PD ISO/TS 14649-201:2011



BSI Standards Publication

Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers

Part 201: Machine tool data for cutting processes

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National foreword

This Published Document is the UK implementation of ISO/TS 14649-201:2011.

The UK participation in its preparation was entrusted to Technical Committee AMT/4, Industrial data and manufacturing interfaces.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Published by BSI Standards Limited 2023

ISBN 978 0 580 76121 8

ICS 25.040.20

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 March 2023.

Amendments/corrigenda issued since publication

Date	Text affected

PD ISO/TS 14649-201:2011

TECHNICAL SPECIFICATION

ISO/TS 14649-201

First edition
2011-12-15

Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers —

Part 201: Machine tool data for cutting processes

Systèmes d'automatisation industrielle et intégration — Commande des dispositifs physiques — Modèle de données pour les contrôleurs numériques informatisés —

Partie 201: Données de la machine-outil pour les procédés de coupe



Reference number
ISO/TS 14649-201:2011(E)

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Published in Switzerland

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 14649-201 was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 1, *Physical device control*.

ISO/TS 14649 consists of the following parts, under the general title *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers*:

— *Part 1: Overview and fundamental principles*

— *Part 10: General process data*

— *Part 11: Process data for milling*

— *Part 12: Process data for turning*

— *Part 13: Process data for wire electrical discharge machining (wire-EDM)*

— *Part 14: Process data for sink electrical discharge machining (sink-EDM)*

— *Part 111: Tools for milling machines*

— *Part 121: Tools for turning machines*

— *Part 201: Machine tool data for cutting processes* [Technical Specification]

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Introduction

Modern manufacturing enterprises are built from facilities spread around the globe, which contain equipment from hundreds of different manufacturers. Immense volumes of product information need to be transferred between the various facilities and machines. Today's digital communications standards have solved the problem of reliably transferring information across global networks. For mechanical parts, the description of product data has been standardized by ISO 10303, leading to the possibility of using standard data throughout the entire process chain in the manufacturing enterprise.

Impediments to realizing this principle are the data formats used at the machine level. Most computer numerical control (CNC) machines are programmed in the ISO 6983 “G and M code” language. Programs are typically generated by computer-aided manufacturing (CAM) systems that use computer-aided design (CAD) information. However, ISO 6983 limits program portability for the following three reasons:

a) the language focuses on programming the tool centre path with respect to machine axes, rather than the machining process with respect to the part;

b) the standard defines the syntax of program statements, but in most cases leaves the semantics ambiguous;

c) vendors usually supplement the language with extensions that are not covered in the limited scope of ISO 6983.

ISO 14649 is a new model of data transfer between CAD/CAM systems and CNC machines, which replaces ISO 6983. It remedies the shortcomings of ISO 6983 by specifying machining processes rather than machine tool motion, using the object-oriented concept of workingsteps. Workingsteps correspond to high-level machining features and associated process parameters. CNCs are responsible for translating workingsteps into axis motion and tool operation. A major benefit of ISO 14649 is its use of existing data models from ISO 10303. As ISO 14649 provides a comprehensive model of the manufacturing process, it can also be used as the basis for a bi- and multi-directional data exchange between all other information technology systems.

ISO 14649 represents an object-oriented, information- and context-preserving approach for numerical control (NC) programming that supersedes data reduction to simple switching instructions or linear and circular movements. As it is object- and feature-oriented and describes the machining operations executed on the workpiece, rather than machine dependent axis motions, it will be running on different machine tools or controllers. This compatibility will spare all data adaptations by post-processors if the new data model is correctly implemented on the NC controllers. If old NC programs in ISO 6983 are intended to be used on such controllers, the corresponding interpreters will need to be able to process the different NC program types in parallel.

In developing ISO 14649, a gradual evolution from ISO 6983 programming to portable feature-based programming has been envisaged. Early adopters of ISO 14649 will certainly support data input of legacy “G and M codes” manually or through programs, just as modern controllers support both command-line interfaces and graphical user interfaces. This is likely to be made easier as open-architecture controllers become more prevalent. Therefore, ISO 14649 does not include legacy program statements, which would otherwise dilute its effectiveness.

The information form in ISO 14649 already allows for major improvements over existing methods, but in order to support even more efficient production, a description of the manufacturing environment will be needed in addition to the manufacturing information. Consequently, this part of ISO 14649 is a first step to permitting the description of machine tools as a manufacturing resource. The description allows process planners to describe their machine needs for a micro-process plan (an ISO 14649 file), referred to as a requirements model. The model also allows existing machine tools to be described as resources for manufacturing, referred to as catalogue models. This part of ISO 14649 is intended to provide a basis for process planning and simulation, for controller developers and for machine tool developers to describe their products, as well as for

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research, for example. This part of ISO 14649 is not intended to replace existing standards for machine tool descriptions, but to provide the information necessary for manufacturing applications in a concise way. It is envisaged that there will be a continuing effort to describe the manufacturing resource environment in a standardized manner, so as to support efficient advanced and flexible manufacturing.

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TECHNICAL SPECIFICATION **ISO/TS 14649-201:2011(E)**

Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers —

Part 201: Machine tool data for cutting processes

1 Scope

This part of ISO 14649 specifies the technology-specific machine tool description data elements needed as process data for manufacturing and machine characteristics. The machine tool descriptions covered in this schema are, initially, milling machines, machining centres, turning machines and multi-tasking machines.

This part of ISO 14649 is not intended to replace existing machine tool description standards, but to cover the specific needs of manufacturing resource description for manufacturing needs in the technologies described in ISO 14649.

Examples of manufacturing applications of this model are:

— part programming for CNC machining;

— process planning;

— a simulation of machining processes;

— analysis of expected machining time and machine tool energy use;

— a description of new machine tools for manufacturing evaluation and/or controller development.

The schema specified in this part of ISO 14649 does not include representations, executable objects and base classes that are common for all technologies. These are referenced from the generic resources of ISO 10303 and from ISO 14649-10.

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 10303-105, *Industrial automation systems and integration — Product data representation and exchange — Part 105: Integrated application resource: Kinematics*

ISO 10303-240, *Industrial automation systems and integration — Product data representation and exchange — Part 240: Application protocol: Process plans for machined products*

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

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