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Building construction — Organization of information about construction works —

Part 3: Framework for object-oriented information

Construction immobilière — Organisation de l'information des travaux de construction —

Partie 3: Schéma pour l'information basée sur l'objet

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 13, *Organization of information about construction works,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 442, *Building Information Modelling (BIM),* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 12006:2007), which has been technically revised.

The main changes are as follows:

— model has been changed and adapted for multiple implementations of dictionaries;

— UML and XML have been introduced in informative annexes;

— API specification has been included;

— relationships among concepts have been made mandatory and concepts have been made more rigid, specific and object-oriented.

A list of all parts in the ISO 12006 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document defines a specification for an extensible taxonomy model, which provides the ability to add concepts like subjects and properties, describe subject by means of properties, and to define relationships between concepts. The set of properties associated with a subject provide the formal definition of the subject as well as its typical behaviour. Properties can have predefined values; and they can be associated with units.

The model makes it possible to describe multiple dictionaries based on the same model. Each concept belongs to one data dictionary. The concepts in one data dictionary can be related to concepts in another data dictionary.

Every entity in the model has a universal unique identifier. The model allows users to describe the development and maintenance of a data dictionary by providing change requests; and it also allows describing the experts reviewing change requests. The model described in this document is proposed as a bridge between classification systems as described in ISO 12006-2 and product modelling as described in ISO 10303-41, ISO 10303-221, ISO 15926-2 and ISO 16739-1.

This document supports the requirements for implementing the concepts described in ISO 23386 and ISO 23387. Not all the concepts from ISO 23386 are provided by the model described in this document.

To simplify and support implementation of dictionaries based on this framework, This document includes UML model[10] and XML schema[11] as Annexes C and D respectively. An API specification is added as Annex B to standardize and define the minimum functionality to extract and exchange data between dictionaries based on this document.

Building construction — Organization of information about construction works —

Part 3: Framework for object-oriented information

1 Scope

This document specifies a language-independent information model which can be used for the development of dictionaries used to store or provide information about construction works. The model is extended by instantiating content, such as further objects and their relationships, allowing the content to serve as an ontology, taxonomy, meronomy, lexicon and thesaurus.

NOTE 1 Lexicons are resources for comprising lexical entries for a given language

NOTE 2 Meronomies are type of hierarchies which deals with part-whole relationships

NOTE 3 Ontologies are formal, explicit specification of a shared conceptualizationIt enables classification systems, information models, object models, data templates and process models to be cross-referenced from within a common framework.

This document provides the description of an API allowing the interconnection of data dictionaries as described in ISO 23386.

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 80000 (all parts), *Quantities and units*

ISO 639 (all parts), *Codes for the representation of names of languages*

ISO/IEC 10646, *Information technology — Universal coded character set (UCS)*

ISO/IEC 9834-8:2014, *Information technology — Procedures for the operation of object identifier registration authorities — Part 8: Generation of universally unique identifiers (UUIDs) and their use in object identifiers*

ISO/IEC 20802-1, *Information technology — Open data protocol (OData) v4.0 — Part 1: Core*

ISO/IEC 20802-2, *Information technology — Open data protocol (OData) v4.0 — Part 2: OData JSON Format*

3 Terms and definitions

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

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

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

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

3.1
data dictionary
database that contains metadata

[SOURCE: ISO 2382, 2121501, modified — The admitted term "information resource dictionary" has been removed. The Notes to entry have been removed.]

3.2
classification
process of assigning *objects* (3.4) to classes according to criteria

[SOURCE: ISO 22274:2013, 3.5]

3.3
data template
data structure used to describe the characteristics of construction *objects* (3.4)

[SOURCE: ISO 23387:2020, 3.3, modified — Exampless and Notes to entry have been removed.]

3.4
object
any part of the perceivable or conceivable world

Note 1 to entry: An object is something abstract or physical toward which thought, feeling, or action is directed.

[SOURCE: ISO 12006-2:2015, 3.1.1]

3.5
property
defined characteristic suitable for the description and differentiation of the *objects* (3.4) in a class

[SOURCE: ISO 22274:2013, 3.25, modified - Example removed.]

3.6
attribute
data element for the computer-sensible description of a *property* (3.5), a relation or a class

EXAMPLE Creation date of a class object in a computer system.

[SOURCE: ISO ISO 22274:2013, 3.2]

4 Language encoding

All information that is specified as type “String”, or that resolves to type “String”, shall be able to be expressed using the UNICODE character set (see ISO 23386) as set out in ISO/IEC 10646, preferably using the UTF-8 encoding form, the UTF-8 encoding scheme and the “UCS Transformation Format 8”.

5 Specification

5.1 General

The model in this document is specified using the EXPRESS data definition language according to ISO 10303-11.

The model is described informally in 5.2, conforming to the EXPRESS-G notation.

The model is described formally in the EXPRESS language specification presented in 5.3 and as an EXPRESS long form specification in Annex A.

NOTE ISO 10303-28, ISO/TS 10303-25 and ISO 10303-22 specify mappings to XML and XMI representations and an API respectively.

5.2 EXPRESS-G specification

The informal EXPRESS-G specification that uses the EXPRESS-G notation is given in three diagrams (Figures 1 to 3), where each diagram specifies a part of the model. All entities in these diagrams are specified formally in 5.3.

— Figure 1 shows the diagram with abstact object of xtdRoot, its attributes and its derived types xtdDictionary, xtdExpertWithStatus, xtdInterval, xtdLanguage, xtdMedia, xtdMultiLanguageText, xtdObject, xtdRational, xtdSymbol, xtdText, xtdUser and xtdUserWithRoles and its subtypes.

— Figure 2 shows the diagram with abstract object of xtdObject, its attribues and its derived types xtdConcept, xtdOrderedValue, xtdChangeRequest, xtdValue, xtdRelationahipToSubject and its subtypes.

— Figure 3 shows the diagram with abstract type of xtdConcept, its attributes and its derived types xtdFilter, xtdCountry, xtdSubdivision, xtdDimension, xtdRelationshipType, xtdExternalDocument, xtdVisualRepresentation, xtdUnit, xtdValueList, xtdRelationshipToProperty, xtdSubject, xtdProperty and its subtypes.

