TECHNICAL SPECIFICATION

ISO/TS 13399-303

First edition
2016-02-01

Cutting tool data representation and exchange —

Part 303: Creation and exchange of 3D models — Solid end mills

Représentation et échange des données relatives aux outils coupants —

Partie 303: Création et échange de modèles 3D — Fraises cylindriques deux tailles monobloc

Reference number
ISO/TS 13399-303:2016(E)

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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).

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

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/TS 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 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 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]
- *Part 303: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of end mills with solid cutting edges* [Technical Specification]
- *Part 304: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of milling cutters with arbor hole and solid cutting edges* [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 cutters 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]

The following parts are under preparation:

- *Part 70: Graphical data layout — Layer settings for tool designs* [Technical Specification]
- *Part 71: Graphical data layout — Creation of documents for the standardized data exchange — Graphical product information* [Technical Specification]
- *Part 72: Creation of documents for the standardized data exchange — Definition of properties for drawing header and their XML-data exchange* [Technical Specification]
- *Part 305: Creation and exchange of 3D models — Modular tooling systems with adjustable cartridges for boring* [Technical Specification]
- *Part 310: Creation and exchange of 3D models — Turning tools with carbide tips* [Technical Specification]

Introduction

This part of ISO/TS 13399 defines the concept, the terms and the definitions on how to design simplified 3D models of milling cutters with arbors hole 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 ISO/TS 13399 (all parts) 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 ISO/TS 13399 (all parts). The increasing demand providing the enduser with 3D models for the purposes defined above is the basis for the development of this series of International Standards.

The objective of this International Standard 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/SC 4 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, and in its extensions defined in ISO 13584-24 and ISO 13584-25.

Cutting tool data representation and exchange —

Part 303: **Creation and exchange of 3D models — Solid end mills**

1 Scope

This part of ISO/TS 13399 specifies a concept for the design of tool items, limited to solid (non-indexable) end mills, with the usage of the related properties and domains of values.

This part of ISO/TS 13399 specifies a common way of design simplified models that contain the following:

— definitions and identifications of the design features of solid (non-indexable) end mills, with a link to the properties used;

— definitions and identifications of the internal structure of the 3D model that represents features and properties of solid (non-indexable) end mills.

The following are outside the scope of this part of ISO/TS 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 cutting items;

— creation and exchange of simplified 3D models for other tool items not being described in the scope of this part of ISO/TS 13399;

— 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 13399-3, *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 13399-60, *Cutting tool data representation and exchange — Part 60: Reference dictionary for connection systems*

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

3 Starting elements, coordinate systems, planes

3.1 General

The design of the 3D models will be done by means of nominal dimensions.

WARNING — There is no guarantee that the 3D model, created according to the methods described in this part of ISO/TS 13399, 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 definitions are taken from ISO/TS 13399-50.

3.2 Reference 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);

— **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)

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

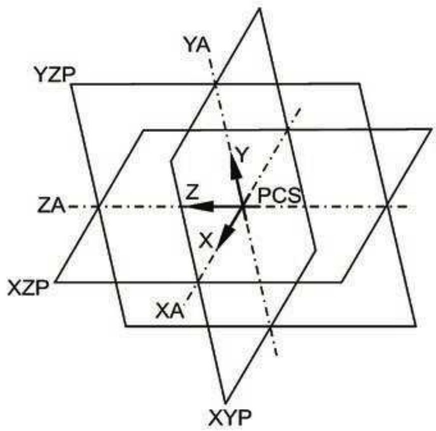

Figure 1 — Reference system

For virtually mounting of solid end mills onto an adaptive item, 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 a tool item. The orientation is shown in Figure 2.

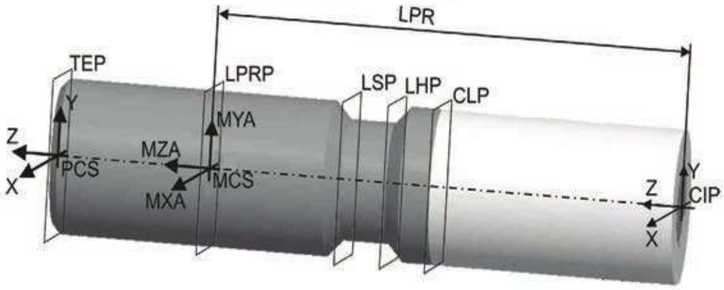

Figure 2 — Orientation of "PCS" and "MCS" reference system (example)

3.3 Coordinate system at the cutting part

The coordinate system at the cutting part, e.g. the centre cutting edge or the planar face, named "coordinate system in process" (CIP), with a defined distance to the PCS, shall be oriented as follows and shown in Figure 3:

— 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.

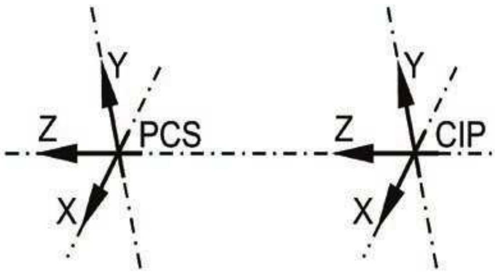

Figure 3 — Orientation of CIP

If the 3D modelling software gives the possibility to include interfaces for components to, for example, mount a face cutting part on to a complete cutting tool, it will be adviced to use the coordinate system "CIP".

If necessary, another designation should be given to the interface of the component (dependent on the software). The name is "CSIF" (for "coordinate system interface") and includes the coordinate system "CIP".

3.4 Planes

The modelling shall be based on planes according to Figure 4, which shall be used as reference, if applicable. Therefore, it is ensured that the model can be varied to suppress single features of independent design features by means of changing the value of one or more parameters. Furthermore, the identification of the different features 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 solid end mills, the planes shall be determined as follows.

— “LHP” head length plane: plane for the head length (LH); based on “CIP”.

— “LSP” shank length plane: plane for the shank length (LS); based on “PCS”.

— “LPRP” protruding length plane: plane for the protruding length (LPR); based on “CIP”.

— “TEP” tool end plane: 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. The overall length (OAL) is the distance between CIP and TEP.

— “CLP” cutting length plane: plane for the cutting depth maximum (APMX); based on “CIP”.

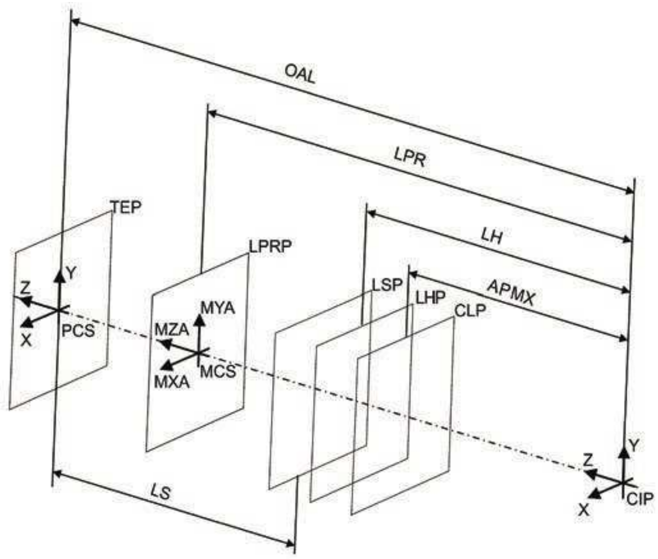

Figure 4 — Planes for design

3.5 Cutting reference point (CRP)

The cutting reference point is the theoretical point of the cutting tool from which the major functional dimensions are taken. Therefore, it shall always be referenced to the cutting diameter as shown in Figure 5.

