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

Part 238:

**Application protocol: Application
interpreted model for computerized
numerical controllers**

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

*Partie 238: Protocole d'application: Modèle d'application interprété pour
des contrôleurs numériques informatisés*



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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 standardizations.

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 10303-238 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. ISO 10303-238 is a member of the application protocols series.

A complete list of parts of ISO 10303 is available from the following URL:

http://www.tc184-sc4.org/titles/STEP_Titles.htm

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation of product information and for the 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 numerical controlled machining and associated processes, including the scope and information requirements defined by the ISO 14649 data model for numerical controllers, augmented with product geometry, geometric dimensioning and tolerancing, and product data management information.

ISO 14649 defines a richer model for information transfer between CAD/CAM systems and computerized numerical control (CNC) machines than that of the older ISO 6983 “G and M code” language. ISO 6983-1 [2] describes the path of the tool centre point with respect to machine axes. ISO 14649 describes machining processes with respect to a part, including part geometry, manufacturing features, sequencing of operations, associated process parameters, and tool requirements.

This part of ISO 10303 specifies the integrated resources necessary to describe the information requirements identified by ISO 14649 in a manner consistent with the part shape, feature, geometric dimension and tolerance information created by design and process-planning activities and represented by ISO 10303-203 [4], ISO 10303-214 [5], ISO 10303-224 [8], and ISO 10303-240 [9]. It is advisable that users of this part of ISO 10303 understand the basic principles and concepts of numerical controlled machining and associated processes and understand and have access to ISO 14649, particularly ISO 14649-1, ISO 14649-10, ISO 14649-11, ISO 14649-12, ISO 14649-111, and ISO 14649-121. A discussion and data planning model is given in ISO 14649-1.

This application protocol defines the context, scope, and information requirements for numerical controlled machining and associated processes and specifies the integrated resources necessary to satisfy these requirements.

Application protocols provide the basis for developing implementations of ISO 10303 and 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. Clause 3 lists the words defined in this part of ISO 10303 and gives pointers to words defined elsewhere. 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 the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM can include select list items and subtypes which are not imported into the AIM. The expanded listing given in Annex A contains the complete EXPRESS

for the AIM without annotation. A listing of the EXPRESS entity names and corresponding short names is given in Annex B. Information object identifiers for the AIM is given in Annex E. A graphical representation of the AIM is given in Annex H. Additional requirements for specific implementation methods are given in Annex C. A reference to computer interpretable listings of the AIM and EXPRESS entity short names is given in Annex I.

Warning:

This part of ISO 10303 provides a specification intended to be implemented in software. Incompatibilities may result in machine-to-machine communication in the case of software developed on the basis of translations of this part of ISO 10303 into languages other than the official ISO languages. It is accordingly strongly recommended that any implementations be developed only on the basis of the texts in the official ISO languages.

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

Part 238:

Application protocol: Application interpreted model for computerized numerical controllers

1 Scope

This part of ISO 10303 specifies the use of the integrated resources necessary for the scope and information requirements for manufacturing using numerical controlled machining and associated processes, including the scope and information requirements defined by the ISO 14649 data model for computerized numerical controllers.

NOTE 1 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.

NOTE 2 This part of ISO 10303 is a member of the “STEP Manufacturing Suite” of ISO 10303 application protocols, which cover a wide range of information associated with the manufacture of a product, such as the input to process planning (ISO 10303-224 [8]), the output from macro-process planning (ISO 10303-240 [9]), numerically-controlled machining (this part of ISO 10303), casting (ISO 10303-223 [7]) and the output from dimensional inspection (ISO 10303-219 [6]). While each application protocol has unique scope elements, other elements, such as manufacturing feature and manufacturing tolerance descriptions, are common to many of these application protocols.

