BS ISO/IEC 11179-32:2023

BSI Standards Publication

Information technology — Metadata registries (MDR)

Part 32: Metamodel for concept system registration

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee IST/40, Data management and interchange.

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Information technology — Metadata registries (MDR) —

Part 32: Metamodel for concept system registration

Technologies de l'information — Registres de métadonnées (RM) — Partie 32: Métamodèle pour l'enregistrement de systèmes de concepts

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Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Abbreviated terms ... **4**
5 Conformance ... **5**
5.1 Overview of conformance ... 5
5.2 Degree of conformance ... 5
5.2.1 General ... 5
5.2.2 Strictly conforming implementations ... 5
5.2.3 Conforming implementations ... 6
5.3 Conformance by feature ... 6
5.4 Registry conformance ... 6
5.4.1 Standard registry profiles ... 6
5.4.2 Conformance labels ... 6
5.5 Implementation conformance statement (ICS) ... 7
5.6 Obligation ... 7
6 Relationship to ISO/IEC 11179-3 ... **7**
6.1 Metamodel for a metadata registry ... 7
6.2 Specification of the metamodel ... 7
6.3 Use of UML Class diagrams and textual description ... 8
6.4 Package dependencies ... 8
6.5 Subclassing the Constraint_Set class ... 9
6.6 Relationship to Classification region in ISO/IEC 11179-3:2023 ... 9
7 Concept_System package ... **9**
7.1 Overview of the Concept_System package ... 9
7.2 Concept System metamodel region ... 9
7.2.1 Overview ... 9
7.2.2 Classes in the Concept System metamodel region ... 10
7.2.3 Associations of the Concept System metamodel region ... 18
8 Binary_Relations package ... **21**
8.1 Overview of Binary_Relations package ... 21
8.2 Binary Relations metamodel region ... 21
8.2.1 Overview ... 21
8.2.2 Classes in the Binary Relations metamodel region ... 21
8.2.3 Datatypes in the Binary_Relation metamodel region ... 22
Annex A (informative) **Consolidated Class Hierarchy** ... **24**
Annex B (informative) **Concept System Examples** ... **25**
Annex C (informative) **Mapping ISO/IEC 11179-3:2023 Classification_Scheme to ISO/IEC 11179-32:2023 Concept_System** ... **54**
Bibliography ... **55**

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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 document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/IEC/JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

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Introduction

ISO/IEC 11179-3 specifies the structure of a Metadata Registry (MDR) and provides a metamodel for registry common facilities. That metamodel is intended to be extended by other parts of ISO/IEC 11179 for specific purposes.

This first edition of ISO/IEC 11179-32, is part of a restructuring of ISO/IEC 11179-3:2013, which has now been broken into multiple parts. This document provides a metamodel for registering metadata about concept systems and binary relations in a Metadata Registry (MDR), as extensions to the registry metamodel specified in ISO/IEC 11179-3.

In Clauses 7 and 8, this document uses:

— **bold** font to highlight terms which represent metadata objects specified by the metamodel;

— normal text for terms which represent concepts defined in Clause 3.

EXAMPLE **Concept** (7.2.2.1) is a class each instance of which models a concept.

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INTERNATIONAL STANDARD **ISO/IEC 11179-32:2023**

Information technology — Metadata registries (MDR) —

Part 32: Metamodel for concept system registration

1 Scope

This document provides a specification for an extension to a metadata registry (MDR), as specified in ISO/IEC 11179-3:2023, in which metadata that describes concept systems can be registered.

The specification in this document, together with the relevant clauses of the specification in ISO/IEC 11179-3, provides the ability to record the following metadata:

— concept systems and associated concepts;

— relations among concepts in a concept system;

— assertions about concepts in a concept system.

The metamodel in this document is intended to support the full description of a concept system, including ontologies.

Where there is a requirement to register an ontology where the details are defined elsewhere, consider using ISO/IEC 19763-3[8] instead.

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/IEC 11179-3:2023, *Information technology — Metadata registries (MDR) — Part 3: Metamodel for registry common facilities*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11179-3 and the following 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
concept
unit of knowledge created by a unique combination of characteristics

Note 1 to entry: Concepts are not necessarily bound to particular natural languages. They are, however, influenced by the social or cultural background which often leads to different categorizations.

Note 2 to entry: This is the concept “concept” as used and designated by the term “concept” in terminology work. It is a very different concept from that designated by other domains such as industrial automation or marketing.