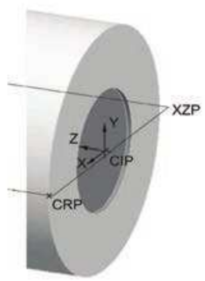

Figure 5 — Position of the cutting reference point “CRP”

4 Design of the model

4.1 General

The sketches (outline contour) and features of the crude geometry may not contain details, like grooves, chamfers, rounding. Those features shall be designed as separate design elements after the crude geometry and shall be grouped as a detailed 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.

Solid end mills shall be designed as rotational symmetric elements based on properties in accordance with ISO/TS 13399-3.

— Geometry of the non-cutting part, including the connection interface, if applicable;

— Geometry of the cutting part.

Both geometrical parts shall be coloured as described in Clause 18.

The total amount of design elements shall be dependent on the level of detail and on the complexity of the tool item.

The specified model structure of the defined basic shapes of solid end mills shall be described as defined in the next clauses of this part of ISO/TS 13399.

The section of "CUT" area ends at the cutting length plane (CLP).

The examples of the design of the different tool types are shown with a cylindrical round shank representing the connection interface feature.

4.2 Necessary parameters for the connection interface feature

Information about the connection interface code shall be filed as properties within the model and being named as parameters, as indicated in Table 1.

Table 1 — Property list for connection interface feature

Preferred symbol	Description	Source of symbol	ISO-ID number
CCMS	connection code machine side	ISO/TS 13399-3 and ISO/TS 13399–4	71D102AE3B252
CCTMS	connection code type machine side	ISO/TS 13399-60	726E3E82E53A6
CCFMS	connection code form type machine side	ISO/TS 13399-60	726E3E84DD902
CZCMS	connection size code machine side	ISO/TS 13399-60	727C2BCCC5596

The information above and other relevant properties shall be incorporated into the model as parameters or shall be taken as a separate file.

5 Non-centre cutting end mill

5.1 General

Figure 6 shows the properties used for identification and classification of non-centre cutting end mills.

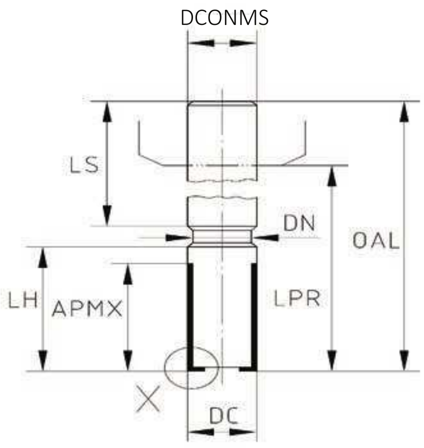

Figure 6 — Non-centre cutting end mill: Determination of properties

5.2 Necessary properties

Table 2 shows the properties needed for the modelling of a non-centre cutting end mill.

Table 2 — Properties for the modelling of a non-centre cutting end mill

Preferred name	Preferred symbol
depth of cut maximum	APMX
plunge depth maximum	AZ
corner chamfer width	CHW
cutting diameter	DC
connection diameter machine side	DCONMS
neck diameter	DN
corner chamfer angle	KCH
head length	LH
protruding length	LPR
shank length	LS
overall length	OAL
corner radius	RE

Detail “X”, as indicated in Figure 7, is also valid for all the following figures, if applicable.

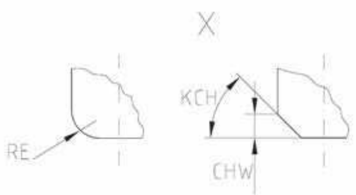

Figure 7 — Detail X

5.3 Geometry of the non-cutting part inclusive of the connection

The basic of that part is a rotational design feature, which contains all elements between the plane “TEP” and the plane “CLP” of the cutting part.

The sketch includes all the elements above and shall be designed in the YZ plane of the “PCS”. The rotational axis is the standard z-axis.

The design of the sketch is as follows.

— 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 “CLP” as shown in Figure 8. If the CAD software does not support the use of datum planes, the sketch shall be fully dimensioned, otherwise, the distances will be in conjunction with the defined datum planes;

— The dimensioning shall be done with the appropriate properties listed in Table 2.

The sketch shall be revolved about the z-axis by 360°.

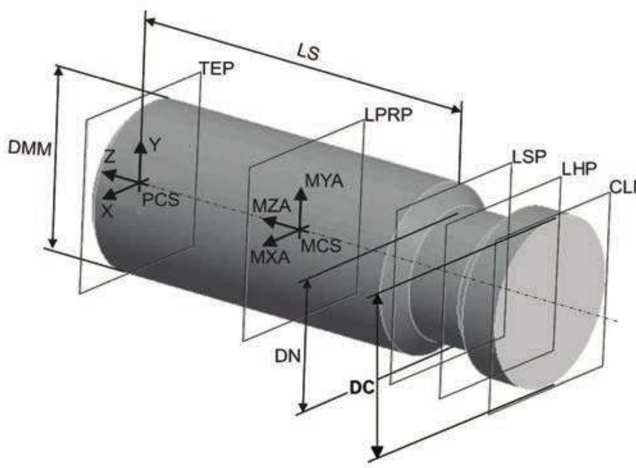

Figure 8 — Non-centre cutting end mill: Non-cutting part inclusive of the shank

5.4 Geometry of the cutting part

The geometry of the cutting part shall be designed as a sketch in YZ plane of the “PCS” with reference to the coordinate system “CIP” and the plane “CLP” as shown in Figure 9.

The rotational axis shall be the standard z-axis.

The design of the sketch is as follows.

— The sketch shall be determined as a half section;

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

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

The sketch will be revolved about the z-axis by 360°.

See Figure 12 for the dimensions for the sketch.

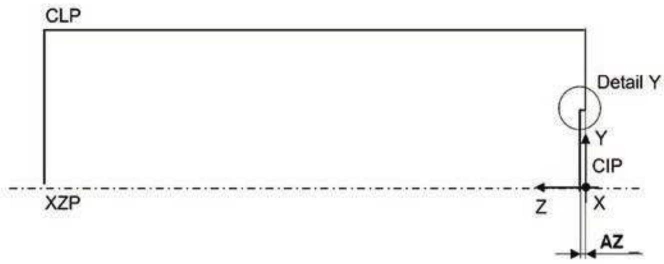

Figure 9 — Non-centre cutting end mill: Sketch of the cutting part

If the dimension of "AZ" is not available, the portion of the non-cutting part at the face will be axially offset with the value of 1 % (but at least 1/10 mm) of the nominal cutting diameter DC in +Z direction (see Figure 10). The diameter of the offset part of the face shall be regularly halving the cutting diameter, but at least 10 % of the cutting diameter.

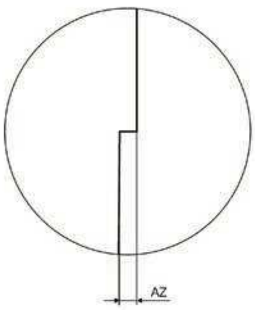

Figure 10 — Non-centre cutting end mill: Detail X of Figure 9

Figure 11 shows the revolved cutting part.

