TECHNICAL SPECIFICATION

ISO/TS 13399-3

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Cutting tool data representation and exchange —

Part 3:
Reference dictionary for tool items

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 29, *Small tools*.

This third edition cancels and replaces the second edition (ISO/TS 13399-3:2014), which has been technically revised.

The main change is as follows:

— update of the classes and properties in line with the modifications in the cutting tool dictionary.

A list of all parts in the ISO 13399 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document defines the terms, properties, and definitions for portions of a cutting tool that support one or more cutting items with defined cutting edges. Tool items include, but are not limited to, turning tools, milling tools, drilling tools, threading tools, etc. The purpose of this document is to provide a reference dictionary to support the use of the general information model defined in ISO 13399-1.

A cutting tool with defined cutting edges is used on a machine to remove material from a workpiece by a shearing action at the cutting edges of the tool. Cutting tool data that can be described by the ISO 13399 series include, but are not limited to, everything between the workpiece and the machine tool. Information about inserts (e.g. regular and irregular shaped replaceable cutting items), solid tools (e.g. solid drill and endmill), assembled tools (e.g. boring bars, indexable drills, and indexable milling cutters), adaptors (e.g. milling arbor and drilling chuck), components (e.g. shims, screws, and clamps), and their relationships can be represented by the ISO 13399 series. The principles of the ISO 13399 series are given in Annex A; and possible assemblies of the components of a cutting tool are illustrated in Figure A.1.

The objective of the ISO 13399 series is to provide the means to represent the information that describes cutting tools in a computer-sensible form that is independent from any particular computer system. The representation facilitates the processing and exchange of cutting tool data within and between different software systems and computer platforms and supports the application of this data in manufacturing planning, cutting operations, and the supply of tools. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and for archiving. The methods used for these representations are those developed by ISO/TC 184/SC 4 for the representation of product data by using standardized information models and reference dictionaries.

An information model is a formal specification of types, ideas, facts, and processes which together describes a portion of interests of the real world and which provides an explicit set of interpretation rules. Information is knowledge of ideas, facts, and/or processes. Data are symbols or functions that represent information for processing purposes. Data are interpreted to extract information by using rules for how that should be done and a dictionary to define the terms that identify the data items. Everyone in a communication process is expected to use the same information model, the same set of explicit rules, and the same dictionary in order to avoid misunderstanding. If an information model and its dictionary are written in a computer-sensible language, then there is the additional benefit that they can be computer processable.

An engineering information model is therefore a specification for data that establishes the meaning of that data in a particular engineering context. A model has to be developed by formal methods to ensure that it meets the needs of the situation that it represents. An engineering information model defines the information objects that represent the concepts in an engineering application, the attributes of the objects, their relationships, and the constraints that add further meaning. An information model is an abstract concept that can be used repeatedly for any example of the real-world situation that it represents. An instance of the model is created when it is populated with the data items and their values that are applicable to a particular example of that situation.

This document uses the following International Standards developed by ISO/TC 184/SC 4 :

— the EXPRESS language defined in ISO 10303-11 for defining the information model in ISO 13399-1;

— the file format for data exchange derived from the model and defined in ISO 10303-21;

— the data dictionary defined in the ISO 13584 series.

Each class, property, or domain of values of this application domain constitutes an entry of the reference dictionary defined in this document. It is associated with a computer-sensible and human-readable definition, and with a computer-sensible identification. Identification of a dictionary entry allows unambiguous reference to it from any application that implements the information model defined in ISO 13399-1.

Definitions and identifications of dictionary entries are defined by means of standard data that consist of instances of the EXPRESS entity data types defined in the common dictionary schema, resulting from a joint effort between ISO/TC 184/SC 4 and IEC SC3D, and in its extensions defined in ISO 13584-24 and ISO 13584-25.

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Cutting tool data representation and exchange —

Part 3:
Reference dictionary for tool items

1 Scope

This document specifies a reference dictionary for tool items, together with their descriptive properties and domains of values.

This document specifies a reference dictionary containing:

— definitions and identifications of the classes of tool items and their features, with an associated classification scheme;

— definitions and identifications of the data element types that represents the properties of tool items and their features;

— definitions and identifications of domains of values for describing the above-mentioned data element types.

The following are within the scope of this document:

— standard data that represent the various classes of tool items and tool item features;

— standard data that represent the various properties of tool items and tool item features;

— standard data that represent domains of values used for properties of tool items and tool item features;

— definition of cutting operations;

— definitions of reference systems for tool items and their properties;

— one implementation method by which the standard data defined in this document can be exchanged.