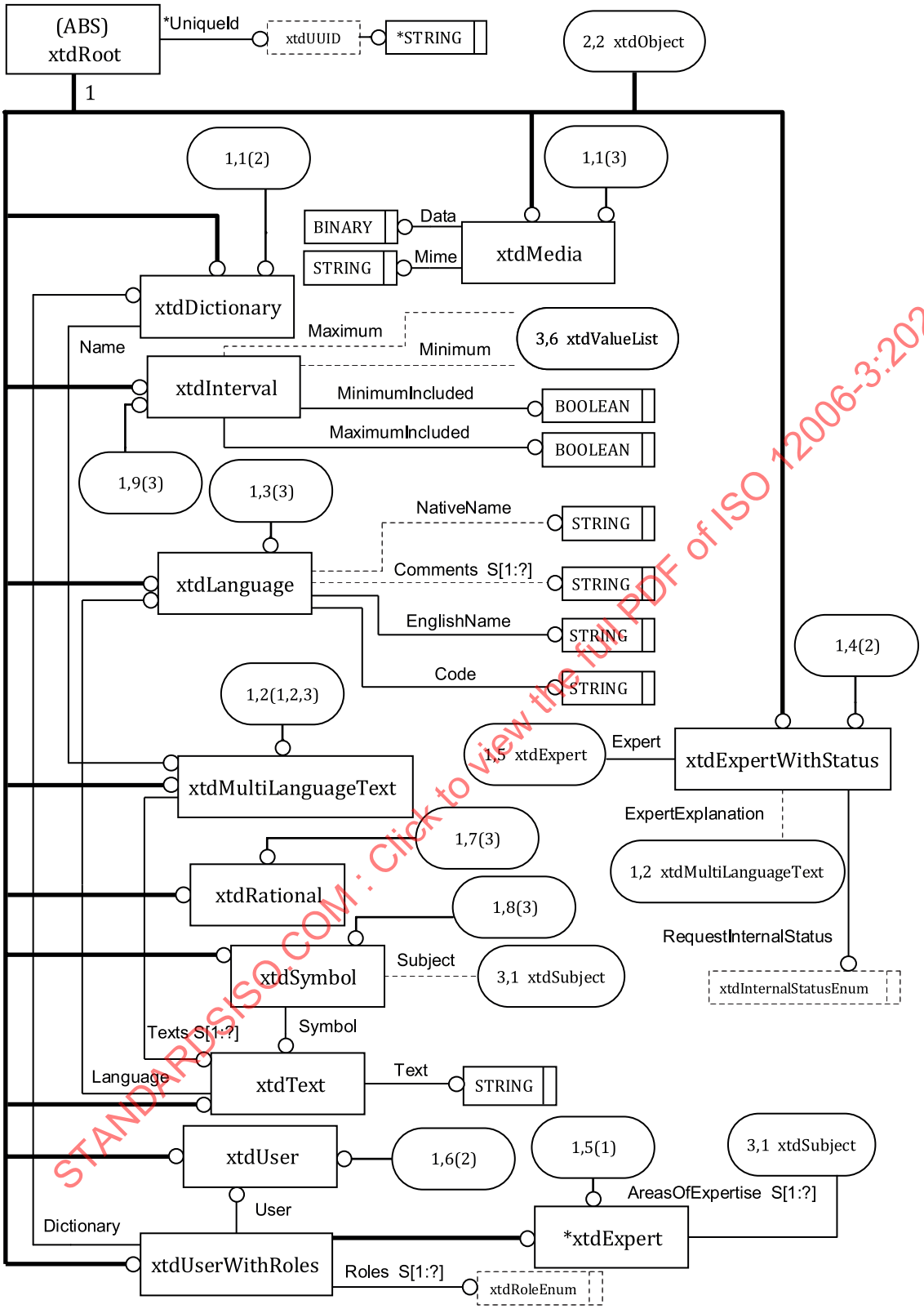

Figure 1 — EXPRESS-G diagram 1 — Top level with root concept

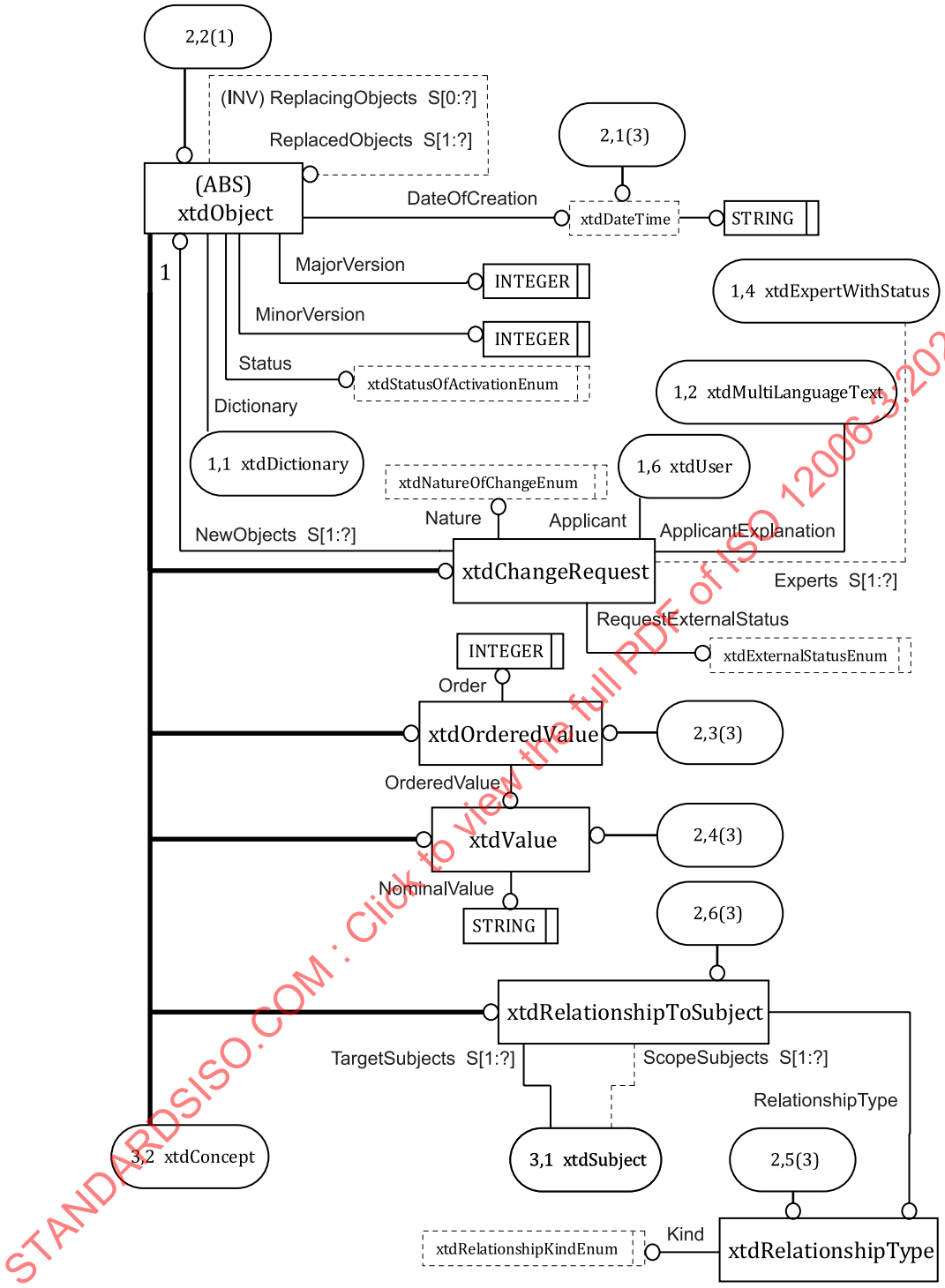

Figure 2 — EXPRESS-G diagram 2 — xtdObject representation

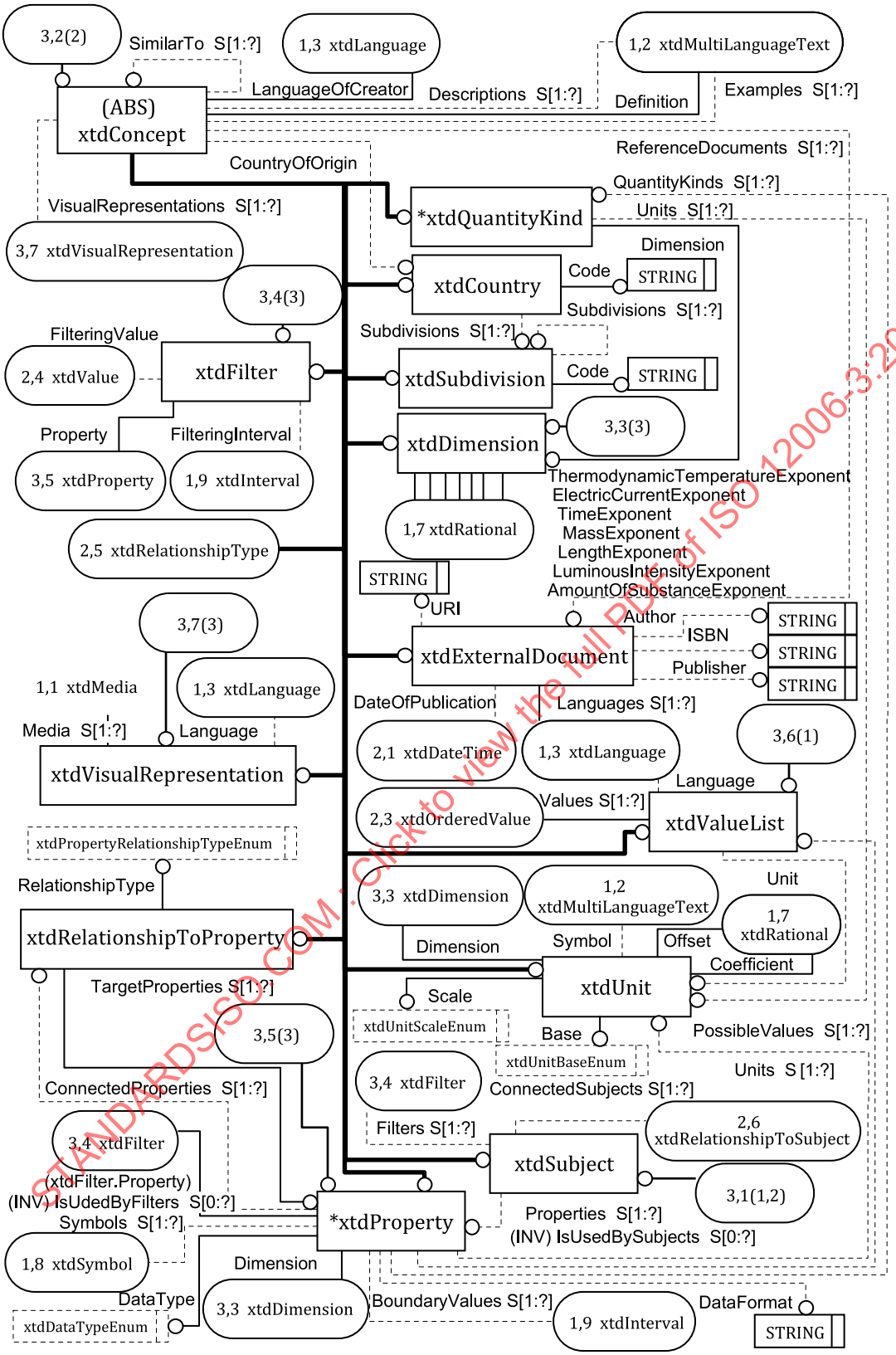

Figure 3 — EXPRESS-G diagram 3 — xtdConcept representation

5.3 EXPRESS specification

5.3.1 General

This formal specification is provided in the EXPRESS language.

The EXPRESS long form specification is provided in Annex A.

Express Specification

(*

ISO_12006_3_VERSION_4

EXPRESS specification:

```
*)
SCHEMA ISO_12006_3_VERSION_4;
(*
```

5.3.2 xtdDateTime

xtdDateTime is a defined data type of simple data type STRING that is used to identify a particular point in time. The date format (the ISO 8601 series) "YYYY-MM-DDThh:mm:ssTZD" should be used.

EXAMPLE The 31st day of May in the year 2000 is written as "2000-05-31T00:00:00Z".

EXPRESS specification:

```
*)
   Type xtdDateTime = STRING;
   END_TYPE;
(*
```

5.3.3 xtdUUID

xtdUUID is a defined data type of simple data type STRING that holds an identifier that is universally unique.

xtdUUID shall be generated according to ISO/IEC 9834-8, and it shall be provided according to the hexadecimal representation ISO/IEC 9834-8:2014, 6.5.

EXAMPLE The 36-character string 1cbeacb2-7449-4671-97d2-3b84def86927 is a universally unique identifier.

EXPRESS specification:

```
*)
   TYPE xtdUUID = STRING (36) FIXED;
   END_TYPE;
(*
```

5.3.4 xtdDataTypeEnum

xtdDataTypeEnum is an enumeration type giving the range of possible simple data types from which a selection can be made. Allowed selections are:

XTD_BOOLEAN Datatype associated with two-valued logic.

XTD_INTEGER Datatype to specify a numeric value without a fractional component.

XTD_RATIONAL Datatype to specify a number that can be expressed as the fraction of two integers.

XTD_REAL Datatype to specify a number that may be represented by a finite or infinite numeral in a fixed radix numeration system.

XTD_COMPLEX Datatype to specify a number that can be expressed in the form a+bi, where a and b are real numbers, and i is the imaginary unit.

XTD_STRING Datatype to express a sequence of characters.

XTD_DATETIME Datatype to specify a date and a time.

EXPRESS specification:

```
*)
   TYPE xtdDataTypeEnum = ENUMERATION OF
     (XTD_BOOLEAN,
      XTD_INTEGER,
      XTD_RATIONAL,
      XTD_REAL,
      XTD_COMPLEX,
      XTD_STRING,
      XTD_DATETIME);
   END_TYPE;
(*
```

5.3.5 xtdExternalStatusEnum

xtdExternalStatusEnum is an enumeration type giving the range of possible values to describe the status of a change request in its validation's process. Allowed selections are:

XTD_PENDING_ASSIGNMENT The change request has been created; no expert has been yet assigned to it.

XTD_UNDERGOING_ANALYSIS The experts assigned to the change request are analysing it.

XTD_PENDING_INFORMATION_REQUEST One or several experts assigned to the change request have requested more information to be able to give an answer.

XTD_VALIDATED The change request has been validated.

XTD_REJECTED The change request has been rejected.

EXPRESS specification:

```
*)
   TYPE xtdExternalStatusEnum = ENUMERATION OF
     (XTD_PENDING_ASSIGNEMENT,
      XTD_UNDERGOING_ANALYSIS,
      XTD_PENDING_INFORMATION_REQUEST,
      XTD_VALIDATED,
      XTD_REJECTED);
   END_TYPE;
(*
```

NOTE "XTD_PENDING_INFORMATION_REQUEST" corresponds to "Complementary information request" in ISO 23386:2020, RA005.

