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ISO 15926-6

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Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities —

Part 6:
Rules for the development and validation of reference data of ISO/TS 15926-4

Systèmes d'automatisation industrielle et intégration — Intégration de données de cycle de vie pour les industries de "process", y compris les usines de production de pétrole et de gaz —

Partie 6: Règles relatives à l'élaboration et à la validation des données de référence de l'ISO/TS 15926-4

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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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 184, *Automation systems and integration*, Subcommittee SC 4, *Industrial data*.

This first edition cancels and replaces the first edition of ISO/TS 15926-6:2013, which has been technically revised.

The main changes are:

— update of the normative references;

— deletion of Clause 8 on the administration of a reference data library;

— deletion of rules for external reference data libraries;

— grouping of all rules under one clause with the subclause numbers in the order of the attributes to improve readability;

— improvement of the separation between the factual rule for an attribute and the options that would exist to choose from;

— improvement of Clause 4 for providing the general principles of the attributes to navigate the user;

— deletion of pieces of text that would be more appropriate in a separate knowledge document.

A list of all parts in the ISO 15926 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

The ISO 15926 series provides a representation process of industry facility life-cycle information. This representation is specified by a generic, conceptual data model that is suitable as the basis for implementation in a shared database or data warehouse. The data model is designed to be used in conjunction with reference data, i.e. standard instances that represent information common to a number of users, production facilities, or both.

Most reference data are in ISO/TS 15926-4. This document specifies the rules that are required for the development and validation of reference data items of ISO/TS 15926-4. This document also contains examples of reference data items.

Some reference data are in ISO/TS 15926-11, ISO/TS 15926-12, or ISO 15926-13. The support for a specific life-cycle activity depends on the use of appropriate reference data in conjunction with the data model.

NOTE   A reference data library used with the ISO 15926 series can be standardized or proprietary. A reference data library which is initially proprietary can subsequently be submitted for standardization. Classes contained within a reference data library can be more or less generic. Generic core classes and commodity classes are likely to be standardized, but specific manufactured product classes are unlikely to be standardized.

Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities —

Part 6:
Rules for the development and validation of reference data of ISO/TS 15926-4

1 Scope

This document specifies technical requirements for the structure and content of a reference data library for ISO/TS 15926-4.

NOTE   This document can also be applied to reference data libraries other than ISO/TS 15926-4.

The following are within the scope of this document:

— identification of a reference data item as specified in ISO/TS 15926-4;

— information that defines a reference data item;

— the way identifying and defining information is recorded using ISO 15926-2;

— the reference data library that contains the reference data items necessary to record identification and defining information;

— the representation of the reference data library that is defined by this document as a spreadsheet.

The following are outside the scope of this document:

— administrative information about the source, the history of changes, and the current status of a reference data item and a reference data library;

— the way administrative information is recorded using ISO 15926-2;

— the reference data library that contains the reference data items necessary to record administrative information;

— defining the scope of reference data libraries within the ISO 15926 series;

— methods and guidelines for implementing ISO 15926-2;

— procedures for maintaining reference data libraries;

— requirements for the representation of a proprietary reference data library.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the 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 15926-2, *Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities — Part 2: Data model*

ISO 80000-1:2022, *Quantities and units — Part 1: General*

3   Terms, definitions, symbols and abbreviated terms

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   Terms and definitions

3.1.1
administrative information
information (3.1.5) about the administration of an item in a *reference data library* (3.1.17)

EXAMPLE   Creation date, last change date, origin, change description, explanatory comment.

[SOURCE: ISO/IEC 11179-3:2023, 3.2.67, modified — The domain has been removed and "registry" has been replaced by "reference data library".]

3.1.2
attribute
data (3.1.4) element for the computer-sensible description of a *property* (3.1.10), a relation or a *class* (3.1.3)

Note 1 to entry: An attribute describes only one detail of a property, class, or relation.

EXAMPLE   The name of a property, the code of a class, the measure unit in which values of a property are provided.

[SOURCE: ISO 13584-42:2010, 3.3]

3.1.3
class
category or division of *things* (3.1.22) based on one or more criteria for inclusion and exclusion

Note 1 to entry: A class need not have any members (things that satisfy its criteria for membership).

Note 2 to entry: Because a spatio-temporal paradigm is used to define individuals in this document, all classes are non-well-founded sets. These are explained in ISO 15926-2:2003, D.2.4.

[SOURCE: ISO 15926-1:2004, 3.1.1]

3.1.4
data
representation of *information* (3.1.5) in a formal manner suitable for communication, interpretation, or processing by human beings or computers

[SOURCE: ISO 10303-2:2024, 3.1.207]

3.1.5
information
facts, concepts, or instructions

[SOURCE: ISO 10303-2:2024, 3.1.227]

3.1.6
instance
data ([3.1.4](#)) that represents, in computer-processable form, some real-world *thing* ([3.1.22](#))

[SOURCE: ISO 15926-1:2004, 3.1.13]

3.1.7
maintenance organization
organizational unit that is responsible for the maintenance of the *reference data library* ([3.1.17](#))

Note 1 to entry: Procedure for the maintenance of ISO/TC 184/SC 4 *reference data* ([3.1.11](#)) is described in ISO/TC 184/SC4 N2591[12].

Note 2 to entry: The maintenance organization in this document represents the combination of the ISO/TC 184/SC 4 secretariat, the ISO/TC 184/SC 4/WG 3 and the ISO/TC 184/SC 4/WG 22 together carrying out the task of maintenance of ISO/TS 15926-4 reference data library published as a database using the procedure. The maintenance team (MT) is defined by the ISO/TC 184/SC 4/WG 3 and the validation team (VT) is defined by the ISO/TC 184/SC 4/WG 22.

3.1.8
possible individual
thing ([3.1.22](#)) that exists in space and time

Note 1 to entry: This definition is taken from ISO 15926-2, in which "possible_individual" is an entity but not a defined term.

3.1.9
power class
set of all *subclasses* ([3.1.21](#)) of a *class* ([3.1.3](#)), including the class itself and the empty set

Note 1 to entry: A subclass of a power class selects subclasses that satisfy a specific context. A restricted set of subclasses can be a "facet" or "aspect".

3.1.10
property
aspect or quality of something that can be determined by measurement or observation

Note 1 to entry: The term "property" is used in ISO 15926-2.

3.1.11
reference data
process plant life-cycle *data* ([3.1.4](#)) that represents *information* ([3.1.5](#)) about *classes* ([3.1.3](#)) or individuals which are common to many process plants or of interest to many users

[SOURCE: ISO 15926-1:2004, 3.1.18]

3.1.12
reference data item
thing ([3.1.22](#)) that is defined within a *reference data library* ([3.1.17](#))

3.1.13
reference data item definition by text
text, and optionally equations and figures that are intended to be understood by a human, and that is the normative definition of a *reference data item* ([3.1.12](#))

3.1.14
reference data item definition by document reference
normative reference to a document that provides the normative definition of a *reference data item* ([3.1.12](#))

3.1.15
reference data item non-human-interpretable identifier
text that is a unique identifier for a *reference data item* ([3.1.12](#)) and that is not intended to be interpreted by a human

Note 1 to entry: The use of a reference data item non-human-interpretable identifier is defined in [5.2](#).

3.1.16
reference data item human-interpretable identifier
text that is a unique identifier for a *reference data item* (3.1.12) and that is intended to be interpreted by a human

Note 1 to entry: The use of a reference data item human-interpretable identifier is defined in 5.3.

Note 2 to entry: If a reference data item is a *class* (3.1.3), then its reference data item human-interpretable identifier can be a term.

Note 3 to entry: The reference data item human-interpretable identifier is used for all references to a reference data item in natural language text definitions.