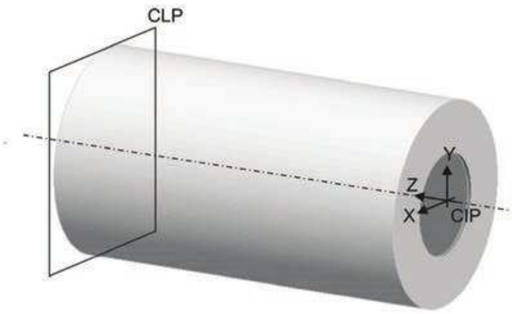

Figure 11 — Non-centre cutting end mill: Revolved body of cutting part

5.5 Complete non-centre cutting end mill

Figure 12 shows the complete solid non-centre cutting end mill with cutting and non-cutting part.

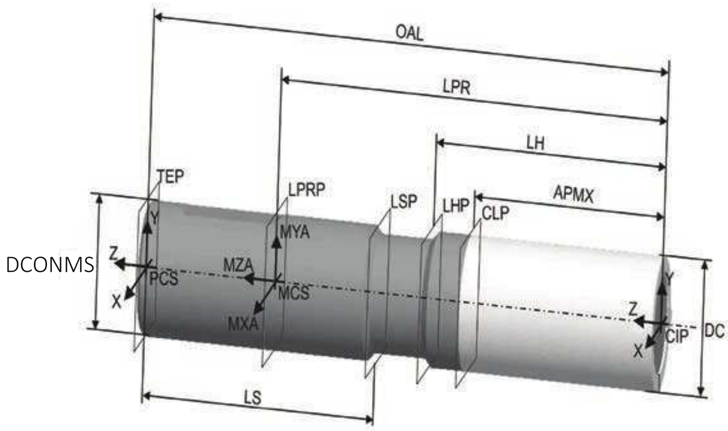

Figure 12 — Complete non-centre cutting end mill

6 Centre cutting end mill

6.1 General

Figure 13 shows the properties used for identification and classification of centre cutting end mills.

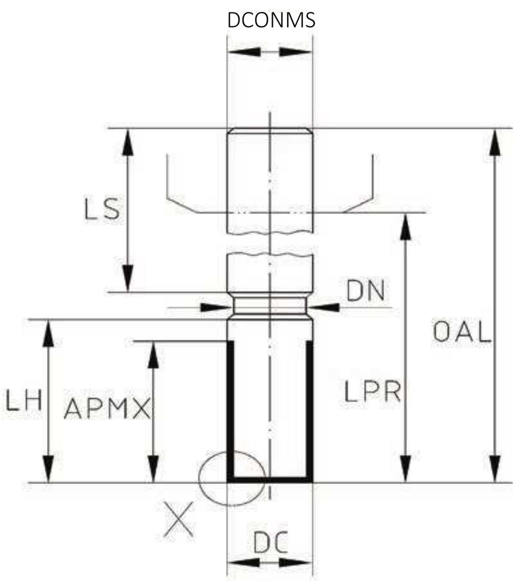

Figure 13 — Centre cutting end mill: Determination of properties

6.2 Necessary properties

See 5.2 and Table 2 for the necessary properties.

For detail X, see Figure 7.

6.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

6.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and the design of the sketch as shown in Figure 14. See Figure 16 for the dimensions for the sketch.

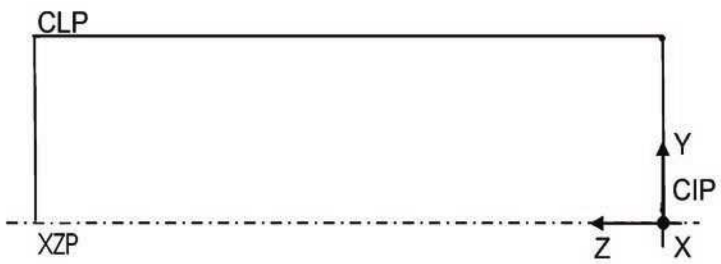

Figure 14 — Centre cutting end mill: Sketch of the cutting part

Figure 15 shows the revolved cutting part.

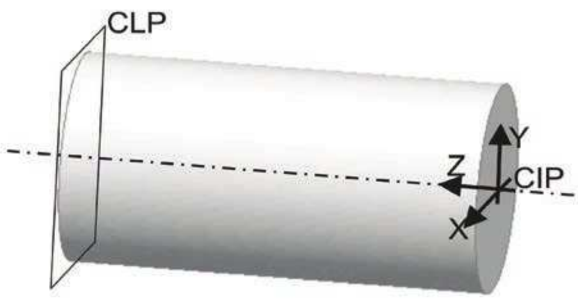

Figure 15 — Centre cutting end mill: Revolved body of cutting part

6.5 Complete centre cutting end mill

Figure 16 shows the complete centre cutting end mill with cutting and non-cutting part.

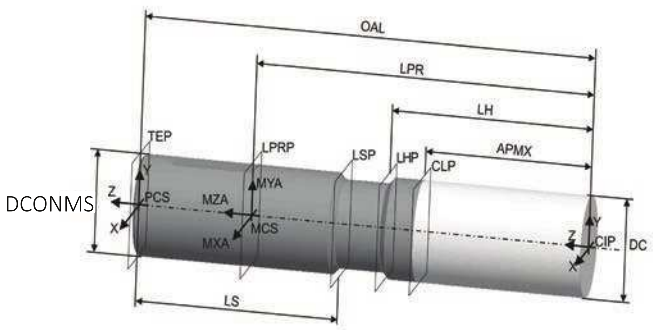

Figure 16 — Complete centre cutting end mill

7 Angular end mill (V-groove)

7.1 General

Figure 17 shows the properties used for identification and classification of V-groove end mills.

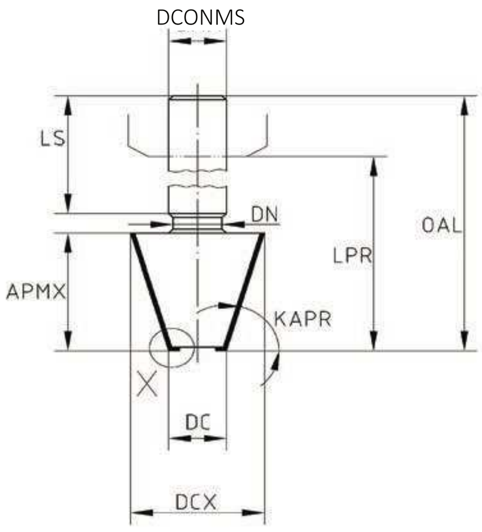

Figure 17 — V-groove end mill: Determination of properties

7.2 Necessary properties

Table 3 shows the properties needed for the modelling of a V-groove end mill.

Table 3 — Properties for the modelling of a V-groove end mill

Preferred name	Preferred symbol
depth of cut maximum	APMX
plunge depth maximum	AZ
corner chamfer width	CHW
cutting diameter	DC
cutting diameter maximum	DCX
connection diameter machine side	DCONMS
neck diameter	DN
tool cutting edge angle	KAPR
corner chamfer angle	KCH
protruding length	LPR
shank length	LS
overall length	OAL
corner radius	RE

For detail X, see Figure 7.

7.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

7.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and the design of the sketch as shown in Figures 18 and 19.

See Figure 21 for the dimensions for the sketch.