5.3.6 xtdInternalStatusEnum

xtdInternalStatusEnum is an enumeration type giving the range of possible values to describe the status of a change request for an expert assigned to it. Allowed selections are:

XTD_UNDERGOING_ANALYSIS The expert is currently analysing the change request.

XTD_PENDING_INFORMATION_REQUEST	The expert has requested more information before giving its decision on the change request.
XTD_NOT_COMPETENT	The expert has declared itself not competent to analyse the change request.
XTD_VALIDATED	The expert has validated the change request.
XTD_REJECTED	The expert has rejected the change request.

EXPRESS specification:

```
*)
TYPE xtdInternalStatusEnum = ENUMERATION OF
    (XTD_UNDERGOING_ANALYSIS,
     XTD_PENDING_INFORMATION_REQUEST,
     XTD_NOT_COMPETENT,
     XTD_VALIDATED,
     XTD_REJECTED);
END_TYPE;
(*
```

5.3.7 xtdNatureOfChangeEnum

xtdNatureOfChangeEnum is an enumeration type giving the range of possible values to describe the nature of a change request. Allowed selections are:

XTD_SIMPLE_CREATION	The creation of a new concept is requested.
XTD_SIMPLE_MODIFICATION	The modification of a concept is required.
XTD_SIMPLE_DEACTIVATION	The deactivation of a concept is required.
XTD_REPLACEMENT	The replacement of a concept by another one is requested.
XTYD_FRAGMENTATION	The replacement of a concept by several others is requested.
XTD_MERGING	The replacement of several concepts by one concept is requested.

EXPRESS specification:

```
*)
   TYPE xtdNatureOfChangeEnum = ENUMERATION OF
     (XTD_SIMPLE_CREATION,
      XTD_SIMPLE_MODIFICATION,
      XTD_SIMPLE_DEACTIVATION,
      XTD_REPLACEMENT,
      XTD_FRAGMENTATION,
      XTD_MERGING);
   END_TYPE;
(*
```

5.3.8 xtdPropertyRelationshipTypeEnum

xtdPropertyRelationshipTypeEnum is an enumeration type giving the range of possible relationships between two properties. Allowed selections are:

XTD_DEPENDS	A property is dependent on others.
XTD_SPECIALIZES	A property is the specialization of another property.

EXPRESS specification:

```
*)
   TYPE xtdPropertyRelationshipTypeEnum = ENUMERATION OF
     (XTD_DEPENDS,
```

```
      XTD_SPECIALIZES);
   END_TYPE;
(*
```

5.3.9 xtdRelationshipKindEnum

Some kinds of relationships are only used for organizing the subjects. The bestknown example is the classification hierarchy where generic classes (represented as subjects) are specialized in several more specific classes/subjects. All real-world objects belong to the specific subjects; the generic subjects are not instantiated. Thus, neither the generic subject nor the (parent) relationship between the specific subjects and the generic subject are ever instantiated (see example in F.3). Rather, this kind of relationship is only used at the schema level to organize elements of the data dictionary but not used as a relationship between instances of the data dictionary.

On the other hand, there are relationships between subjects which may be instantiated. An example is the part-of relationship between a composite product and its constituents (see example in F.3).

xtdRelationshipKindEnum is an enumeration type that specifies whether the relationship is instantiatiable or whether it is only visible at the data dictionary level. The two possible values are SchemaLevel and InstanceLevel.

XTD_INSTANCE_LEVEL The relationship can be instantiated.

XTD_SCHEMA_LEVEL The relationship cannot be instantiated and is used at the data dictionary level.