Note 4 to entry: Names in natural language and terms in dictionaries are often unique only within a context. A reference data item can be used in many contexts. Hence, a reference data item human-interpretable identifier can be longer than a name in a natural language and contain words that qualify a natural language name to ensure that it is unique.

Note 5 to entry: A *reference data library* (3.1.17) can contain additional terms for a reference data item which are not unique and which are used within particular contexts.

3.1.17
reference data library
RDI
managed collection of *reference data* (3.1.11)

[SOURCE: ISO 15926-1:2004, 3.1.19]

3.1.18
reference data library module
collection of *reference data items* (3.1.12) within a *reference data library* (3.1.17) that shares the same subject area

EXAMPLE   Electrical is a reference data library module, represented by a specific spreadsheet, which contains reference data library items (classes) that are of direct interest to the electrical engineering discipline, which in this case is the subject area. In the context of ISO 15926-2, the reference data library module is a *class* (3.1.3) of class with as members all classes contained by the corresponding spreadsheet.

[SOURCE: ISO/TS 15926-4:2024, 3.1.14]

3.1.19
relationship
connection among model elements

Note 1 to entry: In this document, a relationship is one of: an association, a generalization or a specialization.

[SOURCE: ISO/IEC 11179-3:2023, 3.1.4, modified — The domain has been deleted.]

3.1.20
superclass
class (3.1.3) that is a generalization of one or more other classes

Note 1 to entry: The classes being generalized are known as *subclasses* (3.1.21).

Note 2 to entry: A particular class can be a superclass with respect to one *relationship* (3.1.19) and simultaneously a subclass with respect to another relationship.

[SOURCE: ISO/IEC 11179-3:2023, 3.1.9, modified — The domain and note 2 to entry have been deleted.]

3.1.21
subclass
class (3.1.3) that is a specialization of another class

Note 1 to entry: The class being specialized is known as a *superclass* (3.1.20).

Note 2 to entry: A particular class can be a subclass with respect to one *relationship* (3.1.19) and simultaneously a superclass with respect to another relationship.

[SOURCE: ISO/IEC 11179-3:2023, 3.1.10, modified — The domain and note 2 to entry have been deleted.]

3.1.22
thing
anything that is, or can be thought about, or perceived

Note 1 to entry: This definition is taken from ISO 15926-2, in which thing is an entity but not a defined term, including material and non-material objects, ideas, and actions.

3.1.23
upper camel-case notation
naming convention in which compound words are joined together without spaces, and the first letter of every word is uppercase

[SOURCE: ISO/IEC 39794-5:2019, 3.56]

3.2 Symbols

Symbols used in this document are given in Table 1.

Table 1 — Symbols for set theory operations

Symbol	Usage	Meaning of usage
∪	A∪B	union of sets A and B
∩	A∩B	intersection of sets A and B
¬	¬A	complement of set A
*	A*	power set of set A

3.3 Abbreviated terms

CR   Change Request

MT   Maintenance Team

OED   Oxford English Dictionary

OWL   Web Ontology Language

RDL   Reference Data Library

UML   Unified Modelling Language

UoM   Units of Measure

URN   Uniform Resource Name

URI   Uniform Resource Identifier

VT   Validation Team

4 General principles for the content of a reference data library (RDL)

4.1 Structure of the rules for attributes in this document

This document has been structured such that the rules for the attributes are listed in the subclauses of Clause 5. The number of the subclause corresponds to the number of the attribute. The numbering of attributes corresponds to the "Attribute numbers" given in Annex A, where all attributes are listed with the proper reference to the rule's subclauses. Each reference data item shall be defined by assigning values to

the mandatory attributes defined by Table A.1. An explanation of each attribute name is given in Table A.1, together with examples of the attribute.

NOTE   Detailed requirements for using attributes are specified in 4.4.3 and subclauses corresponding to each attribute.

Attributes for defining reference data items are categorized into three groups. Those are described in 4.5, 4.6, and 4.7.

4.2   Naming convention for attributes

Attribute names for a reference data item shall be denoted in the upper camel-case notation.

4.3   Presentation convention

For ease of identification, ISO 15926-2 entities, their subclasses and human-interpretable identifiers are formatted using bold font in this document.

EXAMPLE   Usage of bold font for ISO 15926-2 entities and their subclasses in the explanations:

In a representation of a reference data library in accordance with ISO 15926-2, a human-interpretable identifier is represented by an instance of **reference_data_item_human-interpretable_identification** (subclass of ISO 15926 entity **class_of_identification**).

4.4   Defining a reference data library

4.4.1   Definition and content of a reference data library

This subclause includes the rules for the reference data library as a whole:

— a reference data library;

— minimum information about a reference data item;

— attribute.

4.4.2   Reference data library and reference data item

A reference data library is a collection of reference data items.

A reference data item is a class corresponding to a typical **thing** that appears in industry data, which can be repeatedly used in engineering documents or various data in information systems in that life cycle. A reference data item is specified with several reference data, and the ISO/TS 15926-4 reference data library is characterized by 25 reference data.

One of the mandatory reference data is an identifier defined in 5.2, and another optional reference data is notes defined in 5.8.

NOTE   A reference data item is usually a class but can be a member of **possible_individual**.

EXAMPLE   A "**pump**" is a typical physical **thing** in the engineering phase, and "**maintenance**" is also a typical abstract **thing** in the O&M phase.

4.4.3   Minimum information about a reference data item

A reference data item shall be characterised by minimum information which corresponds to specific attributes as follows:

— a URI for the reference data item;

— a unique non-human-interpretable identifier for the reference data item;

— a unique human-interpretable identifier for the reference data item;

— a definition that is either a text definition or a formal definition using a set theory relationship;

— at least one superclass;

— at least one ISO 15926-2 entity;

— at least one classification;

— units of measure (UoM) attributes if the reference data items are units of measure classes.

The unique non-human-interpretable and human-interpretable identifiers shall be assigned by the maintenance organization.

NOTE   The URI need not be assigned by the maintenance organization. If a URI is assigned to the reference data item by a source which can be normatively referenced, then that URI can be used.

4.4.4   Reference data library

A reference data library shall have a reference data item or reference data items.

A reference data library may be grouped into modules, as defined in 3.1.17. A module shall be named after its classification with additional information depending on the representation of a reference data library. This document defines the rules for the attributes of the representation of the ISO/TS 15926-4 modules as spreadsheets. In future versions of this document, rules for other representations, such as database format, may be added where necessary.

NOTE   The reference data library of ISO/TS 15926-4 are all grouped into separate modules as spreadsheets in which reference data items have the same classifications respectively.

EXAMPLE   Both the class "**centrifugal pump**" and "**dynamic pump**", which have "**rotating equipment class**" for Classification1, are grouped into the same module, and the name of the module is "rotating_equipment-v1.xls" where "-v1.xls" is an additional information specific for a spreadsheet representation as described in Clause 6.

4.5   Reference data item identification

4.5.1   Category of reference data item identification

This category includes the following definitions:

— types of reference data item identification;

— types of text definition and notes of a reference data item;

— formal relationships for definition.

4.5.2   Types of reference data item identification

The reference data item identification shall consist of the following:

— one URI, as specified in 5.1;

— a single non-human-interpretable identifier, as specified in 5.2;

— a single human-interpretable identifier, as specified in 5.3.

The reference data item identification can include any number of synonyms if there are two synonyms, as specified in 5.4 and 5.5.

NOTE 1   5.2 and 5.3 require both the non-human-interpretable and the human-interpretable identifiers to be unique. This implements ISO/IEC 11179-6.

NOTE 2   This document does not specify how an identifier of a reference data item is used in proprietary reference data libraries.

EXAMPLE   Within ISO/TS 15926-4, the class centrifugal pump is identified by the human-interpretable identifier "**centrifugal pump**" and by the non-human-interpretable identifier "7436". The human-interpretable identifier is more memorable.