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Note 3 to entry: A concept is independent of its representation.

[SOURCE: ISO 1087:2019, 3.2.7, modified — Reference to definition of *characteristics* removed. Note 3 to entry added.]

3.2
concept system
system of concepts
set of *concepts* (3.1) structured in one or more related domains according to the *concept relations* (3.3) among its concepts

[SOURCE: ISO 1087:2019, 3.2.28]

3.3
relation
concept relation
sense in which *concepts* (3.1) may be connected, via constituent *relation roles* (3.4)

EXAMPLE Causality is a relation with two constituent roles: cause and effect.

Note 1 to entry: The related concepts may be general or individual concepts.

3.4
relation role
role (3.5) that a *concept* (3.1) plays in a *relation* (3.3)

3.5
role
specified responsibilities

3.6
link
member of a *relation* (3.3)

3.7
link end
end of a *link* (3.6), identifying the *relation role* (3.4) played by a *concept* (3.1) in the link

3.8
binary relation
relation (3.3) with *arity* (3.9) equal to 2 (i.e. whose members all have two ends)

Note 1 to entry: Most common semantic relations are binary, e.g. “equals”, “less than”, “greater than”, “is part of”, etc. An example of a relation which is not binary is “betweenness” (e.g. A is between B and C.).

3.9
arity
number of arguments that a function takes

3.10
reflexivity
characterization of a *binary relation* (3.8) as reflexive, irreflexive or antireflexive

Note 1 to entry: A binary relation, R, is reflexive if for all x, R(x,x) is true. Equality is an example of a reflexive relation.

Note 2 to entry: A binary relation, R, is irreflexive if it is not reflexive. i.e., R(x,x) is not necessarily true for all x.

Note 3 to entry: A binary relation, R, is antireflexive if for all x, R(x,x) is false. Inequality is an example of an antireflexive relation. An antireflexive relation is also irreflexive, but antireflexive is a more specific characterization.

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3.11
symmetry
characterization of a *binary relation* (3.8) as symmetric, asymmetric or antisymmetric

Note 1 to entry: A binary relation, R, is symmetric if for all x, y: R(x,y) implies R(y,x).

EXAMPLE 1 Symmetric relations include: “equals”, “not equals”, “within-2-miles-of”, etc.

Note 2 to entry: Symmetry does not imply *reflexivity* (3.18).

EXAMPLE 2 the “inequality” relation is symmetric, but antireflexive.

Note 3 to entry: A binary relation, R, is asymmetric if for all x,y: R(x,y) does not imply R(y,x).

EXAMPLE 3 Asymmetric relations include: “less than”, “likes”, “father of”, etc.

Note 4 to entry: A binary relation, R, is anti-symmetric if for all x,y: R(x,y) implies not R(y,x). An antisymmetric relation is also asymmetric, but antisymmetric is a more specific characterization.

EXAMPLE 4 “less than” is an antisymmetric relation.

Note 5 to entry: An asymmetric relation is not necessarily antisymmetric.

EXAMPLE 5 Less than or equals.

3.12
transitivity
characterization of a *binary relation* (3.8) as: transitive, intransitive or antitransitive

Note 1 to entry: A binary relation, R, is transitive, if for all x,y,z: R(x,y) and R(y,z) implies R(x,z). Examples of transitive relations include equality, less than and less than or equals.

Note 2 to entry: A binary relation, R, is intransitive if it is not transitive i.e. R(x,y) and R(y,z) does not imply R(x,z).

Note 3 to entry: A binary relation, R, is antitransitive if for all x,y,z: R(x,y) and R(y,z) implies not R(x,z).

Note 4 to entry: An antitransitive relation is also intransitive, but antitransitive is a more specific characterization.

3.13
object
anything perceivable or conceivable

Note 1 to entry: Objects can be material (e.g. “engine”, “sheet of paper”, “diamond”), immaterial (e.g. “conversion ratio”, “project plan”) or imagined (e.g. “unicorn”, “scientific hypothesis”).

[SOURCE: ISO 1087:2019, 3.1.1]

3.14
property
feature of an *object* (3.13)

EXAMPLE 1 “Being made of wood” as a property of a given “table”.

EXAMPLE 2 “Belonging to person A” as a property of a given “pet”.

EXAMPLE 3 “Having been formulated by Einstein” as a property of the equation “$E = mc^2$”.