EXPRESS specification:

```
*)
TYPE xtdRelationshipKindEnum = ENUMERATION OF
    (XTD_INSTANCE_LEVEL,
     XTD_SCHEMA_LEVEL);
END_TYPE;
(*
```

5.3.10 xtdRoleEnum

xtdRoleEnum is an enumeration type giving the range of possible roles that can be attached to a user in a data dictionary. Allowed selections are:

XTD_READER The user can only read the concepts present in the data dictionary.

XTD_CONTRIBUTOR The user can propose new content in the data dictionary.

XTD_EXPERT The user can validate change requests proposed by contributors.

XTD_ADMINISTRATOR The user can administrate the data dictionary and the users.

EXPRESS specification:

```
*)
   TYPE xtdRoleEnum = ENUMERATION OF
     (XTD_READER,
      XTD_CONTRIBUTOR,
      XTD_EXPERT,
      XTD_ADMINISTRATOR);
   END_TYPE;
(*
```

NOTE “XTD_CONTRIBUTOR” corresponds to “applicant” in ISO 23386:2020, 3.2.

5.3.11 xtdStatusOfActivationEnum

xtdStatusOfActivationEnum is an enumeration type giving the range of possible status for a concept into a data dictionary. Allowed selections are:

XTD_ACTIVE The corresponding concept is active in the data dictionary.

XTD_INACTIVE The corresponding concept is inactive in the data dictionary.

EXPRESS specification:

```
*)
   TYPE xtdStatusOfActivationEnum = ENUMERATION OF
     (XTD_ACTIVE,
      XTD_INACTIVE);
   END_TYPE;
(*
```

5.3.12 xtdUnitBaseEnum

xtdUnitBaseEnum is an enumeration type giving the list of possible conversion bases, either linear or logarithmic. This list allows to use irrational values as bases.

See xtdUnit formula and explanations in 5.3.40.

EXPRESS specification:

```
*)
   TYPE xtdUnitBaseEnum = ENUMERATION OF
     (XTD_ONE,
      XTD_TWO,
      XTD_E,
      XTD_PI,
      XTD_TEN);
   END_TYPE;
(*
```

5.3.13 xtdUnitScaleEnum

xtdUnitScaleEnum is an enumeration type which specifies whether a unit is of linear or logarithmic scale.

See Formula (1) and (2) and explanations in 5.3.40.

EXPRESS specification:

```
*)
   TYPE xtdUnitScaleEnum = ENUMERATION OF
     (XTD_LINEAR,
      XTD_LOGARITHMIC);
   END_TYPE;
(*
```

5.3.14 xtdChangeRequest

xtdChangeRequest is a specialization of xtdObject used to provide a change request on any xtdConcept in a data dictionary. A request corresponds to the creation, modification or deactivation of a concept.

For examples of requests of adding a property to a subject, see Annex F.

EXPRESS specification:

```
*)
   ENTITY xtdChangeRequest
     SUBTYPE OF(xtdObject);
       Applicant             : xtdUser;
       NewObjects            : SET[1:?] OF xtdObject;
       Nature                : xtdNatureOfChangeEnum;
       RequestExternalStatus : xtdExternalStatusEnum;
       Experts               : OPTIONAL SET [1:?] OF xtdExpertWithStatus;
       ApplicantExplanation  : xtdMultiLanguageText;
   END_ENTITY;
(*
```

Attribute definitions:

Applicant	User sending the change request.
NewObjects	List of the new objects attached to the change request.
Nature	Nature of the change request. See 5.3.7.
RequestExternalStatus	Status of the request. See 5.3.5.
Experts	List of the experts assigned to the change request.
ApplicantExplanation	Explicative text of the change request in several languages.

5.3.15 xtdConcept

xtdConcept is a specialization of xtdObject and is the abstract entity from which xtdCountry, xtdDimension, xtdExternalDocument, xtdProperty, xtdRelationshipType, xtdRelationshipToProperty, xtdSubdivision, xtdSubject, xtdUnit, xtdValueList, xtdVisualRepresentation xtdFilter and xtdQuantityKind are derived.

xtdConcept is used to store the common attributes of its derived entities. For example, it is the level where the definitions and reference documents are described.

EXPRESS specification:

```
*)
   ENTITY xtdConcept
      ABSTRACT SUPERTYPE OF (ONEOF(
        xtdCountry,
        xtdDimension,
        xtdExternalDocument,
        xtdFilter,
        xtdProperty,
        xtdQuantityKind,
        xtdRelationshipToProperty,
        xtdRelationshipType,
        xtdSubdivision,
        xtdSubject,
        xtdUnit,
        xtdValueList,
        xtdVisualRepresentation))
      SUBTYPE OF (xtdObject);
        ReferenceDocuments     : OPTIONAL SET [1:?] OF xtdExternalDocument;
        Definition             : xtdMultiLanguageText;
        Descriptions           : OPTIONAL SET[1:?] of xtdMultiLanguageText;
        Examples               : OPTIONAL SET[1:?] of xtdMultiLanguageText;
        LanguageOfCreator      : xtdLanguage;
        CountryOfOrigin        : OPTIONAL xtdCountry;
        SimilarTo              : OPTIONAL SET [1:?] OF xtdConcept;
        VisualRepresentations  : OPTIONAL SET [1:?] OF xtdVisualRepresentation;
   END_ENTITY;
(*
```

Attribute definitions:

Definition	A list of instances of xtdMultiLanguageText that holds the definition of the concept in several languages.
Descriptions	A list of instances of xtdMultiLanguageText that holds descriptions of the concept in several languages.
Examples	A list of instances of xtdMultiLanguageText that holds examples of the concept in several languages.

LanguageOfCreator	Language of the creator of the concept.
CountryOfOrigin	Country from where the requirement for this concept originated.
SimilarTo	Used to link similar concepts.
ReferenceDocuments	List of attached reference documents.
VisualRepresentations	Visual representation of the concept through sketches, photos, videos or other multimedia objects.

5.3.16 xtdCountry

xtdCountry is a specialization of xtdConcept used to describe a country by its code according to ISO 3166-1 and its list of subdivisions.

EXPRESS specification:

```
*)
   ENTITY xtdCountry
      SUBTYPE OF (xtdConcept);
        Code         : STRING;
        Subdivisions : OPTIONAL SET [1:?] OF xtdSubdivision;
   END_ENTITY;
*)
```

Attribute definitions:

Code	Alpha-2 code used for the representation of name of countries from ISO 3166-1. EXAMPLE 1 For Belgium Code = BE EXAMPLE 2 For France Code = FR
Subdivisions	List of subdivisions of a country according to ISO 3166-2.

5.3.17 xtdDictionary

xtdDictionary is a specialization of xtdRoot used to represent a data dictionary.

EXPRESS specification:

```
*)
   ENTITY xtdDictionary
      SUBTYPE OF (xtdRoot);
        Name : xtdMultiLanguageText;
   END_ENTITY;
(*
```

Attribute definitions:

Name	Language-dependant name of the data dictionary.

5.3.18 xtdDimension

Dimension shall be defined according to the ISO 80000 series, defined from the 7 base quantities.

Any dimension is defined in a complete and unique way by its decomposition in basic physical quantities in the form of a septuplet of rational numbers.

To allow distinction between “dimension one” and dimensionless, the definitions to be used are:

— Dimension one: all values = 0.

— Dimensionless: At least one of the rationals shall be undefined (denominator=0).

EXAMPLE 1 Acceleration is a dimension defined by LT^{-2}.

EXAMPLE 2 Force is a dimension defined by LMT^{-2}.

EXPRESS specification:

```
*)
   ENTITY xtdDimension
      SUBTYPE OF (xtdConcept);
        LengthExponent                   : xtdRational;
        MassExponent                     : xtdRational;
        TimeExponent                     : xtdRational;
        ElectricCurrentExponent          : xtdRational;
        ThermodynamicTemperatureExponent : xtdRational;
        AmountOfSubstanceExponent        : xtdRational;
        LuminousIntensityExponent        : xtdRational;
END_ENTITY;
*)
```

5.3.19 xtdExpert

xtdExpert is a specialization of xtdUserWithRoles that represents an agent that can validate an xtdChangeRequest in a data dictionary. An expert shall have the role “expert” in list of roles.

EXPRESS specification:

```
*)
   ENTITY xtdExpert
      SUBTYPE OF (xtdUserWithRoles);
        AreasOfExpertise : SET [1:?] OF xtdSubject;
      WHERE
        WR1: xtdRoleEnum.XTD_EXPERT IN Roles;
   END_ENTITY;
*)
```

Attribute definitions:

AreasOfExpertise List of xtdSubject for which the expert can validate a change request.