NOTE 3   The appropriate human-interpretable identifier for a reference data item cannot be known when it is first identified by the maintaining organization for the reference data library. Hence, a reference data item can be identified only by its non-human-interpretable identifier.

4.5.3   Types of text definitions and notes of a reference data item

Text about a reference data item shall be as follows:

— Attribute: TextDefinition.

If a reference data item has a normative definition as defined in 5.6.7, then a reference data item shall not have a text definition.

In case a reference data item is a superclass, the text definition is defined by the superclass statement with distinguishing characteristics. This is explained in 5.6.7. In all other cases, a definition of a reference data item needs to be given, which will be normative. This is defined in 5.6.1:

— Attribute: Source;

— Attribute: Note.

There can be any number of notes about a reference data item, as described in 5.8.

4.6   Classifications

4.6.1   General

A classification of a class plays several roles in the management of classes, as follows:

a)   a classification of a class can be based on the way in which a class is defined;

EXAMPLE 1   The members of the class of functional objects have only function as a criterion. In some cases, there are classification aspects, such as type of pipe fitting, pressure rating of pipe fitting, size of pipe fitting, and material of pipe fitting. Each aspect can be organized using a class of class, typically done in a project RDL.

b)   a classification can be based upon a level in a classification hierarchy;

EXAMPLE 2   Classes in other RDLs, such as project RDLs, which are extensions of ISO/TS 15926-4, can be classified according to the level in the following hierarchy:

— core classes;

— de facto classes;

— standard classes;

— commodity product classes;

— proprietary product classes.

c)   a classification can be based on domain.

EXAMPLE 3   The rotating equipment class has classes relevant to rotating equipment as members. The division of the reference data library into modules is a class classification.

NOTE 1   All classes in ISO/TS 15926-4 are core classes. Other classifications of class are possible.

A **class_of_class** is a class whose members are instances (see 3.1.6) of the class. A **class_of_class** is a means of classifying the subdivisions of a class membership, i.e., they can be used to identify types of subdivisions in ISO 15926-2.

For these purposes, three types of relationships between reference data item and other reference data item(s) or an ISO 15926-2 entity shall be prepared as follows:

— an attribute for inheritance relationship (Attribute: Superclass#);

— an attribute for grouping based on an ISO 15926-2 entity (Attribute: ISO15926-2ENTITY);

— an attribute for grouping based on business use cases (Attribute: Classification1).

NOTE 2   # of Superclass # can be 1, 2, 3, 4 and 5 (See 5.9, 5.10, 5.11, 5.12 and 5.13).

Classifications can be theoretically explained by a power class (see 3.1.9), as shown in Figure 1.

Usually, a class in the reference data library is an instance of the same ISO 15926 entity as its superclass. An exception is where a class in the reference data library is a subclass of an instance of a class of functional objects. This is because a subclass lower down the hierarchy does not necessarily have only function as its criterion. Moreover, classifying a class as a member of a power class of one of its superclasses provides no additional information.

NOTE 3   ISO/TS 15926-4 does not contain the power class. It is represented here because the concept is useful in a project RDL.

NOTE 4   In a project RDL, a class of class can be used to affect the use of members of that class of class since the range of a relationship can be restricted to only members of a specific class of class. When a class is not a member of the class of class that is defined as a range for a specific relationship, instances of that class cannot be used as a range for that specific relationship on the project data level.

EXAMPLE 4   The class "**DOCUMENT TYPE**" can have a power class "**DOCUMENT_TYPE_CLASSIFICATION**". "**correspondence**", "**multimedia**", "**permit**", "**contract**", and "**requisition**" classes are subclasses of "**DOCUMENT_ TYPE**". "**DOCT**" (Document type) and "**CONT**" (Content type) are subclasses of "**DOCUMENT_TYPE_CLASSIFICATION**". "**correspondence**", "**multimedia**", and "**permit**" classes are members of "**DOCT**". "**contract**" and "**requisition**" classes are members of "**CONT**". Those relationships are shown in Figure 1.
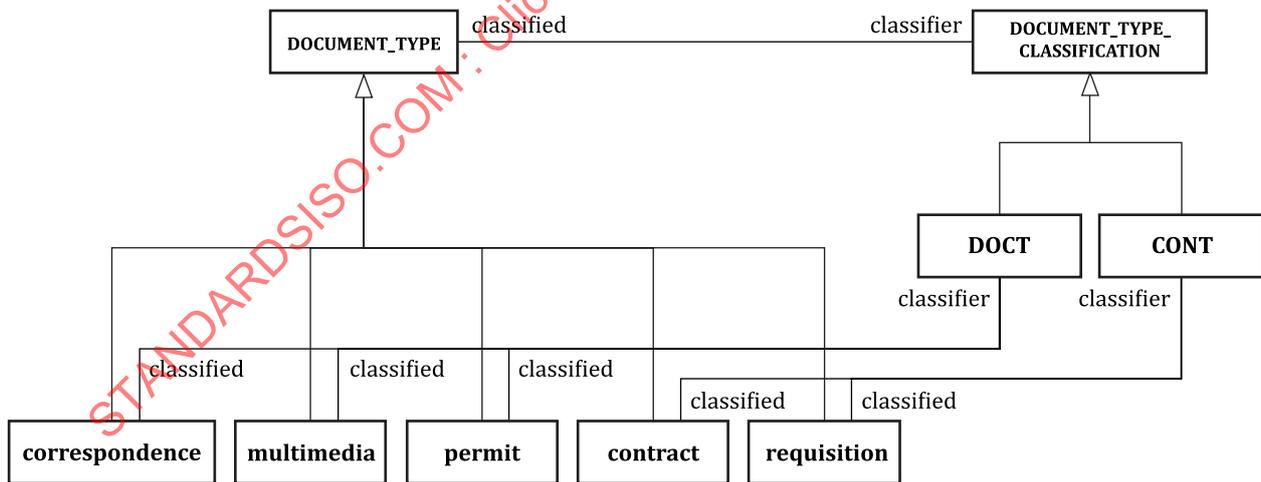

Figure 1 — A UML class diagram related to classifications

NOTE 5   In an EXPRESS implementation of the ISO 15926 series, each class in a reference data library must explicitly be an instance of an entity in the ISO 15926 data model. The choice of this entity is effectively a classification of the class.

4.6.2 Class of inheritance relationship (Attribute: Superclass#)

A reference data item that is a class can have any number of superclasses; thus, multiple inheritance is allowed.

EXAMPLE 1   The class "centrifugal pump" has the class "dynamic pump" as a superclass.

EXAMPLE 2   The class "shell and tube condenser" has the classes "condenser" and "shell and tube heat exchanger" as superclasses.

NOTE   The maximum number of superclasses is five in a spreadsheet representation.

4.6.3 Grouping based on ISO 15926-2 entities

A reference data item shall be a member of an entity in ISO 15926-2 and shall have one Attribute: ISO15926-2Entity.

4.7 Attributes for units of measure (UoM)

This category includes the following definition:

— attributes related to UoM, which are introduced by this document, based on the ISO 80000 series;

— relationships among those attributes.

The UoM data used in industry projects come from various sources. The reason is the UoM data sets are applied to projects in all parts of the world. To date, in practice, there are several UoM data sets that are being used in projects, such as the ISO 80000 series, QUDT, and NASA sets.

The current content of ISO/TS 15926-4 only contains UoMs coming from the ISO 80000 series.

The notations of UoM RDIs shall be in accordance with the ISO 80000 series, and the base unit for RDIs in ISO/TS 15926-4 follows SI units as specified in the ISO 80000 series. In addition to those principles, this document also introduced seven specific attributes to represent UoMs of the ISO 80000 series in a computer-sensible manner.