NOTE 1   The implementation method by which the standard data defined in this document can be exchanged is specified in ISO 10303-21.

The following are outside the scope of this document:

— specialized or expert knowledge in the design and use of cutting tools;

— rules to determine what information should be communicated;

— applications where these standard data can be stored or referenced;

— implementation methods other than the one defined in this document by which the standard data can be exchanged and referenced;

— information model for cutting tools;

— definitions of classes and properties for cutting items;

— definitions of classes and properties for adaptive items;

— definitions of classes and properties for assembly items;

— definitions of classes and properties for connection systems;

— definitions of classes and properties for reference systems.

NOTE 2   The information model for cutting tools is defined in ISO 13399-1.

NOTE 3   The definitions of classes and properties for cutting items, adaptive items, and assembly items are provided in ISO/TS 13399-2, ISO/TS 13399-4, and ISO/TS 13399-5, respectively.

NOTE 4   The definitions of classes and properties for connection systems and reference systems are provided in ISO/TS 13399-50.

2   Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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/TS 13399-50, *Cutting tool data representation and exchange — Part 50: Reference dictionary for reference systems and common concepts*

ISO/TS 13399-100, *Cutting tool data representation and exchange — Part 100: Definitions, principles and methods for reference dictionaries*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 13399-50, ISO/TS 13399-100 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
applicable property
property (3.17) that is defined for some family of items and that applies to any member of this family

[SOURCE: ISO 13584-24:2003, 3.3, modified — "family of parts" has been replaced by "family of items"; "shall apply" has been replaced by "applies"; "any part" has been replaced by "any member"; the EXAMPLE has been removed.]

3.2
basic semantic unit
entity (3.10) that provides an absolute and universally unique identification of a certain object of the application domain that is represented as a *dictionary* (3.9) element

[SOURCE: ISO 13584-42:2010, 3.4, modified — The 3 EXAMPLEs and note 1 to entry have been removed.]

3.3
chip
material removed from a *workpiece* (3.20) by a cutting process

3.4
cutting tool
device or assembly of items for removing material from a *workpiece* (3.20) through a shearing action at the defined cutting edge or edges of the device

Note 1 to entry: A cutting tool can be the assembly of one or more adaptive items, a tool item, and several cutting items on a tool item. See Figure A.1.

[SOURCE: ISO 13399-1:2006, 3.1.]

3.5
data
representation of *information* (3.13) in a formal manner suitable for communication, interpretation, or processing by human beings or computers

[SOURCE: ISO 10303-1:2021, 3.1.29]

3.6
data element type
unit of *data* (3.5) for which the identification, description, and value representation have been specified

[SOURCE: ISO 13584-42:2010, 3.13, modified — Note 1 to entry has been removed.]

3.7
data exchange
storing, accessing, transferring, and archiving of *data* (3.5)

[SOURCE: ISO 10303-1:2021, 3.1.31]

3.8
data type
domain of values

[SOURCE: ISO 10303-11:2004, 3.3.5]

3.9
dictionary
table consisting of a series of entries with one meaning corresponding to each entry in the dictionary and one dictionary entry identifying a single meaning

Note 1 to entry: In the ISO 13399 series, a dictionary is a formal and computer-sensible representation of an *ontology* (3.16).

[SOURCE: ISO 13584-511:2006, 3.1.9, modified — The original notes 1 to 3 to entry have been replaced by a new note 1 to entry.]

3.10
entity
class of *information* (3.13) defined by its attributes which establishes a domain of values defined by common attributes and constraints

3.11
entity data type
representation of an *entity* (3.10)

3.12
implementation method
means for computers to exchange *data* (3.5)

3.13
information
facts, concepts, or instructions

[SOURCE: ISO 10303-1:2021, 3.1.41]

3.14
information model
formal model of a bounded set of facts, concepts, or instructions to meet a specific requirement

3.15
machine side
identification of a direction pointing towards the machine

3.16
ontology
explicit and consensual specification of concepts of an application domain independent of any use of these concepts

Note 1 to entry: In the ISO 13399 series, a *dictionary* (3.9) is the formal and computer-sensible representation of ontology.

[SOURCE: ISO 13584-511:2006, 3.1.20, modified — In note 1 to entry, the reference to "ISO 13584" has been replaced by "the ISO 13399 series".]

3.17
property
defined parameter suitable for the description and differentiation of products

[SOURCE: ISO 13584-42:2010, 3.37, modified — Notes 1 to 5 to entry have been removed.]

