INTERNATIONAL STANDARD

ISO 10303-204

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

Part 204: Application protocol: Mechanical design using boundary representation

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

Partie 204: Protocole d'application: Conception mécanique utilisant une représentation délimitée

Reference number
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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 3.

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 10303-204was prepared by Technical Committee ISO TC184/SC4. *Industrial automation systems and integration*, Subcommittee SC4 *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 protocol series.

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

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

Annexes A, B, C, D and E form an integral part of this part of ISO 10303. Annexes F, G, H, J and K are for information only.

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 protocol series.

This Part of ISO 10303 specifies an application protocol (AP) for mechanical design using boundary representation solid models. A boundary representation solid model provides a complete descripton of the shape of a solid object by describing precisely the geometry and topology of all its internal and external boundaries.

This application protocol defines the context, scope, and information requirements for mechanical design using boundary representation models and specifies the integrated resources necessary to satisfy these requirements.

Application protocols provide the basis for developing implementations of ISO 10303. Application protocols provide the basis for developing abstract test suites for the conformance testing of AP implementations.

Clause 1 defines the scope of the application protocol and summarizes the functionality and data covered by the AP. An application activity model that is the basis for the definition of the scope is provided in annex F. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model, is given in annex G.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in 5.2. note that definitions and the EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes not imported into the AIM. The expanded listing given in Annex A contains the complete EXPRESS of the AIM without annotation. A graphical representation of the AIM is given in annex H. Additional requirements for specific implementation methods are given in annex C.

This Part of ISO 10303 contains the definition of conforming boundary representation solid models and the mechanisms to transfer them via an exchange structure as defined in Part ISO 10303-21. The exchange of such models, with associated visual presentation information is required during the initial desgn of a mechanical product and when detailed designs of components are communicated to suppliers and sub-contractors. In this Part B-reps are characterised by the fact that they can represent models with only planar surfaces (faceted B-rep), models with only analytical surfaces (elementary B-rep) and models with sculptured surfaces and curves (advanced B-rep). The application reference environment in which these B-rep models are used is the generation and exchange of volume-based data in the Computer-aided Mechanical design process. This application places fundamental requirements on the model exchange

and the neutral representation of models. The transfer and archiving of B-rep models at different stages of the design and engineering process requires the following to be maintained:

— the completeness of the models when mapped between application systems;

— the correctness of semantics of the representation;

— the accuracy of the geometric relationships between entity instances which form part of a B-rep model; in particular all vertices shall lie on the edges using them and all edge_curves shall lie on each face using this edge as part of the boundary.

Three different classes of implementation are specified in clause 6.

This application protocol was developed as one component of a series of Mechanical Design application protocols and is complemented by ISO 10303-205 Mechanical design using surface models, see (1). These Parts share a common application environment and have a similar scope for the representation of mechanical parts. The significant differences among these Parts of ISO 10303 is in the manner in which the shape of a mechanical part is represented. In this Part the representation is as a manifold solid boundary representation model. In ISO 10303-205 the shape of the part is represented by a surface model in which all surfaces and bounding curves are fully represented. Figure 1 gives a pictorial representation of the scope of this AP.

NOTE 1 In figure 1 the term scope refers to the intended scope of the information models in this Part of ISO 10303. These information models may be useful as part of an information model for applications shown as 'out of scope' in this diagram.

Figure 2 contains the data planning model that gives a high level description of the requirements for this application protocol, as well as the relationships between the basic data objects.

NOTE 2 A dashed line in figure 2 is used to denote an optional association.

The planning model illustrates that a product may be either a part or an assembly. The shape of a part or assembly is represented by a shape model which takes the form of one, or more, B-reps. Each B-rep is either a faceted B-rep, an elementary B-rep, or an advanced B-rep. Names can be associated with products, parts or shape models. Visual properties may optionally be attached to B-rep models.