Those seven attributes are as follows:

— Attribute: Symbol, as defined in 5.19;

— Attribute: Operator as defined in 5.20;

— Attribute: FirstOperand as defined in 5.21;

— Attribute: SecondOperand as defined in 5.22;

— Attribute: Factor as defined in 5.23;

— Attribute: Prefix as defined in 5.24;

— Attribute: Exponent as defined in 5.25.

Those are only applicable for UoM reference data items registered in the UoM module of ISO/TS 15926-4 reference data library. There are two types of reference data items. One type is unit classes, which are subclasses of class **property_quantification** of ISO 15926-2, and the other types are unit reference data items, which are subclasses of **scale**. Those seven attributes are only applicable to the latter. Attributes for UoM are mandatory, as specified in Table 2 if a reference data item is a member of a unit of measure class.

Table 2 — Possible combination of attributes of UoM

Attribute names	Symbol	Operator	First operand	Second Operand	Factor	Prefix	Exponent
Explanation	If the unit type is	If the operator type is	Possible combination is				
Data type	Symbol specified in ISO 80000 series		UniqueName	UniqueName	(real number)	Prefix name of ISO 80000-1:2022, Table 4	(natural number)
Possible attribute combination based on symbol and operator	(base unit)	(empty)	(n/a)	(n/a)	(n/a)	(n/a)	(n/a)
	(derived unit)	multiply	M	M	(n/a)	(n/a)	(n/a)
		divide	M	M	(n/a)	(n/a)	(n/a)
		factor	M	(n/a)	M	(n/a)	(n/a)
		prefix	M	(n/a)	(n/a)	M	(n/a)
		exponentiate	M	(n/a)	(n/a)	(n/a)	M
		reciprocal	M	(n/a)	(n/a)	(n/a)	(n/a)
Key							
M/O data object is mandatory (M) or optional (O)							

5 Reference data item attributes

5.1 Attribute: URI

5.1.1 General

Requirements for the assignment of URI are specified in 5.1.2, and those syntaxes are specified in 5.1.3.

5.1.2 Assignment of URI

A published reference data item shall be identified by one URI, where a URI is as defined in IETF RFC 8141[17].

NOTE 1   The source URI is usually preferred because it is already in use.

A URI that identifies a reference data item shall not be used to identify anything else.

NOTE 2   The use of URIs is discussed in "Cool URIs don't change"[18].

If a URI is not assigned in a normatively referenced source, then at least one URI shall be assigned by the maintenance organization for the reference data library. An assigned URI shall be derived from the non-human-interpretable identifier or from the human-interpretable identifier.

NOTE 3   When a proprietary RDL is submitted for standardization, the standardization body will assign its own URIs.

5.1.3 Syntax of URI

A URI assigned by the maintenance organization shall consist of the following:

— a prefix allocated to the organization that maintains the reference data library;

— a suffix that is either the non-human-interpretable identifier or the human-interpretable identifier, with any blank replaced by an underscore.

NOTE 1   The prefix is the leading character of the URI that is common to each URI assigned to reference data items in a reference data library. For a URN, the leading characters include, but are not restricted to, the URN prefix that is registered to an organization. For an HTTP URI, the leading characters include but are not restricted to an HTTP domain.

If a URI contains a fragment identifier, then the suffix shall be the fragment identifier.

The URIs that are assigned to a reference data item shall be stated explicitly.

If a URI is derived from a human-interpretable identifier, then the case shall be that specified for the human-interpretable identifier.

NOTE 2   URIs are case sensitive.

NOTE 3   Some implementation methods can require a particular form of URI. For example, ISO/TS 15926-7 requires the use of an HTTP URI.

In a representation of a reference data library in accordance with ISO 15926-2, an identification by URI is represented by an instance of **reference_data_item_identification_by_HTTP_URI** (subclass of ISO 15926 entity **class_of_identification**), which has subclasses as follows:

— **reference_data_item_identification_by_URN**;

— **reference_data_item_identification_by_HTTP_URI_without_fragment_ID**;

— **reference_data_item_identification_by_HTTP_URI_with_fragment_ID**.

NOTE 4   The URI for a reference data item can be represented in a spreadsheet in the columns "URI" as shown in the spreadsheet referenced in Annex A.

5.2   Attribute: UniqueNumber

UniqueNumber is one of the non-human-interpretable identifiers and shall be unique within the reference data library.

The non-human-interpretable identifier shall be allocated by the maintenance organization. Information about the reference data item shall not be encoded in a non-human-interpretable identifier of more than zero or a natural number.

In a representation of a reference data library in accordance with ISO 15926-2, a non-human-interpretable identifier is represented by an instance of **reference_data_item_non-human-interpretable_identifier** (subclass of ISO 15926 entity **class_of_identification**).

NOTE 1   The non-human-interpretable identifier for a reference data item can be represented in a spreadsheet in the column "non-human-interpretable identifier", as shown in the spreadsheet referenced in Annex A.

The characters used in a non-human-interpretable identifier shall be those valid for a URN namespace-specific string, as defined in IETF RFC 8141[17].

The valid characters within a non-human-interpretable identifier are:

— numbers "0" to "9";

— the 26 lowercase letters "a" to "z";

— the 26 uppercase letters "A" to "Z";

— the special characters "(", ")", "+", ",", "-", ".", ":", "=", "@", ";", "$", "_", "!", "*", "'";

— an octet of the form "%" <hex> <hex>.

NOTE 2   The non-human-interpretable identifier can be an internal database key used by the organization that maintains a reference data library.

5.3 Attribute: UniqueName

The requirements for a reference data item human-interpretable identifier are as follows:

— within a reference data library, no two human-interpretable identifiers shall differ solely by character cases;

— UniqueName is one of the human-interpretable identifiers and shall be unique within the reference data library.

NOTE 1   This requirement ensures that two human-interpretable identifiers remain different even if both are converted into upper or lowercase cases.

NOTE 2   The combination of cases that are specified for a human-interpretable identifier is kept and used to construct a URI, which is case-sensitive.

— within a reference data library, one human-interpretable identifier shall not be the natural language plural of another;

— the characters used in a human-interpretable identifier shall be those valid for a URN namespace-specific string, as defined in IETF RFC 8141[17], with the addition of a blank and without underscores.

The valid characters within a human-interpretable identifier are:

— numbers "0" to "9";

— the 26 lowercase letters "a" to "z";

— the 26 uppercase letters "A" to "Z";

— the special characters "(", ")", "+", ",", "-", ".", ":", "=", "@", ";", "$", "_", "!", "*", "'";

— an octet of the form "%" <hex> <hex>.

NOTE 3   Where a human-interpretable identifier is used to construct a URI, blank is replaced by an underscore, as specified in 5.1.

If a reference data item is commonly identified by a natural language word or phrase, then that word or phrase shall be used as the human-interpretable identifier.

NOTE 4   An English word or phrase is usually preferred, but a non-English word or phrase can be chosen as the human-interpretable identifier, where it is considered to be more expressive than English or where the non-English word or phrase is used more widely.

In a representation of a reference data library in accordance with ISO 15926-2, a human-interpretable identifier is represented by an instance of **reference_data_item_human-interpretable_identification** (subclass of the ISO 15926 series entity **class_of_identification**).

Computer-interpretable references to reference data items are usually made by URI. Human-interpretable references are usually made by human-interpretable identifiers. The human-interpretable identifier for a reference data item is not necessarily unique across multiple reference data libraries. Hence, it is recommended that human-interpretable references specify the library as well as the human-interpretable identifier.

The human-interpretable identifier for a reference data item (see 3.1.14) can be represented in a spreadsheet in the column "human-interpretable identifier", as shown in the spreadsheet referenced in Annex A. The normative rules are given in 5.3. To assist a submitter of a change request (CR) to ISO/TS 15926-4, extra recommendations have been included in Annex C.