Condition definitions:

WR1

To be valid, an expert is an xtdUserWithRoles where its attribute Roles contains the value “XTD_EXPERT”.

5.3.20 xtdExpertWithStatus

xtdExpertStatus is a specialization of xtdRoot used to follow the expertise from a specific expert on a change request.

EXPRESS specification:

```
*)
   ENTITY xtdExpertWithStatus
      SUBTYPE OF (xtdRoot);
        Expert                : xtdExpert;
        RequestInternalStatus : xtdInternalStatusEnum;
        ExpertExplanation     : OPTIONAL xtdMultiLanguageText;
   END_ENTITY;
*)
```

Attribute definitions:

Expert	Expert.
RequestInternalStatus	Progress of a request review by the expert. See 5.3.6.
ExpertExplanation	Explanation of the expert decision on the request, in several languages.

5.3.21 xtdExternalDocument

xtdExternalDocument is a specialization of xtdConcept used to represent external documents, books or other written information. The title of the document shall be provided by the attribute “Names” inherited from xtdObejct.

NOTE ISO 23386, 5.3 describes how to name documents.

EXAMPLE 1 “ISO 31” is a series of documents.

EXAMPLE 2 “NS 3420” is a document.

EXPRESS specification:

```
*)
   ENTITY xtdExternalDocument
      SUBTYPE OF(xtdConcept);
        DateOfPublication : OPTIONAL xtdDateTime;
        Author            : OPTIONAL STRING;
        ISBN              : OPTIONAL STRING;
        Languages         : SET [1:?] OF xtdLanguage;
        Publisher         : OPTIONAL String;
        URI               : OPTIONAL STRING;
   END_ENTITY;
(*
```

Attribute definitions:

DateOfPublication	The publication date of the external document.
Author	Information about the author of the document.
ISBN	The International Standard Book Number is a numeric commercial book identifier which is intended to be unique.
Languages	Set of languages of the external document.
Publisher	Information about who published the external document.
URI	Link to the external document.

5.3.22 xtdFilter

xtdFilter is a specialization of xtdConcept used for a data dictionary user to be able to automatically classify model objects by using fixed values or fixed intervals.

An example is provided in F.4.

EXPRESS specification:

```
*)
   ENTITY xtdFilter
      SUBTYPE OF (xtdConcept);
        Property          : xtdProperty;
        FilteringValue    : OPTIONAL xtdValue;
        FilteringInterval : OPTIONAL xtdInterval;
   END_ENTITY;
```

```
*)
```

Attribute definitions:

Property	Property on which the filter will be applied for a specific value or interval.
FilteringValue	Value used to set the filter on the property.
FilteringInterval	Interval used to set the filter on the property.

5.3.23 xtdInterval

xtdInterval is a specialization of xtdRoot used to define the range in which a value can be provided for a property.

EXPRESS specification:

```
*)
   ENTITY xtdInterval
      SUBTYPE OF (xtdRoot);
        Minimum         : OPTIONAL xtdValueList;
        MinimumIncluded : BOOLEAN;
        Maximum         : OPTIONAL xtdValueList;
        MaximumIncluded : BOOLEAN;
   END_ENTITY;
(*
```

Attribute definitions:

Minimum	Lower value in the interval.
MinimumIncluded	Defines if the interval is opened or closed for the minimum value.
Maximum	Higher value in the interval.
MaximumIncluded	Defines if the interval is opened or closed for the maximum value.

5.3.24 xtdLanguage

xtdLanguage represents the language in which names, descriptions, values and references are expressed including its designation in itself and in English as well as the language code.

EXPRESS specification:

```
*)
   ENTITY xtdLanguage
      SUBTYPE OF (xtdRoot);
        EnglishName : STRING;
        NativeName  : OPTIONAL STRING;
        Comments    : OPTIONAL SET [1:?] OF STRING;
        Code        : STRING;
   END_ENTITY;
(*
```

Attribute definitions:

EnglishName	Name of the language in which the identifying descriptive attribute is expressed in the form in which the language is known in English.
NativeName	Name of the language in which the identifying descriptive attribute is expressed in the form in which the language is known.
Comments	Optional list of comments for the language used.

Code The language shall consist of a code as defined by BCP 47 from IETF.

The English name shall be provided according to the ISO 639 series.

EXAMPLE 1 Code = “en”, English Name = “English”

EXAMPLE 2 Code = “de”, English Name = “German”

EXAMPLE 3 Native name “Deutsch” is the name by which the German language is known to German language speakers.

EXAMPLE 4 Native name “Norsk nynorsk” is the name of a particular form of the Norwegian language.

EXAMPLE 5 “British English” is the name of the form of the English language which is characterized by the spelling and intonation used within the British Isles and certain other parts of the world.F

EXAMPLE 6 Code no-NO for Norwegian.

EXAMPLE 7 Code fr-FR for French.

EXAMPLE 8 Code en-US for English (United States).

EXAMPLE 9 Code en-GB for English (United Kingdom).

5.3.25 xtdMedia

xtdMedia is used to represent a concept through sketches, photos, videos or other multimedia objects.

EXPRESS specification:

```
*)
   ENTITY xtdMedia
      SUBTYPE OF (xtdRoot);
        Mime : STRING;
        Data : BINARY;
   END_ENTITY;
(*
```

Attribute definitions:

Mime (Multipurpose Inter-net Mail Extensions) Internet standard that supports text in character sets other than ASCII, as well as attachments of audio, video, images, and application programs.

Data Digital representation of the media

NOTE See IETF RFC 2046.

5.3.26 xtdMultiLanguageText

xtdMultiLanguageText is the entity holding a list of xtdText in several languages.

EXPRESS specification:

```
*)
   ENTITY xtdMultiLanguageText
      SUBTYPE OF (xtdRoot);
        Texts : SET[1:?] OF xtdText;
   END_ENTITY;
(*
```

Attribute definitions:

Texts List of texts in several languages.

5.3.27 xtdObject

xtdObject is a specialization of xtdRoot that is the abstract entity from which xtdChangeRequest, xtdConcept, XtdOrderedValue, xtdRelationshipToSubject and xtdValue are derived.

xtdObject is used to store the common attributes of its derived entities, needed to handle the names, versioning, history, status and data dictionary it belongs to.

NOTE See Annex E for naming conventions.

EXPRESS specification:

```
*)
   ENTITY xtdObject
      ABSTRACT SUPERTYPE OF (ONEOF(
        xtdChangeRequest,
        xtdConcept,
        xtdOrderedValue,
        xtdRelationshipToSubject,
        xtdValue))
      SUBTYPE OF (xtdRoot);
        Dictionary             : xtdDictionary;
        Names                  : SET [1:?] OF xtdMultiLanguageText;
        Status                 : xtdStatusOfActivationEnum;
        MajorVersion           : INTEGER;
        MinorVersion           : INTEGER;
        DateOfCreation         : xtdDateTime;
        ReplacedObjects        : OPTIONAL SET [1:?] OF xtdObject;
        DeprecationExplanation : OPTIONAL xtdMultiLanguageText;
      INVERSE
        ReplacingObjects : SET [0:?] OF xtdObject FOR ReplacedObjects;
   END_ENTITY;
(*
```

Attribute definitions:

Dictionary	Data dictionary to which the object belongs to.
Names	Set of names of the object in different languages. Each object may have multiple names, and this allows for its expression in terms of synonyms. At least a name shall be provided in international English and in the original language of its creator.
DateOfCreation	Date of creation of the concept.
MajorVersion	Allows tracking of major changes. Experts decide if a new major version number shall be applied.
MinorVersion	Allows tracking of minor changes, e.g. new translation, changes of typos: if the major version number changes, the minor version starts again at 1. Experts decide if a new minor version number can be applied or if a new major version is needed.
ReplacedObjects	List of objects replaced by the current object.
DeprecationExplanation	Sentence explaining the reason of the deprecation, which can explain how to convert values to conform to the new object.
Status	Status of the object during its life cycle. See 5.3.11.

NOTE MajorVersion corresponds to “Version number” in ISO 23386:2020, PA009.

NOTE MinorVersion corresponds to “Revision number” in ISO 23386:2020, PA010.

5.3.28 xtdOrderedValue

xtdOrderedValue is a specialization of xtdObject used to connect a value with its order in a list of predefined values.