EXAMPLE 4 “Being compassionate” as a property of a given “person”.

EXAMPLE 5 “Having a given cable” as a property of a given “computer mouse”.

Note 1 to entry: One or more objects can have the same property.

[SOURCE: ISO 1087:2019, 3.1.3]

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3.15
characteristic
abstraction of a *property* (3.14)

EXAMPLE "Having a cable for connecting with a computer" as a characteristic of the concept "cord mouse".

Note 1 to entry: Characteristics are used for describing *concepts* (3.6).

[SOURCE: ISO 1087:2019, 3.2.1]

3.16
notation
formal syntax and associated semantics for the representation of information

EXAMPLE UML,[5],[6],[7] MOF, OCL, OWL[11]/RDF,[12] SKOS,[13] CGIF,[9] XCL,[9] XTM[17] or ISO/IEC 11404[4]

Note 1 to entry: A formal syntax consists of a set of symbols and the rules for their use.

Note 2 to entry: Formal syntax is often intended for machine processing.

[SOURCE: ISO/IEC 11179-3:2023, 3.2.36]

3.17
assertion
sentence or proposition in logic which is asserted (or assumed) to be true

3.18
cardinality
number of elements in a set

Note 1 to entry: cf. *multiplicity* (3.19)

Note 2 to entry: Adapted from ISO/IEC 19501:2005,[5] Glossary.

3.19
multiplicity
specification of the range of allowable *cardinalities* (3.18) that a set may assume

Note 1 to entry: Multiplicity specifications may be given for roles within *associations* (ISO/IEC 11179-3:2023, 3.1.5)

Note 2 to entry: A multiplicity is a (possibly infinite) subset of the nonnegative integers

Note 3 to entry: Adapted from ISO/IEC 19501:2005,[5] Glossary.

3.20
taxonomy
type of hierarchy which deals with generalization/specialization relationships

Note 1 to entry: cf. *meronomy* (3.21)

3.21
meronomy
type of hierarchy which deals with part-whole relationships

Note 1 to entry: cf. *taxonomy* (3.20)

4 Abbreviated terms

CD	Conceptual Domain
CL[9]	Common Logic
CLIF[9]	Common Logic Interchange Format

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OWL[11]	Web Ontology Language
OWL-DL	OWL Description Logic
RDF[12]	Resource Description Framework
SKOS[13]	Simple Knowledge Organization System
UML[5][6][7]	Unified Modeling Language
URI	Uniform Resource Identifier
W3C[15]	World Wide Web Consortium
XCL[9]	eXtended Common Logic markup language
XML[16]	eXtensible Markup Language
XTM[17]	XML Topic Maps

5 Conformance

5.1 Overview of conformance

Conformance rules for a Metadata Registry are specified in ISO/IEC 11179-3:2023, Clause 4. The clause "Degree of Conformance" is repeated here for convenience. The subsequent subclauses extend the rules from ISO/IEC 11179-3.

5.2 Degree of conformance

5.2.1 General

The distinction between "strictly conforming" and "conforming" implementations is necessary to address the simultaneous needs for interoperability and extensions. This document describes specifications that promote interoperability. Extensions are motivated by needs of users, vendors, institutions and industries, and:

a) are not directly specified by this document;

b) are specified and agreed to outside this document;

c) may serve as trial usage for future editions of this document.

A strictly conforming implementation can be limited in usefulness but is maximally interoperable with respect to this document. A conforming implementation can be more useful but can be less interoperable with respect to this document.

5.2.2 Strictly conforming implementations

A strictly conforming implementation:

a) shall support all mandatory, optional and conditional classes, attributes, datatypes and associations;

b) shall not use, test, access or probe for any extension features nor extensions to classes, attributes, datatypes, associations or any combination thereof;

c) shall not recognize, nor act on, nor allow the production of classes, attributes, datatypes, associations or any combination thereof that are dependent on any unspecified, undefined or implementation-defined behaviour.

NOTE The use of extensions to the metamodel can cause undefined behaviour.

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5.2.3 Conforming implementations

A conforming implementation:

a) shall support all mandatory, optional and conditional classes, attributes, datatypes and associations;

b) as permitted by the implementation, may use, test, access or probe for extension features or extensions to classes, attributes, datatypes, associations or any combination thereof;

c) may recognize, act on or allow the production of classes, attributes, datatypes, associations or any combination thereof that are dependent on implementation-defined behaviour.

