TECHNICAL SPECIFICATION

ISO/TS 13399-203

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Cutting tool data representation and exchange —

Part 203: Creation and exchange of 3D models — Replaceable inserts for drilling

Représentation et échange des données relatives aux outils coupants —

Partie 203: Création et échange de modèles 3D — Plaquettes échangeables pour perçage

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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 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 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 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 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 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 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 designation system for customer solution cutting tools is to form the subject of a future Part 51.

Introduction

This part of ISO 13399 defines the concept, terms and definitions regarding the creation and exchange of simplified 3D models of replaceable inserts for drilling that can be used with 3D models of cutting tools for NC-programming, simulation of manufacturing processes and the collision determination within machining processes. It is not intended to standardize the design of the replaceable insert for drilling itself, nor the cutting tool.

A replaceable insert for drilling is used in combination with a cutting tool 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 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 for providing the end-user with 3D models for the purposes defined above is the basis for the development of this ISO 13399 series.

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/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 and in its extensions defined in ISO 13584-24 and ISO 13584-25.

Cutting tool data representation and exchange —

Part 203:
Creation and exchange of 3D models — Replaceable inserts for drilling

1 Scope

This part of ISO 13399 specifies a concept for the design of cutting items, limited to any kind of replaceable inserts for drilling, using related properties and domains of values.

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

— definitions and identification of the design features of replaceable inserts for drilling, with a link to the properties used;

— definitions and identification of the internal structure of the 3D model that represents the features and properties of replaceable inserts for drilling;

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 other cutting items not described in this part of ISO 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 13399-2, *Cutting tool data representation and exchange — Part 2: Reference dictionary for the cutting items*

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

3 Starting element, coordinate systems planes

3.1 General

The creation of 3D models shall 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 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 of the definitions have been taken from ISO/TS 13399-50.

3.2 Reference system

The reference system consists of the following standard elements:

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

— **three orthogonal planes**: planes in the coordinate system that contain the axes of the system, named “XY plane” (XYP), “XZ plane” (XZP) and “YZ plane” (YZP);

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

The primary coordinate system, which determines the insert position in space is shown in Figure 1.

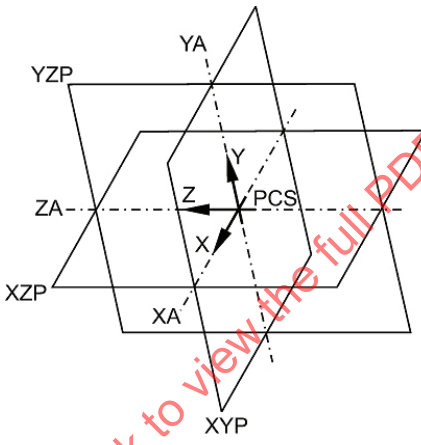

Figure 1 — Reference system “PCS”

3.3 Mounting coordinate system (“MCS”)

For virtually mounting of replaceable inserts for drilling onto a tool item, an additional reference system shall be defined. This reference system is called “mounting coordinate system” (MCS). Its location and orientation are shown in Figures 2 and 3 and are defined as follows:

— z-axis of MCS is collinear with the z-axis of PCS;

— x-axis of MCS is parallel to the x-axis of PCS;

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

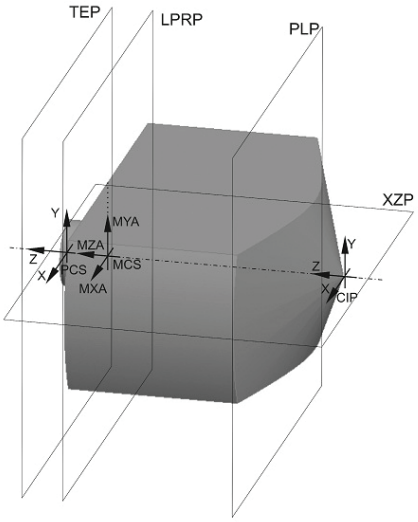

Figure 2 — Incongruent PCS and MCS

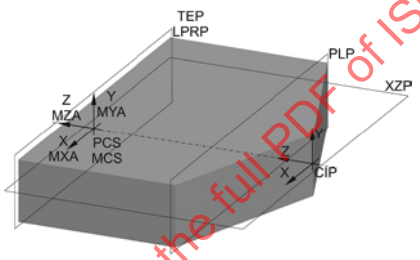

Figure 3 — Congruent PCS and MCS systems

3.4 Coordinate system at the cutting part

The coordinate system at the cutting part, i.e. at the drill point, is named “coordinate system in process” (CIP), and is oriented with a defined distance to the PCS as indicated in Figure 4 and as follows:

