TECHNICAL SPECIFICATION

ISO/TS 13399-80

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Cutting tool data representation and exchange —

Part 80: Creation and exchange of 3D models — Overview and principles

Représentation et échange des données relatives aux outils coupants —

Partie 80: Création et échange de modèles 3D — Vue d'ensemble et principes

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 29, *Small tools*.

ISO 13399 consists of the following parts, under the general title *Cutting tool data representation and exchange*:

— *Part 1: Overview, fundamental principles and general information model*

— *Part 2: Reference dictionary for the cutting items* [Technical Specification]

— *Part 3: Reference dictionary for tool items* [Technical Specification]

— *Part 4: Reference dictionary for adaptive items* [Technical Specification]

— *Part 5: Reference dictionary for assembly items* [Technical Specification]

— *Part 50: Reference dictionary for reference systems and common concepts* [Technical Specification]

— *Part 60: Reference dictionary for connection systems* [Technical Specification]

— *Part 80: Creation and exchange of 3D models — Overview and principles* [Technical Specification]

— *Part 100: Definitions, principles and methods for reference dictionaries* [Technical Specification]

— *Part 150: Usage guidelines* [Technical Specification]

— *Part 201: Creation and exchange of 3D models — Regular inserts* [Technical Specification]

— *Part 301: Concept for the design of 3D models based on properties according to* ISO/TS 13399-3*: Modelling of thread-cutting taps, thread-forming taps and thread-cutting dies* [Technical Specification]

— *Part 302: Concept for the design of 3D models based on properties according to* ISO/TS 13399-3*: Modelling of solid drills and countersinking tools* [Technical Specification]

The following parts are under preparation:

— *Part 51: Designation system for customer solution cutting tools* [*Technical Specification*]

— *Part 202: Creation and exchange of 3D models — Irregular inserts* [Technical Specification]

— *Part 203: Creation and exchange of 3D models — Replaceable inserts for drilling* [Technical Specification]

— *Part 204: Creation and exchange of 3D models — Inserts for reaming* [Technical Specification]

— *Part 303: Creation and exchange of 3D models — Solid end mills* [Technical Specification]

— *Part 304: Creation and exchange of 3D models — Solid milling cutter with arbor hole* [Technical Specification]

— *Part 307: Creation and exchange of 3D models — End mills for indexable inserts* [Technical Specification]

— *Part 308: Creation and exchange of 3D models — Milling cutter with arbor hole for indexable inserts* [Technical Specification]

— *Part 309: Creation and exchange of 3D models — Tool holders for indexable inserts* [Technical Specification]

— *Part 311: Creation and exchange of 3D models — Solid reamers* [Technical Specification]

— *Part 312: Creation and exchange of 3D models — Reamers for indexable inserts* [Technical Specification]

— *Part 401: Creation and exchange of 3D models — Converting, extending and reducing adaptive items* [Technical Specification]

— *Part 405: Creation and exchange of 3D models — Collets* [Technical Specification]

Introduction

This part of ISO 13399 defines the concept, the terms, and the definitions regarding the creation and exchange of simplified 3D of cutting items, tool items, and adaptive items that can be used for NC-programming, simulation of the manufacturing processes and the determination of collision within machining processes. It is not intended to standardize the design of the items themselves.

Cutting tool data that can be described by ISO 13399 include, but are not limited to, everything between the workpiece and the machine tool. Information about inserts, solid tools, assembled tools, adaptors, components, and their relationships can be represented by this part of ISO 13399. The increasing demand providing the end user with 3D models for the purposes defined above is the basis for the development of this series of International Standards.

The objective of ISO 13399 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 will facilitate the processing and exchange of cutting tool data within and between different software systems and computer platforms and support 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 that are used for these representations are those developed by ISO TC 184, *Automation systems and integration for the representation of product data*, SC 4, *Industrial data*, by using standardized information models and reference dictionaries.

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/TC 3, *Information structures, documentation and graphical symbols*, SC 3D, *Product properties and classes and their identification*, and in its extensions defined in ISO 13584-24 and ISO 13584-25.

Cutting tool data representation and exchange —

Part 80:
Creation and exchange of 3D models — Overview and principles

1 Scope

This part of ISO 13399 specifies the basic principles for the creation and exchange of simplified 3D models of cutting items, tool items, and adaptive items, using related properties and domains of values.