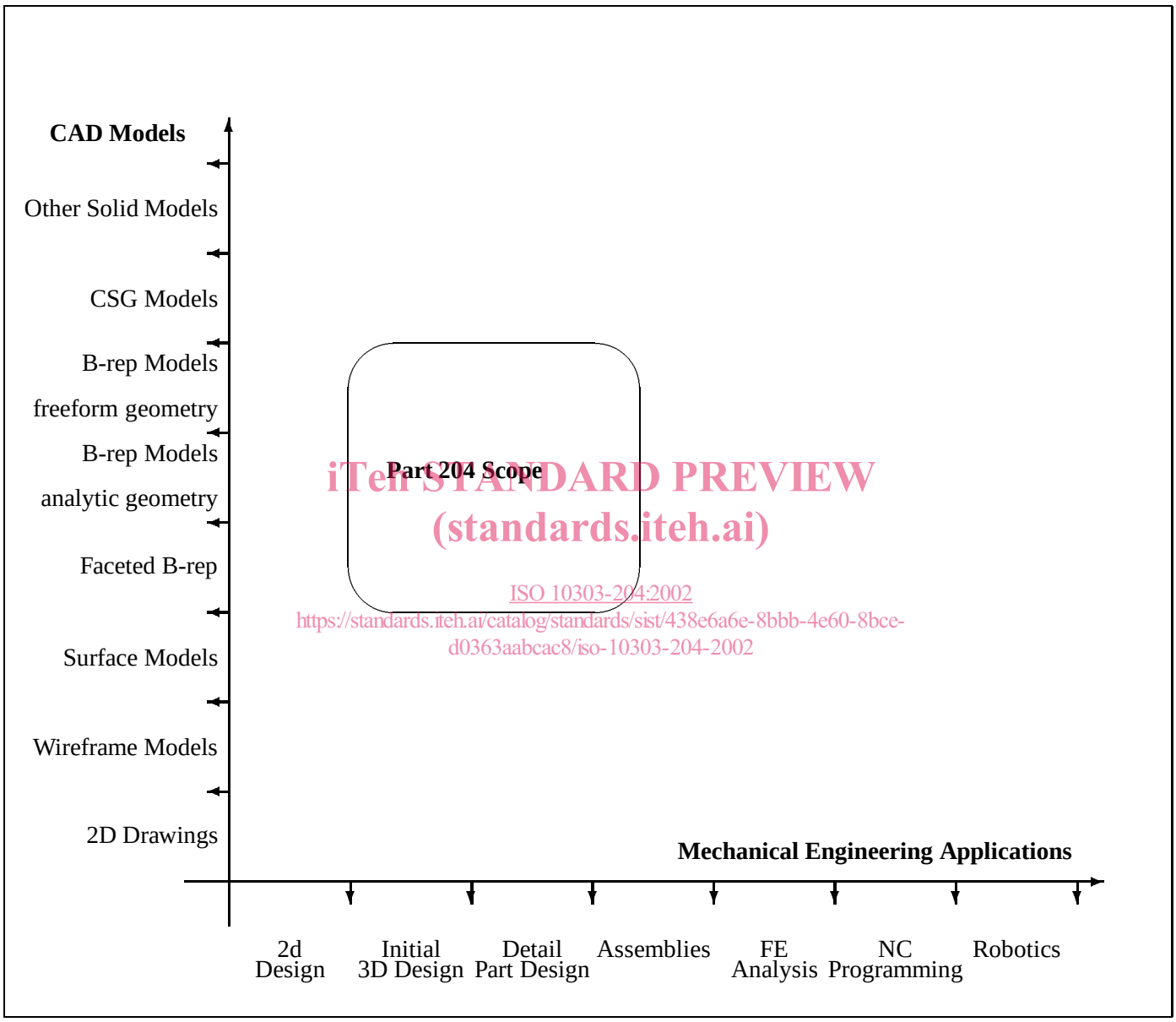

Figure 1 – The scope of this part of ISO 10303 in the contexts of CAD models and mechanical engineering applications