— z-axis of CIP points to the PCS;

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

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

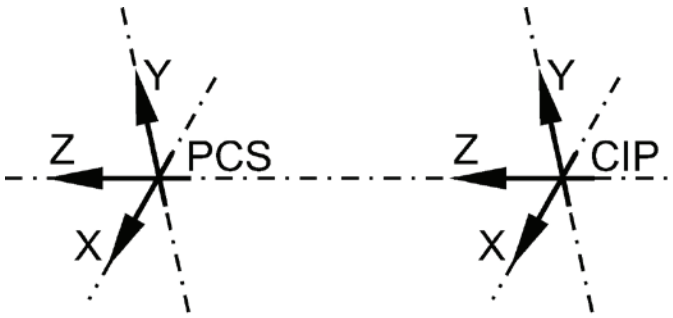

Figure 4 — Orientation of CIP

NOTE If the 3D modelling software gives the possibility to include interfaces for components, e.g. to mount a centre drill onto a complete cutting tool, it is advised to use the coordinate system "CIP". If necessary, another designation can be given to the interface of the component (dependent on the software). This name is "CSIF" (for "coordinate system interface) and includes the coordinate system "CIP".

3.5 Planes

The modelling shall take place based on planes according to Figure 3, which are used as reference, if applicable. Therefore, it is possible 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.

The independency of the design features requires a precise check of the single elements, especially on drills with multiple diameters.

For the 3D visualization of drilling and countersinking tools with non-indexable cutting edges, the planes shall be determined as indicated in Figure 5 and as follows:

— "LPRP" plane for the protruding length (LPR); based on "CIP";

— "LFP" plane for the distance between the MCS and the point that forms the full cutting diameter, measured parallel to the tool axis; based on MCS;

— "TEP" (tool end plane) plane for the overall length (OAL); based on "CIP".

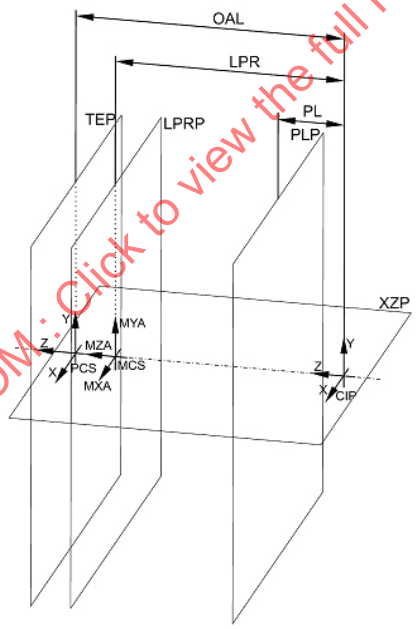

Figure 5 — Planes for design

3.6 Cutting reference point (CRP)

For the design of the point or chisel edge, the cutting reference point shall be defined. The point shall be defined as the theoretical cutting edge in the XZ plane of the "PCS". Therefore, it shall always be referenced to the cutting diameter, see Figure 6.

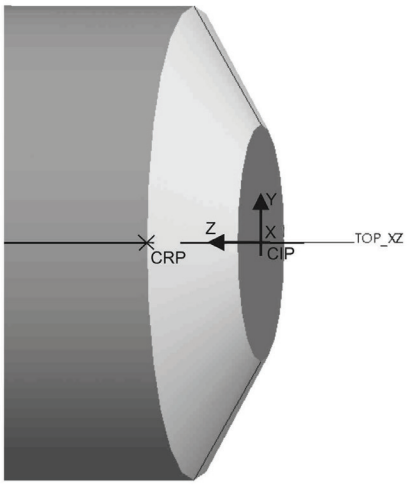

Figure 6 — Position of the cutting reference point "CRP"

4 Design of the model

The sketches and contours of the crude geometry shall 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 shall be named precision geometry.