5.4 Attribute: Synonym1

A reference data item shall have a synonym for use in natural language text.

A synonym shall not be used to make a computer-interpretable reference to a reference data item.

If a synonym is used within a context, such as a language, community, or class of activity, then it is recommended that the context be stated.

The same text can be a synonym for more than one reference data item. It is recommended that the synonym be unique within a context.

A synonym cannot be used to make a computer-interpretable reference because it can identify more than one item within a reference data library and because no computer-interpretable mechanism is provided to link the synonym to a context.

NOTE 1   Synonyms can be represented in a spreadsheet in the columns "Synonym1" or "Synonym2", as shown in the spreadsheet referenced in Annex A.

In a representation of a reference data library in accordance with ISO 15926-2, a synonym is represented by an instance of **reference_data_item_alternative_human-interpretable_identifier** (subclass of ISO 15926-2 entity **class_of_identification**).

NOTE 2   The syntax of Synonym1 is the same as that of UniqueName.

NOTE 3   The maximum number of synonyms is two in a spreadsheet representation.

5.5   Attribute: Synonym2

The requirements for Synonym2 are the same as Synonym1 and are as specified in 5.4.

5.6   Attribute: TextDefinition

5.6.1   Content of a reference data item text definition

In ISO/TS 15926-4, the attribute TextDefinition of a reference data item shall be normative. A reference data item text definition shall be either:

— a reference data item text definition by explicit text, as defined in 5.6.2; or

— a reference data item text definition by explicit text taken from a source, as defined in 5.6.3; or

— a reference data item text definition by document reference, as defined in 5.6.4.

A set of reference documents shall be defined for a reference data library. If a text definition can be found within the set of reference documents, then a reference data item text definition by document reference shall be used, as defined in 5.6.5. If a text definition cannot be found in the set of reference documents, then a reference data item text definition by explicit text shall be used, as defined in 5.6.2.

For a standard reference data library, the set of reference documents is the set of documents to which a normative reference can be made. The normative rules are given in 5.6.2 and 5.6.7. To assist a submitter of a CR to ISO/TS 15926-4, extra recommendations are provided in Annex C.

5.6.2   Reference data item definition by explicit text

A text definition of a reference data item by explicit text shall be specified by reference to a source within the set of reference documents defined for a reference data library if:

— a definition cannot be found, or;

— the definition in a source is not in conformity with the requirements for a reference data item definition by text stated in 5.6.1, or;

— the source cannot be normatively referenced.

This item is only valid for a reference data library that is standard.

If a text definition of a reference data item cannot be specified by reference to a source, then it shall be specified by the explicit text.

In a representation of a reference data library in accordance with ISO 15926-2, a text definition is represented by an instance of **reference_data_item_definition_by_text** (subclass of ISO 15926-2 entity **class_of_definition**).

NOTE   The definition of a reference data item can be represented in a spreadsheet in the column "TextDefinition", as shown in the spreadsheet referenced in Annex A.

5.6.3   Reference data item text definition by explicit text taken from a source

The text shall be copied from the source document without change, except in the following circumstances:

— if permission for copying from the source cannot be obtained, then a new definition shall be created;

— if the definition in the source is not in conformity with the requirements for a reference data item definition by text stated in 5.6.1, then the definition of the source shall be adapted;

— if the definition in the source is not in conformity with the recommendations for a reference data item text definition by document reference stated in Annex C, then the definition of the source may be adapted.

Adaptation of a definition shall not change its meaning.

NOTE 1   Common reasons for adaptation are as follows:

— the terminology of the definition in the source document is different from the terminology of the reference data library;

— the definition in the source document does not separate the definitive part from informative notes and examples.

In a representation of a reference data library in accordance with ISO 15926-2, a source of a copied text definition is represented by an instance of a **source_of_text** (subclass of ISO 15926-2 entity **class_of_definition**).

NOTE 2   The source of the definition of a reference data item can be represented in a spreadsheet in the column "source", as shown in the spreadsheet referenced in Annex A.

EXAMPLE 1   The class "**widget**" is defined within ABC Company technical specification W_123. This document cannot be normatively referenced, so the text is extracted and represented explicitly.

In a reference data library implemented as an instantiation of entity types defined in ISO 15926-2, the relationship of **reference_data_item_definition_by_text** and **source_of_text** is shown in Figure 2.
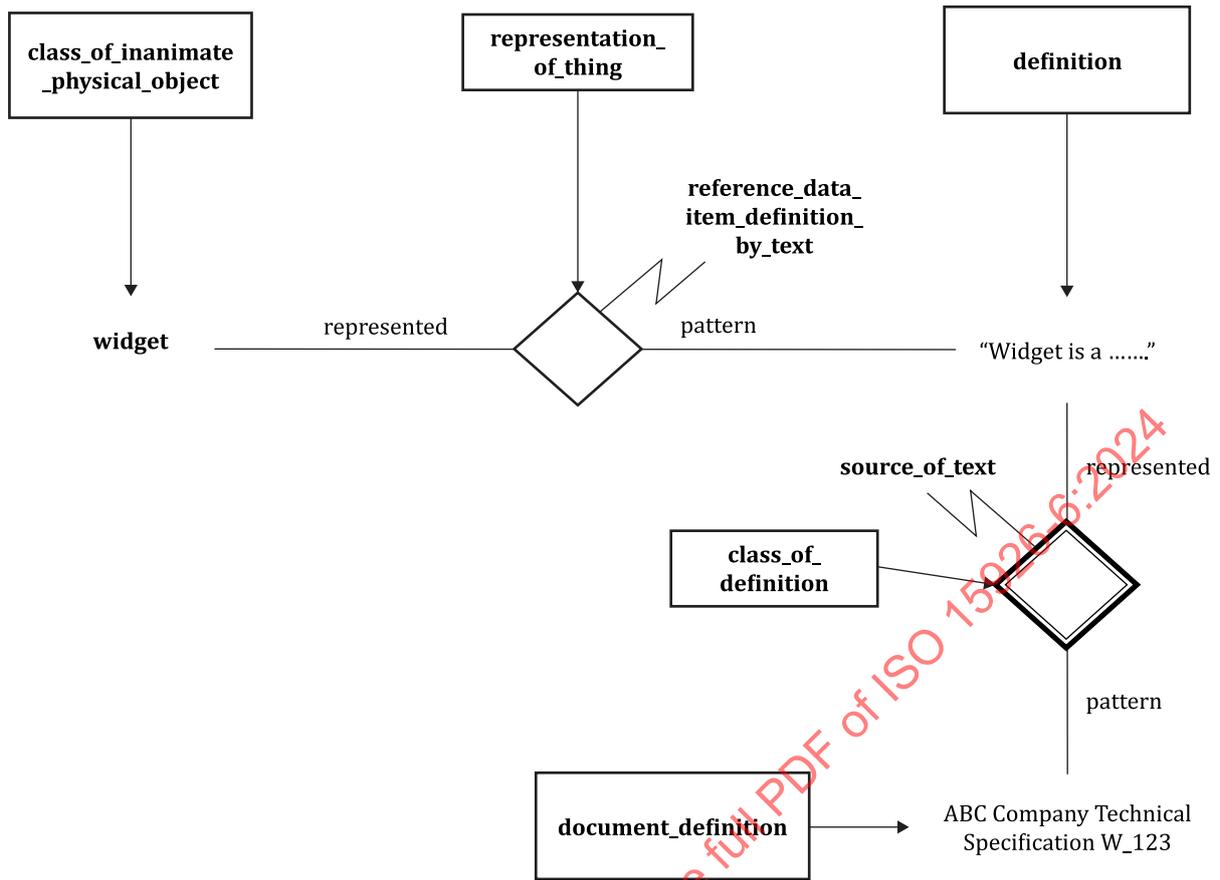
Figure 2 — Source of text as an instantiation of entity types defined in ISO 15926-2

In a representation of a reference data library in accordance with ISO 15926-2, the source of an adapted text definition is represented by an instance of the class of relationship **source_of_adapted_text**.

