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Cutting tool data representation and exchange —

Part 306: Creation and exchange of 3D models — Drills and countersinking tools for indexable inserts

Représentation et échange des données relatives aux outils coupants —

Partie 306: Création et échange des modèles 3D — Forets et outils à chanfreiner et à lamer à plaquettes amovibles

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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*.

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.

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

Introduction

This document defines the concept of how to design simplified 3D models of drills and countersinking tools for indexable inserts, 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 providing the end user with 3D models for the purposes defined above is the basis for the development of the ISO 13399 series.

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 306:
Creation and exchange of 3D models — Drills and countersinking tools for indexable inserts

1 Scope

This document specifies a concept for the design of tool items, limited to any kind drilling and countersinking tools for indexable inserts, 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 drills and countersinking tools for indexable inserts.

The following are outside the scope of this document:

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

— concept of 3D models for cutting tools;

— concept of 3D models for cutting items;

— concept of 3D models for other tool items 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, 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 13399-50, *Cutting tool data representation and exchange — Part 50: Reference dictionary for reference systems and common concepts*

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

ISO/TS 13399-201, *Cutting tool data representation and exchange — Part 201: Creation and exchange of 3D models — Regular inserts*

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 Starting elements, coordinate systems, planes

4.1 General

The modelling of 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.

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

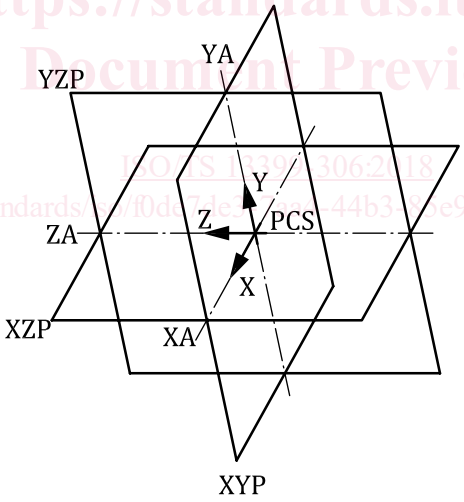

Figure 1 — Reference system

For virtually mounting of drilling and countersinking tools onto an adaptive item an additional reference system has to be defined. This reference system, called "mounting coordinate system" (MCS), shall be located at the starting point of the protruding length of a tool item. The orientation is shown in Figure 2.

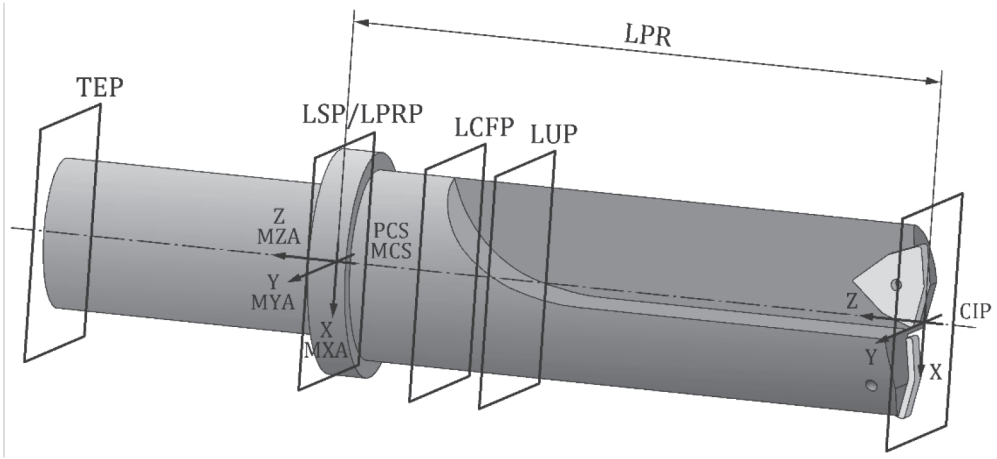

Figure 2 — Example of orientation of "PCS" and "MCS" reference system

4.3 Coordinate system at the cutting part

The coordinate system at the cutting part, named "coordinate system in process" (CIP) — with a defined distance to the PCS shall be oriented as shown in Figure 3:

— The origin is on a plane that is parallel to the XY-pane of PCS and is located on the most front cutting point;

— z-axis of CIP points to the PCS;

— z-axis of CIP is collinear to the z-axis of PCS;

— y-axis of CIP is parallel to the y-axis of PCS.