The order of the structure of the model shall be determined 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.

Replaceable inserts for drilling shall be built as rotational symmetric design elements based on properties in accordance with ISO/TS 13399-2:

— geometry of the cutting part

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

NOTE 1 The basic shapes of replaceable inserts for drilling is designed with the PCS.

NOTE 2 The total amount of design elements is focused on the depth of modelling and the complexity of the cutting tool.

Within the following clauses, the specified structure of the model of the defined basic shapes of drilling and countersinking tools shall be described.

4.1 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 — Parameterlist for insert interface feature

Preferred symbol	Description	Source of symbol	ISO-ID number
IIC	insert interface code	ISO/TS 13399-2	71CE7A9936610

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

5 Replaceable insert with chip flute

5.1 General

Figure 7 indicates the properties needed for the design of replaceable insert with chip flute.

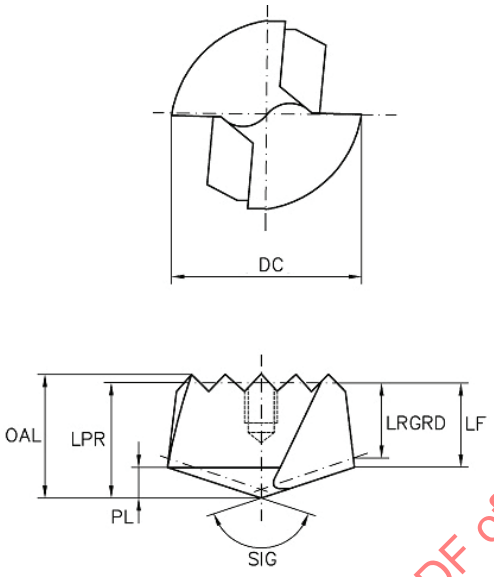

Figure 7 — Determination of properties for a replaceable insert with chip flute

5.2 Necessary properties

To design the profile of replaceable insert with chip flute, properties in Table 2 shall be applied to the simplified model.

Table 2 — Properties for the modelling of a replaceable insert with chip flutes

Preferred name	Preferred symbol
cutting diameter	DC
functional length	LF
protruding length	LPR
residual grinding length	LRGRD
overall length	OAL
point length	PL
point angle	SIG

NOTE 1 The properties "residual grinding length, LRGRD" and "point length, PL" are for information only. These properties are not be used to create the model. If there is a deviation between the calculated dimensions of LPR = LF+PL, the point of the insert are to be rounded accordingly.

NOTE 2 The property "PL" can be calculated with a function using the terms "DC" and "SIG", but for practical reasons, this property is used as a reference dimension only.

5.3 Structure of the basic geometry

The basis of the part is a rotational design feature, which contains all elements between the plane "TEP" and the coordinate system "CIP".

The sketch includes all the elements above and is designed on 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 systems "PCS" and "CIP" and to the planes "LPRP" and "LFP" according to Figure 8. The dimension "DC" creates the cutting diameter. 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 2.

The sketch shall be revolved 360 degrees about the z-axis, see Figures 9 and 10.

