properties: — Alternative use — Class — Composed property — Domain — Reference document
GA023	Parent group of properties	Enables a sub-group to be linked to a parent group via their globally unique identifiers (attribute GA001) Any property attached to a group is inherited by the sub-group(s)		Optional	Optional	Single value	

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5 Management rules to author and maintain properties and groups of properties

5.1 Interactions amongst users, experts and data dictionaries

Figures 1 and 2 represent the interactions amongst the users, the experts, the data dictionaries and the interconnected reference system modelled in accordance with ISO/IEC 19510.

These interactions shall be applied for a property (Figure 1) or a group of properties (Figure 2). An example of implementing these interactions for a group of properties is provided in Annex A.

In the instance of new data dictionaries or existing data dictionaries that wish to conform to this document, this process can be adapted accordingly, for example experts could be users in case of a new data dictionary.

In all cases the content shall be validated by experts.

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Figure 1 — Management of the interconnected data dictionaries for a property

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Figure 2 — Management of the interconnected data dictionaries for a group of properties

5.2 Description of actions

5.2.1 General

The interactions described below apply in the same manner to properties and to groups of properties.

For the user, any action on the interconnected reference system starts with a search for a property via an interface providing access to the network of data dictionaries. This interface transmits the request to all of the interconnected data dictionaries.

This search leads to the compilation of the replies from the interconnected data dictionaries.

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If the user is satisfied with the result, the user retrieves the attributes of the property.

If not, the user can modify the terms of the search or make a property creation, modification or deactivation request.

The property creation, modification or deactivation request form is based on the attributes and the request form management rules specified in Tables 1, 2 and 3.

A search addresses all the attributes that define a property.

5.2.2 Requests

5.2.2.1 General

The requests correspond to property creation, modification or deactivation actions. These requests are addressed to the experts in accordance with the table of correspondence (5.4). These requests shall follow the management rules from 5.1 and shall be handled in the network of data dictionaries.

The requests can be as follows.

5.2.2.2 Creation

In the case of a creation request, the property is created immediately with its unique identifier. Its calculated status is "inactive".

EXAMPLE Creation of a property that has not been found in the data dictionary.

5.2.2.3 Modification - revision change

A validated modification revision change request corresponds to the updating of one or more attributes of the property.

A modification revision change is a modification which changes not at all the semantic of the property.

It is up to the experts to decide if the modification revision change can be accepted or if it shall be a replacement action.

If the modification revision change is accepted by the experts, the attribute “revision number” of the property shall be changed.

EXAMPLE Typographical (typo) correction.

5.2.2.4 Deactivation

A deactivation request corresponds to a modification of the property. After validating of the deactivation request by the experts, the value of the calculated status of the property changes to "inactive". The property is not deleted from the system (property archive).

EXAMPLE The user found a property which is no longer applicable and proposes to change its attribute “status” to “inactive”.

5.2.2.5 Replacement (a creation and a deactivation)

A replacement request corresponds to the creation of the property and the deactivation of the property it replaces. After validation of the replacement request by the experts, the replaced property is deactivated. Its calculated status changes to "inactive". Its PA012 attribute is automatically populated with the globally unique identifier of the property that replaces it.

EXAMPLE 1 The user found a property which is no longer applicable and has created a new one to replace it.

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If someone proposes to link a new property to a group of properties, this group of properties shall have a new version number.

EXAMPLE 2 A user searches in the data dictionary for a group of properties “window”; he finds out that the property “height” is missing for this group of properties. This user proposes to link “height” to “window”. If this proposal is accepted by the experts, the group of properties will have a new version number.

If a user removes a link from an existing property to a group of properties, a new group of properties should be created, replacing the old one.

EXAMPLE 3 A user finds out that in the group of properties “window” the property “reaction to fire” will be replaced by a new one because of changes in a standard. He asks to remove the link from “reaction to fire” to “window”. A new group will be created, replacing the old one using the attributes PA011 and PA012 and the attribute “status” will be set to “inactive” for the old group. The new property will be linked to the new group of properties. The user will fill in the property attribute “deprecation explanation” of the old group.

