INTERNATIONAL
STANDARD

ISO
10303-521

First edition
2003-03-01

Industrial automation systems and integration — Product data representation and exchange —

Part 521:
Application interpreted construct: Manifold subsurface

Systèmes d'automatisation industrielle et intégration — Représentation et échange de données de produits —

Partie 521: Construction interprétée d'application: Surface complexe à topologie non eulérienne

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

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.

ISO 10303-521 was prepared by Technical Committee ISO/TC 184/SC 4, *Industrial automation systems and integration,* Subcommittee SC 4, *Industrial data.*

This International Standard is organised as a series of parts, each published separately. The structure of this International Standard is decribed in ISO 10303-1.

Each part of this International Standard is a member of one of the following series: decription methods, implementation methods, conformance testing methodology and framework, integrated generic resources, integrated application resources, application protocols, abstract test suites, application interpreted constructs, and application modules. This part is a member of the application interpreted construct series.

A complete list of parts of ISO 10303 is available from Internet:

<http://www.tc184-sc4.org/titles/STEP_Titles.rtf>

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Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing products throughout their life cycle. This mechanism is suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and as a basis for archiving.

This part of ISO 10303 is a member of the application interpreted construct series. An application interpreted construct (AIC) provides a logical grouping of interpreted constructs that supports a specific functionality for the usage of product data across multiple application contexts. An interpreted construct is a common interpretation of the integrated resources that supports shared information requirements among application protocols.

This document specifies the application interpreted construct for manifold subsurface. This provides the definition of a shape representation containing open shells, each of which is identified as being part of another open or closed shell. The shells are defined using faces with explicit topology and fully defined geometry. The faces of the shells defined in this AIC either use the **advanced_face** definition from ISO 10303-511, or have similar properties.

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Industrial automation systems and integration — Product data representation and exchange —

Part 521: Application interpreted construct: Manifold subsurface

1   Scope

This part of ISO 10303 specifies the interpretation of the integrated resources to satisfy the requirement for the definition of a shape representation containing open shells defined as connected face sub sets. The domain of each connected face sub set is part of the domain of another open, or closed shell. Within the connected face sub set individual faces or edges may be identified as being subfaces, or subedges.

The following are within the scope of this part of ISO 10303:

— 3D geometry;

— advanced faces;

— connected face sub sets;

— mappings and geometric transformations;

— open shells;

— relationships between domains of topological objects;

— subedges;

— subfaces;

— unbounded geometry with associated topological boundaries;

— use of topology to bound geometric entities.

The following are outside the scope of this part of ISO 10303:

— 2D geometry other than for the definition of a pcurve in the parameter space of a surface;

— boundary representation solid models;

— bounded curves other than polylines and B-spline curves;

— bounded surfaces other than B-spline surfaces;

— non-manifold geometry;

— offset curves and surfaces;

— unbounded geometry without topological boundaries.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8824-1: 1998, *Information technology - Abstract syntax notation one (ASN.1) Part 1: Specification of basic notation*

ISO 10303-1: 1994, *Industrial automation systems and integration - Product data representation and exchange - Part 1: Overview and fundamental principles*

ISO 10303-11: 1994, *Industrial automation systems and integration - Product data representation and exchange - Part 11: Description methods: The EXPRESS language reference manual*

ISO 10303-41: 2000, *Industrial automation systems and integration - Product data representation and exchange - Part 41: Integrated generic resource: Fundamentals of product description and support*

ISO 10303-42: 2000, *Industrial automation systems and integration - Product data representation and exchange - Part 42: Integrated generic resource: Geometric and topological representation*

ISO 10303-43: 2000, *Industrial automation systems and integration - Product data representation and exchange - Part 43: Integrated generic resource: Representation structures*

ISO 10303-202: 1995, *Industrial automation systems and integration - Product data representation and exchange - Part 202: Application protocol: Associative draughting*

ISO 10303-511: 2001, *Industrial automation systems and integration - Product data representation and exchange - Part 511: Application interpreted construct: Topologically bounded surface*

3 Terms, definitions and abbreviations

3.1 Terms defined in ISO 10303-1

For the purposes of this part of ISO 10303, the following terms defined in ISO 10303-1 apply.

— application;

— application context;

— application protocol;

— implementation method;

— integrated resource;

— interpretation;

— product data.

3.2 Terms defined in ISO 10303-42

For the purposes of this part of ISO 10303, the following terms defined in ISO 10303-42 apply.

— arcwise connected;

— axi-symmetric;

— boundary;

— bounds;

— coordinate space;

— curve;

— domain;

— extent;

— open curve;

— orientable;

— surface;

— topological sense.