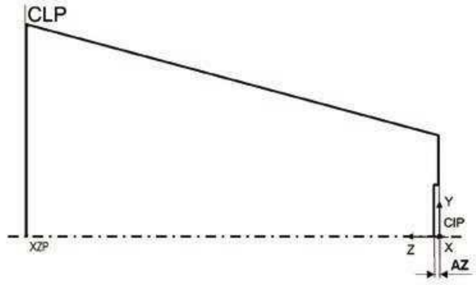

Figure 18 — V-groove end mill: Sketch of the cutting part

If the dimension of "AZ" is not available, the portion of the non-cutting part at the face will be axially offset with the value of 1 % (but at least 1/10 mm) of the nominal cutting diameter DC in +Z direction. The diameter of the offset part of the face shall be regularly halving the cutting diameter, but at least 10 % of the cutting diameter.

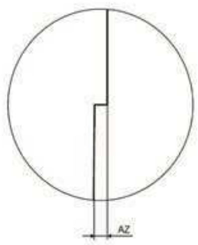

Figure 19 — Detail of Figure 18

Figure 20 shows the revolved cutting part.

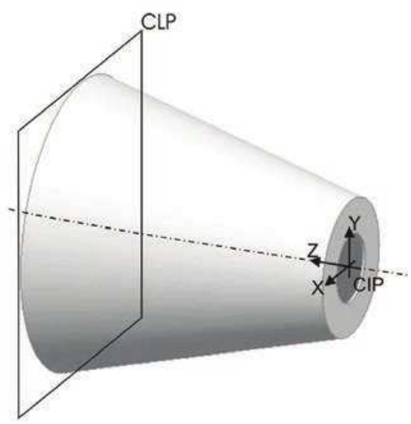

Figure 20 — V-groove end mill: Revolved body of cutting part

7.5 V-groove end mill, complete

Figure 21 shows the complete V-groove end mill with cutting and non-cutting part.

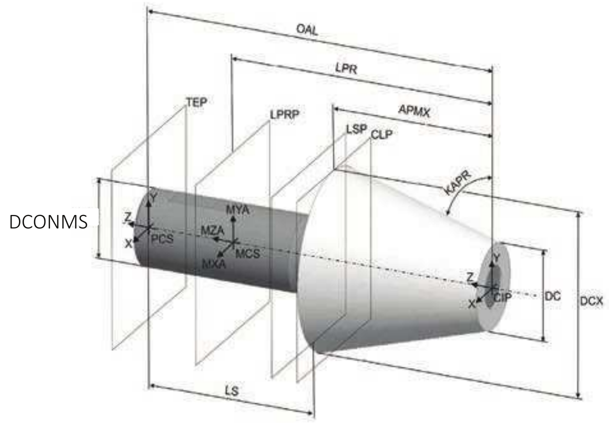

Figure 21 — Complete V-groove end mill

8 Dovetail end mill

8.1 General

Figure 22 shows the properties used for identification and classification of dovetail end mills.

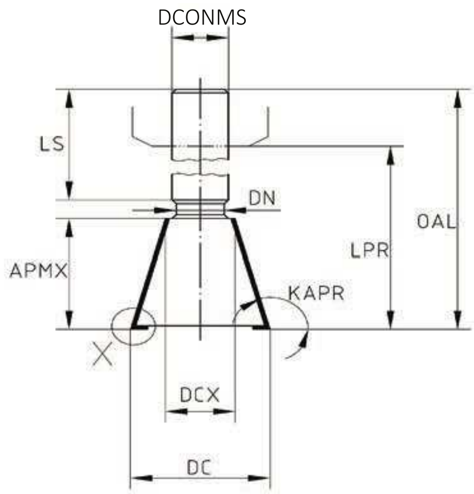

Figure 22 — Dovetail end mill: determination of properties

8.2 Necessary properties

See 7.2 and Table 3 for the necessary properties.

8.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

8.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and the design of the sketch as shown in Figures 23 and 24.

See Figure 26 for the dimensions for the sketch.

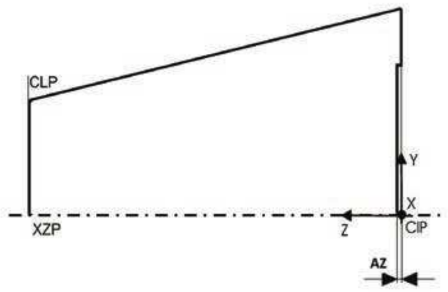

Figure 23 — Dovetail end mill: Sketch of the cutting part

If the dimension of “AZ” is not available, the portion of the non-cutting part at the face will be axially offset with the value of 1 % (but at least 1/10 mm) of the nominal cutting diameter DC in +Z direction. The diameter of the offset part of the face shall be regularly halving the cutting diameter, but at least 10 % of the cutting diameter.

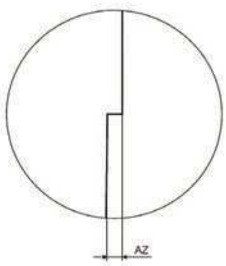

Figure 24 — Detail of Figure 23

Figure 25 shows the revolved cutting part.

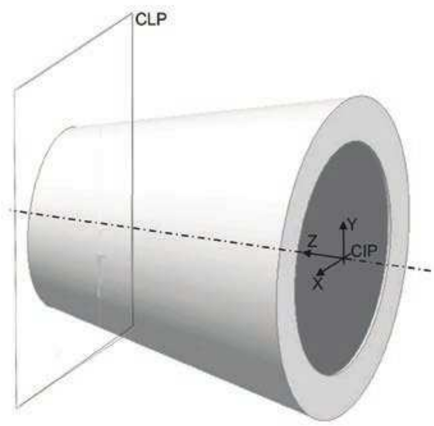

Figure 25 — Dovetail end mill: Revolved body of cutting part

8.5 Complete dovetail end mill, complete

Figure 26 shows the complete dovetail end mill with cutting and non-cutting part.

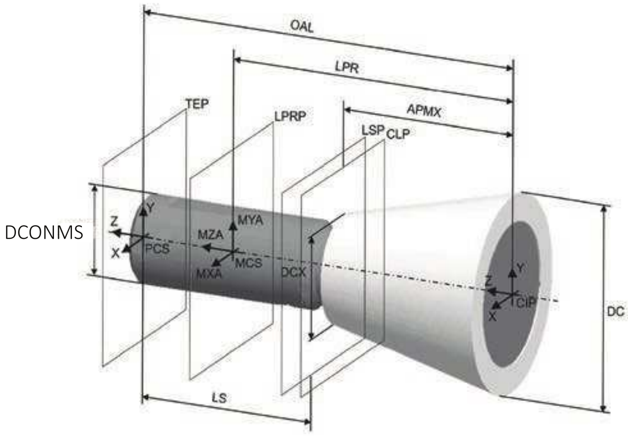

Figure 26 — Complete dovetail end mill

9 T-slot end mill

9.1 General

Figure 27 shows the properties used for the identification and classification of T-slot end mills.

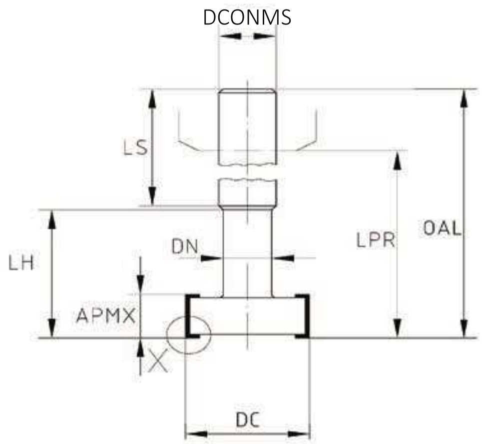

Figure 27 — T-slot end mill: Determination of properties

9.2 Necessary properties

See 5.2 and Table 2 for the necessary properties.