5.2.2.6 Fragmentation, replacement of one property by several properties (several creations and one deactivation)

A fragmentation request corresponds to the deactivation of the property and the creation of several properties. After validation of the fragmentation request by the experts, the fragmented property is deactivated. Its calculated status changes to "inactive". Its PA012 attribute is automatically populated with the globally unique identifiers of the properties that replace it.

5.2.2.7 Merging, replacement of several properties by a single property (one creation and several deactivations)

A merge request corresponds to the creation of one property and the deactivation of several properties. After validation of the merge request by the experts, the merged properties are deactivated. The calculated status of the merged properties changes to "inactive", PA012 attributes are then automatically populated with the globally unique identifier of the created property that replaces them.

EXAMPLE Merging of duplicate properties.

5.2.3 Management of duplicates

The procedure to remove duplicate properties shall be carried out on the relevant attributes. The management of duplicates cannot be fully automated.

5.3 Naming of reference documents

5.3.1 Standardization documents

Standardization documents shall be named following the ISO/IEC directives, Part 2 Principles and rules for the structure and drafting of ISO and IEC documents, 10.3.

5.3.2 Regulation documents

European legislation: the code “EU” followed by "-" followed by the name; the name shall be the same as the one published in the Official Journal of the European Union

EXAMPLE 1 Example for a European legislation:

EU - COMMISSION REGULATION (EU) 2017/2158 of 20 November 2017 establishing mitigation measures and benchmark levels for the reduction of the presence of acrylamide in food

National legislation: the code of the country followed by “-“ followed by the name; the name shall be the same as the one published in the Official Journal of the country

EXAMPLE 2 Example for a national legislation:

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BS 7671:2008+A3:2015; Requirements for Electrical Installations. IET Wiring Regulations.

5.3.3 Other documents

The name shall unambiguously identify the document and its version.

5.4 List of request attributes

Table 3 defines the list of required information to manage actions on properties and groups of properties.

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Table 3 — Attributes of a request

Code	Name	Description	Example	Management rule	Type	List of values
RA001	Globally unique identifier of the property (or properties) concerned	Globally unique identifier	936DA01F-9ABD-4D9D-80C7-02AF-85C822A8	Mandatory	Multiple values	
RA002	Comment	Detailed expression of the request		Mandatory	String	
RA003	Applicant	All the necessary information to contact the applicant (person or entity)		Mandatory		
RA004	Language code	Language code of the creator	FR	Mandatory	List	Values from IETF language-TAG + "IFC-IFC"
RA005	External status	Status of the request which indicates its stage of progress in the process between the creator and the experts		Mandatory	List	Pending assignment Undergoing analysis Complementary information request Validated Rejected
RA006	Internal status	Status of the request for each expert which indicates its stage of progress in the experts' process; the internal status is associated with the pair {Request, Expert} (appraisal).		Mandatory	List	Undergoing analysis Information pending Not competent Validated Rejected
RA007	Date of submission	Date of submission of the request	2014-04-30T10:39:53Z	Mandatory	Date	In accordance with ISO 8601 (all parts)
RA008	Nature	Characterises the request with respect to the existence of a property		Mandatory	List	Simple creation Simple modification Simple deactivation Replacement Fragmentation Merging

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5.5 Connection between data dictionaries, sharing and mapping properties and groups of properties

To allow connection between data dictionaries, data dictionaries shall be identified using attributes described in Table 4.

Table 4 — Attributes of a data dictionary

Code	Name	Description	Example	Management rule	Type	List of values
DA001	Name	Name of the interconnected data dictionary		Mandatory	List single value	List of the interconnected data dictionaries
DA002	Data dictionary identifier	Globally unique identifier	936DA01F-9ABD-4D9D-80C7-02AF-85C822A8	Mandatory	Single value	

5.6 Data dictionaries interconnection

In order to be part of a network of data dictionaries, each data dictionary shall support the exchange of properties, groups of properties, experts, users and requests. The web-based exchange shall be structured following ISO 12006-3.