3.3   Terms defined in ISO 10303-202

For the purposes of this part of ISO 10303, the following term defined in ISO 10303-202 applies.

—   application interpreted construct.

3.4   Terms defined in ISO 10303-511

For the purposes of this part of ISO 10303, the following term defined in ISO 10303-511 applies.

—   advanced face.

3.5   Other definitions

3.5.1
Connected face subset
set of arcwise connected faces whose domain is a portion of the domain of an existing connected face set

NOTE 1   In this part of ISO 10303 a connected face subset is also required to be of type open shell.

3.5.2
manifold subsurface shape representation
shape representation containing connected face sub sets in the form of open shells

NOTE 1   Each open shell has a domain that is part of the domain of another connected face set. The faces of the connected face sub set may be defined as subfaces.

3.5.3
subedge
edge whose domain is a connected portion of the domain of another edge

3.5.4
subface
face whose domain is a connected portion of the domain of another face

NOTE 1   In this part of ISO 10303 a subface has a domain which is part of the domain of an advanced face.

3.6   Abbreviations

For the purposes of this part of ISO 10303, the following abbreviations apply.

  AIC   Application Interpreted Construct
  AP   Application Protocol

4 EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources and contains the types, entity specializations, and functions that are specific to this part of ISO 10303.

NOTE 1   There may be subtypes and items of select lists that appear in the integrated resources that are not imported into the AIC. Constructs are eliminated from the subtype tree or select list through the use of the implicit interface rules of ISO 10303-11. References to eliminated constructs are outside the scope of the AIC. In some cases, all items of the select list are eliminated. Because AICs are intended to be implemented in the context of an application protocol, the items of the select list will be defined by the scope of the application protocol.

This application interpreted construct provides a consistent set of geometric and topological entities for the definition of manifold subsurface shape representation. Faces may be advanced faces or subfaces referencing an advanced face. Edges are required to be subedges, or, to have their geometry defined by curves. The highest level entity in this AIC is **manifold_subsurface_shape_representation** which is a specialised type of **shape_representation** (see ISO 10303-41). The rules on this entity ensure that the topology and geometry are fully defined.

NOTE 2   This AIC uses all the entities and types from the topologically bounded surface AIC (**aic_topologically_bounded_surface**). ISO 10303-511 should be referred to in order to obtain the complete data set.

EXPRESS specification:

```
*)
 SCHEMA aic_manifold_subsurface;
  USE FROM aic_topologically_bounded_surface; -- ISO 10303-511

  USE FROM geometry_schema    -- ISO  10303-42
      (cartesian_transformation_operator_3d);
  USE FROM topology_schema  -- ISO  10303-42
      (closed_shell,
       connected_face_set,
       connected_face_sub_set,
       face,
       open_shell,
       subedge,
       subface);

  USE FROM representation_schema(mapped_item);   -- ISO  10303-43

  USE FROM product_property_representation_schema   -- ISO  10303-41
      (shape_representation);
 (*
```

NOTE 3   The schemas referenced above can be found in the following parts of ISO 10303:

`geometry_schema`	ISO 10303-42: 2000
`topology_schema`	ISO 10303-42: 2000
`representation_schema`	ISO 10303-43
`product_property_representation_schema`	ISO 10303-41
`aic_topologically_bounded_surface`	ISO 10303-511

4.1 Fundamental concepts and assumptions

The following entities[1] are intended to be independently instantiated in the application protocol schemas that use this AIC:

— advanced_face [511];

— axis2_placement_2d [511];

— axis2_placement_3d [511];

— brep_with_voids;

— bezier_curve [511];

— bezier_surface [511];

— b_spline_curve_with_knots [511];

— b_spline_surface_with_knots [511];

— cartesian_point [511];

— cartesian_transformation_operator_3d;

— circle [511];

— closed_shell;

— conical_surface [511];

— definitional_representation [511];

— degenerate_toroidal_surface [511];

— connected_face_sub_set;

— cylindrical_surface [511];

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[1]The entities marked [511] are defined in the **aic_topologically_bounded_surface**

— direction [511];

— edge_curve [511];

— edge_loop [511];

— ellipse [511];

— face_bound [511];

— face_outer_bound [511];

— geometric_representation_context [511];

— hyperbola [511];

— line [511];

— manifold_subsurface_shape_representation;

— mapped_item;

— open_shell;

— parabola [511];

— parametric_representation_context [511];

— pcurve [511];

— plane [511];

— polyline [511];

— quasi_uniform_curve [511];

— quasi_uniform_surface [511];

— rational_b_spline_curve [511];

— rational_b_spline_surface [511];

— representation_map;

— spherical_surface [511];

— subedge;