NOTE 1 All strictly conforming implementations are also conforming implementations.

NOTE 2 The use of extensions to the metamodel can cause undefined behaviour.

5.3 Conformance by feature

Conformance claims may be made to Clause 7 and optionally Clause 8, or to specific features within these clauses. Those clauses are also dependent upon one or more other clauses of ISO/IEC 11179-3, so conformance to all or part of those clauses shall be understood to imply conformance also to relevant provisions specified in one or more of the clauses in ISO/IEC 11179-3.

A conformance statement shall specify exactly the features supported and not supported.

5.4 Registry conformance

5.4.1 Standard registry profiles

This document specifies the following standard profiles in addition to those specified in ISO/IEC 11179-3:2023, 4.4.2.

— **Concept System Registry**: Implements Clause 7 in addition to all provisions of the "Basic Registry" profile of ISO/IEC 11179-3:2023, 4.4.2;

— **Concept System and Binary Relations Registry**: Implements Clauses 7 and 8 in addition to all provisions of the "Basic Registry" profile of ISO/IEC 11179-3:2023, 4.4.2;

— **Concept System Registry with mapping**: Implements Clause 7 in addition to all provisions of the "Basic Registry with mapping" profile of ISO/IEC 11179-3:2023, 4.4.2;

— **Concept System and Binary Relations Registry with mapping**: Implements Clauses 7 and 8 in addition to all provisions of the "Basic Registry with mapping" profile of ISO/IEC 11179-3:2023, 4.4.2.

5.4.2 Conformance labels

Conformance to the profiles specified in 5.4.1 may be claimed using the following labels, respectively:

— ISO/IEC 11179-32:2023 Concept System Registry;

— ISO/IEC 11179-32:2023 Concept System and Binary Relations Registry;

— ISO/IEC 11179-32:2023 Concept System Registry with mapping;

— ISO/IEC 11179-32:2023 Concept System Registry and Binary Relations with mapping.

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5.5 Implementation conformance statement (ICS)

An implementation claiming conformance to this document shall include an Implementation Conformance Statement stating:

a) whether it conforms or strictly conforms;

b) which clauses are or are not supported;

c) what extensions, if any, are supported or used.

A standard profile may be referenced, if applicable.

EXAMPLE Product Z strictly conforms to ISO/IEC 11179-32:2023 Concept System Registry with Mapping.

5.6 Obligation

Properties and relationships specified in this document are one of: Mandatory, Conditional or Optional. The obligation is not explicitly stated but is to be inferred from the multiplicity of the property or relationship, and the presence or absence of a condition. In addition, a Registration Authority can specify additional constraints to be applied to particular **Administered_Items** (see ISO/IEC 11179-3:2023, 9.4.2), using **Constraint_Sets** (see ISO/IEC 11179-3:2023, 9.4.6). See 6.5.

For the purpose of conformance:

a) Mandatory properties and relationships shall exist and shall conform to the provisions of this document.

b) Anything specified as Conditional within this document shall be treated as Mandatory if the associated condition is satisfied and shall otherwise be not present.

c) Optional properties and relationships are not required to exist, but if they do exist, they shall conform to the provisions of this document.

Such obligation is enforced if and only if the Registration Status of the associated registry items is Recorded or higher (see ISO/IEC 11179-3:2023, 9.4.6.3 and ISO/IEC 11179-6:2023,[3] 4.4).

6 Relationship to ISO/IEC 11179-3

6.1 Metamodel for a metadata registry

A metamodel is a model that describes other models. A metamodel provides a mechanism for understanding the precise structure and components of the specified models, which are needed for the successful sharing of the models by users, software facilities or both.

ISO/IEC 11179-3 uses a metamodel to describe the information model of a metadata registry. The registry in turn will be used to describe and model other data, for example about enterprise, public administration or business applications. The registry metamodel is specified as a conceptual data model, i.e., one that describes how relevant information is structured in the natural world. In other words, it is how the human mind is accustomed to thinking of the information.

6.2 Specification of the metamodel

The conventions used in specifying the metamodel are described in ISO/IEC 11179-3:2023, 5.3. Many of the classes specified in this document inherit from **Item**, which is specified in ISO/IEC 11179-3:2023, 6.4.2.1. As **Items**, instances of these classes may be identified, registered, administered, named, defined and classified.