Simplified 3D models contain the following:

— naming and defining of the basic design features of cutting items, tool items, and adaptive items, with an association to the used properties;

— naming and defining of the internal structure of the 3D model that represents the features and the properties of cutting items, tool items, and adaptive items;

— naming and defining of those elements and features that are not defined in ISO/TS 13399-50, but are necessary to design 3D models.

The following are outside the scope of this part of ISO 13399:

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

— creation and exchange of simplified 3D models for cutting tools;

— creation and exchange of simplified 3D models for tool items;

— creation and exchange of simplified 3D models for adaptive items;

— creation and exchange of simplified 3D models for assembly items and auxiliary items.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 13399-2, *Cutting tool data representation and exchange — Part 2: Reference dictionary for the cutting items*

ISO/TS 13399-3, *Cutting tool data representation and exchange — Part 3: Reference dictionary for tool items*

ISO/TS 13399-4, *Cutting tool data representation and exchange — Part 4: Reference dictionary for adaptive items*

ISO/TS 13399-5, *Cutting tool data representation and exchange — Part 5: Reference dictionary for assembly items*

ISO/TS 13399-50, *Cutting tool data representation and exchange — Part 50: Reference dictionary for reference systems and common concepts*

ISO/TS 13399-60, *Cutting tool data representation and exchange — Part 60: Reference dictionary for connection systems*

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

3 Designation of design elements

3.1 General

The creation of 3D models shall be by means of nominal dimensions.

NOTE Some of the definitions are taken from ISO/TS 13399-50.

All designations of 3D design elements (coordinate systems, planes, axes, points, solid design elements) shall be based on the designations and preferred symbols of ISO/TS 13399-2 to ISO/TS 13399-60.

If additional properties are required, they shall be requested through the ISO 13399 Maintenance Agency as defined in ISO/TS 13399-100:2008, Annex D.

3.2 Reference system

3.2.1 Primary coordinate system "PCS"

The primary coordinate system, as shown in Figure 1, shall consist of the following standard elements:

— right-handed rectangular Cartesian system in three-dimensional space with three principal axes labelled X, Y, and Z;

— three orthogonal planes built from the three principal axes and named "XYP", "XZP", and "YZP";

— three orthogonal axes built from the planes and named "XA", "YA", and "ZA".

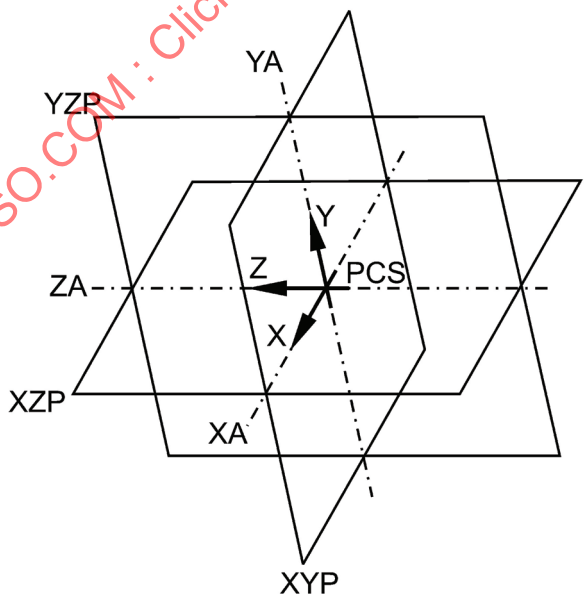


Figure 1 — Primary coordinate system "PCS"

3.2.2 Coordinate system workpiece side "CSW"

A single coordinate system at the workpiece side is named "coordinate system workpiece side" (CSW) and is used for the mounting of cutting tool components to build a complete cutting tool. If more than one CSW is used to assemble a complete cutting tool, the CSWs shall be indexed.

CSW is a right-handed rectangular Cartesian system in three-dimensional space with three principal axes labelled "XW", "YW", and "ZW". Figure 2 shows an example of CSW orientation.

