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

Part 523:

**Application interpreted construct: Curve
swept solid**

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

*Partie 523: Construction interprétée d'application: Solide balayé par une
courbe*

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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 part of ISO 10303 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10303-523 was prepared by Technical Committee ISO TC184/SC4, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data*.

ISO 10303 is organized as a series of parts, each published separately. The structure of ISO 10303 is described in ISO 10303-1.

Each part of ISO 10303 is a member of one of the following series: description 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 the Internet:

<http://www.tc184-sc4.org/titles/STEP_titles.htm>

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 curve swept solid. This provides the definition of a shape representation containing swept solids, each of which is either a **swept_area_solid** or a **swept_disk_solid**. A new subtype of **surface_curve_swept_area_solid** is included to enable more precise control of the orientation of a planar area as it is swept along a directrix to create a solid.

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Industrial automation systems and integration — Product data representation and exchange — Part 523: Application interpreted construct: Curve swept solid

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 implicitly defined solids created by sweeping operations. The solids defined by sweeping a planar area along a directrix curve. For the **surface_curve_swept_area_solid** both the area and directrix are explicitly defined. For other types of swept_area_solid the directrix is implicitly defined, as a line or a circle. In the case of the swept_disk_solid the bounds of the area are implicitly defined circles.

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

- 3D geometry;
- directrix curves;
- swept area solids;
- swept disk solids;
- surface curve swept area solids;
- use of B-spline surfaces to define a ruled surface for the purpose of defining a swept solid;
- planar areas with explicit geometric bounds;

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;
- curves and surfaces not used as part of the definition of a swept solid;
- non-manifold geometry;
- offset curves and surfaces;

- use of topology to bound geometric entities.

2 Normative references

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

ISO/IEC 8824-1:1995, *Information technology — Abstract syntax notation one (ASN.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: 1996, *Industrial automation systems and integration — Product data representation and exchange — Part 202: Application protocol: Associative draughting*

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;
- bounds;
- coordinate space;
- curve;
- surface.

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. [ISO 10303-523:2004
https://standards.iteh.ai/catalog/standards/sist/81b9baee-b2bb-444a-b37b-37ab28ab07e7/iso-10303-523-2004](https://standards.iteh.ai/catalog/standards/sist/81b9baee-b2bb-444a-b37b-37ab28ab07e7/iso-10303-523-2004)

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

curve swept solid shape representation

shape representation containing solids defined by sweeping a planar area along a directrix curve.

NOTE In the cases of an **extruded_area_solid** and a **revolved_area_solid** the directrix is not explicitly defined.

3.5.2

ruled surface

surface generated by a family of straight lines joining points with corresponding parameter values on two edge curves

NOTE In this part of ISO 10303 a ruled surface is a B-spline surface of degree 1 in u, the edge curves are defined by the control points of the surface. has a domain which is part of

3.5.3

ruled surface swept area solid

solid created by sweeping a planar area along a directrix curve drawn on a ruled surface

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.

<https://standards.iteh.ai/catalog/standards/sist/81b9baee-b2bb-444a-b37b-10303-523-2004>

This application interpreted construct provides a consistent set of geometric entities for the definition of a curve swept solid shape representation. Each solid in the representation is required to be a **surface-curve_swept_area_solid**, an **extruded_area_solid**, a **revolved_area_solid** or a **swept_disk_solid**. An instance of **surface-curve_swept_area_solid** may be specialised as a **ruled_surface_swept_area_solid**. The highest level entity in this AIC is **curve_swept_solid_shape_representation** which is a specialised type of **shape_representation** (see ISO 10303-41). The rules on this entity ensure that the shapes included are swept solids or mapped copies of swept solids.