For detail X, see Figure 7.

9.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

9.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and in accordance to Figure 28.

See Figure 30 for the dimensions for the sketch.

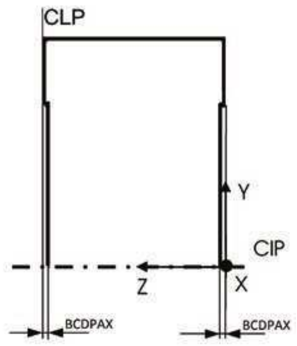

Figure 28 — T-slot end mill: Sketch of cutting part

Figure 29 shows the revolved cutting part of the T-slot end mill.

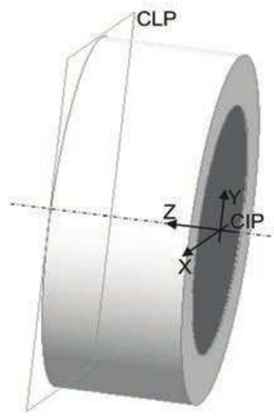

Figure 29 — T-slot end mill: Revolved body of cutting part

9.5 Complete T-slot end mill

Figure 30 shows the complete T-slot end mill with cutting and non-cutting part.

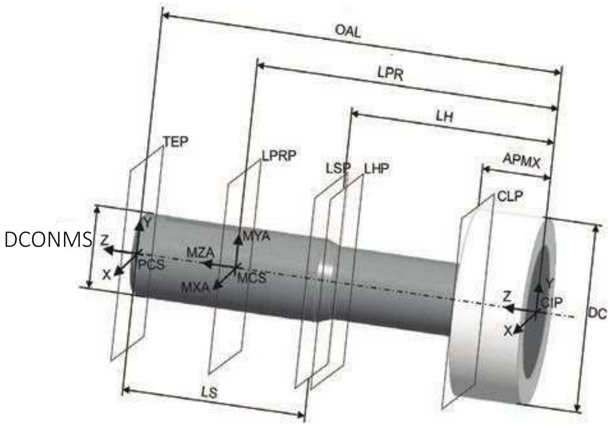

Figure 30 — Complete T-slot end mill

10 Ball-nosed end mill

10.1 General

Figure 31 shows the properties used for identification and classification of ball-nosed end mills.

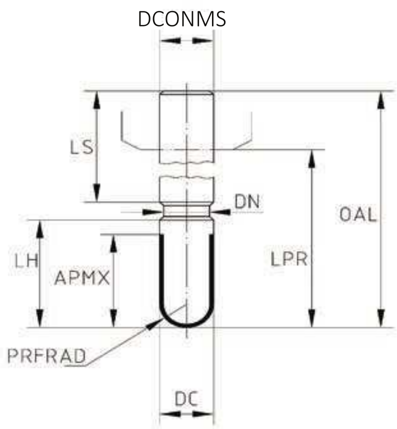

Figure 31 — Ball-nosed end mill: Determination of properties

10.2 Necessary properties

Table 4 shows the properties needed for the modelling of a V-groove end mill.

Table 4 — Properties for the modelling of a ball-nosed end mill

Preferred name	Preferred symbol
depth of cut maximum	APMX
cutting diameter	DC
connection diameter machine side	DCONMS
neck diameter	DN
head length	LH
protruding length	LPR

Table 4 *(continued)*

Preferred name	Preferred symbol
shank length	LS
overall length	OAL
profile radius	PRFRAD

10.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

10.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and in accordance to Figure 32.

See Figure 34 for the dimensions for the sketch.

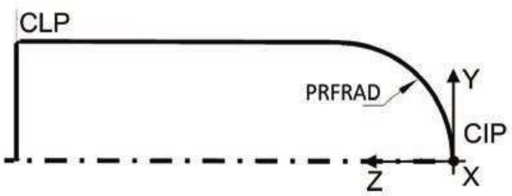

Figure 32 — Ball-nosed end mill: Sketch of cutting part

Figure 33 shows the revolved cutting part of the ball-nosed end mill.

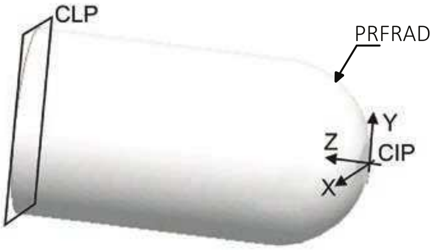

Figure 33 — Ball-nosed end mill: Revolved body of cutting part

10.5 Complete ball-nosed end mill

Figure 34 shows the complete ball-nosed end mill with cutting and non-cutting part.

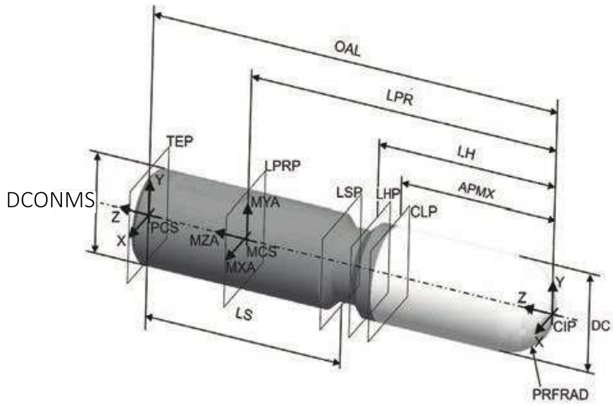

Figure 34 — Complete ball-nosed end mill

11 Die end mill

11.1 General

Figure 35 shows the properties used for identification and classification of ball-nosed end mills.

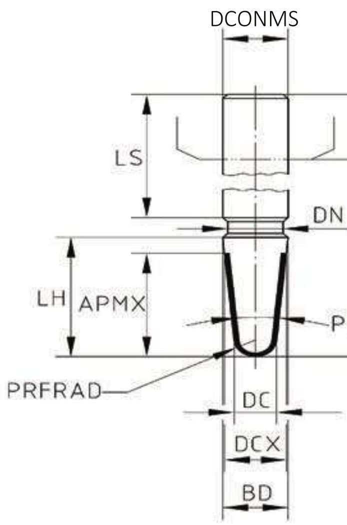

Figure 35 — Die end mill: Determination of properties

11.2 Necessary properties

Table 5 shows the properties needed for the modelling of a die end mill.

Table 5 — Properties for the modelling of a die end mill

Preferred name	Preferred symbol
depth of cut maximum	APMX
body diameter	BD
cutting diameter	DC
cutting diameter	DCX

Table 5 *(continued)*

Preferred name	Preferred symbol
connection diameter machine side	DCONMS
neck diameter	DN
head length	LH
protruding length	LPR
shank length	LS
overall length	OAL
profile angle	PRFA
profile radius	PRFRAD

11.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

11.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and in accordance to Figure 36.

See Figure 38 for the dimensions for the sketch.