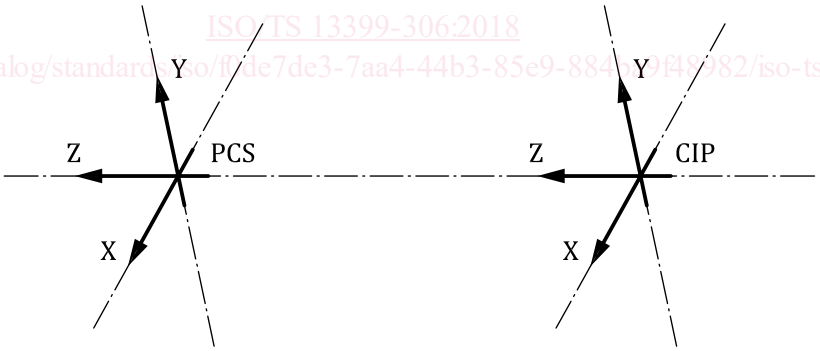

Figure 3 — Orientation of CIP

4.4 Planes

The modelling shall take place based on planes according to Figure 4, which is 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 is simplified in using the plane concept, even if they contact each other with the same size; e.g. chip flute, shank, and so on.

For the 3D visualization of drilling and countersinking tools for indexable inserts, the general planes shall be determined according to the following (see Figure 4):

— "TEP" the tool end plane is 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;

— "OALP" overall length plane located with the distance of "OAL" from "TEP";

— "PLP" point length plane reference to "OALP" with distance of "PL";

— "LCFP" chip flute length plane references to "OALP" with distance of "LCF";

— "LSP" shank length plane referenced to "TEP" with distance of "LS" — only applicable if the connection is a kind of cylindrical shank;

— "LUP" usable length plane referenced to "OALP" with distance of "LU".

Other planes, if necessary shall be defined in the appropriate clauses.

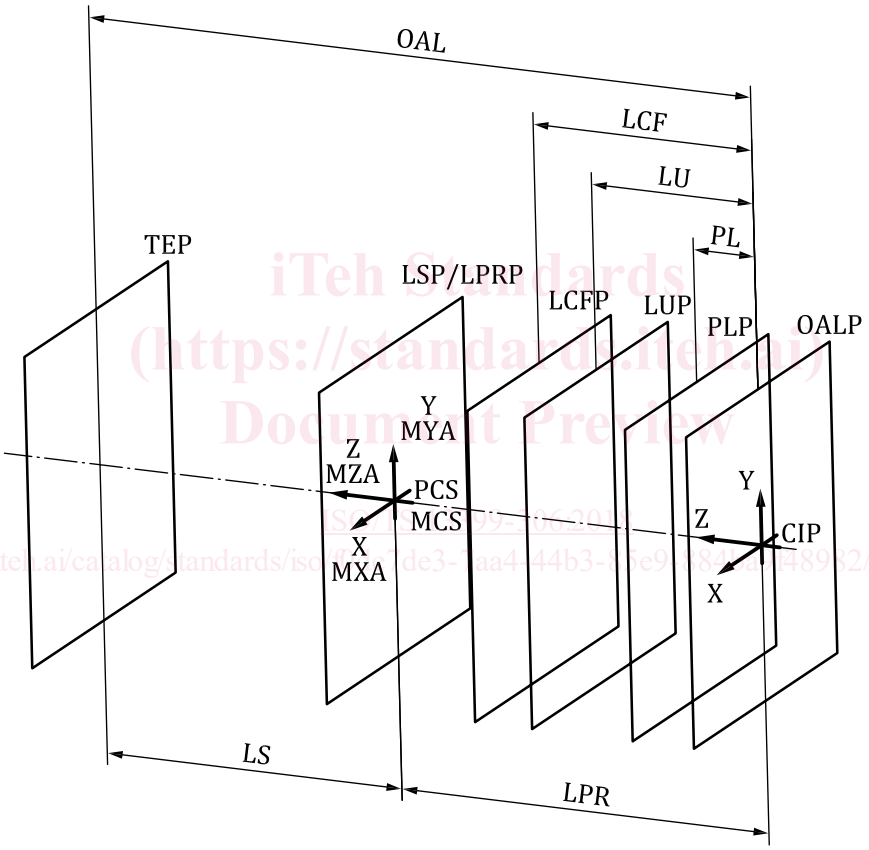

Figure 4 — Planes for design

4.5 Adjustment coordinate system on workpiece side

4.5.1 General

Additional coordinate systems for mounting components "CSWx_y" (coordinate system workpiece side) shall be defined according to ISO/TS 13399-50.