EXAMPLE 2   The reference data item text description for the reference data item "pipeline scraper" is as follows:

— **physical_object** that has blades or brushes and that is intended to be inserted into a "**pipeline**" for cleaning purposes;

— a "**pipeline scraper**" is pushed along a "**pipeline**" by the pressure of the "**fluid**" behind it. A "**pipeline scraper**" can clean out rust, wax, scale, and debris;

— the definition of "**pipeline scraper**" is adapted from the definition of "**pig**" in Reference [19]. **Pig** is a wider concept that also encompasses devices for inspection;

— in a reference data library implemented as an instantiation of entity types defined in ISO 15926-2, the instantiation of EXAMPLE 2 is shown in Figure 3.
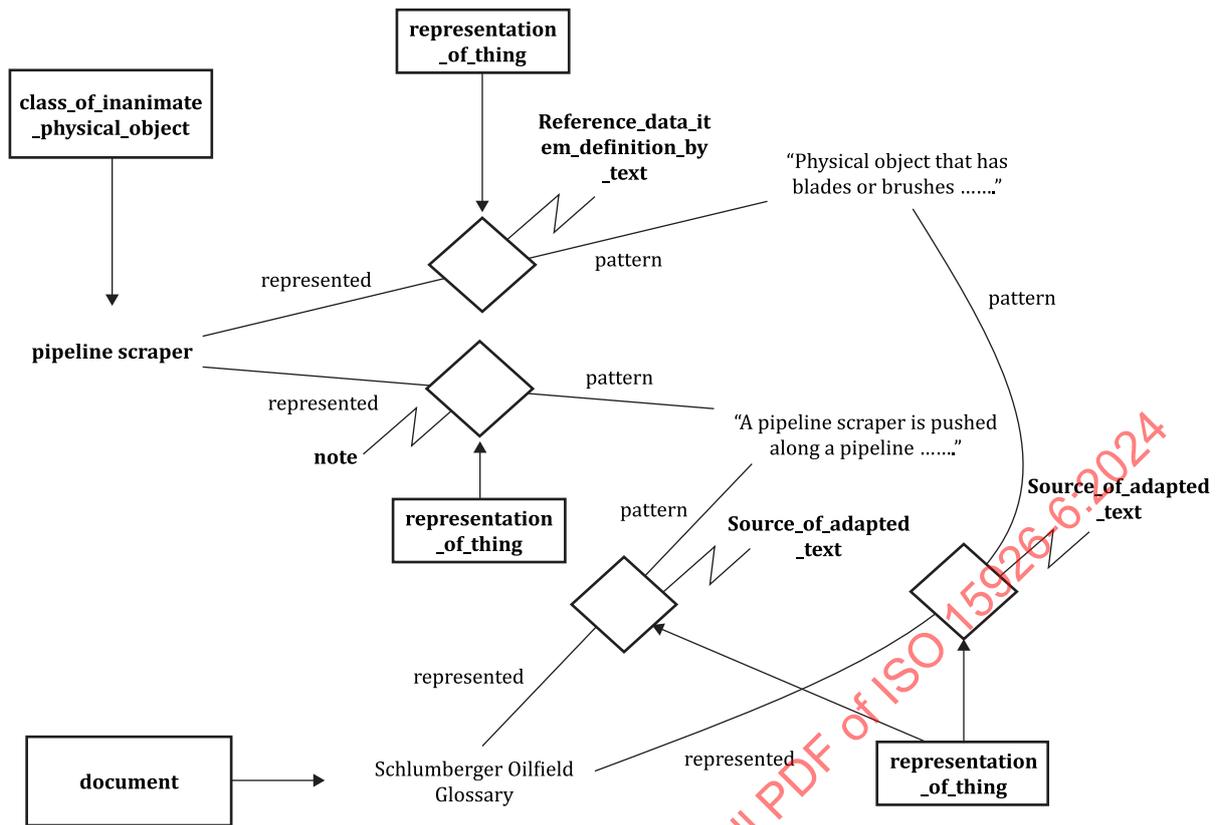
Figure 3 — Source of adapted text as an instantiation of entity types defined in ISO 15926-2

5.6.4 Reference data item text definition by document reference

A reference data item definition by document reference shall be of the form:

`<reference data item identifier within the source document>` as defined by `<source document identifier>`

NOTE 1   If the definition in the source document is concise, then the reference data item definition by text can have a note that repeats the definition.

NOTE 2   If the definition in the referenced document is not in conformity with one of the preferred forms for a reference data item definition by explicit text stated in 5.6.2, then the reference data item definition by text can have a note that gives an adapted definition.

EXAMPLE 1   The reference data item definition by text for the reference data item "**person**" is as follows:

— "**person**", as defined by ISO 10303-41:2022, 20.4.10 person;

— the referenced definition is "A **person** is an individual human being";

— a definition which is in conformity with a preferred form in this document is "**physical_object** that is a human being", and this form includes the relationship with the class **physical_object**. This relationship is also stated in computer-interpretable form as a specialization.

If a reference data item corresponds to one of the meanings of a word in the OED, then the reference data item definition by document reference shall consist of the following:

— <the word in the OED>: "<the meaning of the word specified in the OED>" as defined by `<edition of the OED>`.

EXAMPLE 2   The reference data item definition by text for the reference data item "**person**" is as follows:

— **person**: "individual human being" as defined by the OED edition X, meaning 1;

— a definition, which is in conformity with a preferred form in this document, is "**physical_object** that is a human being".

In a representation of a reference data library in accordance with ISO 15926-2:

— a text definition by document reference is represented by an instance of **reference_data_item_definition_by_document_reference** (subclass of ISO 15926-2 entity **class_of_definition**);

— the source of a normative definition is represented by an instance of **normative_source_of_definition** (subclass of ISO 15926-2 entity **class_of_definition**).

5.6.5 Requirements for a reference data item text definition

The requirements for a reference data item definition by text are as follows:

a) a reference data item definition by text shall not contain information that is not part of the definition;

EXAMPLE 1   Information about the usual material used for the construction of a class of equipment item is not be included unless this is part of the definition.

EXAMPLE 2   Information about the usual use of a class of equipment item is not be included unless this is part of the definition.

NOTE 1   Additional information can be included as notes.

b) a reference data item definition by text shall not contain a complete definition of another reference data item in the same reference data library but shall instead make reference using its human-interpretable identifier;

c) a reference data item definition by text shall make reference to other reference data items in accordance with 5.6.2;

d) a reference data item definition by text shall be stated as a descriptive phrase, clause, or one or more sentences with equations and figures as necessary;

e) except where a reference data item can be formally defined in terms of recursion, a reference data item definition by text shall not refer to the reference data item that it defines. A reference data item is not a term. Hence, the reference data item human-interpretable identifier can be used in the definition of a reference data item. If this is done, it shall be made clear that the words are understood according to their natural language meaning.

Hence, if the OED definition of the word pump was equivalent to the ISO/TS 15926-4 class "**pump**", then the class with the reference data item human-interpretable identifier "**pump**" can be defined as follows:

— "**physical_object** that is a **pump** (with the first meaning defined in the OED)".

