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Cutting tool data representation and exchange —

Part 406: Creation and exchange of 3D models — Modelling of connection interface

Représentation et échange des données relatives aux outils coupants —

Partie 406: Création et échanges de modèles 3D — Conception d'interfaces de connexion

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Foreword

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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).

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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*.

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 concept, terms and definitions of how to design simplified 3D models of connection interfaces for the design of cutting tools 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 cutting tool itself.

A cutting tool is used in 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, solid tools, assembled tools, adaptors, components and their relationships can be represented by this document. The increasing demand for 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 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 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*, SC 4, *Industrial data*, for the representation of product 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/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 406:
Creation and exchange of 3D models — Modelling of connection interface

1 Scope

This document defines the concept of how to design the connection interfaces for adaptive and tool items, limited to any kind of standardized connections, together with the usage of the related properties and domains of values.

This document specifies the requirements of simplified 3D models for data exchange of connection interface.

Not all dimensions given in this document are defined in the ISO 13399 series.

The following are outside the scope of this document:

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

— concept of 3D models for cutting tools;

— concept of 3D models for cutting items;

— concept of 3D models for other connection interfaces not being described in the scope of this document;

— concept of 3D models for adaptive items;

— concept of 3D models for assembly items and auxiliary items.

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 296, *Machine tools — Self-holding tapers for tool shanks*

ISO 239, *Drill chuck tapers*

ISO 3338 (all parts), *Cylindrical shanks for milling cutters*

ISO 5414-1, *Tool chucks (end mill holders) with clamp screws for flatted cylindrical shank tools — Part 1: Dimensions of the driving system of tool shanks*

ISO 5414-2, *Tool chucks (end mill holders) with clamp screws for flatted cylindrical shank tools — Part 2: Connecting dimensions of chucks and designation*

ISO 6462, *Face and shoulder milling cutters with indexable inserts — Dimensions*

ISO 7388 (all parts), *Tool shanks with 7/24 taper for automatic tool changers*

ISO 9270-1, *7/24 taper spindle noses for automatic tool changers — Part 1: Dimensions and designation of spindle noses of forms S and SF*

ISO 9270-2, *7/24 taper spindle noses for automatic tool changers — Part 2: Dimensions and designation of spindle noses of forms J and JF*

ISO 9766, *Drills with indexable inserts — Cylindrical shanks with a parallel flat*

ISO 10649-1, *Cutter arbors with parallel key and tenon drive — Part 1: General dimensions*

ISO 10897, *Collets for tool holders with taper ratio 1:10 — Collets, holders, nuts*

ISO 10889 (all parts), *Tool holders with cylindrical shank*

ISO 12164-1, *Hollow taper interface with flange contact surface — Part 1: Shanks — Dimensions*

ISO 12164-2, *Hollow taper interface with flange contact surface — Part 2: Receivers — Dimensions*

ISO 12164-3, *Hollow taper interface with flange contact surface — Part 3: Dimensions of shanks for stationary tools*

ISO 12164-4, *Hollow taper interface with flange contact surface — Part 4: Dimensions of receivers for stationary tools*

ISO 15488, *Collets with 8 degree setting angle for tool shanks — Collets, nuts and fitting dimensions*

ISO/TS 13399-80, *Cutting tool data representation and exchange — Part 80: Creation and exchange of 3D models — Overview and principles*

ISO/TS 13399-401, *Cutting tool data representation and exchange — Part 401: Creation and exchange of 3D models — Converting, extending and reducing adaptive items*

ISO 26622-1, *Modular taper interface with ball track system — Part 1: Dimensions and designation of shanks*

ISO 26622-2, *Modular taper interface with ball track system — Part 2: Dimensions and designation of receivers*

ISO 26623-1, *Polygonal taper interface with flange contact surface — Part 1: Dimensions and designation of shanks*

ISO 26623-2, *Polygonal taper interface with flange contact surface — Part 2: Dimensions and designation of receivers*

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Abbreviated terms

DCONMS	connection diameter machine side
DM	polygonal diameter according to ISO 26623-1
DF	flange diameter
DIX	maximum body diameter according to the ISO 12164 series
MXA	X-axis of the MCS coordinate system

MYA	Y-axis of the MCS coordinate system
MZA	Z-axis of the MCS coordinate system
LPCON	connection protruding length
LPR	protruding length
LS	shank length
OAL	overall length

5 Starting elements, coordinate systems and planes

5.1 General

The modelling of the 3D models shall be done by means of nominal dimensions. Some examples of nominal dimensions are given in Annex A. Deviations within the tolerances are allowed.