6 Governance of a data dictionary

6.1 General

The management of a data dictionary that is part of a network of coordinated data dictionaries following this document's methodology requires a management structure for all the commissions of experts.

6.2 Experts' management structure

The management structure is tasked with organising the functioning of the commissions of experts:

— dealing with experts and areas of competence;

  — selecting the areas of competence used in the data dictionary;

  — seeking experts for an area of competence as necessary;

  — validating the admission of the experts attached to one or several areas of competence;

— managing and maintaining an efficient and effective process;

  — the identified expert should be notified automatically that they have an approval to consider, and a clear and consistent time scale identified for approval;

    EXAMPLE Once the identified time has elapsed, agreement cannot be reached by the experts. If the request is outside of the area of expertise of the experts, the request will automatically be referred to the authority of the area of competence, which will be in charge of finding a new expert. There will then be a clear and consistent time scale identified for approval. The approval time scale will be stepped based on the number of requests submitted by the user, this will be clearly identified at the beginning of the approval process.

— the conflicts between experts shall be arbitrated and resolved;

— the management structure shall coordinate the interoperability with other data dictionaries.

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6.3 Commissions of experts

6.3.1 General

The implementation of the management rules defined in Figure 1 and 2 need a commission of experts. An example of commission of experts is provided in Annex D.

6.3.2 Missions of the commissions of experts

The experts have several missions:

— analysing requests;

— validating or refusing the addition or the modification of properties, including their deactivation;

— validating or refusing groups of properties.

6.3.3 Opinions of the commissions of experts

Opinions delivered by the commissions of experts shall be supported by arguments and published in the interconnected reference system.

7 Governance of a network of data dictionaries

In order to maintain the quality of a network of data dictionaries, a formal governance procedure should be established.

If the governance of a network of data dictionaries is existing, the governance shall establish authority, responsibility and accountability for the management process of a network of data dictionaries following this document.

Some examples of governance models are provided in the Annex B.

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Annex A
(informative)

Implementation of the process for a manufacturer searching for product properties related to fire regulations

Step 1: The manufacturer is signing into a data dictionary and completing a search form in plain text.

Step 2: The tool is retrieving the search results from its own database and all the connected data dictionaries.

Step 3: The manufacturer consults the results and selects accordingly. He/she can review each attribute of the group of properties (for example the attached reference documents).

The implementation of this process is described in Figure A.1.

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Figure A.1 — Example of implementation of the process described in Figure 2

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Annex B
(informative)

Examples of composition of a management structure

B.1 EXAMPLE 1

The management structure is made up of representatives of recognised organisations:

— regulation;

— standardization;

— industry;

— trades.

B.2 EXAMPLE 2

See Figure B.1.

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Figure B.1 — Example of composition of a management structure

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Annex C
(informative)

Example of base and derived quantities

Table C.1 and Table C.2 provide examples of base and derived quantities from ISO 80000-1:2009; the column dimension of these tables present examples of values for the attribute PA028. This list is not exhaustive.

Table C.1 — Base quantities from ISO 80000-1:2009

Base quantities	Description	Dimension	SI unit	SI symbol
Length	One-dimensional extent of an object	L	metre	m
Mass	A measure of resistance to acceleration	M	kilogram	kg
Time	The duration of an event	T	second	s
Electric current	Rate of flow of electrical charge per unit time	I	ampere	A
Thermodynamic temperature	Average kinetic energy per degree of freedom of a system	θ	kelvin	K
Amount of substance	Number of particles compared to the number of atoms in 0,012 kg of 12C	N	mole	mol
Luminous intensity	Wavelength-weighted power of emitted light per unit solid angle	J	candela	cd

