TECHNICAL SPECIFICATION

ISO/TS 23301

First edition
2021-12

STEP geometry visualization services

Services de visualisation de la géométrie STEP

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

Reference number
ISO/TS 23301:2021(E)

© ISO 2021

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

Contents

Page

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

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.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved

Introduction

There is a confirmed opportunity for industries to have a structured approach on 3D product visualization and to enable integration of product data in visualization applications across the life cycle of the product in all areas of a company.

The integrated standard for the exchange of product model data (STEP) in the enterprise processes has great value to contribute to this goal.

Business scenarios exist related to the visualization of product data other than geometry (e.g. metadata, production data, financial data).

The ability to trustfully share, distribute, collect, store, maintain, transfer, process and present product data associated with its geometry to support business processes distributed in enterprise networks is a key component of the digital transformation of our industries.

As long as data sets are managed by a single management system, we can ensure quality and traceability of the data set. However, when data is shared with partners in a supply chain, the data sets are usually copied and extracted from their initial management system and they lose all the traceability and links with the other product data. This document provides a solution to this problem.

This document is the first of a series of documents to provide an integrated framework using the ISO 10303 series to allow the consumption of product data in supply-chains and in companies using geometries as human-computer interface to access these product data through visualization applications. This is realized by using metadata to support the audit trail of the transformation of a geometry definition, and web services based on the utilisation of these metadata. This framework can also be used for automated product data consumption by software.

Annex A contains an identifier that unambiguously identifies this document in an open information system.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

STEP geometry visualization services

1 Scope

This document defines a set of metadata to support the audit trail of the transformation of a geometry definition, while it is distributed and shared in supply-chains, to ensure the traceability of geometric model data. It also defines a set of web services based on the utilisation of these metadata.

The following are within the scope of this document:

- metadata definitions for geometry transformation audit trail:
  - syntax for storing these metadata in geometry data sets in various formats;
  - conformance level for implementers and business processes;
  - definitions of web services to query the geometric model data set and its associated metadata.

The following are outside the scope of this document:

- service specifications for CAD operations;
- specifications of a cybersecurity infrastructure to enable web services;
- the technical implementation of a STEP geometry services client or server;
- any geometric model definition;
- any product and manufacturing information (PMI) definition;
- archiving.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

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 8601-1, *Date and time — Representations for information interchange — Part 1: Basic rules*

ISO 10303-21, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*

ISO 14306, *Industrial automation systems and integration — JT file format specification for 3D visualization*

ISO 16684-1, *Graphic technology — Extensible metadata platform (XMP) — Part 1: Data model, serialization and core properties*

ISO 16684-3, *Graphic technology — Extensible metadata platform (XMP) specification — Part 3: JSON-LD serialization of XMP*

ISO 17506:—[1)], *Industrial automation systems and integration — COLLADA digital asset schema specification for 3D visualization of industrial data*

ISO/IEC 19775-1, *Information technology — Computer graphics, image processing and environmental data representation — Extensible 3D (X3D) — Part 1: Architecture and base components*

1) Under preparation. Stage at the time of publication: ISO/FDIS 17506:2021.

© ISO 2021 – All rights reserved

ECMA-404, *The JSON data interchange syntax*

3 Terms and definitions

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

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

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

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

3.1
boundary representation solid model
B-rep
type of geometric model in which the size and shape of a solid is defined in terms of the faces, edges and vertices which make up its boundary

[SOURCE: ISO 10303-42:2019, 3.1.2.5]

3.2
constructive solid geometry
CSG
type of geometric modelling in which a solid is defined as the result of a sequence of regularized Boolean operations operating on solid models

[SOURCE: ISO 10303-42:2019, 3.1.2.12]

3.3
derived geometry
geometric representation generated from another representation

Note 1 to entry: The derivation is realized by actions such as using another representation method, another format, approximations, simplification

EXAMPLE A "6-face *B-rep*" (3.1) is derived from a CSG (3.2) "solid block".

3.4
converted geometry
result of changing the data format of a geometry

Note 1 to entry: The import and export operations in a CAD system produce converted geometry.

Note 2 to entry: Converted geometry is a kind of *derived geometry* (3.3).

3.5
design intent
intentions of the designer of a model with regard to how it may be instantiated or modified

Note 1 to entry: The aspects of design intent relevant to ISO 10303-108 are concerned with the information represented in the parameters and constraints associated with a model. More generally, design intent also includes the procedural or construction history of a model, which is the subject of ISO 10303-55. All aspects of design intent influence the behaviour of a model under editing operations.

[SOURCE: ISO 10303-108, 3.7.10, modified — Changed "this part of ISO 10303" to "ISO 10303-108" in Note 1 to entry].

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

 © ISO 2021 – All rights reserved

3.6
geometry data set
serialized representation of geometry data which can be exchanged between two systems

Note 1 to entry: The geometry data set can be instantiated into a single file, a set of files, a web service payload or the result of a database query.

3.7
geometry service
web-service supporting retrieval of geometry-related data

Note 1 to entry: Geometry related data can be:

— a *geometry data set* (3.6) or one of its subsets;

— geometric properties of a geometry data;

— metadata related to a geometry data set;

— non-geometric product data related to a geometry identifier.