4.5.2 Designation of the coordinate system workpiece side

The designation of the coordinate system workpiece side is given in ISO/TS 13399-80:2017, 5.2.2.

5 Design of the model

5.1 General

The design of the model shall be according to ISO/TS 13399-80.

5.2 Necessary properties for inserts

5.2.1 General

Necessary properties for the design of the pocket seat features shall be taken in accordance of the defined properties for cutting items (see ISO/TS 13399-2). To be able to differentiate between tool-item and cutting-item properties, a postfix shall be added to the preferred symbols of the cutting-item properties. The postfix has the same code and sequence as the different coordinate systems on workpiece side that are defined in 4.5.

5.2.2 Properties for equilateral, equiangular and equilateral, non-equiangular inserts

Equilateral and equiangular inserts are:

— H — hexagonal insert;

— O — octagonal insert;

— P — pentagonal insert;

— S — square insert;

— T — triangular insert.

Equilateral and non-equiangular inserts are:

— C, D, E, M, V — rhombic insert;

— W — trigon insert.

Table 1 lists the properties for regular inserts with inscribed circle.

Table 1 — Properties for modelling equilateral, equiangular and equilateral, non-equiangular pocket seats

Preferred name	Preferred symbol
Clearance angle major	AN
Insert included angle	EPSR
Insert included angle minor	EPSRN
Inscribed circle diameter	IC
Cutting edge length[a]	L[a]
Corner radius	RE
Corner radius minor	REN
Insert thickness	S
[a] Shall be calculated. It is dependent on IC and EPSR.	

5.2.3 Properties for non-equilateral, equiangular and non-equilateral, non-equiangular inserts

Non-equilateral and equiangular inserts are:

— L — rectangular insert.

Non-equilateral and non-equiangular inserts are:

— A, B, K — parallelogram-shaped insert.

Table 2 lists the properties for regular inserts of rectangular and parallelogram shape.

Table 2 — Properties for modelling non-equilateral, equiangular and non-equilateral, non-equiangular pocket seats

Preferred name	Preferred symbol
Clearance angle major	AN
Clearance angle minor	ANN
Insert included angle	EPSR
Insert length	INSL
Corner radius	RE
Corner radius minor	REN
Insert thickness	S
Insert width	W1
Cutting edge length[a]	L[a]
[a] Shall be calculated. it is dependent on INSL and EPSR.	

5.2.4 Design of the pocket seat feature

The design shall be done in accordance with ISO/TS 13399-201, but without any corner configuration on the opposite side where the functional dimensions are based.

6 Twist drill for indexable inserts (ISYC: 306-01)

6.1 General

Figure 5 shows the properties to be used for the design of a twist drill.

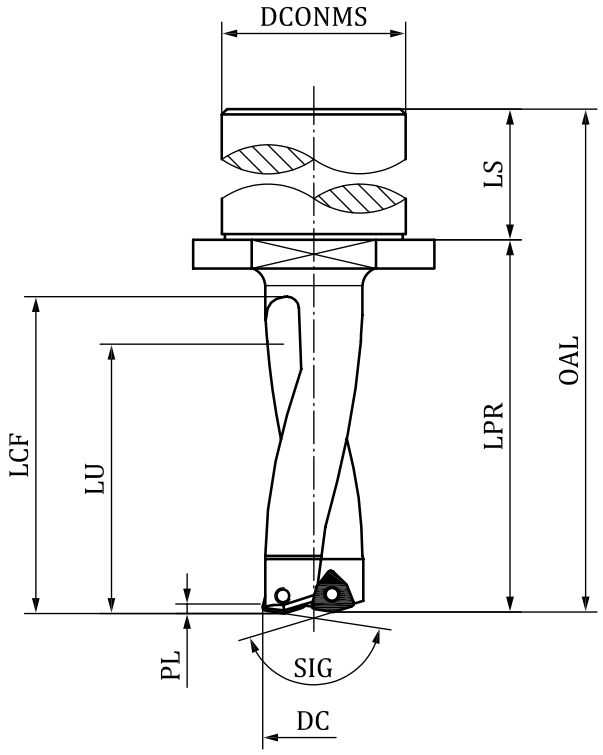

Figure 5 — Determination of properties of twist drill for indexable inserts

6.2 Necessary properties

Table 3 lists the properties being needed for the modelling of twist drills.