EXPRESS specification:

*)

```
SCHEMA aic_curve_swept_solid;
```

```
USE FROM geometry_schema -- ISO 10303-42
    (axis2_placement_2d,
     axis2_placement_3d,
     bezier_curve,
     bezier_surface,
     b_spline_curve,
```

```

b_spline_curve_with_knots,
b_spline_surface,
b_spline_surface_with_knots,
cartesian_point,
circle,
composite_curve_on_surface,
conical_surface,
cylindrical_surface,
degenerate_toroidal_surface,
direction,
ellipse,
geometric_representation_context,
hyperbola,
line,
parabola,
pcurve,
plane,
polyline,
quasi_uniform_curve,
quasi_uniform_surface,
rational_b_spline_curve,
rational_b_spline_surface,
spherical_surface,
surface_curve,
surface_of_linear_extrusion,
surface_of_revolution,
swept_surface,
toroidal_surface,
trimmed_curve,
uniform_curve,
uniform_surface,
vector);

```

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```

USE FROM geometric_model_schema -- ISO 10303-42
(extruded_area_solid,
revolved_area_solid,
surface_curve_swept_area_solid,
swept_disk_solid);

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

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

```

NOTE 1 The **b_spline_curve** and **b_spline_surface** entities are explicitly interfaced (i.e. included in the USE FROM lists) to allow rules in the **ruled_surface_swept_area_solid** entity to access attributes of these entities. For the use of this AIC these entities shall only be instantiated as one, or more, of their subtypes.

NOTE 2 The schemas referenced above can be found in the following parts of ISO 10303:

geometry_schema	ISO 10303-42: 2000, as modified by amendment 1
geometric_model_schema	ISO 10303-42: 2000, as modified by amendment 1
representation_schema	ISO 10303-43
product_property_representation_schema	ISO 10303-41

4.1 Fundamental concepts and assumptions

An application protocol that uses this AIC shall ensure that the **shape_representation** entity is instantiated as an **curve_swept_solid_shape_representation**.

All geometry imported into this AIC is used for the purpose of defining swept solids.

4.2 aic_curve_swept_solid schema entity definitions

4.2.1 curve_swept_solid_shape_representation

The **curve_swept_solid_shape_representation** is a type of **shape_representation** in which the shape of a product is represented by specialisations of **swept_area_solid** or **swept_disk_solid** entities.

Each **solid_model** in the **representation** is required to be a **swept_area_solid** or a **swept_disk_solid**.

Particular types of **swept_area_solid** that may be included are **extruded_area_solid**, **revolved_area_solid**, and **surface_curve_swept_area_solid**, including the **ruled_surface_swept_area_solid**.

EXPRESS specification: <https://standards.iteh.ai/catalog/standards/sist/81b9baee-b2bb-444a-b37b-37ab28ab07e7/iso-10303-523-2004>

```

*)
ENTITY curve_swept_solid_shape_representation
SUBTYPE OF (shape_representation);
WHERE
  WR1: SIZEOF (QUERY (it <* SELF.items |
    NOT (SIZEOF ([ 'AIC_CURVE_SWEPT_SOLID.SWEPT_AREA_SOLID',
      'AIC_CURVE_SWEPT_SOLID.SWEPT_DISK_SOLID',
      'AIC_CURVE_SWEPT_SOLID.MAPPED_ITEM',
      'AIC_CURVE_SWEPT_SOLID.AXIS2_PLACEMENT_3D' ] *
        TYPEOF(it)) = 1))) = 0;
  WR2: SIZEOF (QUERY (it <* SELF.items |
    SIZEOF([ 'AIC_CURVE_SWEPT_SOLID.SWEPT_AREA_SOLID',
      'AIC_CURVE_SWEPT_SOLID.SWEPT_DISK_SOLID',
      'AIC_CURVE_SWEPT_SOLID.MAPPED_ITEM' ] * TYPEOF(it)) =1 )) > 0;
  WR3: SIZEOF (QUERY (mi <* QUERY (it <* items |
    'AIC_CURVE_SWEPT_SOLID.MAPPED_ITEM' IN TYPEOF(it)) |
    NOT ('AIC_CURVE_SWEPT_SOLID.CURVE_SWEPT_SOLID_SHAPE_REPRESENTATION' IN
      TYPEOF(mi\mapped_item.mapping_source .
        mapped_representation)))) = 0;
  WR4: SIZEOF (QUERY (scsas <* QUERY (it <* SELF.items |
    'AIC_CURVE_SWEPT_SOLID.SURFACE_CURVE_SWEPT_AREA_SOLID' IN

```