3.8
level of detail
LOD
description of detail and extent of geometric model information

3.9
native geometry
native CAD
data format used to write to memory using the authoring CAD application's CAD kernel

Note 1 to entry: This capability is used in order to save the *original geometry* (3.10) model as data and to reuse it without any loss with the original authoring tool.

Original geometry is often considered to be replicated only by reading the *native geometry* from memory into the CAD / modelling application using the same system, version or installation, used to initially author the *original geometry*, although even this is not guaranteed.

3.10
original geometry
geometry as defined by a modeler (human being) in a CAD tool using CAD authoring functions based on mathematical constructs

Note 1 to entry: The *original geometry* is the first initial geometry construction that holds the design intent.

Note 2 to entry: This is also often referred to as *native CAD* (3.9). However, a *native CAD* is in fact referring to the native CAD kernel and CAD format of the CAD tool manipulating the geometry. It therefore can also be any geometry derived from another CAD format.

Note 3 to entry: Geometry as initially authored in a CAD / modelling application using that tool's geometric modelling system, operations, and database. The author's design intent (3.5) as well as the characteristics and artefacts of the application's implementation of geometric and solid modelling algorithms, are present in the original geometry, thus distinguishing it from "exact geometry". *Original geometry* can take on many forms, e.g. *B-rep* (3.1), CSG (3.2), hybrid, tessellated, and be modelled using many modelling paradigms, e.g. procedural, explicit, dual, parametric features with construction history.

Note 4 to entry: While often misused and interchanged for each other, *original geometry* is distinguished from *native geometry* (3.9).

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

3.11
procedural model
generative model
history-based model
model described in terms of the operation of a sequence of procedures (which may include the solution of constraint sets), as opposed to an explicit or evaluated model which captures the end result of applying those procedures

Note 1 to entry: Although procedural models are outside the scope of ISO 10303-108, they are defined here to make an important distinction between two fundamentally different modelling approaches. The present resource is intended to be compatible with ISO 10303-55, which provides representations for the exchange of procedurally defined models.

[SOURCE: ISO 10303-108, 3.7.28, modified — Changed "this part of ISO 10303" to "ISO 10303-108"].

3.12
product and manufacturing information
PMI
non-geometric attributes in 3D CAD and Collaborative Product Development systems necessary for manufacturing product components and assemblies

Note 1 to entry: PMI may include geometric dimensions and tolerances, symbols, notes, surface finish, and material specifications.

[SOURCE: ISO 10303-62, 3.1.3.2]

3.13
tessellated geometry
geometry composed of a large number of planar tiles, usually of triangular shape

Note 1 to entry: *Tessellated geometry* is frequently used as an approximation to the exact shape of an object.

[SOURCE: ISO 10303-42, 3.1.2.47]

3.14
3D visualization
visual presentation on a screen or another media of graphical and textual three-dimensional representations of a set of data representing an object, information or results of a computational process in order to facilitate capture of the understanding of the object, for visual information sharing with users and sometimes to promote decision process by a human looking at the data visualized in a medium

[SOURCE: ISO 14306:2017, 3.1.1]

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

4 High level business scenarios

4.1 General

Geometry services can be deployed in a large variety of business scenarios. Some of them are presented below.

4.2 Check for updates

A supplier receives, from an original equipment manufacturer (OEM), a 3D Model of a part that the company has to manufacture.

During the development process, the supplier and the OEM can access the version information that the supplier has and confirm that it is the appropriate version through web services.

© ISO 2021 – All rights reserved

The following metadata shall be available: creator, name, ID and URI of the 3D Model, from the 3D model owner and from the 3D Model provider. It also needs the level of detail (LOD) of the data set to confirm that it can execute its task with the available information.

4.3 Visualization #1

A user shall perform a review and receives a metadata file.

The user queries the repository with the product Id/version in the metadata file to get the data set to load and visualize.

The query specifies the format and LOD to review.

The following metadata shall be available: ID and URI of the 3D Model from the 3D Model provider.

4.4 Visualization #2

From a large assembly data set already loaded for fast visualization, query the repository for a more detailed representation of a part with special concern [exact boundary representation (B-rep) with PMI].

The following metadata shall be available: ID and URI of the 3D Model from the 3D Model provider.

4.5 Retrieve product lifecycle management (PLM) data of a product

A user is viewing a part in visualizer software. The current data set contains only geometry.

Query the repository with the product Id/version to get PLM attributes of this product and display them in the viewer.

The following metadata shall be available: ID and URI of the 3D Model from the 3D Model owner.

4.6 Archiving

Ensure traceability from the original geometry data set in a Product Data Management (PDM) system and the geometry data set in an archiving system.

Following metadata shall be available: ID, URI, creation date, name, creator of the 3D Model from the 3D Model owner

5 Information requirements

5.1 Review of geometry, topology and shape definitions

The concepts defined below are extracted from ISO 10303-41, ISO 10303-42, ISO 10303-43.

This document considers a geometry data set as a collection of geometric models as defined in ISO 10303-42.

The geometric models in ISO 10303-42 provide data specifications describing the precise size and shape of three-dimensional solid objects. The geometric shape models provide a complete representation of the shape, which in many cases includes both geometric and topological data. Included here are the two classical types of solid model, constructive solid geometry (CSG) and B-rep. Tesselation is another common representation for geometry which provides light-weight data sets but is less accurate than the two previous solid model types but which other entities, providing a rather less complete description of the geometry of a product, and with less consistency constraints, are also included.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

The geometric models are composed of geometric and topological data. Their primary application is for explicit representation of the shape or geometric form of a product model. The shape representation has been designed to facilitate stable and efficient communication when mapped to a physical file.