3.18
transient surface
part of the surface which is formed on the *workpiece* (3.20) by the cutting edge and removed during the following cutting stroke, during the following revolution of the tool or workpiece, or by the following cutting edge

[SOURCE: ISO 3002-1:1982, 3.1.3]

3.19
visible property
property (3.17) that has a definition meaningful in the scope of a given characterization class, but that does not necessarily apply to the various products belonging to this class

[SOURCE: ISO 13584-42:2010, 3.46]

3.20
workpiece
object on which a cutting action is performed

[SOURCE: ISO/TS 13399-2:2021, 3.21]

3.21
workpiece side
identification of a direction pointing towards the *workpiece* (3.20)

4   Abbreviated terms

BSU   basic semantic unit

DET   data element type

5 Representation of the ontology concepts as dictionary entries

5.1 General

A concept in the ontology is identified by a name in lower-case characters. The name of a class that represents the concept in the dictionary is identified by lowercase characters with multiple words joined by an underscore character.

EXAMPLE   "tool item type" is the name of a concept in the ontology. "tool_item_type" is the identifier of the class in the dictionary that represents the concept.

Data for tool items are grouped into two main classes: tool_item_feature and tool_item_type. The items in the classification of tool_item_type are identified by a label that is derived from the main application of a tool. However, it should be recognized that a tool can be used for more than one type of cutting operation. A tool_item_feature is an aspect of a tool_item_type that can not exist in isolation from the tool_item_type. A classification of cutting operations is also provided for completeness and to aid definitions.

Some of the definitions of properties that are applicable to tool items are defined in terms of a primary coordinate system. The coordinate system is the same for adaptive items, cutting items, and tool items and is defined in ISO/TS 13399-50. The applications of this coordinate system to tool items are described in this document. All functional dimensions of a tool item that uses replaceable cutting items are defined on the assembly of the tool item and the master insert. The convention followed is "the tool in hand".

Each entry in the dictionary, either a class or a property, is identified with a numerical code (BSU) that is generated at random when the dictionary is compiled. A BSU can be made unique by the addition of a code that is a reference to the supplier of the dictionary. Each classified item in 5.2, 5.3, and 5.4 is associated with its definition from the dictionary.

The ISO 13399 series shall follow the principles in Annex A. The structure of the classification is provided in Annex B. The definitions of the cutting item classes are provided in Annex C. The properties applicable to tool item classes are defined in Annex D.

5.2 Reference systems for tool items

5.2.1 General

The primary coordinate system used for tool items in this document is the same coordinate system as is defined in ISO/TS 13399-50. The additional reference entities relevant for tool items are as follows:

— coordinate_system_in_process;

— coordinate_system_workpiece_side;

— cutting_reference_point;

— dependency;

— feed_direction_primary;

— master_insert;

— mirror_plane;

— mounting_coordinate_system;

— primary_coordinate_system;

— prismatic_tool_item_position;

— round_tool_item_position;

— tool_cutting_edge_plane;

— tool_feed_plane;

— tool_rake_plane;

— xy-plane;

— xyw-plane;

— xz-plane;

— xzw-plane;

— yz-plane;

— yzw-plane.

5.2.2   cutting_reference_point

Theoretical sharp point of the cutting tool from which the major functional dimensions are taken.

NOTE 1   For the calculation of this point the following cases apply:

Case 1:   For a tool cutting edge angle less than or equal to 90°, the point is the intersection of the tool_cutting_edge_plane, the tool_feed_plane, and the tool_rake_plane.

Case 2:   For a tool cutting edge angle greater than 90°, the point is the intersection of the tool_feed_plane, a plane perpendicular to the tool_feed_plane and tangential to the cutting corner, and the tool_rake_plane.

Case 3:   For ISO tool styles D and V with only axial rake, the point is the intersection of a plane perpendicular to the primary feed direction and tangential to the cutting edge (tangential point), a plane parallel to the feed direction through the tangential point, and the tool_rake_plane.

Case 4a: For round inserts with one feed direction parallel to the tool axis, the point is the intersection of a plane perpendicular to the primary feed direction and tangential to the cutting edge (tangential point), a plane parallel to the feed direction through the tangential point, and the tool_rake_plane.

Case 4b: For round inserts with two feed directions, one parallel to the tool axis and one perpendicular to the tool axis with two cutting_reference_point, each point is the intersection of a plane perpendicular to its feed direction and tangential to the cutting edge (tangential point), a plane parallel to the feed direction through the tangential point, and the tool_rake_plane.

NOTE 2   In Case 3, the theoretical sharp corner of the insert and the cutting_reference_point are on the plane that is perpendicular to the tool_feed_plane.