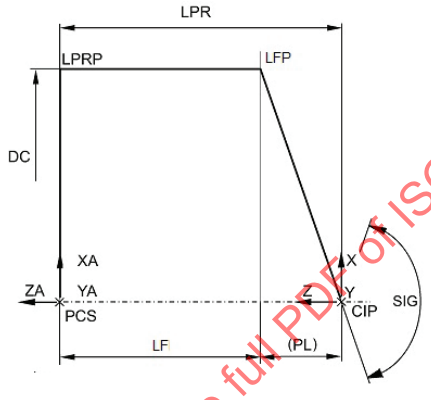

Figure 8 — Basic geometry: sketch

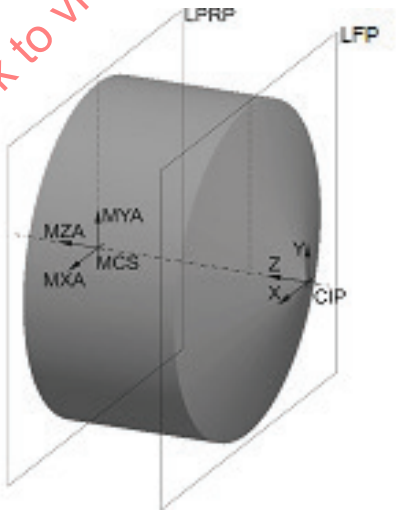

Figure 9 — Basic geometry: revolved body

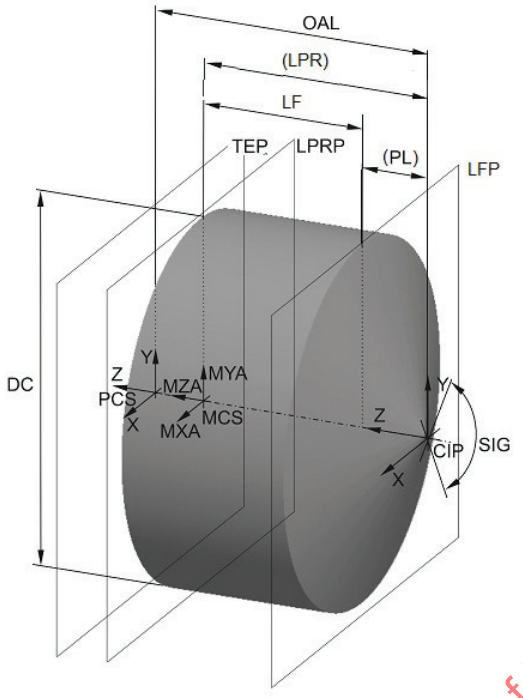

Figure 10 — Replaceable insert with chip flute: Basic geometry, complete

NOTE More detail need not be shown. Including details to the model is described in Clause 8.

6 Replaceable insert, flat

6.1 General

Figure 11 indicates the properties needed for the design of replaceable insert, flat.

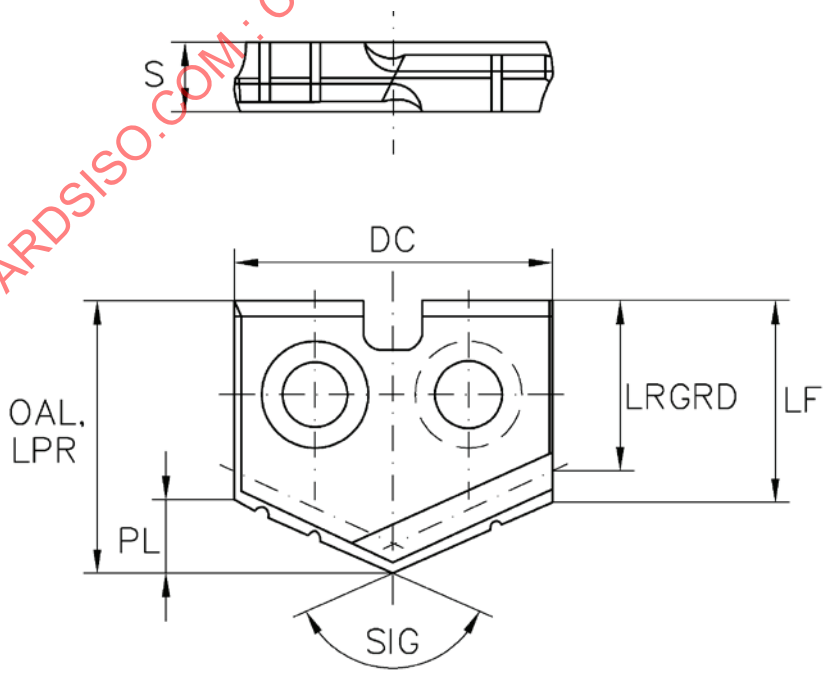

Figure 11 — Determination of properties of a replaceable insert, flat

6.2 Necessary properties

To design the profile of replaceable insert, flat, properties in Table 3 shall be applied to the simplified model.