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6.3 Use of UML Class diagrams and textual description

This document uses both text and UML class diagrams to describe the metamodel. Both are normative and are intended to be complementary. However, if a conflict exists between what is specified in UML and what is specified in text, the text takes precedence until a correction is made to make them consistent. Further, if a conflict exists between a formal definition and other normative text, the formal definition takes precedence until a correction is made to make them consistent.

A consolidated UML class hierarchy is included as Annex A.

While the model diagrams are presented in UML notation, this document does not assume nor endorse any specific system environment, database management system, database design paradigm, system development methodology, data definition language, command language, system interface, user interface, computing platform or any technology required for implementation.

6.4 Package dependencies

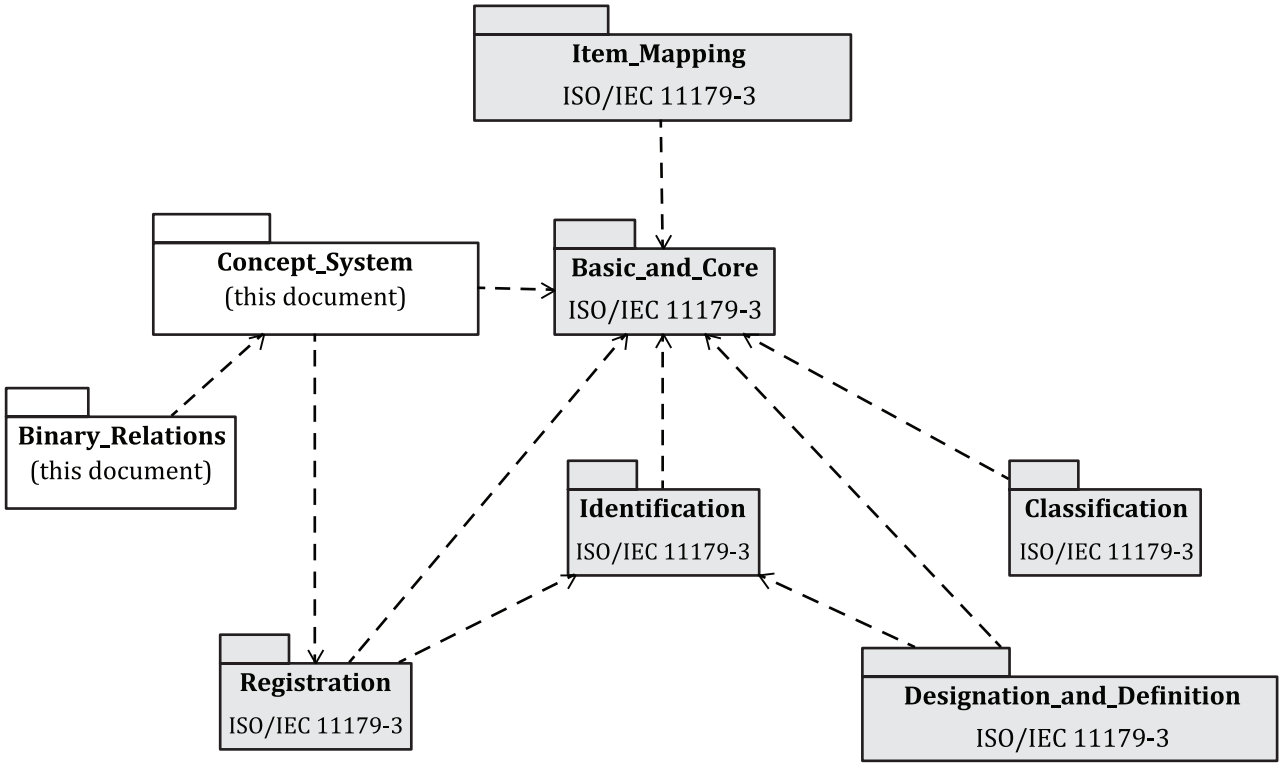

Figure 1 — Package dependencies

Figure 1 illustrates the dependencies among the packages. The **Concept_System** and **Binary_Relations** packages are specified in this document. All the other packages are specified in ISO/IEC 11179-3:2023.