EXPRESS specification:

```
*)
   ENTITY xtdOrderedValue
      SUBTYPE OF(xtdObject);
        OrderedValue : xtdValue;
        Order        : Integer;
   END_ENTITY;
(*
```

Attribute definition:

OrderedValue

Link to a value.

Order

Order of the value in its corresponding list of values.

5.3.29 xtdProperty

xtdProperty is a specialization of xtdConcept.

Definition of the meaning of a value that can be attached to a subject that is used to qualify or quantify an xtdObject.

EXAMPLE 1 “Width” is an xtdProperty.

EXAMPLE 2 “Door width” is an xtdProperty used to qualify the “width” of the xtdSubject “door”.

EXAMPLE 3 “Heat transfer” is an xtdProperty.

EXAMPLE 4 “Colour” is an xtdProperty.

EXAMPLE 5 “Duration” is an xtdProperty.

EXAMPLE 6 “Comfort” is an xtdProperty.

EXPRESS specification:

```
*)
   ENTITY xtdProperty
      SUBTYPE OF (xtdConcept);
        Dimension           : xtdDimension;
        DataType            : xtdDataTypeEnum;
        DataFormat          : OPTIONAL STRING;
        Symbols             : OPTIONAL SET [1:?] OF xtdSymbol;
        PossibleValues      : OPTIONAL SET [1:?] OF xtdValueList;
        BoundaryValues      : OPTIONAL SET [1:?] OF xtdInterval;
        Units               : OPTIONAL SET [1:?] OF xtdUnit;
        ConnectedProperties : OPTIONAL SET [1:?] OF xtdRelationshipToProperty;
        QuantityKinds       : OPTIONAL SET [1:?] OF xtdQuantityKind;
      INVERSE
        IsUsedBySubjects : SET [0:?] OF xtdSubject FOR Properties;
        IsUdedByFilters  : SET [0:?] OF xtdFilter FOR Property;
      WHERE
        WR1: ((NOT(EXISTS(QuantityKinds)))) OR ((EXISTS(QuantityKinds)) AND
(SIZEOF(QUERY(temp <* QuantityKinds | temp.Dimension <> Dimension)) = 0));
   END_ENTITY;
(*
```

Attribute definitions:

Dimension	Dimension of the property according to the ISO 80000 series.
DataType	Data type of the value of the property. See 5.3.4.
DataFormat	Pattern for the property values, the meaning of the pattern is implementation dependant.
Symbols	Symbols of the property.
PossibleValues	List of the possible values that can be provided for the property. Several sets of possible values can be provided to allow providing them in different languages.
BoundaryValues	Intervals of possible values for the property.
Units	List of units that can be attached to a value.
ConnectedProperties	List of properties connected to the current property. The connection can be a specialization or a dependency.
QuantityKinds	List of the corresponding quantity kinds. All the quantity kinds shall have the same dimension as the property.

Condition definitions:

WR1

To be valid, a property shall:

— not include quantity kinds

or

— include only quantity kinds with a dimension that is the same as the dimension of the property.

5.3.30 xtdQuantityKind

xtdQuantityKind shall be used to distinguish different kinds of quantities that have the same dimension. In this case, units of the common dimension are often specifically related to one kind of quantities and may not be used in other kinds of quantities. Therefore, a xtdQuantityKind references the xtdDimension and collects all the xtdUnits of that dimension that are related to the kind of quantity.
EXPRESS specification:

```
*)
   ENTITY xtdQuantityKind
      SUBTYPE OF (xtdConcept);
        Dimension : xtdDimension;
        Units     : OPTIONAL SET [1:?] OF xtdUnit;
      WHERE
        WR1: (NOT(EXISTS(Units))) OR ((EXISTS(Units)) AND (SIZEOF(QUERY(temp <* Units |
temp.Dimension <> Dimension))= 0));
   END_ENTITY;
*)
```

Attribute definitions:

Dimension	Dimension of the quantity kind.
Units	List of units used for the quantity kind. Each unit shall have the same dimension as the quantity kind.

Condition definitions:

WR1

To be valid, a quantity kind shall:

— not include units

or

— include only units whith a dimension that is the same as the dimension of the quantity kind.

5.3.31 xtdRational

xtdRational is used to describe a rational number.

EXPRESS specification:

```
*)
   ENTITY xtdRational
      SUBTYPE OF (xtdRoot);
        Numerator   : INTEGER;
        Denominator : INTEGER;
   END_ENTITY;
*)
```

5.3.32 xtdRelationshipToProperty

xtdRelationshipToProperty is a specialization of xtdConcept used to connect two properties; the connection can be a dependency or a specialization. Specialization means that the related property is specialized by the current property. Dependency means that the current property's value may change if the value of one of the related properties is changed. The dependency shall be implemented on the instance level either by means of a table or by means of a function.

EXPRESS specification:

```
*)
   ENTITY xtdRelationshipToProperty
      SUBTYPE OF (xtdConcept);
        TargetProperties : SET[1:?] OF xtdProperty;
        RelationshipType : xtdPropertyRelationshipTypeEnum;
   END_ENTITY;
(*
```

Attribute definitions:

TargetProperties List of properties to which the current property is connected.

RelationshipType Definition of the type of relationships between two properties. See 5.3.8.

5.3.33 xtdRelationshipToSubject

xtdRelationshipToSubject is a specialization of xtdObject used to connect a subject to other subjects with a qualified relationship. The connection can be done within a specific context.

EXPRESS specification:

```
*)
   ENTITY xtdRelationshipToSubject
      SUBTYPE OF (xtdObject);
        RelationshipType : xtdRelationshipType;
        TargetSubjects   : SET [1:?] OF xtdSubject;
        ScopeSubjects    : OPTIONAL SET [1:?] OF xtdSubject;
   END_ENTITY;
(*
```

Attribute definitions:

RelationshipType	A relationship defined in the data dictionary used to connect the subject for a specific purpose.
TargetSubjects	List of subjects connected with the relationship type.
ScopeSubject	Subject corresponding to the context in which the relationship is defined, scope of the relationship.

EXAMPLE A radiator (Subject) can be linked to a controller (TargetSubject) in the context of a heating system (ScopeSubject) by a 'is driven by' (RelationshipType) relationship.

5.3.34 xtdRelationshipType

xtdRelationshipType is a specialization of xtdConcept used to specify the semantics of relationships. In the same way as xtdSubject is used to specify the semantics of objects, the xtdRelationship gives the relationship a name, a definition, description, explains it further by an example, etc. By the Kind of attribute, it specifies whether the relationship is instantiable or just important at the data dictionary level.

The relationshipType can be referenced from any concrete relationship between subjects or properties. It is referenced from the entities xtdRelationshipToSubject and xtdRelationshipToProperty by means of the attribute RelationshipType.

EXPRESS specification:

```
*)
   ENTITY xtdRelationshipType
      SUBTYPE OF(xtdConcept);
        Kind : xtdRelationshipKindEnum;
   END_ENTITY;
(*
```

Attribute definitions:

Kind	Indicates whether the relationship can be instantiated or is only applicable at the data dictionary level. See 5.3.9.

5.3.35 xtdRoot

xtdRoot is the abstract entity through which all entities get their unique identifier.

EXPRESS specification:

```
*)
   ENTITY xtdRoot
      ABSTRACT SUPERTYPE OF (ONEOF(
        xtdDictionary,
        xtdExpertWithStatus,
        xtdInterval,
        xtdLanguage,
        xtdMedia,
        xtdMultilanguageText,
        xtdObject,
        xtdRational,
        xtdSymbol,
        xtdText,
        xtdUser,
        xtdUserWithRoles));
        UniqueId : xtdUUID;
      UNIQUE
        UR1 : UniqueId;
   END_ENTITY;
(*
```

Attribute definitions:

UniqueId	Universally unique identifier.

5.3.36 xtdSubdivision

xtdSubdivision is a specialization of xtdConcept used to describe the subdivision of a country by its code according to ISO 3166-2.

EXPRESS specification:

```
*)
   ENTITY xtdSubdivision
      SUBTYPE OF (xtdConcept);
        Subdivisions : OPTIONAL SET [1:?] OF xtdSubdivision;
        Code         : STRING;
   END_ENTITY;
*)
```

Attribute definitions:

Subdivisions	List of subdivisions according to ISO 3166-2.
Code	Alpha code used for the representation of name of subdivisions from ISO 3166-2.