5.2.3   feed_direction_primary

Direction of movement of a cutting tool to achieve the main cutting function of the tool.

5.2.4   master_insert

Nominal, replaceable cutting item that is used for defining the dimensions of a cutting tool.

NOTE 1   A master insert can substitute for either a regular or an irregular insert and uses the position of the item that it replaces.

NOTE 2   Definitions making use of a master insert also apply to solid or brazed tools.

5.2.5   prismatic_tool_item_position

Identifies the location of a prismatic tool item where:

— the base of the tool item shall be coplanar with the XZ-plane;

— the normal for the base of the item shall be in the –Y direction;

— the rear backing surface shall be coplanar with the YZ-plane;

— the normal for the rear backing surface shall be in the –X direction;

— the end of the item shall be coplanar with the XY-plane;

— the normal for the end of the item shall be in the –Z direction; and

— the rake face of the primary cutting item shall be completely visible in the XZ quadrant.

NOTE 1   This definition applies to right-handed tool items. Left-handed tool items are as defined for right-handed items but mirrored through the YZ-plane.

NOTE 2   For cartridges, the top of the axial adjustment screw shall be coincident with the XY-plane.

5.2.6   round_tool_item_position

Identifies the location of a round tool item where:

— the axis of the tool item shall be colinear with the Z-axis;

— the vector of the shank that points in the Z direction shall also point towards the workpiece side;

— the drive slots or clamping flats, if present, shall be parallel with the XZ-plane;

— the contact surface of the coupling, the gauge plane, or the end of the cylindrical shank shall be coplanar with the XY-plane; and

— the rake face of the primary cutting item shall be visible in the XZ quadrant.

NOTE   This definition applies to right-handed tool items. Left-handed tool items are as defined for right-handed tool items but mirrored through the YZ-plane.

If a bore is present, the vector of the bore of the item that points in the Z direction shall also point towards the workpiece side.

5.2.7   tool_cutting_edge_plane

Plane perpendicular to the xy-plane through the major cutting edge of a master insert or of a solid tool.

5.2.8   tool_feed_plane

Plane perpendicular to the xy-plane that is parallel to the primary feed direction of the tool item and that is tangential to the cutting corner of the master insert or of a solid tool.

5.2.9   tool_rake_plane

Plane that contains the cutting edges of a master insert or of a solid tool.

5.3   Tool item feature

5.3.1   tool_item_feature

Generic family of characteristics of a tool item that cannot exist independently of the tool item. tool_item_feature has the following subclasses:

— chip_management;

— drill_point;

— guide_pilot_feature;

— pilot_drill_feature;

— tool_hub.

5.3.2   chip_management

Generic class of features of the tool body or assembly to control the direction of motion of the chip channel exit.

End of the chip channel on the machine side.

5.3.3   drill_point

Part of a drill that first makes contact with the workpiece.

5.3.4   guide_pilot_feature

Portion of a cylindrical tool in front of the cutting portion that acts to limit the sideways movement of the tool in operation.

5.3.5   pilot_drill_feature

Part of a larger drill for guiding the main cutting operation.

5.3.6   tool_hub

Central part of a disk-shaped tool item with increased thickness.

5.4   Tool item type

5.4.1   tool_item_type

Generic family of items that support or hold one or more cutting items in a cutting operation. tool_item_type has the following subclasses:

— broach;

— burr_tool;

— cartridge;

— drill;

— mill;

— ream;

— rotating_borer;

— threading_die;

— threading_tap;

— turn.

5.4.2   broach

5.4.2.1   General

Family of items designed for use mainly in broaching operations. Broach has the following subclasses:

— cylindrical_broach;

— disk_broach;

— prismatic_broach;

— tapered_broach.

5.4.2.2   cylindrical_broach

Tool item used for changing the dimensions of an existing profile that has a constant circular cross section and cutting edges around the whole circumference.

5.4.2.3   disk_broach

Disk-shaped tool item used for changing the dimensions of an existing profile and that has the cutting edges on the periphery of the disk.

5.4.2.4   prismatic_broach

Tool item with a constant rectangular cross section used for changing the dimensions of an existing profile and that has cutting items on one side of the cross section.

5.4.2.5   tapered_broach

Tool item for changing the dimensions of an existing profile and that has continuously varying cross section with cutting edges surrounding the cross section.

NOTE   The cross section can be rectangular, circular, or elliptical.

5.4.3   burr_tool

Small rotating tool for removing areas of roughness from a machined edge.

5.4.4   cartridge

Tool item that carries a solid cutting edge or locks a replaceable insert and is designed to be mounted onto either an adaptive item or a tool item.