WARNING — There is no guarantee that the 3D model, created according to the methods described in this document, is a true representation of the physical tool supplied by the tool manufacturer. If the models are used for simulation purposes — e.g. CAM simulation — it shall be taken into consideration that the real product dimensions can differ from those nominal dimensions.

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

5.2 Reference system (PCS — Primary coordinate system)

The reference system consists of the following standard elements as shown in Figure 1:

— **standard coordinate system**: right-handed rectangular Cartesian system in three dimensional space, called primary coordinate system (PCS);

— **3 orthogonal planes**: planes in the coordinate system that contain the axis of the system, named xy-plane (XYP), xz-plane (XZP) and yz-plane (YZP);

— **3 orthogonal axes**: axes built as intersections of the three orthogonal planes lines respectively, named x-axis (XA), y-axis (YA) and z-axis (ZA).

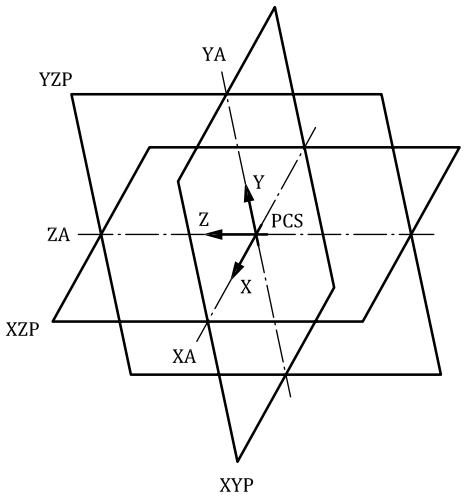

Figure 1 — Primary coordinate system

5.3 Position of the connection interface

5.3.1 General

The definition of the connection interface position — also called the PCS location — in 5.3.2 and 5.3.3 applies to right-handed adaptive or tool items. Left-handed items are as defined for right-handed items but mirrored through the yz-plane.

5.3.2 Prismatic connection interface

The prismatic connection interface shall be as follows:

— the base of the connection interface shall be coplanar with the xz-plane;

— the normal for the base of the connection interface 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 connection interface shall be coplanar with the xy-plane;

— the normal for the end of the connection interface shall be in the +z direction.

5.3.3 Round connection interface

The round connection interface shall be as follows:

— the axis of the connection interface shall be collinear 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 connection interface and the gauge plane or the end of the cylindrical shank shall be coplanar with the xy-plane;

— if there is a bore, then the vector of the bore that points in the –z direction shall also point towards the workpiece side.

5.4 Mounting coordinate system

For virtually mounting of e.g. adaptive items on to another adaptive item to create a complete cutting tool or directly into the machine tool, an additional reference system shall be defined. This reference system is called mounting coordinate system (MCS). It is located at the starting point of the protruding length of the adaptive item. This point is located at the contact surface of the coupling or the gauge plane, or at the standardized shank length of a cylindrical shank.

Figure 2 shows an example of the location of the MCS in relation to the PCS.

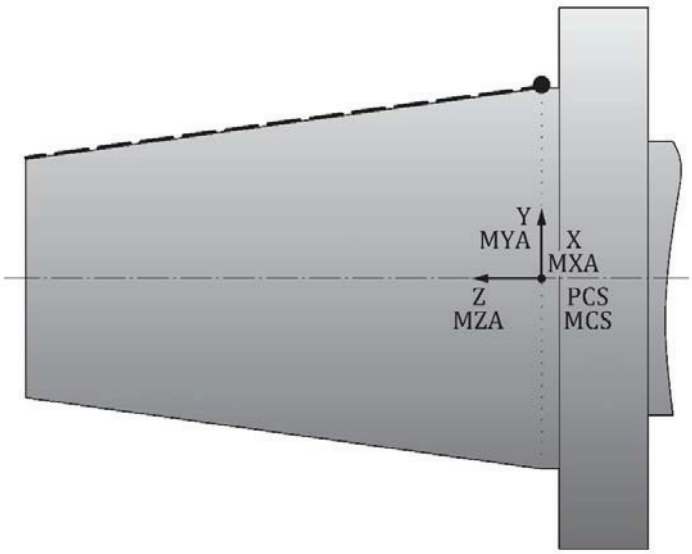

Figure 2 — Example of orientation and location of PCS and MCS

5.5 Planes

The modelling shall take place based on planes according to Figure 3, used as reference, if applicable. Therefore it is assured to be able to vary the model or to suppress single features of independent design features by means of changing the value of one or more parameter of the model design. Furthermore, the identification of the different areas shall be simplified in using the plane concept, even if they contact each other with the same size, e.g. chip flute, shank.