The geometry is exclusively the geometry of parametric curves and surfaces. It includes the point, curve and surface entities and other entities, functions and data types necessary for their definition. A common scheme has been used for the definition of both two-dimensional and three-dimensional geometry. All geometry is defined in a coordinate system which is established as part of the context of the item which it represents.

The topology is concerned with connectivity relationships between objects rather than with the precise geometric form of objects. ISO 10303-42 defines the basic topological entities and specialized subtypes of these. In some cases, the subtypes have geometric associations. Also included are functions, particularly constraint functions, and data types necessary for the definitions of the topological entities.

In addition to the geometric models, other product related information can be instantiated in a geometry data set, e.g. saved view and display attributes, e.g. colour, transparency, texture, PMI represented as graphical geometry helpers or semantic metadata, links to product metadata.

5.2 Geometry data set definition

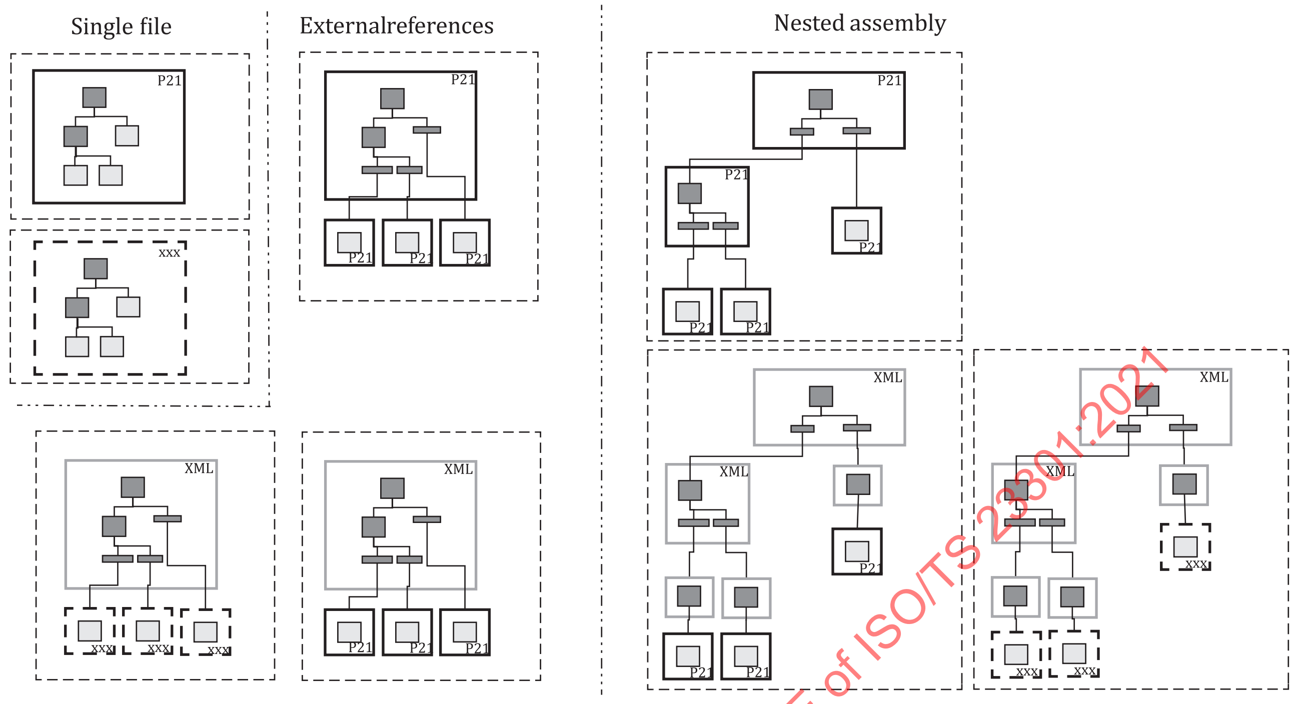
The geometry data set (3.6) is a collection of models as defined in ISO 10303-42 with or without assembly structure. In addition to the geometric models, other product related information can be instantiated in a geometry data set, e.g. PMI represented as graphical geometry helpers or semantic metadata, links to product metadata.

The geometry data set can be instantiated into a single file, a set of files (see Figure 1), a web service payload or by the result of a database query.

EXAMPLES Simple shape CSG, simple shape B-rep, complex part without PMI, complex part with PMI, assembly of parts with tessellated shapes and PMI.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

 © ISO 2021 – All rights reserved



Key

- product
- reference to product or part
- part (geometry)
- STEP P21 file
- STEP XML file
- other file
- data set

Figure 1 — Examples of geometry data set file organization

5.3 Metadata for STEP geometry services

5.3.1 General

Geometry data sets can be linked together as long as they are under the management of a single PLM system. This allows audit trails and transformation processes to be controlled.