Table 3 — Properties for the modelling of a replaceable flatted insert

Preferred name	Preferred symbol
cutting diameter	DC
functional length	LF
protruding length	LPR
residual grinding length	LRGRD
overall length	OAL
point length	PL
point angle	SIG
insert thickness	S

NOTE 1 The properties "residual grinding length, LRGRD" and "point length, PL" are for information only. These properties are not to be used to create the model. If there is a deviation between the calculated dimensions of LPR = LF+PL, the point of the insert are to be rounded accordingly.

NOTE 2 The property "PL" can be calculated with a function using the terms "DC" and "SIG", but for practical reasons, this property is used as a reference dimension only.

6.3 Structure of the basic geometry

The basis of the part shall be a flatted rotational design feature, which contains all elements between the plane "TEP" and the coordinate system "CIP".

The sketch includes all the elements above and is designed on 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 systems "PCS" and "CIP" and to the planes "LPRP" and "LFP" according to Figure 12. The dimension "DC" creates the cutting diameter. 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 3.

The sketch shall be revolved about the z-axis by 360 degrees and then trimmed about the insert thickness "S" symmetrically about the xz-plane XZP, see Figures 13 and 14.

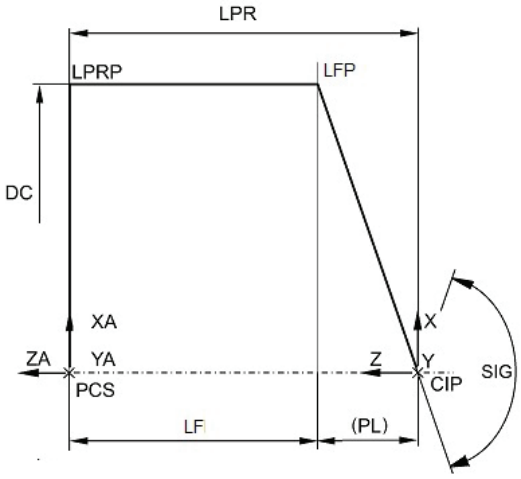

Figure 12 — Basic geometry: sketch

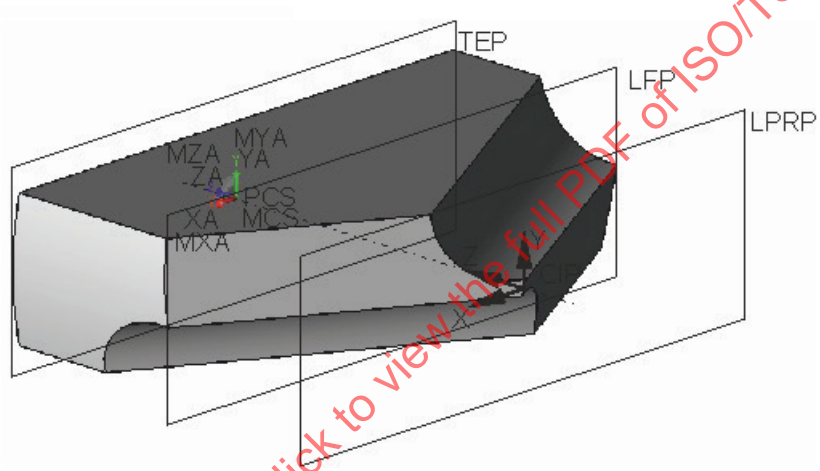

Figure 13 — Basic geometry: body