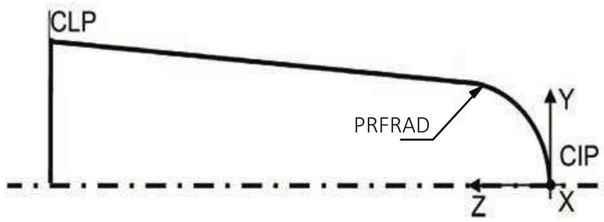

Figure 36 — Die end mill: Sketch of cutting part

Figure 37 shows the revolved cutting part of the die end mill.

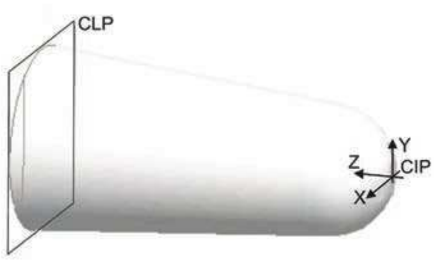

Figure 37 — Die end mill: Revolved body of cutting part

11.5 Complete die end mill

Figure 38 shows the complete die end mill with cutting and non-cutting part.

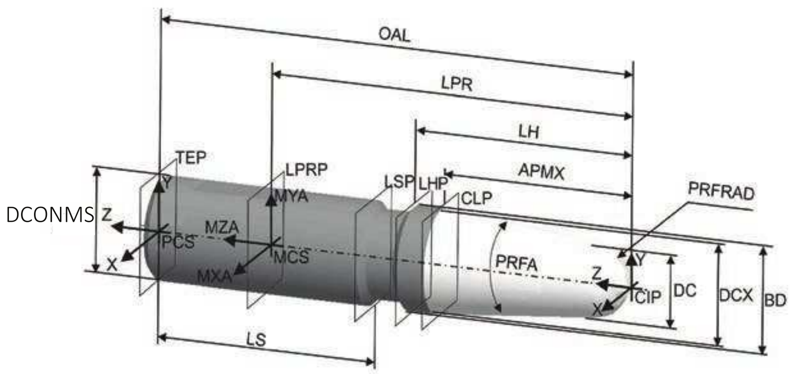

Figure 38 — Complete die end mill

12 Concave rounded profile end mill

12.1 General

Figure 39 shows the properties used for identification and classification of concave rounded end mills.

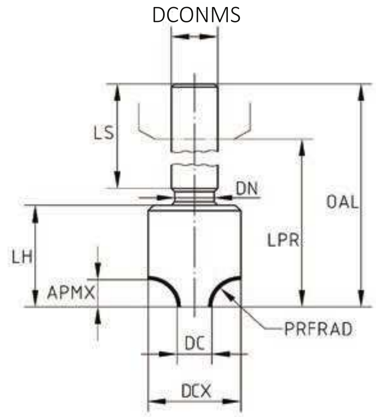

Figure 39 — Concave rounded profile end mill: Determination of properties

12.2 Necessary properties

See 10.2 and Table 4 for the necessary properties.

12.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

12.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and in accordance to Figure 40.

See Figure 42 for the dimensions for the sketch.

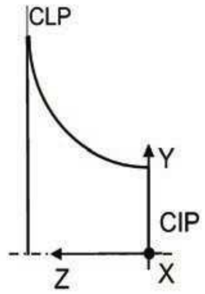

Figure 40 — Concave rounded end mill: Sketch of cutting part

Figure 41 shows the revolved cutting part of the concave rounded end mill.

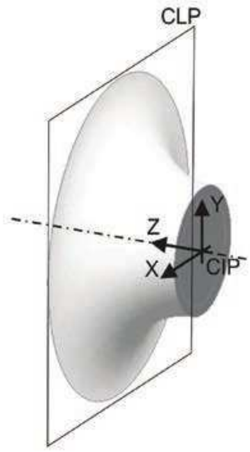

Figure 41 — Concave rounded end mill: Revolved body of cutting part

12.5 Complete concave rounded profile end mill

Figure 42 shows the complete rounded end mill with cutting and non-cutting part.

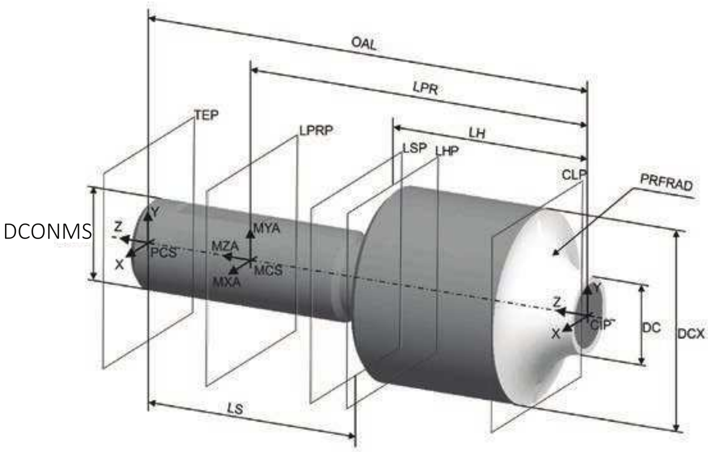

Figure 42 — Complete concave rounded end mill

13 Thread end mill

13.1 General

Figure 43 shows the properties used for identification and classification of thread end mills.

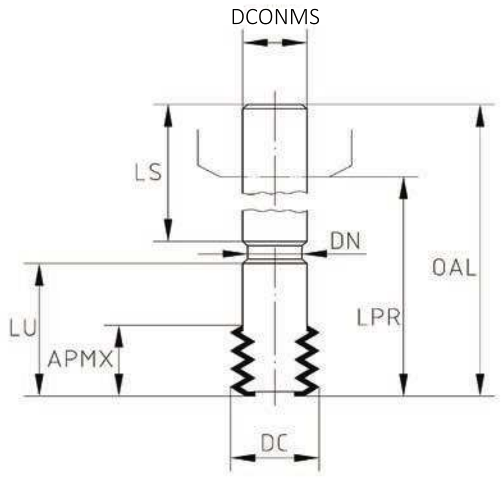

Figure 43 — Thread end mill: Determination of properties

13.2 Necessary properties

Table 6 shows the properties needed for the modelling of a thread end mill.

Table 6 — Properties for the modelling of a thread end mill

Preferred name	Preferred symbol
depth of cut maximum	APMX
cutting diameter	DC
connection diameter machine side	DCONMS
neck diameter	DN
head length	LH
protruding length	LPR
shank length	LS
overall length	OAL

For the identification of the thread, the properties listed in Table 7 shall be used.

Table 7 — Additional properties to classify a thread end mill

Preferred name	Preferred symbol
thread form type	THFT
thread pitch	TP
threads per inch	TPI

The properties listed in Table 7 shall be incorporated into Table 1.

13.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

13.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and in accordance to Figure 44.

See Figure 46 for the dimensions for the sketch.

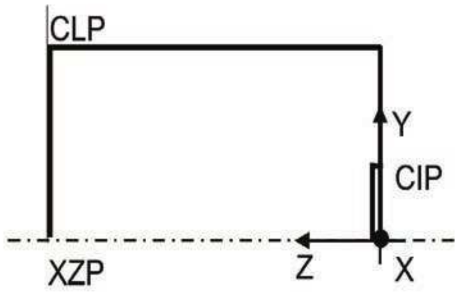

Figure 44 — Thread end mill: Sketch of cutting part

Figure 45 shows the revolved cutting part of the thread end mill.