Once a geometry data set is taken out of a PLM system, the traceability to the evolution of this data set is lost. There is a need for a mechanism that allows keeping track of the geometry data set origins and evolutions. Figure 2 illustrates how the metadata are added when a geometry data set leaves the management system of the original geometry data set owner and is modified by other actors before arriving in a destination system.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

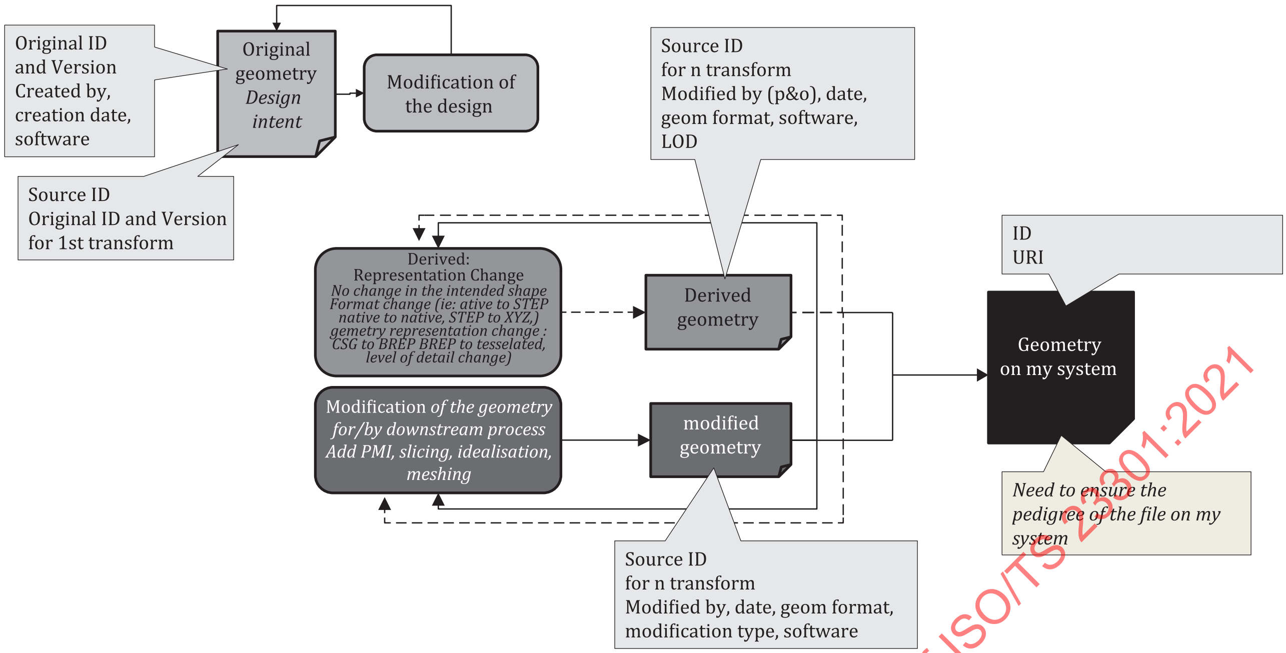


Figure 2 — Updates of metadata

In addition to data traceability, information searching and big data analysis, especially in the web environment, benefit from using semantic metadata to index information from geometry data sets in a multiplicity of formats.

5.3.2 XMP

Metadata shall be represented in Extensible Markup Language (XML) and the grammar of the XML representing the metadata shall be defined according to the extensible metadata platform (XMP) specification ISO 16684-1. XMP is a technology for embedding metadata into documents and was first published in ISO 16684-1 in 2012.

5.3.3 Included namespaces

XMP metadata is organized in namespaces (ISO 16684-1:2019, 6.2) and may include properties from one or more namespace. There is no requirement that all properties from a namespace must be present. The following namespaces definitions are included in this document:

Namespace	Property
Dublin Core	dc:contributor dc:creator dc:format dc:title
XMP basic	xmp:CreateDate xmp:CreatorTool xmp:ModifyDate
XMP media management	xmpMM: InstanceID xmpMM:DocumentID xmpMM:OriginalDocumentID

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved

5.3.4 sgs namespace

This document describes the STEP geometry services namespace that contains the additional characteristics needed to satisfy the audit trail requirement.

— The field namespace URI is `https://standards.iso.org/iso/ts/23301/`

— The preferred field namespace prefix is sgs

Namespace	Property
STEP Geometry Services	sgs:level-of-detail sgs:modification-type sgs:modification-comments sgs:original-URI sgs:SHA3-256 sgs:source-URI

Table 1 — Metadata name and description

23301 name	XMP	Description
created-by	dc:creator	Reference of the organization responsible for the original geometry data set.
creation-date	xmp:CreateDate	Validation date of the original geometry data set.
format	dc:format	Reference to the standards serialization format of the current data set, mime-type.
id	xmpMM:InstanceID	Uniquely identifies the current geometry data set in the management system of the organisation modifying the data set. Different versions of geometry data set must have different **InstanceID** but may have the same **DocumentID**.
Level-of-detail	sgs:level-of-detail	Multi-valued enumeration describing the type LOD of the geometry as defined in the geometry descriptions of EN 17412-1 Reference Data Library http://standards/iso.org/iso/23301/rdl/23301.owl classes shall be used to specify this attribute. Annex C describes the valid values, their identifications and their definitions.
modification-type	sgs:modification-type	Multi-valued enumeration describing the type of the modifications, transformations or additions made to the data set. The valid values for this enumeration are defined in the ISO 23301 (this document) Reference Data Library in http://standards/iso.org/iso/23301/rdl/23301.owl. Annex B describes the valid values, their identifications and their definitions.
modification-comments	sgs:modification-comments	Free text providing details on the modification.
modified-by	dc:contributor	Reference of the organization responsible for the last modification of the geometry data set.
modified-date	xmp:ModifyDate	Last modification date of the geometry data set as defined in the management system of the organization modifying the data set.
name	dc:title	Name of the geometry data set.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved

Table 1 *(continued)*

23301 name	XMP	Description
original-id	xmpMM:OriginalDocumentID	Identifier of the geometry data set in the management system of the organisation issuing the original geometry representing the design intent. This value links a geometry data set to its original source.
original-URI	sgs:original-URI	URI to the **OriginalDocumentID**
software	xmp:CreatorTool	Software used to generate the current data set.
source-id	xmpMM:DocumentID	Uniquely identifies the geometry data issued by the management system of the organisation which has provided the data set. Different versions of a geometry data set may have the same **DocumentID.**
source-URI	sgs:source-URI	URI of the **DocumentID**
SHA3-256	sgs:SHA3-256	Hash key of the geometry data set.

The data format for each metadata value is defined in Table 2.

In the metadata sets the URI elements have two specific purposes within a distributed services architecture that operates on STEP defined geometry.

One purpose is to ensure integrity and validity of the product of the service, giving the user of the service confidence that the correct and expected input was used to the service. A common use case would be a product whose geometric definition changes with successive revisions. Each revision should have a unique URI that both the producer of the original data and the user of the service can agree on; the knowledge of this URI can be shared even if the service user does not have authority to view the original data. The service user can examine the metadata packet, either embedded in the product or in a sidecar file, to verify that the correct revision was used as original data.

An additional purpose of the metadata is to allow the service user to retrieve the original data. In this case, the URI identifier, should also be a URL. As a global URL, it is irrelevant to the user whether the URL is served by the same service provider or by another data provider. The use case for which this purpose is applicable is a search application in which the service product is used to determine if the original data should be retrieved. A specific case is a 3D visualization application that allows a user to select a product part and retrieve the original geometry for further analysis.

5.4 Cybersecurity context and requirements

The specifications shall be implemented within the industry cybersecurity context and requirements needed for a specific use case.

This document does not specify any cybersecurity requirements related to the implementation of this document.

The specification of the web services in Clause 7 shall be associated with a cybersecurity infrastructure

6 Implementation requirements

6.1 General principles

The metadata shall be provided as a set of property-value pairs within the data set, either embedded in the files forming the data set, using the geometry description format chosen for data serialization, or in a separate file called sidecar file in XMP format.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

 © ISO 2021 – All rights reserved

The following clauses describe how to implement the metadata either in a sidecar file or embedded in existing standards format.

6.2 XMP sidecar file

When the geometry description format cannot embed the metadata, an XMP “sidecar” file can be used to store and transfer the metadata. This XMP file can also be used when the geometry files already exist in the repository and cannot or should not be modified.

The sidecar file can include a SHA3-256 hash key of the geometry data set. This hash shall not be computed on a set of files which includes the side car file. It shall only cover the geometry files.

An example of the sidecar file is available in Annex C.

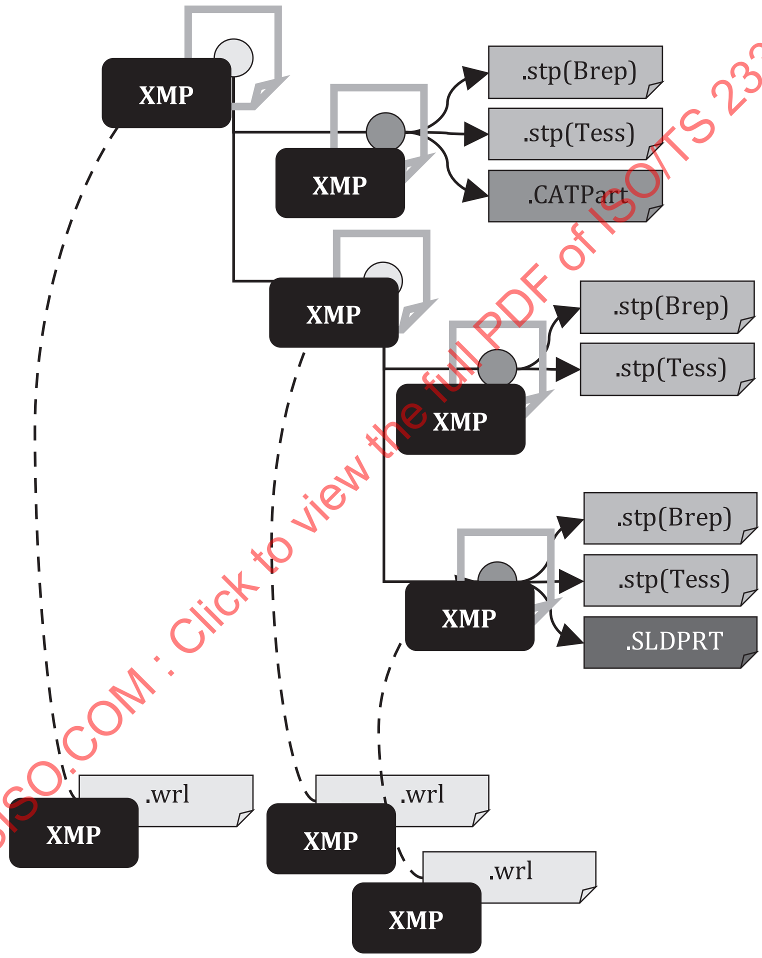


Figure 3 — XMP sidecar files with fully shattered assembly

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

6.3 ECMA-404 JSON

For a geometry data set serialized as JSON format, the metadata shall conform to ISO 16684-3.