In many cases, the reference data item human-interpretable identifier for a chemical or a drug is the complete and unambiguous definition of the reference data item. The following text can be both the reference data item human-interpretable identifier and the text definition of a reference data item:

— "N-(1-NAPTHYL)-ETHYLENEDIAMINE DIHYDROCHLORIDE";

— a reference data item text definition that specifies a physical quantity shall be formulated in accordance with ISO 80000-1;

— a reference data item text definition taken from a source which cannot be normatively referenced shall have the standard form defined in 5.6.4.

5.6.6 Use of a reference data item human-interpretable identifier in a text definition

Within a reference data item definition by text, reference to a reference data item shall be made by the reference data item human-interpretable identifier or by any other designation of the reference data item with a URI of the reference data item given in parentheses.

The requirements for the use of a reference data item human-interpretable identifier are as follows:

a) a reference data item human-interpretable identifier used within text shall be explicitly indicated;

   NOTE   A human-interpretable identifier can be indicated by one of the following methods:

   — it is in capitals;

   — it is in bold font;

   — it is within "<" and ">";

   — it is a hypertext link to a definition of the reference data item;

   — it is followed by the text "(reference data item human-interpretable identifier)".

b) a reference data item human-interpretable identifier for a class shall be interpreted as a reference to a member of the class;

   EXAMPLE 1   The following text refers to a member of the class "**impeller**":

   "where the rotation of the **impeller** is intended to create a radial pressure gradient within the **fluid**".

c) a reference to a class shall be made by text as follows:

class "`<reference data item human-interpretable identifier>`";

EXAMPLE 2   The following sentence describes the relationship between the classes with reference data item human-interpretable identifiers "**reciprocating pump**" and "**impeller**":

The class "**reciprocating pump**" is disjoint with the class "**centrifugal pump**".

d) if a reference data item human-interpretable identifier for a class has a natural language plural, then the plural shall be used to refer to more than one member of the class;

   EXAMPLE 3   The following text refers to more than one member of the class "**bolt**":

   "**joint** that is made using **bolts**".

e) if a reference data item human-interpretable identifier for a class does not have a natural language plural, then more than one member of the class shall be referred to by text of the form:

members of the class "`<reference data item human-interpretable identifier>`";

EXAMPLE 4   The following text refers to more than one member of the class "XB-57":

joint that is made using members of the class "XB-57."

The above text needs to be redrafted for the chosen option of angle brackets.

5.6.7   Standard forms for a reference data item text definition

5.6.7.1   Qualified superclass in accordance with ISO 1087

The qualified superclass form defines a class by specifying the following:

— a base superclass;

— distinguishing characteristics.

The form is as follows:

`<base superclass>` that `<text that describes the distinguishing characteristics>`

The selected base superclass shall be defined elsewhere in the reference data library. The most immediate superclass within the reference data library shall be chosen.

The distinguishing characteristics are the necessary and sufficient conditions that determine whether or not a member of the base superclass is a member of the defined class. The text may make reference to equations and figures. The necessary and sufficient conditions are often the possession of a qualitative distinguishing characteristic, such as an operating principle. The qualified superclass is a superclass in accordance with ISO 1087.

EXAMPLE 1   The definition of the class "**centrifugal pump**" is as follows:

pump that consists of an **impeller** enclosed within a **casing**, where the rotation of the **impeller** is intended to create a radial pressure gradient within the **fluid**

EXAMPLE 2   The definition of the class "**ASME class**" is as follows:

a **class** that is defined within an ASME standard

5.6.7.2   Qualified superclass as a complete sentence

The form is a variant of the form defined in ISO 1087 that is a complete sentence, as follows:

A `<defined class>` is a `<base superclass>` that `<text that describes the distinguishing characteristics>`.

EXAMPLE 1   The definition of the class "**centrifugal pump**" is as follows:

pump that consists of an **impeller** enclosed within a **casing**, where the rotation of the **impeller** is intended to create a radial pressure gradient within the **fluid**

EXAMPLE 2   The definition of the class "**ASME class**" is as follows:

class that is defined within an ASME standard

5.6.7.3   Formal relationships for definition

A class is given a formal definition by a relationship in one of the following ways:

intersection: the class S is defined by a relationship with classes $X_1, X_2, ..., X_n$ of the form:

$$S = X_1 \cap X_2 \cap ... \cap X_n$$

union: the class S is defined by a relationship with classes $X_1, X_2, ..., X_n$ of the form:

$$S = X_1 \cup X_2 \cup ... \cup X_n$$

difference: the class S is defined by a relationship with classes X and Y of the form:

$$S = X \cap \neg Y$$

image: the class S is defined by the class of relationship f and the class X, where:

— f is a function from A to B;

— X is a subclass of B;

— S consists of all members a of A, such that there exists an x in X where (a, x) is in f.

5.6.7.4   Text definition of intersection

If a class is defined as an intersection of classes, then one of the superclasses shall be regarded as the base superclass, and membership of the others shall be regarded as the necessary and sufficient conditions. In this case, the qualified superclas**s** form is:

`<superclass 1>` that is also a `<superclass 2>`

where their intersection is of more than two classes, the qualified superclass form is:

`<superclass 1>` that is also a `<superclass 2>` and a `<superclass 3>`.

EXAMPLE   The definition of the class "**control valve**" is as follows:

valve that is also a **control device**

5.6.7.5   Text definition of union

For a class that is defined as a union of classes, a common superclass of all of the classes in the union is regarded as the base superclass, and membership in one of the others is regarded as a necessary and sufficient condition. In this case, the qualified superclass form is:

`<superclass>` that is either a `<class in union 1>` or a `<class in union 2>`.

5.6.7.6   Text definition of power set

For a class that is defined as the power set of another, where the human-interpretable identifier of class A is a natural language term with a plural form, then the text definition of class A*, which is the power set of class A, shall be as follows:

`<base superclass>` that is a subclass of the class "`<human-interpretable identifier of class A>`".

EXAMPLE   The definition of the class "**heat exchanger class**" is as follows:

class that is a subclass of the class "**heat exchanger**"

5.6.7.7   Intention within a text definition

For a class of physical objects that are defined by the intended use of the members, the words "intended to" shall be used.

EXAMPLE 1   The definition of the class "**pump**" is as follows:

physical_object that is intended to impart mechanical energy to a **fluid**

NOTE   It can use a pump for something else, but this is not part of the definition.

For a class of activity that is defined by the intended outcome of the members, the words "intended to" shall be used.

EXAMPLE 2   The definition of the class "**cooling**" is as follows:

activity that is intended to reduce the temperature of a **physical_object**

5.6.7.8   List of conditions

For a class that is defined by specifying a list of necessary and sufficient conditions, the form is as follows:

a thing is a `<defined class>` if and only if:

— condition 1;

— condition 2;

— etc.

NOTE   A list of conditions form is not in conformity with ISO 1087. The form is used for classes where each condition requires a lengthy definition.

5.7   Attribute: Source

The attribute "Source" points to the source of the text definition of the reference data item. This subclause provides rules for the order of sources to be respected. A text definition for a reference data item shall be sought from the following types of source documents outside the reference data library, prioritised in the order of the following list:

— set of reference documents for the reference data library;

NOTE 1   This set of documents defines the terms commonly used by the community for which the reference data library is defined.

— ISO and IEC standards;

— other international or national standards;

EXAMPLE 1   Standards published by CEN or CENELEC.

EXAMPLE 2   Standards published by ANSI or DIN.

— standards defined by industry bodies;

EXAMPLE 3   Standards published by the American Petroleum Institute (API) or NORSOK.

— other published documents used within the industry;

NOTE 2   This set of documents includes publications by professional societies and industry groups that do not seek formal standardization, such as the Society of Manufacturing Engineers (SME) and the Association for Operations Management (APICS).

EXAMPLE 4   A widely used academic textbook.

EXAMPLE 5   A widely used glossary published by a commercial organization.

— dictionary.

EXAMPLE 6   OED.