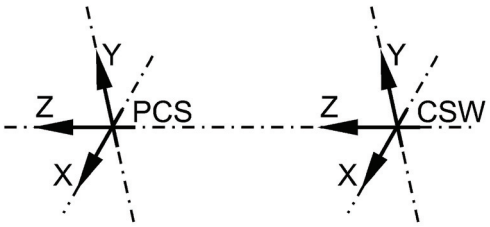


Figure 2 — Example of CSW orientation

Case 1: One coordinate system at the workpiece side

A single coordinate system at the workpiece side shall be designated "CSW".

Case 2: One coordinate system at workpiece side on different levels

A single coordinate system on different levels shall be designated "CSWn", e.g. "CSW1", "CSW2". The numbering starts at the workpiece side and ends at the machine side in the direction of the positive Z-axis. On a stepped tool, the CSW closest to the workpiece shall be on level 1, the CSW on the next stepped diameter shall be on the next level.

Case 3: Multiple coordinate systems at one level and different angles

Multiple coordinate systems at one level, but different angles and not at the centre of the tool axis shall be designated "CSWn_m", where the "n" defines the level and the "m" defines the number of the coordinate system itself. The counting starts at the three o'clock position counting in counterclockwise direction while looking towards the machine spindle (positive Z-axis).

Case 4: Multiple coordinate systems at one level, one angle and different diameters

The designation is the same as described in case 3. The counting starts at the smallest diameter.

Case 5: Multiple coordinate systems at multiple levels, different angles and different diameters

The designation is the same as described in case 3. The counting starts at the smallest diameter and at the three o'clock position counting in counterclockwise direction while looking towards the machine spindle (positive Z-axis).

All cases defined above are applicable to tool items, adaptive items, and cutting tools.