For the 3D visualization of this kind of adaptive items defined in the scope the general planes shall be determined as follows:

— TEP: tool end plane located at that end of the connection that points away from the workpiece; if the tool does not have a contact surface and/or a gauge line the TEP is coplanar with the xy-plane of the PCS;

— LSP: shank length plane referenced to TEP with distance of shank length (LS); it is only applicable if the connection is a kind of cylindrical shank.

Other planes, if necessary, shall be defined in the appropriate clauses. Figure 3 shows an example of determined planes for the design.

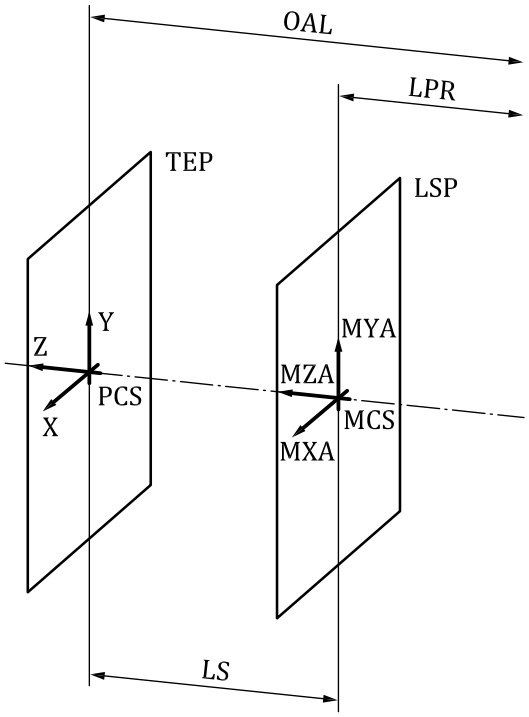

Figure 3 — Example of planes for the design

6 Design of the connection interface

The sketches and contours of the crude geometry do not contain any details, such as grooves, chamfers, rounding. These details shall be designed as separate design features after the design of the crude geometry and therefore they are named precision geometry.

The order of the structure of the model shall be kept by means of the state of the technology of the CAD systems. It shall be waived on references between the design components of the cutting and non-cutting part.

Connection interfaces shall be built either as rotational symmetric design elements, if they are revolving about their axis, or as extrusion design, if they are designed non-symmetrically, both based on properties in accordance with the individual standards.

Within the following clauses the specific structure of the model of the defined basic shapes of connection interfaces is described.

7 BFA-drill chuck taper

7.1 General

For the design of drill chuck tapers the appropriate standards shall be used. The design is shown on the example of the drill chuck taper according to the ISO 239 style of Morse taper.

7.2 Necessary properties

For the design of the drill chuck taper interface the dimensions for the shank and receiver shall be in accordance with ISO 239. Also, the symbols defined in ISO 239 shall be taken for the design.

7.3 Contours (sketches) for solid bodies

Figure 4 shows the design of the sketch of the shank and Figure 5 shows the sketch of the receiver. The sketches shall be revolved about their z-axis. The design of any details like chamfers, undercuts or roundings of the shank or the receiver shall be waived, if these features are not necessary for the function.

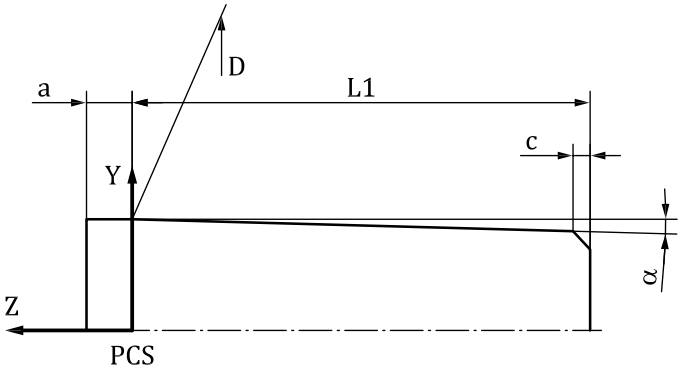

Figure 4 — Design of the sketch for male connection

The design of the flange is only necessary for the right positioning of the solid body for the subtraction from the body of the main item itself. Therefore the dimensions "da" and "b" on the flange are not given in the appropriate standard.

