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

Part 42:

**Integrated generic resource: Geometric  
and topological representation**

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*Systemes d'automatisation industrielle et integration — Représentation  
et échange de données de produits —*

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*Partie 42: Ressource générique intégrée: Représentation géométrique  
et topologique*



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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 10303-42 was prepared by Technical Committee ISO / TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

This third edition cancels and replaces the second edition (ISO 10303-42:2000) of which it constitutes a minor technical revision. The first edition (ISO 10303-42:1994) is provisionally retained to support continued use and maintenance of implementations based on the first edition, and to satisfy normative references in other parts of ISO 10303.

The corrections published in ISO 10303-42:2000/Cor.1:2001 are incorporated in this edition.

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

Each part of this International Standard 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 integrated generic resources series.

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

`<http://www.tc184-sc4.org/titles/STEP\_titles.rtf>`

Should further parts of ISO 10303 be published, they will follow the same numbering pattern.

This part of ISO 10303 is a member of the integrated resources series. The integrated resources specify a single conceptual product data model.

## 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 specifies the integrated resources used for geometric and topological representation. Their primary application is for explicit representation of the shape or geometric form of a product model. The shape representation presented here has been designed to facilitate stable and efficient communication when mapped to a physical file.

The geometry in clause 4 is exclusively the geometry of parametric curves and surfaces. It includes the 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. These concepts are fully defined in ISO 10303 Part 43.

The topology in clause 5 is concerned with connectivity relationships between objects rather than with the precise geometric form of objects. This clause contains the basic topological entities and specialised 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.

The geometric models in clause 6 provide basic resources for the communication of data 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 boundary representation (B-rep). Other entities, providing a rather less complete description of the geometry of a product, and with less consistency constraints, are also included.

This edition incorporates modifications that are upwardly compatible with the previous editions. Modifications to EXPRESS specifications are upwardly compatible if:

- instances encoded according to ISO 10303-21 and that conform to an ISO 10303 application protocol based on the previous edition of this part, also conform to a revision of that application protocol based on this edition;
- interfaces that conform to ISO 10303-22 and to an ISO 10303 application protocol based on the previous edition of this part, also conform to a revision of that application protocol based on this edition;
- the mapping tables of ISO 10303 application protocols based on the previous edition of this part remain valid in a revision of that application protocol based on this edition.

Technical modifications to ISO 10303-42:1994 are categorised as follows:

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- changes to the EXPRESS declarations,
- new EXPRESS declarations.

The following EXPRESS declarations were modified in creating edition 2:

geometry schema:

- **axis1\_placement;**
- **base\_axis;**
- **build\_axes;**
- **build\_2axes;**
- **cartesian\_transformation\_operator\_3d;**
- **cartesian\_transformation\_operator\_2d;**
- **composite\_curve\_segment;**
- **constraints\_param\_b\_spline;**
- **cross\_product;** <https://standards.iteh.ai/catalog/standards/sist/931e779a-dde3-4d29-9a33-fc3e7006ab1b/iso-10303-42-2003>
- **curve\_bounded\_surface;**
- **default\_b\_spline\_curve\_weights;**
- **default\_b\_spline\_knot\_mult;**
- **default\_b\_spline\_knots;**
- **default\_b\_spline\_surface\_weights;**
- **geometric\_representation\_item;**
- **get\_basis\_surface;**
- **list\_to\_array;**
- **make\_array\_of\_array;**
- **orthogonal\_complement;**
- **point;**

- **rectangular\_composite\_surface;**
- **scalar\_times\_vector;**
- **surface\_of\_revolution;**
- **surface\_patch;**
- **swept\_surface;**
- **trimmed\_curve;**
- **vector\_sum;**
- **vector\_difference;**

topology schema:

- **edge;**
- **edge\_reversed;**
- **face\_bound\_reversed;**
- **face\_reversed;**
- **face\_surface;**
- **mixed\_loop\_type\_set;**
- **path\_head\_to\_tail;**
- **path\_reversed;**
- **shell\_reversed;**

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- **face\_reversed;** <https://standards.iteh.ai/catalog/standards/sist/931e779a-dde3-4d29-9a33-fc3e7006ab1b/iso-10303-42-2003>

geometric model schema:

- **boolean\_operand;**
- **build\_transformed\_set;**
- **csg\_primitive;**
- **csg\_solid;**