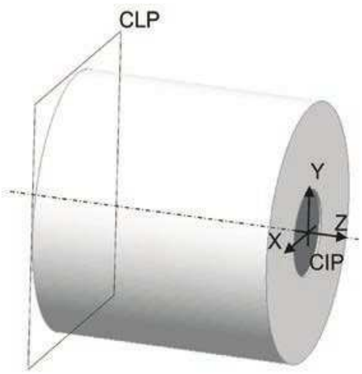

Figure 45 — Thread end mill: Revolved body of cutting part

13.5 Complete thread end mill

Figure 46 shows the complete thread end mill with cutting and non-cutting part.

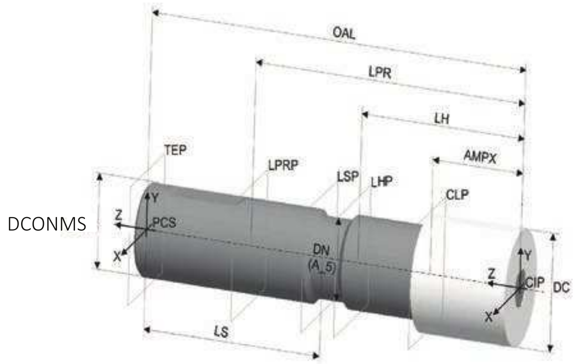

Figure 46 — Complete thread end mill

14 Cutting stylus

14.1 General

Figure 47 shows the properties used for identification and classification of cutting stylus.

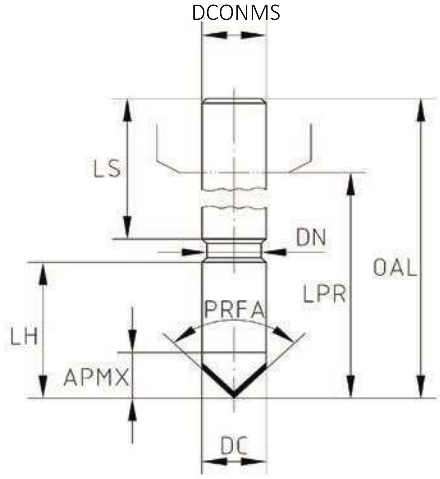

Figure 47 — Cutting stylus: Determination of properties

14.2 Necessary properties

Table 8 shows the properties needed for the modelling of a cutting stylus.

Table 8 — Properties for the modelling of a cutting stylus

Preferred name	Preferred symbol
depth of cut maximum	APMX
cutting diameter	DC
connection diameter machine side	DCONMS
neck diameter	DN
head length	LH
protruding length	LPR

Table 8 *(continued)*

Preferred name	Preferred symbol
shank length	LS
overall length	OAL
profile angle	PRFA

14.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

14.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and in accordance to Figure 48.

See Figure 50 for the dimensions for the sketch.

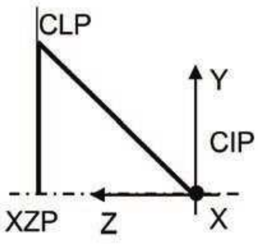

Figure 48 — Cutting stylus: Sketch of cutting part

Figure 49 shows the revolved cutting part of the cutting stylus.

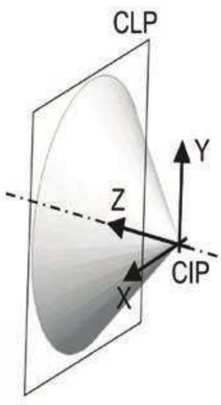

Figure 49 — Cutting stylus: Revolved body of cutting part

14.5 Complete cutting stylus, complete

Figure 50 shows the complete cutting stylus with cutting and non-cutting part.

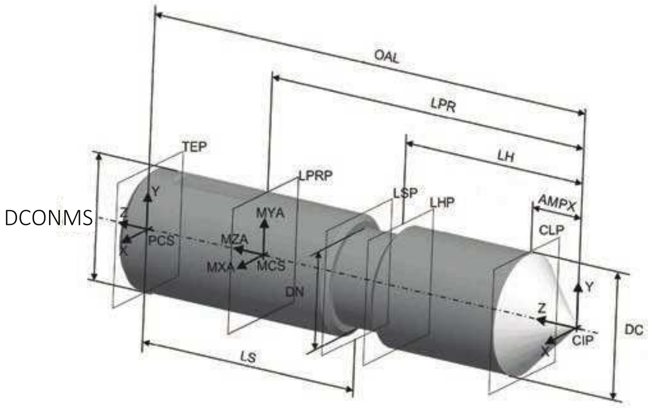

Figure 50 — Complete cutting stylus

15 Thread end mill with drilling part

15.1 General

Figure 51 shows the properties used for identification and classification of thread end mill with drilling part.

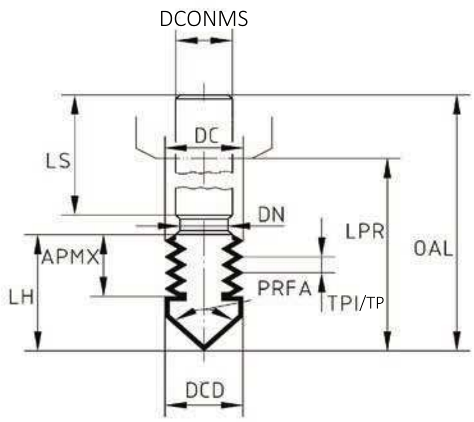

Figure 51 — Thread end mill with drilling part: Determination of properties

15.2 Necessary properties

Table 9 shows the properties needed for the modelling of a thread end mill with drilling part.

Table 9 — Properties for the modelling of a thread end mill with drilling part

Preferred name	Preferred symbol
depth of cut maximum	APMX
cutting diameter	DC
cutting diameter drilling part	DCD
connection diameter machine side	DCONMS

[a] On drills, this angle is named point angle with its preferred symbol “SIG”.

Table 9 *(continued)*

Preferred name	Preferred symbol
neck diameter	DN
head length	LH
protruding length	LPR
shank length	LS
overall length	OAL
profile angle[a]	PRFA
[a] On drills, this angle is named point angle with its preferred symbol "SIG".	

For the classification of a thread end mill with drilling part, additional properties shall be be necessary. See Table 7 for the determination of these properties.

15.3 Geometry of the non-cutting part inclusive of the connection

The structure of the model shall be as described in 5.3 and in accordance to Figure 8.

15.4 Geometry of the cutting part

The structure of the model shall be as described in 5.4 and in accordance to Figure 52.

See Figure 54 for the dimensions for the sketch.

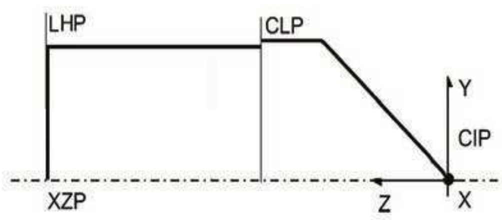

Figure 52 — Thread end mill with drilling part: Sketch of cutting part

Figure 53 shows the revolved cutting part of the thread end mill with drilling part.

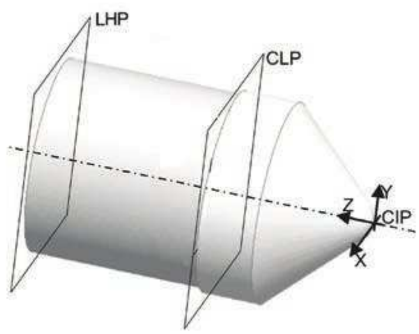

Figure 53 — Thread end mill with drilling part: Revolved body of cutting part

15.5 Complete thread end mill with drilling part

Figure 54 shows the complete thread end mill with drilling part with cutting and non-cutting part.