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

- mechanical parts for manufacturing;
- manufacturing process descriptions, including manufacturing operations, sequences of operations, and associated information as defined in ISO 14649;

NOTE 3 The ISO 14649 documents available at the time of publication cover milling, drilling, and turning processes (ISO 14649-11 and ISO 14649-12). Future editions of this part of ISO 10303 might include additional numerically-controlled processes if additional ISO 14649 descriptions become available.

- the AS-IS and TO-BE shapes of a mechanical part;
- manufacturing features of a part;
- manufacturing tolerance requirements of a part;

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- tool requirements for machining operations;
- tool paths for machining operations;
- manufacture of mechanical products using manufacturing processes defined in ISO 14649;
- manufacturing product discipline view.

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

- composite material parts;
- description of manufacturing activities not related to automatic execution by a computerized numerical controller.

NOTE 4 This includes activities such as factory capacity planning and scheduling.

- a catalogue of machines available on a factory floor;
- a catalogue of tools available in a machine tool magazine;
- design features of a part;
- manufacturing preplanning activities;
- product discipline views other than manufacturing.

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 286-1:1988, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 1101:2004, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 2806:1994, *Industrial automation systems and integration — Numerical control of machines — Vocabulary*

ISO 5459:1981, *Technical drawings — Geometric tolerancing — Datums and datum-systems for geometrical tolerances*

ISO/IEC 8824-1:2002, *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 10303-21:2002, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*

ISO 10303-28:—¹⁾, *Industrial automation systems and integration — Product data representation and exchange — Part 28: Implementation methods: XML representations of EXPRESS schemas and data*

ISO 10303-41:2005, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resource: Fundamentals of product description and support*

ISO 10303-42:2003, *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 10303-44:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resource: Product structure configuration*

ISO 10303-45:1998, *Industrial automation systems and integration — Product data representation and exchange — Part 45: Integrated generic resource: Materials*

ISO 10303-47:1997, *Industrial automation systems and integration — Product data representation and exchange — Part 47: Integrated generic resource: Shape variation tolerances*

ISO 10303-49:1998, *Industrial automation systems and integration — Product data representation and exchange — Part 49: Integrated generic resource: Process structure and properties*

ISO 10303-501:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 501: Application interpreted construct: Edge-based wireframe*

ISO 10303-502:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 502: Application interpreted construct: Shell-based wireframe*

ISO 10303-507:2001, *Industrial automation systems and integration — Product data representation and exchange — Part 507: Application interpreted construct: Geometrically bounded surface*

ISO 10303-508:2001, *Industrial automation systems and integration — Product data representation and exchange — Part 508: Application interpreted construct: Non-manifold surface*

1) To be published. (Revision of ISO 10303-28:2003)

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ISO 10303-509:2001, *Industrial automation systems and integration — Product data representation and exchange — Part 509: Application interpreted construct: Manifold surface*

ISO 10303-510:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 510: Application interpreted construct: Geometrically bounded wireframe*

ISO 10303-511:2001, *Industrial automation systems and integration — Product data representation and exchange — Part 511: Application interpreted construct: Topologically 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 10303-514:1999, *Industrial automation systems and integration — Product data representation and exchange — Part 514: Application interpreted construct: Advanced boundary representation*

ISO 10303-519:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 519: Application interpreted construct: Geometric tolerances*

ISO 10303-522:2006, *Industrial automation systems and integration — Product data representation and exchange — Part 522: Application interpreted construct: Machining features*

ISO 13584-20:1998, *Industrial automation systems and integration — Parts library — Part 20: Logical resource: Logical model of expressions*

ISO 14649-1:2003, *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers — Part 1: Overview and fundamental principles*

ISO 14649-10:2004, *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers — Part 10: General process data*

ISO 14649-11:2004, *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers — Part 11: Process data for milling*

ISO 14649-12:2005, *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers — Part 12: Process data for turning*

ISO 14649-111:—¹⁾, *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers — Part 111: Tools for milling*

ISO 14649-121:2005, *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers — Part 121: Tools for turning machines*

1) To be published.