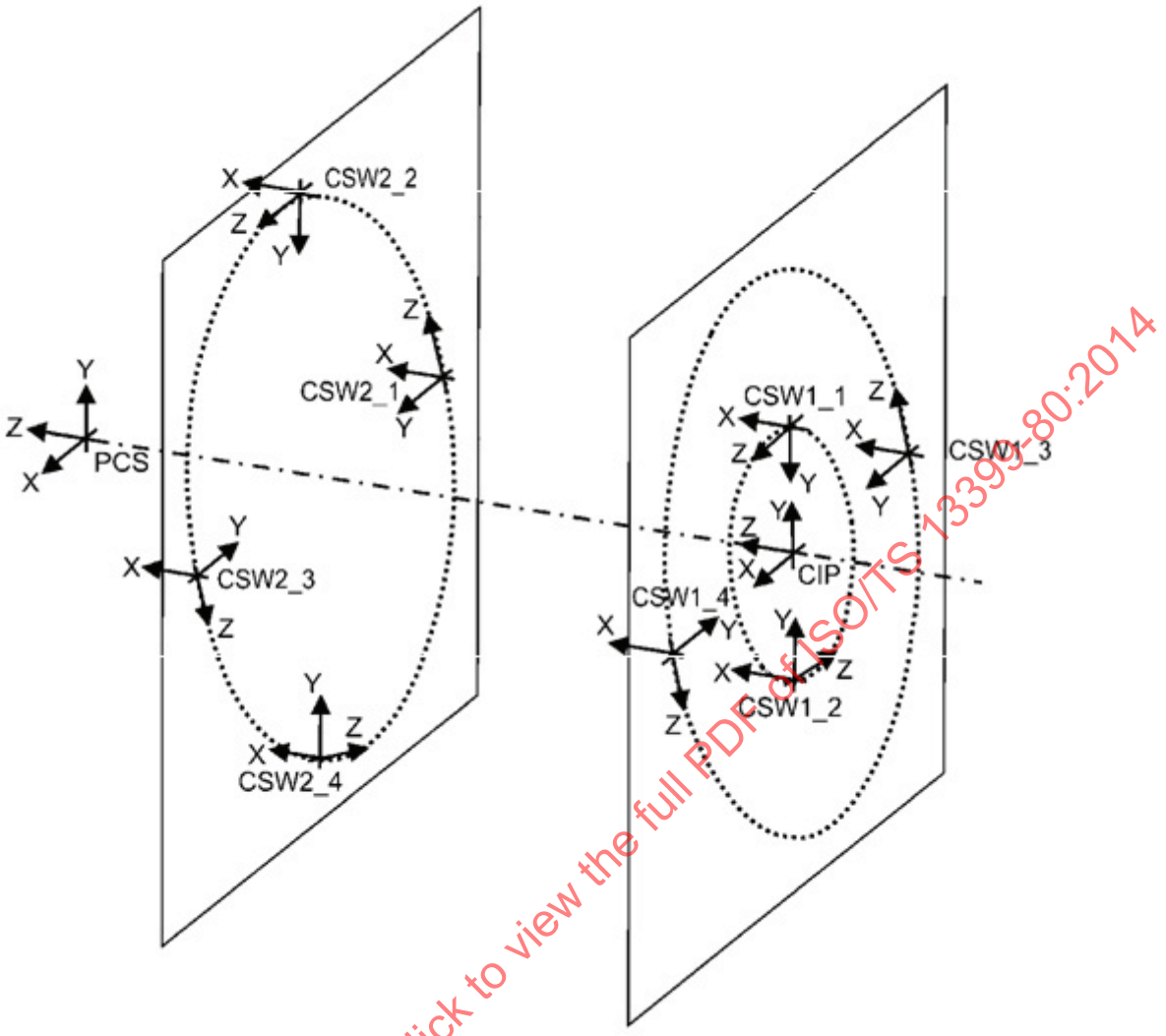


Figure 3 — Adjustment coordinate system on workpiece side

3.3 Planes

3.3.1 Primary planes

See 3.2.1.

3.3.2 Planes at workpiece side

For each existing "CSW", the three planes shall be built from the principal axes and named "XYWP", "XZWP", or "YZWP". If more than one CSW is on the item model, they shall be indexed as defined in 3.2.2.

3.4 Axes

3.4.1 Primary axes

See 3.2.1.

3.4.2 Axes at workpiece side

For each existing “CSW”, the three planes shall be built from the principal axes and named as “XWA”, “YWA”, or “ZWA”. If more than one CSW is on the item model, they shall be indexed as defined in 3.2.2.

3.5 Solid design elements

Solid design elements like profiles, revolved bodies, extruded bodies, and so on, as well as their sketches, shall have descriptive and useful names, e.g. for the pocket seat of an insert: “POCKET_SEAT_FEATURE”.

3.6 Level of detail

3.6.1 General

Simplified models shall be differentiated by the level of detail:

— basic geometry (see 3.6.2);

— detailed geometry (extended design) (see 3.6.3).

Defined use cases impact different levels of detail. A production model is not covered by this International Standard because of the impact on data exchange and other processes.

3.6.2 Basic geometry

The basic geometry shall be unambiguous, but not necessarily accurate to reality. The shell of the geometry shall be shown to scale as well as any detail being used for functionality and identification. No relevant features for unambiguous depiction and/or function can be omitted.

If features located at the periphery shall be simplified, then the maximum dimensions shall be taken for the design of these features. Examinations of collision are possible unconfined in regards of these features.

The design of internal features is at the designer’s discretion as long as it is unimportant for the function.

The maximum space of extension shall be enclosed. Features like chamfers, rounding, slots, threads, chip flutes, and internal contours can be omitted as long as they are not relevant for unambiguous depiction.

The basic geometry can be used for the planning of products, operating devices, and equipment. The main focus is on a small data file volume and the characteristic geometrical properties as used for NC-programming and simulation processes.

3.6.3 Detailed geometry (extended design)

The detailed geometry shall be a realistic design of the part, but without any proprietary geometry that can be used to manufacture the part.

Exception: Thread shall be designed simplified.

4 Colour settings

4.1 Colour setting for the model

3D model shall have colour settings as follows:

— geometry of the cutting part: light grey with 80 % white [RGB (red green blue): 204/204/204];

— geometry of the shank (interface to machine) and the non-cutting part: grey with 50 % white (RGB: 127/127/127);

— geometry of spare parts (if desired to visualize): dark grey with 30 % white (RGB: 77/77/77).