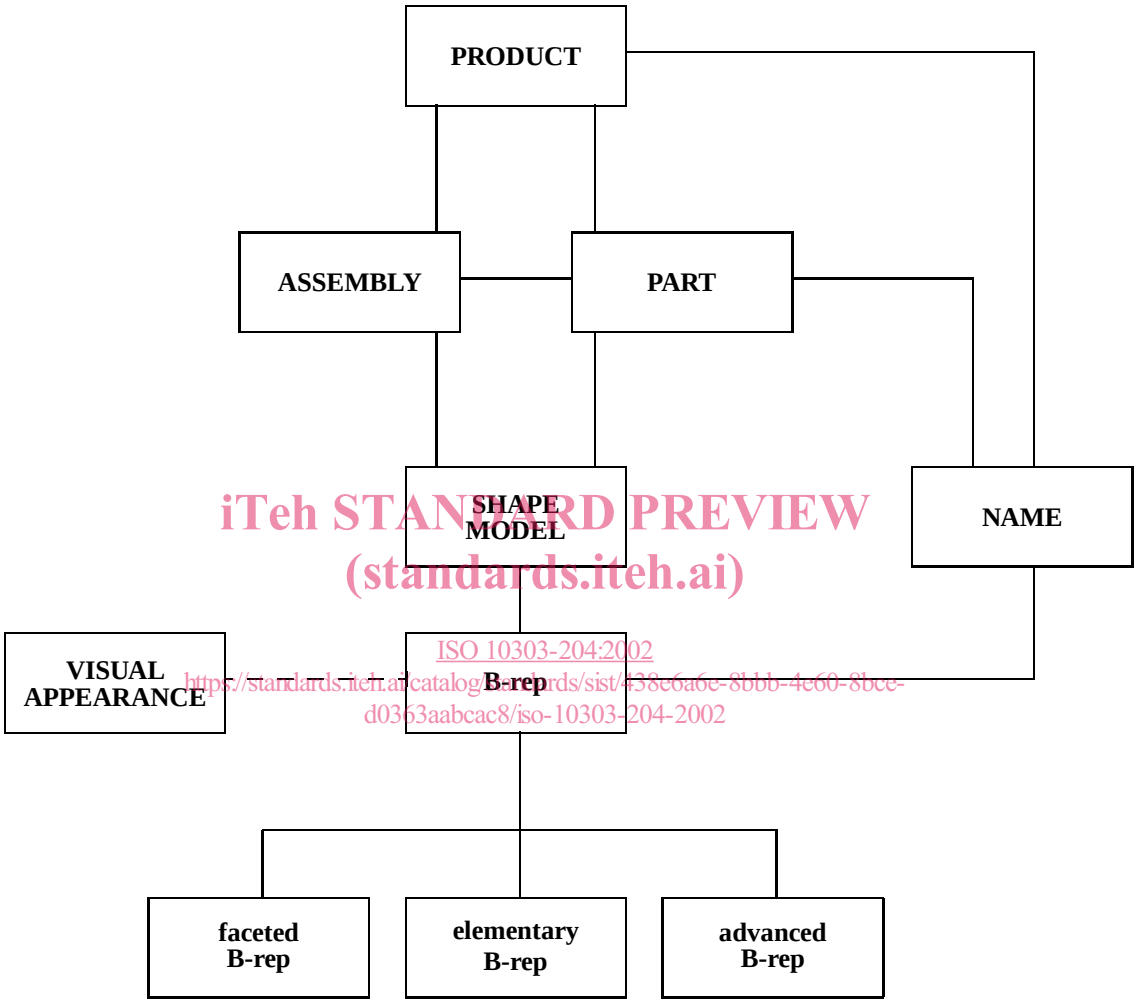

Figure 2 – Data planning model

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Part 204: Application protocol: Mechanical design using boundary representation

1 Scope

This part of ISO 10303 specifies the use of the integrated resources necessary for the scope and information requirements for the use and exchange of boundary representation solid models in the mechanical engineering design context.

NOTE The application activity model in annex F provides a graphical representation of the processes and information flows that are the basis for the definition of the scope of this part of ISO 10303.

This document describes an application reference environment for the generation and exchange of volume-based design data in the computer-aided mechanical design process, together with appropriate data models and a physical file implementation form. The information model supports all geometric and topological aspects of a complete description of the shape and size of an object. It was originally developed for applications in mechanical engineering design using the CAD modelling technique boundary representation (B-rep) solid modelling and may be appropriate for other application areas using this technique.

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

— Three types of B-rep model that are used to represent shape:

  a) faceted B-rep model;

  b) B-rep model with elementary surfaces;

  c) B-rep model with sculptured surfaces;

— curve and surface geometry;

— curves defined in parameter space (pcurves);

— manifold topology;

— product identification information;

— the association of simple presentation attributes such as line-style, line-width, colour with an entire B-rep model, or, with geometric or topological elements of a B-rep model;

— preservation of user-defined names of objects;

— units and measures associated with geometric elements;

— assemblies of parts and sub-assemblies.

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

— Other types of shape representation:

  a) wireframe models;

  b) surface models;

  c) geometrically trimmed curves and surfaces;

  d) constructive solid geometry models;

  e) compound B-rep models.

— Geometric and topological data:

  a) 2D geometry, other than for the definition of pcurves;

  b) self-intersecting geometry;

  c) non-manifold topology.

— Dimensioning;

— Tolerances;

— Manufacturing information;

— Advanced presentation features such as multiple views, character fonts and symbols.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10303. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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 10303-21:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*

ISO 10303-22:1998, *Industrial automation systems and integration — Product data representation and exchange — Part 22: Implementation methods: Standard data access interface*

ISO 10303-31:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 31: Conformance testing methodology and framework: General concepts*

ISO 10303-41:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resources: Fundamentals of product description and support*

ISO 10303-42:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resources: Geometric and topological representation*

ISO 10303-43:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 43: Integrated generic resources: Representation structures*

ISO 10303-44:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resources: Product structure configuration*

ISO 10303-46:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 46: Integrated generic resources: Visual presentation.*

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

ISO 10303-512:1999, *Industrial automation systems and integration — Product data representation and exchange — Part 512: Application interpreted construct: Faceted boundary representation*

ISO 10303-513:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 513: Application interpreted construct: Elementary boundary representation*

ISO 10303-514:1999, *Industrial automation systems and integration — Product data representation and exchange — Part 514: Application interpreted construct: Advanced boundary representation*

ISO 10303-517:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 517: Application interpreted construct: Mechanical design geometric presentation*

ISO 10303-518[1)], *Industrial automation systems and integration — Product data representation and exchange — Part 518: Application interpreted construct: Mechanical design shaded presentation*

ISO/IEC 8824-1:1998, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

[1)] To be published.

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.

— abstract test suite;

— application;

— application activity model (AAM);

— application context;

— application interpreted model (AIM);

— application object;

— application protocol (AP);

— application reference model (ARM);

— assembly;

— component;

— conformance class;

— conformance requirement;

— conformance testing;

— context;

— data;

— data exchange;

— implementation method;

— interpretation;

— integrated resource;

— model;

— PICS proforma;