EXAMPLE BE-VAN for the province of Antwerp in Belgium.

5.3.37 xtdSubject

xtdSubject is a specialization of xtdConcept;It contains a list of properties that can be associated to filters with other subjects.

An xtdSubject can be physical or logical.

NOTE xtdSubject corresponds to a "group of properties" as defined in ISO 23386.

EXAMPLE 1 "Roof" is an xtdSubject.

EXAMPLE 2 "Lobby" is an xtdSubject.

EXAMPLE 3 "Control system" is an xtdSubject.

EXAMPLE 4 "Road" is an xtdSubject.

EXAMPLE 5 "Airport" is an xtdSubject.

EXAMPLE 6 "Software" is an xtdSubject.

EXPRESS specification:

```
*)
   ENTITY xtdSubject
      SUBTYPE OF(xtdConcept);
        Properties         : OPTIONAL SET [1:?] OF xtdProperty;
        ConnectedSubjects  : OPTIONAL SET [1:?] OF xtdRelationshipToSubject;
        Filters            : OPTIONAL SET [1:?] OF xtdFilter;
   END_ENTITY;
(*
```

Attribute definitions:

Properties	List of the properties attached to the subject.
ConnectedSubjects	List of subjects connected with a qualified relationship.

Filters	List of filters used for mapping or automatic classification purpose. See F.4.

5.3.38 xtdSymbol

xtdSymbol is used to attach a symbol to a property in the context of a specific subject.

EXPRESS specification:

```
*)
   ENTITY xtdSymbol
      SUBTYPE OF (xtdRoot);
        Symbol  : xtdText;
        Subject : OPTIONAL xtdSubject;
   END_ENTITY;
*)
```

Attribute definitions:

Symbol	Unicode symbol of the property
Subject	Subject used to attach a specific “context” for using the symbol of a property.

5.3.39 xtdText

xtdText is a text represented in a specific language.

EXPRESS specification:

```
*)
   ENTITY xtdText
      SUBTYPE OF (xtdRoot);
        Text     : STRING;
        Language : xtdLanguage;
   END_ENTITY;
(*
```

Attribute definitions:

Text	Text value expressed in the corresponding language.
Language	Language used for the text.

5.3.40 xtdUnit

xtdUnit allows the representation of units.

For examples of xtdUnit, see F.2.

xtdUnit describes the conversion formula that can be used to compute the value M corresponding to a quantity in the unit from a value corresponding to the value M_0 of the same quantity decomposed in base units of SI. See ISO 80000-1:2009, 3.12.

The decomposition in base units shall be similar to the decomposition of the corresponding base dimension. This allows checking that a unit is valid to qualify the values of a property.

Formula (1) and (2) shall be used:

Scale: logarithmic →

$$M = C * log_B(M_0) + D \quad (1)$$

Where

C is the `Coefficient` attribute of xtdUnit

B is the `Base` attribute of xtdUnit

D is the `Offset` attribute of xtdUnit

Scale: linear →

$$M = C * \frac{M_0}{B} + D \quad (2)$$

Where

C is the `Coefficient` attribute of xtdUnit

B is the `Base` attribute of xtdUnit

D is the `Offset` attribute of xtdUnit

EXPRESS specification:

```
*)
   ENTITY xtdUnit
      SUBTYPE OF (xtdConcept);
        Dimension   : xtdDimension;
        Symbol      : OPTIONAL xtdMultiLanguageText;
        Coefficient : xtdRational;
        Scale       : xtdUnitScaleEnum;
        Base        : xtdUnitBaseEnum;
        Offset      : xtdRational;
   END_ENTITY;
(*
```

Attribute definitions:

Dimension	Dimension of the unit.
Symbol	Optional symbol denominating the unit.
Coefficient	Proportionality factor. See ISO 80000-1:2009, 3.12.
Scale	Specifies whether the scale of a unit is linear or logarithmic. See 5.3.13.
Base	Allows to introduce irrational numbers. See 5.3.12.
Offset	Offset of origins.

5.3.41 xtdUser

xtdUser represents any agent interacting with dictionaries.

EXPRESS specification:

```
*)
   ENTITY xtdUser
      SUBTYPE OF (xtdRoot);
   END_ENTITY;
(*
```

5.3.42 xtdUserWithRoles

xtdUserWithRoles represents any agent interacting with a given data dictionary and with specific roles.

EXPRESS specification:

```
*)
   ENTITY xtdUserWithRoles
      SUPERTYPE OF (xtdExpert)
      SUBTYPE OF (xtdRoot);
        Dictionary : xtdDictionary;
        User       : xtdUser;
        Roles      : SET [1:?] OF xtdRoleEnum;
   END_ENTITY;
(*
```

Attribute definitions:

Dictionary	Data dictionary to which the user with a role belongs.
User	Any agent interacting with dictionaries.
Roles	List of roles the user can have in the given data dictionary. See 5.3.10.

5.3.43 xtdValue

xtdValue is a specialization of xtdObject that can hold the description of a value of an xtdProperty.

EXAMPLE 1 “Blue” is a value for “colour”.

EXAMPLE 2 “-1” to represent an integer value.

EXAMPLE 3 “true” to represent a Boolean value.

NOTE Values can be defined according to ISO/IEC 11404.

EXPRESS specification:

```
*)
   ENTITY xtdValue
      SUBTYPE OF (xtdObject);
        NominalValue : STRING;
   END_ENTITY;
(*
```

Attribute definitions:

NominalValue	text string holding the nominal value.

NOTE A datatype from the property can validate an entry in a data dictionary.

5.3.44 xtdValueList

List of ordered values expressed in a given unit or a given language if needed.

EXPRESS specification:

```
*)
   ENTITY xtdValueList
      SUBTYPE OF (xtdConcept);
        Unit     : OPTIONAL xtdUnit;
        Values   : SET[1:?] of xtdOrderedValue;
        Language : OPTIONAL xtdLanguage;
END_ENTITY;
*)
```

Attribute definitions:

Unit	Unit associated to the provided list of values.

Values	List of values in a given unit.
Language	Language associated to the list of values when the values are text values.

5.3.45 xtdVisualRepresentation

xtdVisualRepresentation is used to represent a concept through sketches, photos, videos, or other multimedia objects in a specific language.

EXPRESS specification:

```
*)
   ENTITY xtdVisualRepresentation
      SUBTYPE OF (xtdConcept);
        Media    : SET [1:?] OF xtdMedia;
        Language : OPTIONAL xtdLanguage;
   END_ENTITY;
(*
```

Attribute definitions:

Media	Content of the visual representation.
Language	Language of the visual representation if applicable.

6 Application programming interface (API)

Any implementation of this document shall provide an application programming interface that conforms to the open data protocol (OData): ISO/IEC 20802-1 (core) and ISO/IEC 20802-2 (JSON).

This interface shall implement at least the verb GET of this protocol with the following request options: select, filter, expand, orderby, count.

The minimum query nesting depth shall be 2 levels.

Access shall be provided for each of the classes described in Annex B, which provides the API full description.

Implementations may provide any other additional access protocols.

7 XML representations

An XSD Schema is included in Annex D.

Annex A
(normative)

EXPRESS long form specification

This formal specification is provided in the EXPRESS language.

See link:

https://standards.iso.org/iso/12006/-3/ed-2/en/12006-3_AnnexA_EXPRESS.exp

Annex B
(normative)

Application programming interface specification

See link:

https://standards.iso.org/iso/12006/-3/ed-2/en/12006-3_AnnexB_API%20OData%20metadata.xml

Annex C
(informative)

UML representation

Figures C.1 and C.2 shows an UML representation of the framework based on the EXPRESS representation of this document.

The complete UML is the combination of figures C.1 and C.2, corresponding respectively to the left and right parts, by superimposing the circled marks A to I.