4.2 Colour setting for the cutting edge line and the cutting part line

The aim of the this International Standard is to provide 3D models for end-to-end use in the NC process chain including the simulation processes. To ensure this, it is important to add a feature as follows:

— models of replaceable inserts shall contain a closed polyline, named “cutting edge line”, along the simplified cutting edges;

— models of cutting tools with non-indexable cutting edges shall contain either a closed or an open polyline, named “cutting part line” (this line can be created by means of using the virtual “cross-section” along the tool axis applying on the cutting part).

In both cases, the result shall be a simplified line, which represents the simplified 3D geometry.

This line shall be visualized in the model in a blue colour (RGB: 0/0/255); in printed versions of the standards of this International Standard, it shall be visualized in black. The line shall be grouped to the layer “CUT”.

If a CAD-system does not allow the colours to be set as described above, the setting should have a deviation of ±1 % of the given RGB values, which shall be interpreted as follows:

— cutting part: 79 % to 81 % white;

— non-cutting part: 49 % to 51 % white;

— spare part: 29 % to 31 % white.

The RGB values shall be calculated accordingly.

4.2.1 Colour setting overview

See Figure 4.

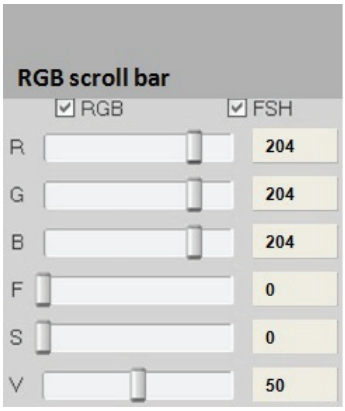
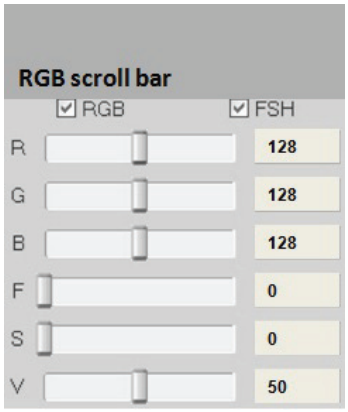
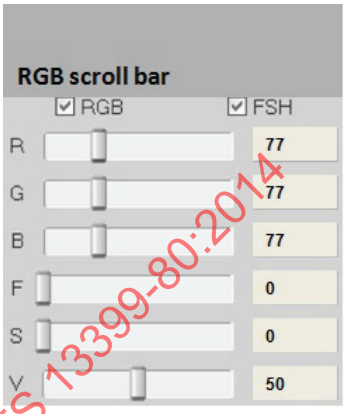
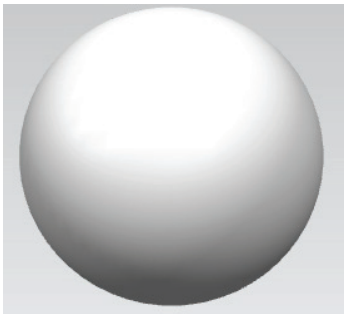
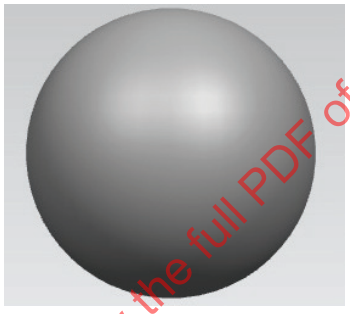
Colour setting for		
the cutting part	the non-cutting part and shank	the spare part
		
		
“light grey” 80 % white	“medium grey” 50 % white	“iron grey” 30 % white

Figure 4 — Example of colour settings in a CAD system

5 3D model data exchange

5.1 General

For the 3D model data exchange of cutting tools, a differentiation shall be necessary between the cutting and non-cutting geometry.

5.2 Structure of the layers

Table 1 shows the necessary layers for a data exchange of a 3D model data exchange.

Table 1 — Structure of layers

Layer name	Description of the layer content
CUT	Bounding geometry of the cutting part, if applicable.
NOCUT	Bounding geometry of the non-cutting part.
DETAILS	Simplified presentation of the complete geometry of the cutting tool.
DEFPOINTS	All defined coordinate systems “PCS”, “MCS”, and CSWs.

6 Data exchange

The data exchange format is determined as defined in ISO 10303-214, known as STEP AP 214. The specification of the data exchange model is defined within the appropriate part of this International Standard.