The lines in the figure illustrate dependencies in the direction of the arrow. In order to implement a package that has dependencies, the packages on which it is dependent shall also be implemented. The dependencies are of three types:

a) Subclassing from classes in another package, e.g. **Relation** (7.2.2.3) in the **Concept_System** package is subclassed from the **Concept** class in the **Basic and Core** package (ISO/IEC 11179-3:2023, 6.4.2.2), and **Concept_Constraint_Set** (7.2.2.8) in the **Concept_System** package is subclassed from the **Constraint_Set** class in the **Registration** package (ISO/IEC 11179-3:2023, 9.4.6).

b) Relationship between classes, e.g. **Registered_Item** in the **Registration** package (ISO/IEC 11179-3:2023, 9.4.1) has a relationship with **Reference_Document** in the **Basic_and_Core** package (ISO/IEC 11179-3:2023, 6.3.8).

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c) Some attributes use a predefined datatype or a class from another package as a datatype, e.g. the contact attribute of the **Stewardship_Record** class in the **Registration** package (ISO/IEC 11179-3:2023, 9.4.7) uses the **Contact** class of the **Basic_and_Core** package (ISO/IEC 11179-3:2023, 6.3.5) as a datatype.

Conformance options are specified in Clause 5 and standard conformance profiles in 5.3.

6.5 Subclassing the Constraint_Set class

This document extends the **Constraint_Set** class (ISO/IEC 11179-3:2023, 9.4.6) by specifying subclasses to support constraints specified in this document. See Figure 2.

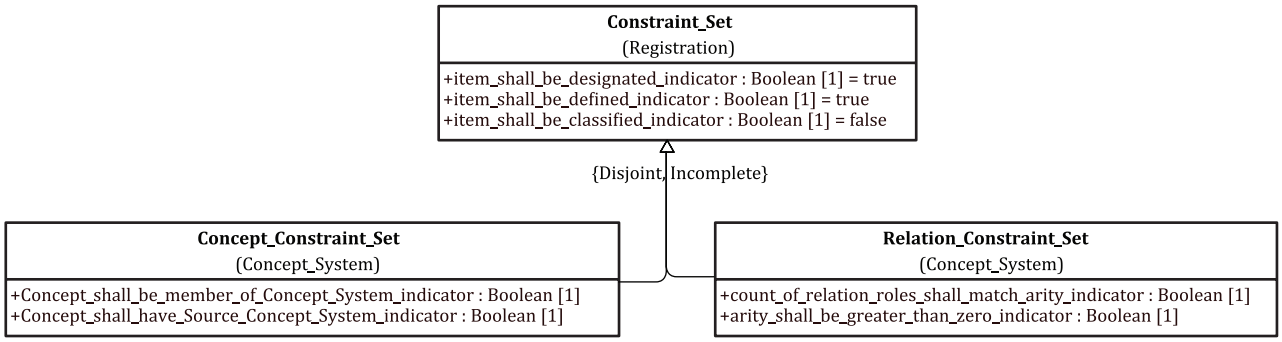

Figure 2 — Subclassing Constraint_Set

Concept_Constraint_Set is specified in 7.2.2.8.

Relation_Constraint_Set is specified in 7.2.2.9.

Any registry implementation shall provide a mechanism to enforce these constraints.

6.6 Relationship to Classification region in ISO/IEC 11179-3:2023

There are some overlaps in functionality between the **Concept_System** package specified in this document and the **Classification** package specified in ISO/IEC 11179-3:2023, Clause 10. Annex C provides a mapping between the two facilities and an explanation for the duplication.

7 Concept_System package

7.1 Overview of the Concept_System package

The **Concept_System** package consists of a single metamodel region, the Concept System metamodel region.

7.2 Concept System metamodel region

7.2.1 Overview

The Concept System metamodel region is illustrated in Figure 3. The purpose of this metamodel region is to describe concepts (abstract units of knowledge), represented by instances of **Concept** (7.2.2.1), and the various relations, represented by instances of **Relation** (7.2.2.3), which hold among the concepts. Support for more advanced concept systems, such as ontologies with formal semantics is provided through the use of assertions, represented by instances of **Assertion** (7.2.2.5). Annex B provides examples using SKOS, ORM, OWL and CLIF.