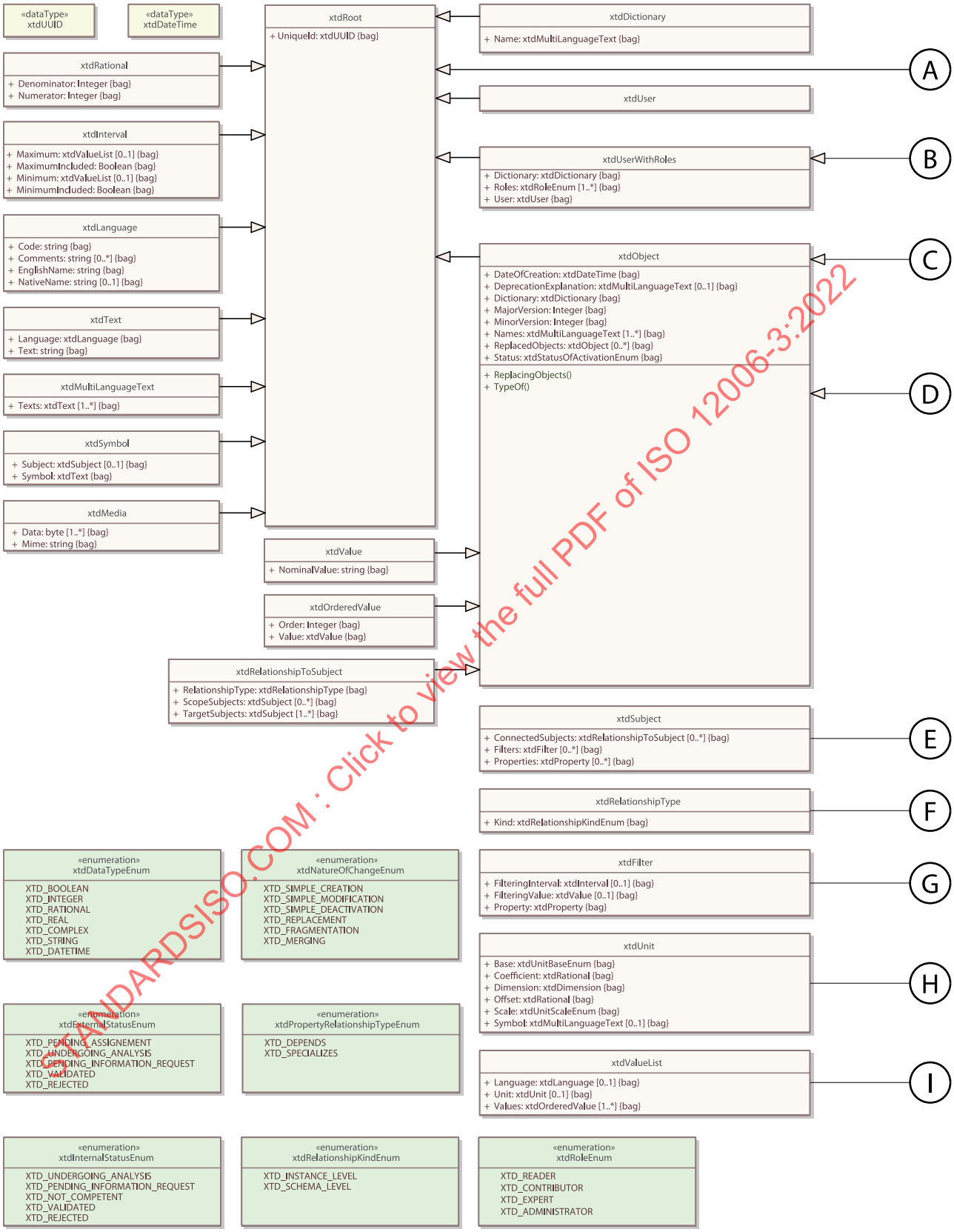

Figure C.1 — UML representation of EXPRESS – Left hand of diagram

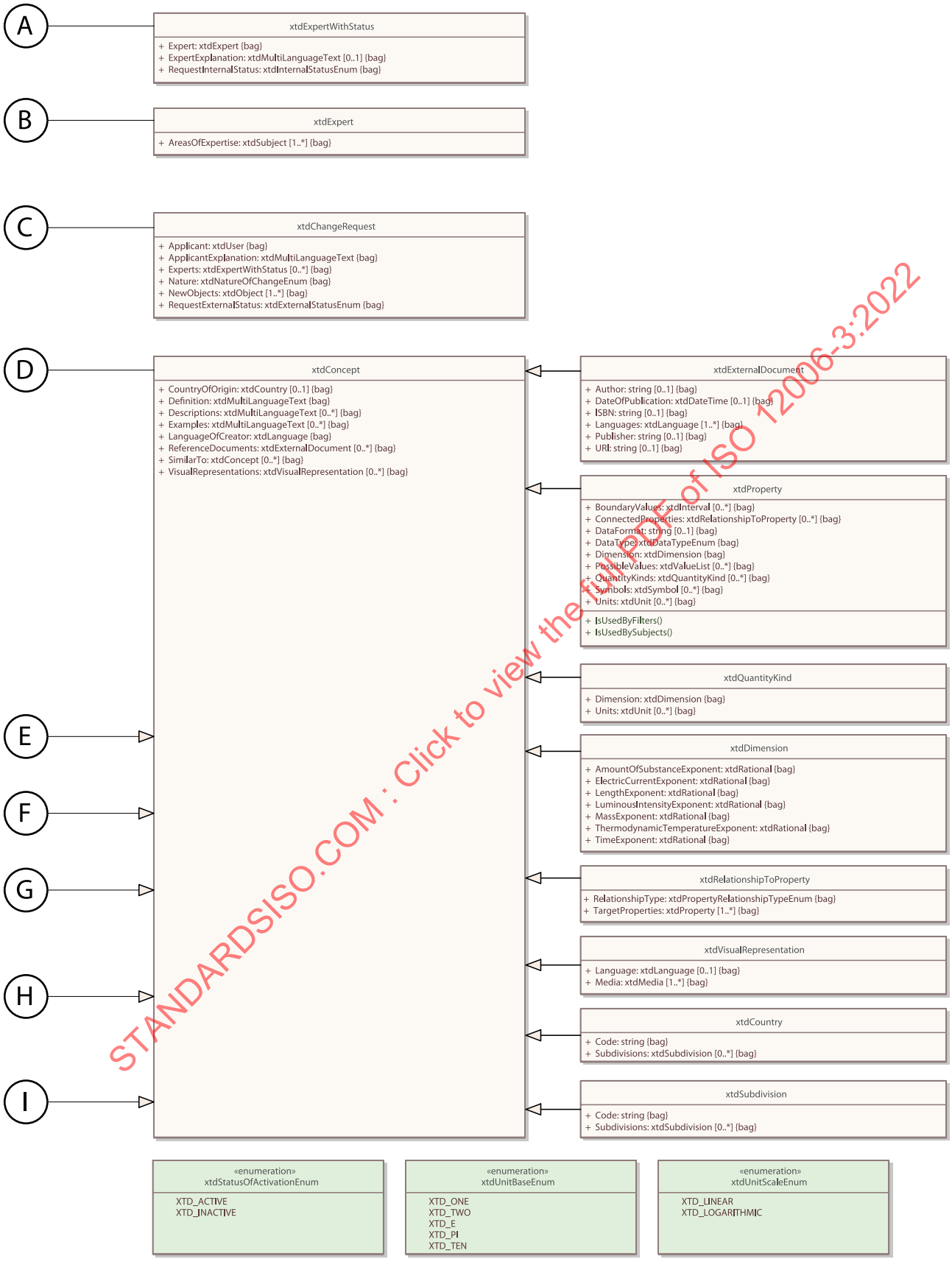

Figure C.2 — UML representation of EXPRESS – Right hand of diagram

Annex D
(informative)

XSD representation of the schema

See link:

https://standards.iso.org/iso/12006/-3/ed-2/en/12006-3_AnnexD_XSD.xsd

Annex E
(informative)

Naming conventions

E.1 General

The following naming convention has been used in the development of this document. These conventions do not apply to the population or use of the framework.

E.2 Characters used for names

The characters [A-Z] upper case, [a-z] lower case and [0-9] numeric are used for names.

E.3 Case of names

Names are written in upper- and lower-case characters as a single name without spaces.

The first character of each word in normal usage following the schema prefix is written as an upper-case character. All other characters forming part of the same word in normal usage are written in lower case characters.

E.4 Length of names

The length of names is not restricted.

E.5 xtd prefix

Names are prefixed by the term "xtd" to identify their usage within the ISO 12006-3 information model. "xtd" is an acronym for extensible taxonomy definition.

E.6 Names of entities other than relationship entities

The name of an entity is a noun or combination of nouns denoting the "content" or "type" of the entity.

E.7 Plural naming of aggregation

Names of attributes and relationships within an aggregation are expressed in the plural form.