6.4 ISO 10303-21

For ISO 10303-42 and ISO 10303-242 geometries in ISO 10303-21 ASCII implementations, metadata shall be defined either in:

— the ANCHOR section of the ISO 10303-21 file as simple type anchor items. An example is provided in Annex D;

© ISO 2021 – All rights reserved

— or XMP sidecar file.

6.5 10303 XML implementations

Use XMP sidecar file.

6.6 QIF-XML

The following XML schema shall be referenced by the data that shall be provided as a set of property-value pairs in the header part of the data set, using the geometry description format chosen for data serialization.

Use XMP sidecar file.

6.7 ISO/IEC 19775-1 (X3D)

The metadata are contained in a MetadataSet element. This MetadataSet element shall be a child node of the X3D CADAssembly node containing the converted geometry data set.

Each metadata is represented by a MetadataString element with a containerField attribute set to "value", the name attribute to the metadata name and the value attribute to the value of the metadata.

NOTE 1 The complete specification of the X3D Metadata Nodes is available at https://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/components/core.html#Metadata

NOTE 2 The complete specification of the X3D CADGeometry Component is available at https://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/components/CADGeometry.html

An example of the metadata implementation in X3D is available in Annex E.

6.8 ISO 17506 (Collada)

Use XMP side car

6.9 3D PDF

XMP metadata format is used to store the metadata in a 3D PDF data set.

Provide the instantiation of the metadata using XMP.

6.10 ISO 14306

Use XMP side car.

7 Geometry services specification

7.1 Description

A service in conformance with this document provides access to the following resources:

— geometry data set or one of its subsets;

— geometric properties of a geometry data set;

— metadata related to a geometry data set;

— non-geometric product data related to a geometry identifier.

EXAMPLE

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

 © ISO 2021 – All rights reserved

Give me the 3D visualization representation of this STEP part with this ID. Is the 3D visualization format [AP242|X3D|JT|Colada]?

Tell me what the visualization formats are that you can deliver to me for this part?

Give information (quality metadata) about this geometry data set.

The pilot described in Annex F was used to demonstrate the applicability of the web services.

7.2 REST API

There are three types of responses:

— a single geometry file with ISO 23301 (this document) metadata and the mime-type of the file;

— an AP242 XML product data file without geometry;

— an AP242 XML product data file with external references to geometry file (with ISO/TS 23031 metadata).

The query can include the response mime-type for single geometry files.

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

7.3 Service definition

```
Service 1       : get_data_set (list of identifiers)
  Purpose       : Get a set of parts of the identifiers specified
  HTTP request : GET {base_url}/parts
  Parameters    :    part-ids: List<uuid>
                     with-geom-models: List<geom-model-type>
                     with-sub-parts: Boolean
                     with-meta-data: Boolean
                     start-index: integer
                     page-size: integer
  Request Body : Filtering conditions (any): JSON
  Response Body: ZIP file containing stpx and requested parts

Service 2       : get_dataset(http://mycompanyname/uuid)
  Purpose       : Get a part of the identifier specified
  HTTP request : GET {base_url}/parts/{part_id}
  Parameters    :    with-geom-models: List<geom-model-type>
                     with-sub-parts: Boolean
                     sub-parts-depth: integer
                     with-meta-data: Boolean
  Request Body : N/A
  Response Body: ZIP file containing stpx and requested parts

Service 3       : get_data_set(http://mycompanyname/uuid/top1/child2/grandchild3)
  Purpose       : Get a part that is located in the path as specified in            an
assembly of the identifier specified.
  HTTP request : GET {base_url}/parts/{part_id}
  Parameters    :    with-geom-models: List<geom-model-type>
                     with-sub-parts: Boolean
                     sub-parts-depth: integer
                     with-meta-data: Boolean
  Request Body : Filtering conditions (Path in the assembly {part_id})
  Response Body: ZIP file containing stpx and requested parts

Service 4       : get_data_set(http://mycompanyname/uuid/*)
  Purpose       : Get all parts in an assembly of the identifier specified.
  HTTP request : GET {base_url}/parts/{part_id}
  Parameters    :    with-geom-models: List<geom-model-type>
                     with-sub-parts: boolean = TRUE
                     sub-parts-depth: integer
                     with-meta-data: Boolean
  Request Body : N/A
  Response Body: ZIP file containing stpx and requested parts

Service 5       : get_data_set(identifier, filter, format)
```