5.8   Attribute: Notes

In a representation of a reference data library in accordance with ISO 15926-2, a note is represented by an instance of **reference_data_item_note** (subclass of ISO 15926-2 entity **class_of_description**). **Class_of_description** of ISO 15926-2 allows any representation, such as textual notes, figures, pictures, and photos, while the rule for this document restricts the representation of textual notes.

NOTE 1   A note about a reference data item can be represented in a spreadsheet in the column "Notes", as shown in the spreadsheet referenced in Annex A.

NOTE 2   A reference data item can have any number of text notes that contains information about it.

5.9   Attribute: Superclass1

The first specialized superclass of reference data item shall be defined based on the requirement in 4.5.2. The priority is proposed by the submitter of a CR. In the SC 4 Annex ST procedure[12], the Maintenance Team (MT) and the Validation Team (VT) will evaluate and validate the proposal. In this stage, it is impossible to list priorities. Much more practical experience with CRs needs to be gained.

NOTE   The maximum number of superclasses is five in a spreadsheet representation.

EXAMPLE 1   The class "**centrifugal pump**" has the class "**dynamic pump**" as a superclass.

EXAMPLE 2   The class "**shell and tube condenser**" has the classes "**condenser**" and "**shell and tube heat exchanger**" as superclasses.

5.10 Attribute: Superclass2

The second most specialized superclass of a reference data item shall be defined based on the requirement in 4.5.2.

The requirements for Superclass2 are the same as Superclass1 and are as specified in 5.9.

5.11 Attribute: Superclass3

The third most specialized superclass of a reference data item shall be defined based on the requirement in 4.5.2.

The requirements for Superclass3 are the same as Superclass1 and are as specified in 5.9.

5.12 Attribute: Superclass4

The fourth most specialized superclass of a reference data item shall be defined based on the requirement in 4.5.2.

The requirements for Superclass4 are the same as Superclass1 and are as specified in 5.9.

5.13 Attribute: Superclass5

The fifth most specialized superclass of a reference data item shall be defined based on the requirement in 4.5.2.

The requirements for Superclass5 are the same as Superclass1 and are as specified in 5.9.

5.14 Attribute: ISO15926-2Entity

A reference data item shall be classified as a member of an entity of ISO 15926-2, which shall be the entity that is the lowest possible in the ISO 15926-2 hierarchy that has the reference data item as a member.

NOTE   This allows the reference data library recorded as an instance of ISO 15926-2 entity.

EXAMPLE   The class "**centrifugal pump**" is a member of the class **class_of_inanimate_physical_object**, which is an entity in ISO 15926-2.

5.15 Attribute: Classification1

The first classification of a reference data item shall be defined based on the requirement in 4.5. The priority is proposed by the submitter of a CR. In the SC 4 Annex ST procedure[12], MT and VT will evaluate and validate the proposal.

NOTE   The maximum number of classifications is four in a spreadsheet representation.

5.16 Attribute: Classification2

The second classification of a reference data item shall be defined based on the requirement in 4.5.

The requirements for Classification2 are the same as Classification1 and are as specified in 5.15.

5.17 Attribute: Classification3

The third classification of a reference data item shall be defined based on the requirement in 4.5.

The requirements for Classification3 are the same as Classification1 and are as specified in 5.15.

5.18 Attribute: Classification4

The fourth classification of a reference data item shall be defined based on the requirement in 4.5.

The requirements for Classification4 are the same as Classification1 and are as specified in 5.15.

5.19 Attribute: Symbol

Symbol is used to represent a unit of measure. A notation of the unit of measure shall be in conformity with ISO 80000-1:2022, 7.1.4.

EXAMPLE 1   The symbol for the unit of measure "metre per second" is m/s.

EXAMPLE 2   The symbol for UniqueName "foot cubed per minute" and Synonym1 "cubic foot per minute" is ft^3/min.

EXAMPLE 3   The symbol for UniqueName "centimetre" is cm.

EXAMPLE 4   The symbol for UniqueName "centimetre squared" is cm^2.

5.20 Attribute: Operator

The value of the Operator shall be one of the following: "multiply", "divide", "factor", "exponentiate", "reciprocal" or null.

EXAMPLE   The unit of measure "metre per second" is defined by the "divide" operator with FirstOperand "metre" and SecondOperand "second".

In ISO 80000-1:2022, 7.1.3, "dyadic operators" are mentioned. Additionally, in ISO 80000-1:2022, 7.2.2, combinations of Symbols are defined. Two operands, such as FirstOperand and SecondOperand, relate to "dyadic operators".

5.21 Attribute: FirstOperand

FirstOperand shall be used for the designation of the first unit of measure in a "multiply", "divide", "factor" or "exponentiate" operation.

EXAMPLE   In the case of UniqueName "candela per square metre" and Symbol "cd/m2", "candela" is FirstOperand.

5.22 Attribute: SecondOperand

SecondOperand shall be used for the designation of the second unit of measure in a "multiply" or "divide" operation.

EXAMPLE   In the case of UniqueName "candela per square metre" and Symbol "cd/m2", "meter squared" is SecondOperand.

5.23 Attribute: Factor

According to ISO 80000-1:2022, 6.5.4, factor shall be a real number which is used to derive one unit of measure from another in a "factor" operation.

EXAMPLE   UniqueName "inch" is defined by the "factor" operator with FirstOperand "metre" and the factor 0,025 4.

5.24 Attribute: Prefix

The prefix shall be a name from the ISO 80000-1:2022 list given in Table 3 in this document to derive one unit of measure from another in a "factor" operation.

EXAMPLE   UniqueName "kilometre" is defined by the "factor" operator with the first operand "metre" and the Prefix "kilo".

The relationship between Factor and Prefix in terms of SI units is described in in ISO 80000-1:2022, 6.5.4 with Table 4 which is shown in Table 3 in this document.

Table 3 — SI prefixes

Factor	Prefix	
	Name	**Symbol**
10^{24}	yotta	Y
10^{21}	zetta	Z
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecta	h
10^{1}	deca	da

Factor	Prefix	
	Name	**Symbol**
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a
10^{-21}	zepto	z
10^{-24}	yocto	y

5.25 Attribute: Exponent

Exponent shall be an integer number used to derive one unit of measure from another in an "exponentiate" operation.

EXAMPLE   UniqueName "inch squared" is defined by the "exponentiate" Operator with FirstOperand "inch" and Exponent 2.

According to ISO 80000-1:2022, 7.2.2, exponentiation (powering) has priority over multiplication and division and over monadic operations, for example $-a^2$ is equal to $-(a^2)$, not $(-a)^2$.

According to ISO 80000-1:2022, 7.3.3, negative exponents should be avoided when the numbers are expressed with digits, except when the base is 10.

If the value of Exponent is limited to natural integers, "plus exponentiate" and "minus exponentiate" is used for the operation string.

If the value of Exponent is extended to use fractions, the square root and the cubic root are expressed with 1/2 and 1/3, respectively.

6   Representation of a reference data library

A reference data library shall be represented in a format that:

— is an implementation semantics defined by ISO 15926-2 as extended by the reference data defined in this document;

— can hold the minimum information about a reference data item defined in 4.4.2.

NOTE 1   The ISO/TS 15926-4 reference data library can be represented in different formats, as in the following:

— spreadsheet;

— a relational database;

— OWL;

— XML.

If a reference data library is published as an ISO standard, then only one format can be normative.

In practice, industrial companies that reference ISO/TS 15926-4 use the spreadsheet representation of the standard. Therefore, this document provides the rules for representing the reference data library in spreadsheets. As other representations emerge, future editions of this document will address either additional or appropriate rules for those representations, or both.

NOTE 2   The spreadsheet representation defined in <u>Annex A</u> is used in <u>Annex B</u> to represent the reference data library defined in this document.