Table C.2 — Examples of derived quantities from ISO 80000-1:2009

Derived quantities	Description	Dimension	SI derived unit	SI symbol
Acceleration	Change of the speed or velocity per unit time	LT^{-2}	metre per second per second	$m\ s^{-2}$
Plane angle	Ratio of circular arc length to radius	1	radian	rad
Solid angle	Ratio of area on a sphere to its radius squared	1	steradian	sr
Capacitance	Stored charge per unit electric potential	$L^{-2}M^{-1}T^{4}I^{2}$	farad	F
Electric field strength	Strength of the electric field	$LMT^{-3}I^{-1}$	volt per metre	$V\ m^{-1}$
Magnetic field strength	Strength of a magnetic field	$L^{-1}I$	ampere per metre	$A\ m^{-1}$
Electric charge	The force per unit electric field strength	TI	coulomb	C
Electrical conductance	Measure for how easily current flows through a material	$L^{-2}M^{-1}T^{3}I^{2}$	siemens	S
Current density	Electric current per unit cross-section area	$L^{-2}I$	ampere per square metre	$A\ m^{-2}$
Energy	Capacity of a body or system to do work	$L^{2}MT^{-2}$	joule	J
Entropy	Logarithmic measure of the number of available states of a system	$L^{2}MT^{-2}\theta^{-1}$	joule per kelvin	$J\ K^{-1}$
Force	Transfer of momentum per unit time	LMT^{-2}	newton	N
Frequency	Number of (periodic) occurrences per unit time	T^{-1}	hertz	Hz
Impedance	Resistance to an alternating current of a given frequency, including effect on phase	$L^{2}MT^{-3}I^{-2}$	ohm	Ω

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Table C.2 *(continued)*

Derived quantities	Description	Dimension	SI derived unit	SI symbol
Inductance	Magnetic flux generated per unit current through a circuit	$L^2MT^{-2}I^{-2}$	henry	H
Magnetic flux density	Measure for the strength of the magnetic field	$MT^{-2}I^{-1}$	tesla	T
Volume density	Mass per unit volume	$L^{-3}M$	kilogram per cubic metre	kg m^{-3}
Permittivity	Measure for how the polarization of a material is affected by the application of an external electric field	$L^{-3}M^{-1}T^4I^2$	farad per metre	F m^{-1}
Electric potential	Energy required to move a unit charge through an electric field from a reference point	$L^2MT^{-3}I^2$	volt	V
Pressure	Force per unit area	$L^{-1}MT^{-2}$	pascal	Pa
Power	Rate of transfer of energy per unit time	L^2MT^{-3}	watt	W
Electrical resistance	Electric potential per unit electric current	$L^2MT^{-3}I^{-2}$	ohm	Ω
Electrical resistivity	Bulk property equivalent of electrical resistance	$L^3MT^{-3}I^{-2}$	ohm metre	Ω m
Area	Extent of a surface	L^2	square metre	m^2
Thermal conductivity	Measure for the ease with a material conducts heat	$LMT^3\theta^{-1}$	watt per metre per kelvin	w m^{-1} k^{-1}
Velocity	Speed and direction of an object	LT^{-1}	metre per second	m s^{-1}
Angular speed	The angle incremented in a plane by a segment connecting an object and a reference point per unit time	T^{-1}	radian per second	rad s^{-1}
Volume	Three-dimensional extent of an object	L^3	cubic metre	m^3

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Annex D
(informative)

Example of composition of a commission of experts

The criterion of admissibility of an expert into a commission of experts is based on the legitimacy of that person with respect to one or more groups of properties in the following families:

— regulatory documents: person representing a government organisation;

— standardizing documents: member of standardization commission, technical committees;

— certification documents: member of certificating organisations;

— professional documents: member of professional organisations;

— classifications: member of organisations managing recognised classifications;

— interchange standards: member of organisations managing recognised interchange standards.

More than one expert will be attached to an area of competence.

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