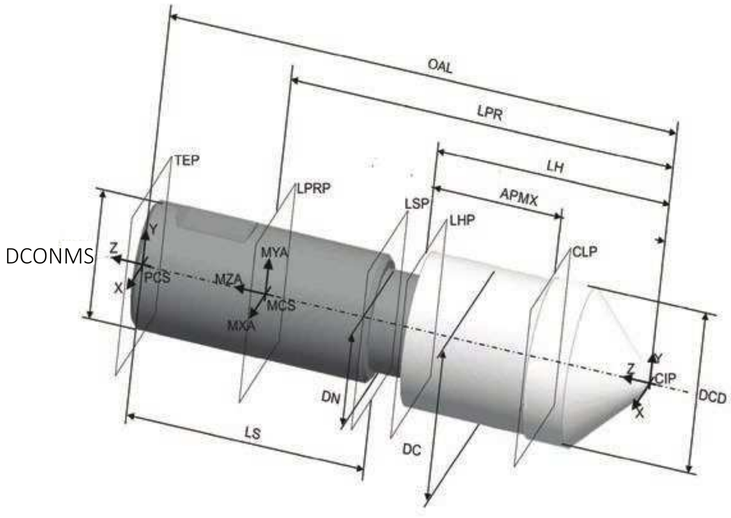

Figure 54 — Complete thread end mill with drilling part

16 Design of details

16.1 Basics for modelling

All details shall be designed as separate design features and shall not be incorporated into the revolved body of the crude geometry.

16.2 Contact/clamping surfaces — Orientation

Clamping surfaces that shall be visualized within the model and have to be orientated by means of a unique orientation. The normal of the face shall be parallel with the "+Y-axis" of the primary coordinate system "PCS".

16.3 Chamfers, rounding, others

Necessary chamfers and rounding shall be created within the according function of the 3D CAD system.

17 Attributes of surfaces — Visualization of the model features

The colour settings, as part of the attributes of the surfaces, shall be taken in accordance to ISO/TS 13399-80.

Some CAD systems identify only one surface of the same diameter even if these surfaces are mated by means of two solid design features. Therefore, in order to address the surface attributes to each of these features, a revolved design feature shall be created over the cutting part feature. In the tree of elements and features, this element is called "CUTTING_SURFACE". This design feature shall be created with the sketch elements of the cutting and non-cutting part and shall be placed at the end of the tree.

NOTE Some CAD systems give the possibility to use the available lines of the main sketches for the creation of the "CUTTING_SURFACE". Hereby, the datum planes "LCFP" and other planes are used as references. With the suppression of the main design elements, all referenced design elements are also supressed.

18 Structure of the design elements (tree of model)

On solid (non-indexable) end mills, it shall be distinguished between cutting "CUT" and non-cutting "NOCUT" design features. This shall take place by means of building groups. Hereby, it is necessary that both groups can be suppressed or deactivated separately, without mutual impact.

All the detailed design features shall be put together in a separate group named "DETAILS". This group shall be the last element of the tree. The group "DETAILS" is dependent on the groups "CUT" and "NOCUT" and shall be suppressed, if either one of these two groups, "CUT" or "NOCUT", shall be suppressed (see Figure 55).

This kind of grouping shall only be built if the containing design features are arranged consecutively. Therefore, care shall be taken for the correct sequence of the design features with notice to avoid references.

The structure shall be as shown in Figure 55 and shall be similar in other CAD systems.

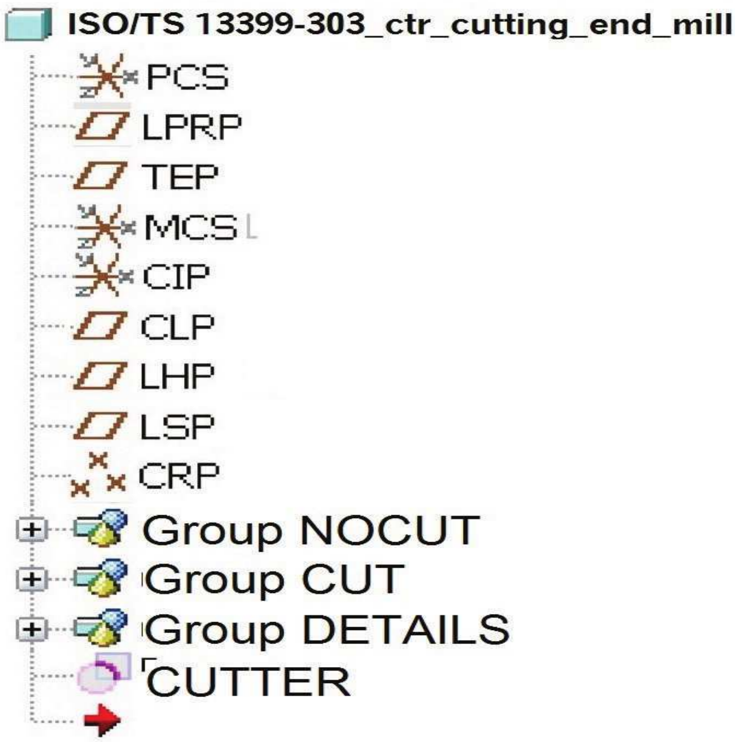

Figure 55 — Non-centre cutting end mill: Example of the structure of design features

19 Data exchange model

Example model of a non-centre cutting end mill is illustrated in Figure 56. All of those models shall contain the geometrical features (collision contour), primary coordinate system "PCS", the mounting coordinate system "MCS", the coordinate system in process "CIP" and the cutting part line that are relevant for the collision examination.

Key

1 cutting part line

Figure 56 — Data exchange model: Non-centre cutting end mill

Annex A
(informative)

Information about nominal dimensions

A nominal dimension, nominal size or trade size is a size "in name only" used for identification. The nominal size might not match any dimension of the product, but within the domain of that product, the nominal size might correspond to a large number of highly standardized dimensions and tolerances. A nominal size might not even carry any unit of measure. In measurement, a nominal value is often a value existing in name only. It is assigned as a convenient designation rather than calculated by data analysis or following usual rounding methods. The use of nominal values can be based on de facto standards or some technical standards.

All real measurements have some variation depending on the accuracy and precision of the production method and the measurement uncertainty. The use of reported values often involves engineering tolerances.

Table A.1 — Examples of nominal dimensions/sizes

Description	Value	Tolerance	Lower limit	Upper limit	Nominal dimension/ size
Morse taper size 5	MT5	—	—	—	5
internal diameter	Ø 25	H6	25,000	25,013	25,000
external diameter	Ø 25	g7	24,972	24,993	25,000
square shank size h × b	32 × 25	h13	31,61 × 24,67	32 × 25	32 × 25

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[2] ISO 13584-24, *Industrial automation systems and integration — Parts library — Part 24: Logical resource: Logical model of supplier library*

[3] ISO 13584-25, *Industrial automation systems and integration — Parts library — Part 25: Logical resource: Logical model of supplier library with aggregate values and explicit content*

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

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

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

[7] ISO/TS 13399-70[1)], *Cutting tool data representation and exchange — Part 70: Graphical data layout — Layer settings for tooldesigns*

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

[9] ISO/TS 13399-150, *Cutting tool data representation and exchange — Part 150: Usage guidelines*

1) To be published.

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