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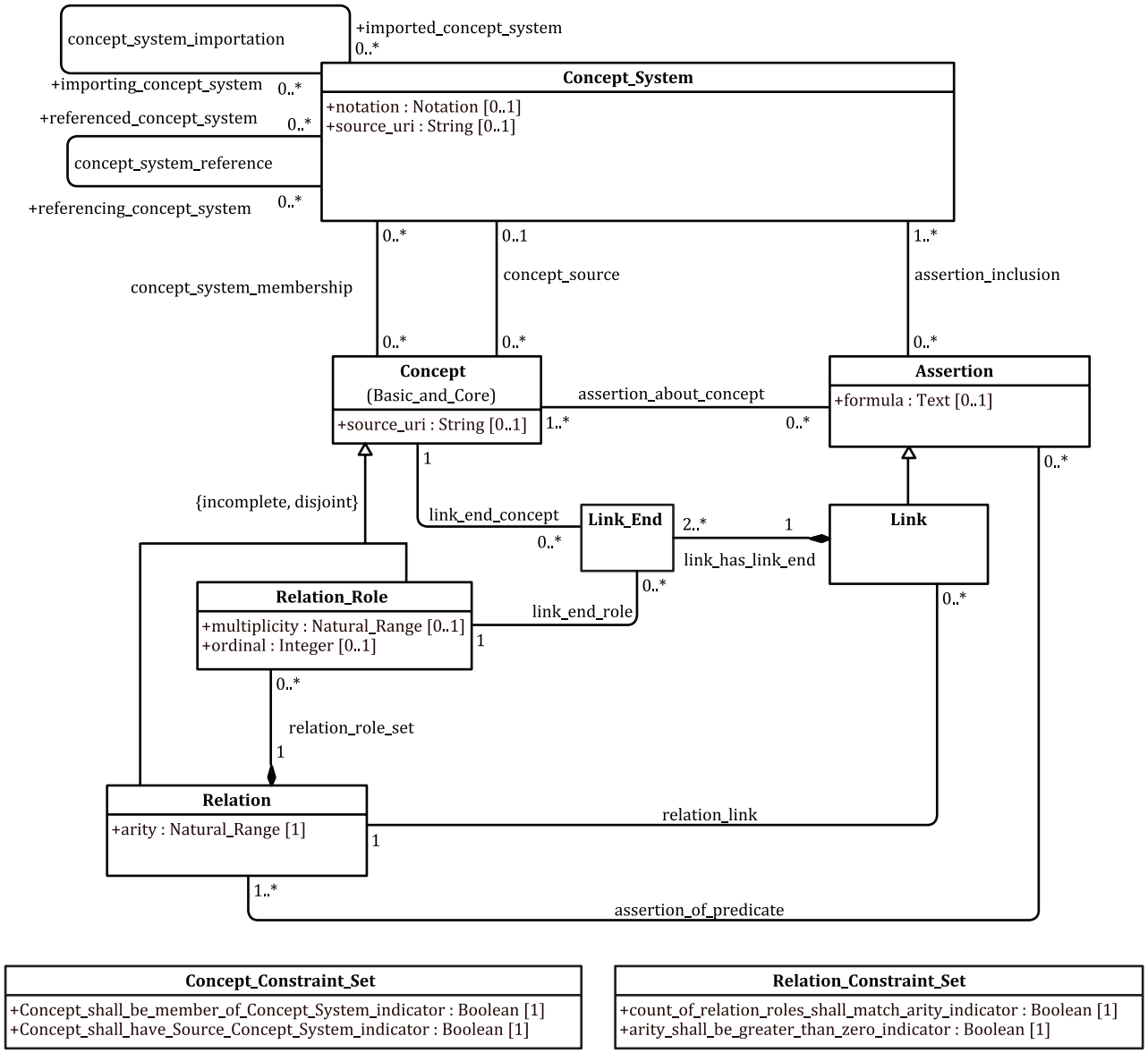

Figure 3 — Concept system metamodel region

7.2.2 Classes in the Concept System metamodel region

7.2.2.1 Concept class

7.2.2.1.1 Direct superclass

Concept is a subclass of **Item** (ISO/IEC 11179-3:2023, 6.4.2.1), allowing instances to be identified, registered, administered, named, defined and classified.

7.2.2.1.2 Description of Concept

Concept is part of the Core metamodel and is specified in ISO/IEC 11179-3:2023, 6.4.2.2. Additional associations are specified in this metamodel region.

Concept is a class, each instance of which models a concept, a unit of knowledge created by a unique combination of characteristics. A concept is independent of representation.

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Concept is a superclass of both **Relation** (7.2.2.3) and **Relation_Role** (7.2.2.4). These specializations are disjoint, and the specialization hierarchy is incomplete.