Table 3 — Properties for the modelling of a twist drill

Preferred name	Preferred symbol
Body diameter	BD
Cutting diameter	DC
Flange diameter	DF
Shank diameter	DCONMS
Flange thickness	FLGT
Protruding length	LPR
Shank length	LS
Usable length	LU
Overall length	OAL
Offset chip flute inner pocket	OFFCFIN
Offset chip flute outer pocket	OFFCFEX
Chip flute length	LCF
Point length	PL
Chip flute radius	RCF
Point angle	SIG

6.3 Basic geometry

A rotational design feature contains all elements between the plane "TEP" and the separation plane "CIP" to the cutting part.

The sketch (outline contour) shall include all the elements above and it shall be designed on the XZ plane of the "PCS". The rotational axis is the standard z-axis.

Design of the sketch:

— the sketch shall be determined as a half section;

— the sketch shall be constrained to the coordinate system "PCS" and to the planes "TEP" and "CIP". If the CAD software does not support the use of datum planes, the sketch shall be fully dimensioned otherwise the distances shall be in conjunction with the defined datum planes;

— the dimensioning shall be done with the appropriate properties listed in Table 1.

The sketch shall be revolved about the Z-axis by 360 ° as the basic geometry is shown in Figure 6.

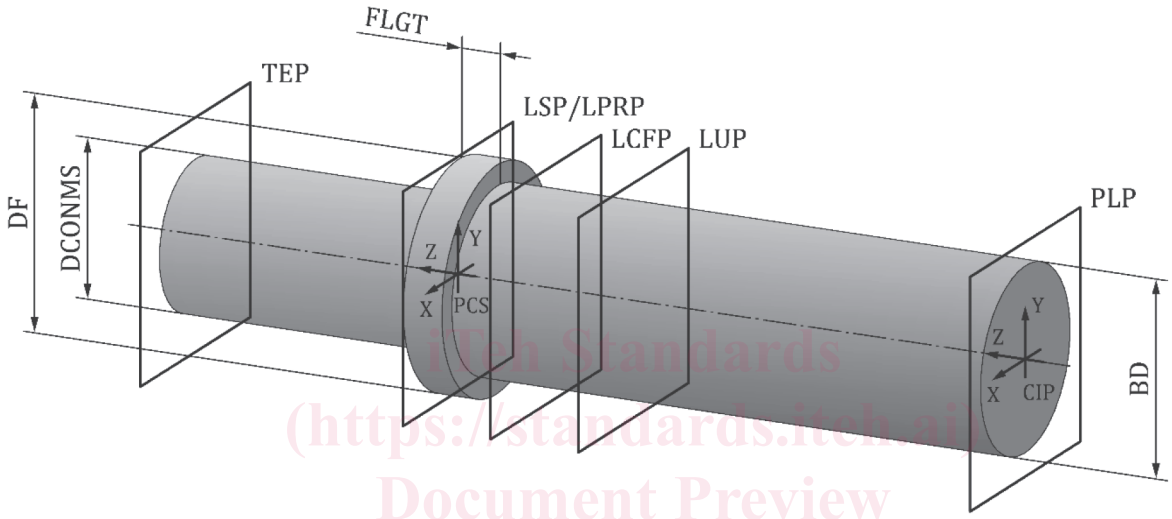

Figure 6 — Basic geometry of a twist drill

6.4 Determination of the position of the mounting coordinate system of insert

A coordinate system workpiece side and the corresponding planes shall be determined for each insert in accordance with their definitions in ISO/TS 13399-50.

The coordinate systems "CSWx_y" shall be referenced to "PCS". As illustrated in Figure 7, the position is determined through:

— the dimensions DC, LF;

— the geometry of the insert;

— the cutting reference point.