© ISO 2021 – All rights reserved

```
  Purpose      : Get all parts filtered and of format as specified in an assembly of the
identifier specified.
  HTTP request : GET {base_url}/parts/{part_id}
  Parameters   :    with-geom-models: List<geom-model-type>
                    with-sub-parts: Boolean
                    sub-parts-depth: integer
                    with-meta-data: Boolean
  Request Body : Filtering conditions (any): JSON
  Response Body: ZIP file containing stpx and requested parts

Service 6      : get_data_set( identifier, in bouding box, format)
  Purpose      : Get all parts in the bounding box and of format as specified in an
assembly of the identifier specified.
  HTTP request : GET {base_url}/parts/{part_id}
  Parameters   :    with-geom-models: List<geom-model-type>
                    with-sub-parts: Boolean
                    sub-parts-depth: integer
                    with-meta-data: Boolean
  Request Body : Filtering conditions (Bounding box): JSON
  Response Body: ZIP file containing stpx and requested parts

Service 7      : get_data_set(identifier, PDM query filter, format)
  Purpose      : Get all parts filtered by "PDM query filter" and of format as specified
in an assembly of the identifier specified.
  HTTP request : GET {base_url}/parts/{part_id}
  Parameters   :    with-geom-models: List<geom-model-type>
                    with-sub-parts: Boolean
                    sub-parts-depth: integer
                    with-meta-data: Boolean
  Request Body : Filtering conditions (PDM query filter): JSON
  Response Body: ZIP file containing stpx and requested parts

Service 8      : get_child(identifier)
  Purpose      : Get direct child parts of an assembly of the identifier specified.
  HTTP request : GET {base_url}/parts/{part_id}
  Parameters   :    with-geom-models: List<geom-model-type>
                    with-sub-parts: boolean = TRUE
                    sub-parts-depth: integer = 1
                    with-meta-data: Boolean
  Request Body : Filtering conditions (PDM query filter): JSON
  Response Body: ZIP file containing stpx and requested parts

Service 9      : get_geom_property(identifier)
  Purpose      : Get geometry properties of the types specified of a part of the
identifier specified.
  HTTP request : GET {base_url}/parts/{part_id}/geom-props
                 GET {base_url}/parts/{part_id}/geom-props/center-of-gravity
                 GET {base_url}/parts/{part_id}/geom-props/bounding-box
                 GET {base_url}/parts/{part_id}/geom-props/surface-area
                 GET {base_url}/parts/{part_id}/geom-props/volume
  Parameters   :    N/A
  Request Body : N/A
  Response Body: Property value(s): JSON

Service 10     : get_property(identifier)
  Purpose      : Get properties of the types specified of a part of the identifier
specified.
  HTTP request : GET {base_url}/parts/{part_id}/properties
                 GET {base_url}/parts/{part_id}/properties/material
                 GET {base_url}/parts/{part_id}/properties/texture
                 GET {base_url}/parts/{part_id}/properties/color
  Parameters   :    N/A
  Request Body : N/A
  Response Body: Property value(s): JSON

Service 11     : get_meta_data(identifier)
  Purpose      : Get meta data of a part of the identifier specified
  HTTP request : GET {base_url}/parts/{part_id}/meta-data
  Parameters   :    with-sub-parts: Boolean
  Request Body : N/A
  Response Body: ZIP file containing XMP file(s)
```

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved

8 Conformance requirements

The following table provides the conformance requirements level. The requirement levels are cumulative.

— Conformance level 1 shall provide all metadata values for level 1.

— Conformance level 2 shall provide all metadata values for level 1 and level 2.

— Conformance level 3 shall provide all metadata values for level 1, level 2 and level 3.

— Conformance level 4 shall provide all metadata values for level 1, level 2 and level 3 in a sidecar with a hash key of the data set.

Table 2 — Metadata format and conformance level

Metadata name	Conformance	Format
created-by	level1	UTF-8
creation-date	level1	ISO 8601-1
format	level3	UTF-8
id	level1	UTF-8
level-of-detail	level3	enumeration of UTF-8
modification-type	level3	enumeration of UTF-8
modification-comments	level3	UTF-8
modified-by	level2	UTF-8
modified-date	level2	ISO 8601-1
name	level1	UTF-8
original-id	level1	UTF-8
original-URI	level1	UTF-8
software	level3	UTF-8
source-id	level1	UTF-8
source-URI	level1	UTF-8

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved

Annex A
(informative)

Information object registration

To provide for unambiguous identification of an information object in an open system, the object identifier

{iso standard 23301 version (1)}

is assigned to this document. The meaning of this value is defined in ISO/IEC 8824-1 and is described in ISO 10303-1.

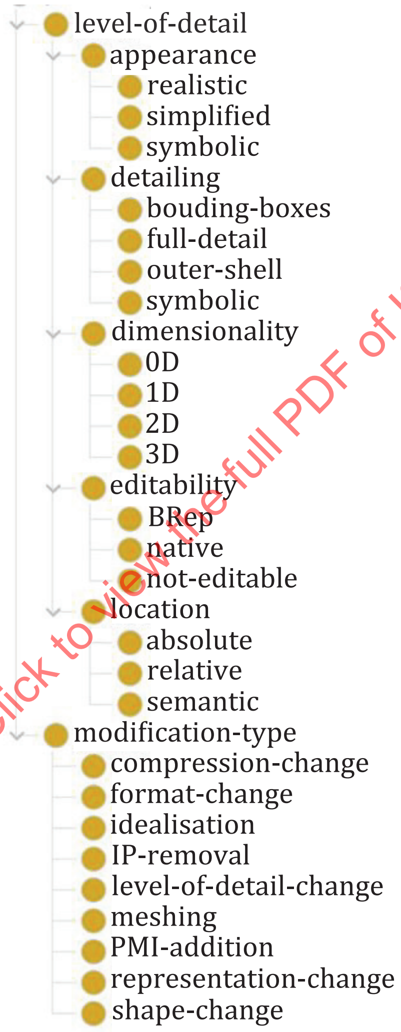
STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved

Annex B
(informative)

Reference Data Library (RDL) listing

The RDL for this document is represented in Figure B.1 and available in OWL syntax.



STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

Figure B.1 — RDL data structure for this document


```
<?xml version="1.0"?>
<rdf:RDF xmlns="https://standards.iso.org/10303/rdl/23301#"
     xml:base="https://standards.iso.org/10303/rdl/23301"
     xmlns:owl="http://www.w3.org/2002/07/owl#"
     xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:xml="http://www.w3.org/XML/1998/namespace"
     xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
     xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
    <owl:Ontology rdf:about="https://standards.iso.org/10303/rdl/23301"/>

    <!--
    ///////////////////////////////////////////////////////////////////////////////////////
//
    //
```

```
    // Classes
    //
    ///////////////////////////////////////////////////////////////////////////////////////
//
     -->

    <!-- http://standards.iso.org/10303/rdl/23301#BRep -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#BRep">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#editability"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#IP-removal -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#IP-removal">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>modificaaiton which removes industrial property inforamtion for a
dataset. EXAMPLE: transforming an exact geometry with features as a BREP with explicit
shapes definitions</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#PMI-addition -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#PMI-addition">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>addition of PMI to the dataset</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#absolute -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#absolute">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#location"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#appearance -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#appearance">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/rdl/23301#level-of-
detail"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#bouding-boxes -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#bouding-boxes">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#detailing"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#compression-change -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#compression-change">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>modification of the compression algorithm applied to the dataset</
rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#detailing -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#detailing">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/rdl/23301#level-of-
detail"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#dimensionality -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#dimensionality">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/rdl/23301#level-of-
detail"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#editability -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#editability">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/rdl/23301#level-of-
detail"/>
    </owl:Class>
```

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

 © ISO 2021 – All rights reserved

```
    <!-- http://standards.iso.org/10303/rdl/23301#format-change -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#format-change">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>modification of the serialisation format of the dataset. EXAMPLE: a
CAD native dataset is translated in the ISO 10303-242 in p21 format. a 10303-242 p21
dataset is transformed in 10303-242 xml + p21</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#full-detail -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#full-detail">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#detailing"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#idealisation -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#idealisation">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>optimisation of the shape to answer the business needs , maily for
simulation and analysis purpose</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#level-of-detail -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#level-of-detail"/>

    <!-- http://standards.iso.org/10303/rdl/23301#level-of-detail-change -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#level-of-detail-
change">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>modification of the dataset level of detail</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#location -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#location">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/rdl/23301#level-of-
detail"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#meshing -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#meshing">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>geometric dataset has been transformed into a mesh</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#modification-type -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#modification-type">
        <rdfs:comment>the type of the modifications, transformations or additions made to
a data set</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#native -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#native">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#editability"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#not-editable -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#not-editable">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#editability"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#outer-shell -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#outer-shell">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#detailing"/>
    </owl:Class>
```

STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved

```
    <!-- http://standards.iso.org/10303/rdl/23301#realistic -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#realistic">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#appearance"/>
        <rdfs:label xml:lang="en">realistic</rdfs:label>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#relative -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#relative">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#location"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#representation-change -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#representation-change">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>modification of the representation. this can include change of
geometry type like 2D or 3D , CSG or BREP, tesselation,</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#semantic -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#semantic">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#location"/>
        <rdfs:isDefinedBy>description of the complexity of the object geometry compared to
the real-world
object. This is expressed as a continuum ranging from symbolic over simplified to
detailed.
More refined geometric representations can contain more features, and/or be more
decomposed, thereby being a better approximation of the shape of the real-world object.
EXAMPLE 1: For facility management purposes the detailing of a boiler can be symbolic as a
box including the volume of the operational space.
EXAMPLE 2: For clash detection purpose the detailing of a boiler can be simplified and
reduced to outer shell.
EXAMPLE 3: For visualisation purpose the detailing of a boiler can use the detailed
geometry from the manufacturer.</rdfs:isDefinedBy>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#shape-change -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#shape-change">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#modification-type"/>
        <rdfs:comment>the shape of the geometry has been changed</rdfs:comment>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#simplfied -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#simplfied">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#appearance"/>
        <rdfs:label xml:lang="en">simplified</rdfs:label>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#symbolic -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#symbolic">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#appearance"/>
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#detailing"/>
        <rdfs:label xml:lang="en">symbolic</rdfs:label>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#0D -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#0D">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#dimensionality"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#1D -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#1D">
```


STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

 © ISO 2021 – All rights reserved

```
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#dimensionality"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#2D -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#2D">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#dimensionality"/>
    </owl:Class>

    <!-- http://standards.iso.org/10303/rdl/23301#3D -->
    <owl:Class rdf:about="http://standards.iso.org/10303/rdl/23301#3D">
        <rdfs:subClassOf rdf:resource="http://standards.iso.org/10303/
rdl/23301#dimensionality"/>
    </owl:Class>
</rdf:RDF>
<!-- Generated by the OWL API (version 4.5.9.2019-02-01T07:24:44Z)
https://github.com/owlcs/owlapi -->
```


STANDARDSISO.COM : Click to view the full PDF of ISO/TS 23301:2021

© ISO 2021 – All rights reserved