7.2.2.1.3 Associations of Concept

As a subclass of **Item**, **Concept** inherits **Item**'s associations (ISO/IEC 11179-3:2023, 6.4.2.1.2). This metamodel region specifies the following associations:

— **concept_system_membership** (7.2.3.1);

— **concept_source** (7.2.3.2);

— **assertion_about_concept** (7.2.3.7);

— **link_end_concept** (7.2.3.11).

7.2.2.1.4 Attributes of Concept

The attributes of **Concept** are specified in ISO/IEC 11179-3:2023, 6.4.2.2.4.

7.2.2.2 Concept_System class

7.2.2.2.1 Direct superclass

Concept_System is a subclass of **Item** (ISO/IEC 11179-3:2023, 6.4.2.1), allowing instances to be identified, registered, administered, named, defined and classified.

7.2.2.2.2 Description of Concept_System

Concept_System is a class, each instance of which models a concept system, a set of concepts structured according to the relations among them.

A minimal concept system can simply be a collection of concepts. A more elaborate concept system could be a collection of concepts organized into a taxonomy or meronomy specified by means of various relations (e.g. semantic relations) among the concepts.

NOTE 1 Examples of concept systems are included in Annex B.

NOTE 2 If a concept system is available in multiple notations, it is good practice to register the concept system only once and to use reference documents to record the various notations.

7.2.2.2.3 Associations of *Concept_System*

A **Concept_System** has the following associations:

— **concept_system_membership** (7.2.3.1);

— **concept_source** (7.2.3.2);

— **concept_system_reference** (7.2.3.3);

— **concept_system_importation** (7.2.3.4);

— **assertion_inclusion** (7.2.3.6).

7.2.2.2.4 Attributes of Concept_System

See Table 1.

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Table 1 — Attributes of Concept_System

Attribute name	Multiplicity	Datatype	Description
notation	0..1	**Notation** (ISO/IEC 11179-3:2023, 6.2.7)	Definition: notation used in specification of this concept system. Comment: Examples of such notations include XCL Common Logic (ISO/IEC 24707) or OWL-DL XML notation (Ontology Web Language from W3C).
source_uri	0..1	**String** (ISO/IEC 11179-3:2023, 6.2.11)	Definition: URI that enables access to the concept system Provides access to details of the concept system that are external to the registry.

7.2.2.3 Relation class

7.2.2.3.1 Direct superclass

Relation is a subclass of **Concept** (specified in ISO/IEC 11179-3:2023, 6.4.2.2). **Concept** in turn is a subclass of **Item** (specified in ISO/IEC 11179-3:2023, 6.4.2.1), allowing instances to be identified, registered, administered, named, defined and classified.

7.2.2.3.2 Description of Relation

Relation is a class, each instance of which models a relation, a sense in which concepts may be connected via constituent relation roles.

Relation is a superclass of the **Binary_Relation** class which is described in 8.2.2.2.

Any relation is also a concept in its own right (and hence **Relation** is a subclass of **Concept**). A unary relation is just a concept and should be registered as such. Only relations with arity 2 or greater can be registered as **Relations**.

A reflexive relation (i.e. one which refers to itself) needs to be modelled using an **Assertion**.

NOTE 1 A **Relation** is a subset of the powerset of RxUD, for some role set R, where UD is the universe of discourse.

NOTE 2 An *n*-ary **Relation** on sets A_1, ..., A_n is a set of ordered *n*-tuples $<a_1, ..., a_n>$ where a_i is an element of A_i for all *i*, *i between 1 and n*. Thus, an *n*-ary **Relation** on sets A_1, ..., A_n is a subset of Cartesian product A_1 x ... x A_n. Membership of an n-tuple in the **Relation** is specified through **Assertions**, the simplest form of which is a **Link** representing exactly one tuple of the **Relation**. In this metamodel, **Relations** are defined over sets of **Concepts**.

NOTE 3 In this metamodel, unordered n-tuples are used with named **Relation_Roles** rather than positional elements of the n-tuple. The ordering can optionally be specified using the **ordinal** attribute on **Relation_Role**.

7.2.2.3.3 Associations of Relation

As a subclass of **Concept**, **Relation** inherits **Concept**'s associations. **Relation** has the following additional associations:

— **relation_role_set** (7.2.3.5);

— **relation_link** (7.2.3.9);

— **assertion_of_predicate** (7.2.3.8).

7.2.2.3.4 Attributes of Relation

See Table 2.

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