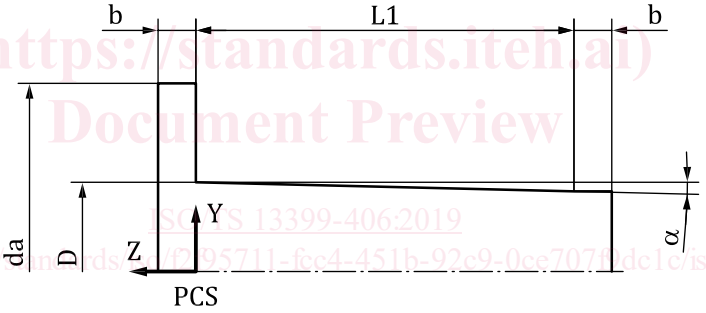

Figure 5 — Design of the sketch for female connection

7.4 Solid bodies of the drill chuck taper

The sketch of each of the connection shall be revolved about its z-axis. Figures 6 and 7 show the created solid body of the male taper and the female taper. The male taper shall be united with the body of the adaptive item while the female taper shall be subtracted from the main body of the tool item.

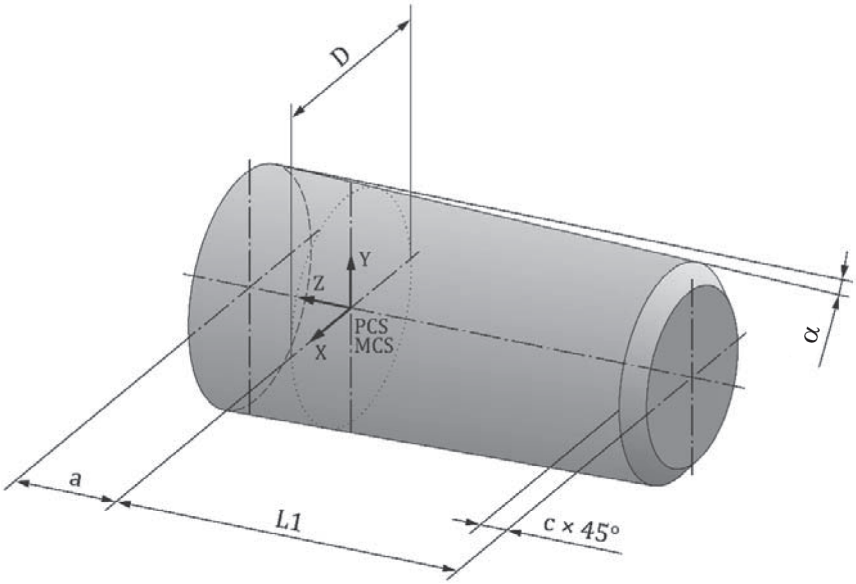

Figure 6 — Solid body of drill chuck taper — Male

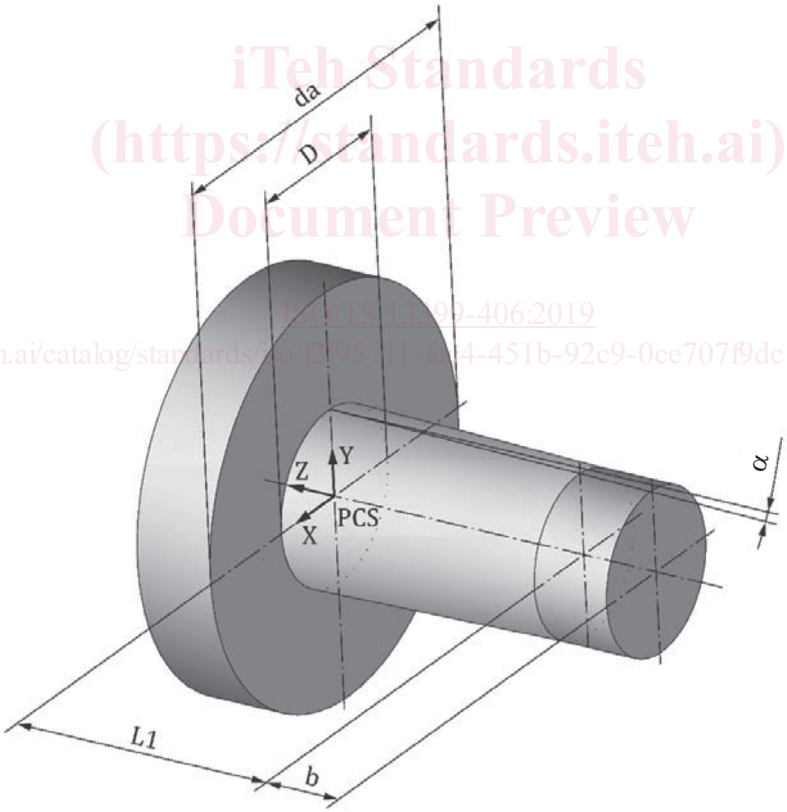

Figure 7 — Solid body of drill chuck taper — Female

Figure 8 shows an example of the female part of a drill chuck taper.