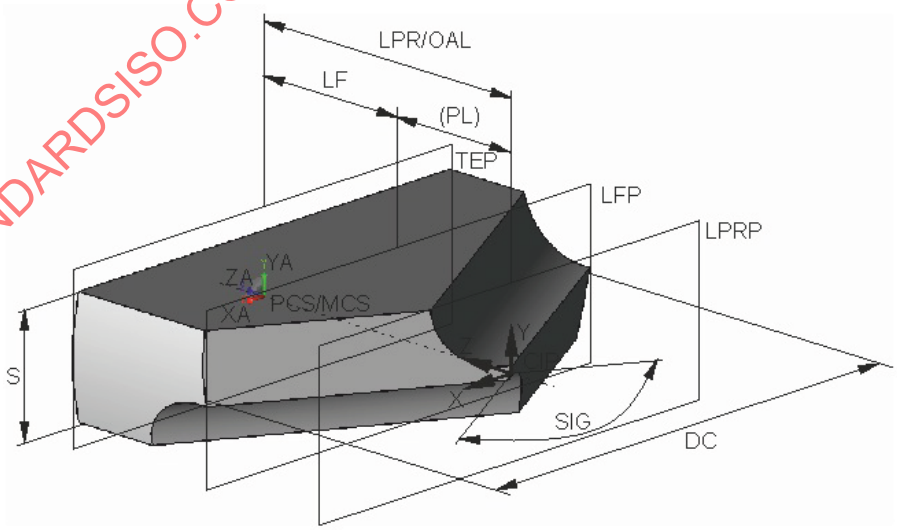

Figure 14 — Flatted, replaceable insert: Basic body, complete

7 Replaceable insert flatted with chip flute

7.1 General

Figure 15 indicates the properties needed for the design of replaceable insert flatted chip flute.

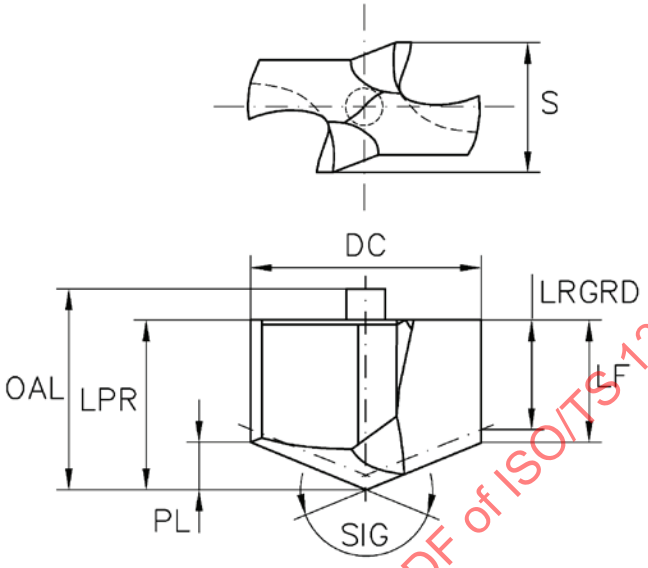

Figure 15 — Determination of properties of a replaceable insert, flatted with chip flute

7.2 Necessary properties

To design the profile of replaceable insert, flatted chip flute, properties in Table 4 shall be applied to the simplified model.

Table 4 — Properties for the modelling of a replaceable flatted insert with chip flutes

Preferred name	Preferred symbol
cutting diameter	DC
functional length	LF
protruding length	LPR
residual grinding length	LRGRD
overall length	OAL
point length	PL
insert thickness	S
point angle	SIG

NOTE 1 The properties “residual grinding length, LRGRD” and “point length, PL” are for information only. These properties are not to be used to create the model. If there is a deviation between the calculated dimensions of LPR = LF+PL, the point of the insert are to be rounded accordingly.

NOTE 2 The property “PL” can be calculated with a function using the terms “DC” and “SIG”, but for practical reasons, this property is used as a reference dimension only.

7.3 Structure of the basic geometry

For the design of the replaceable insert see 6.3.

The structure of the basic geometry shall be as indicated in Figures 16 to 18.

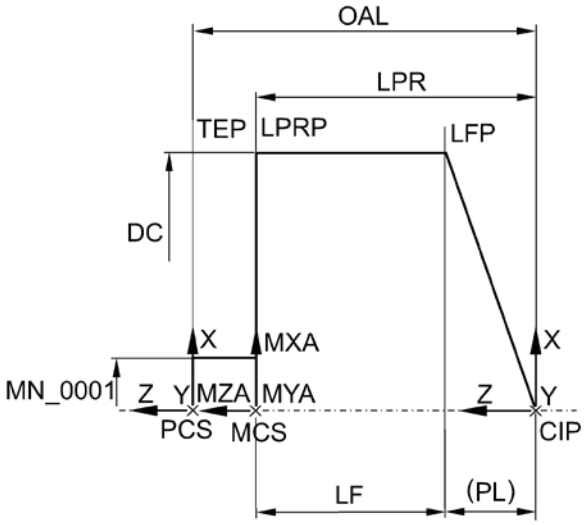

Figure 16 — Basic geometry: sketch

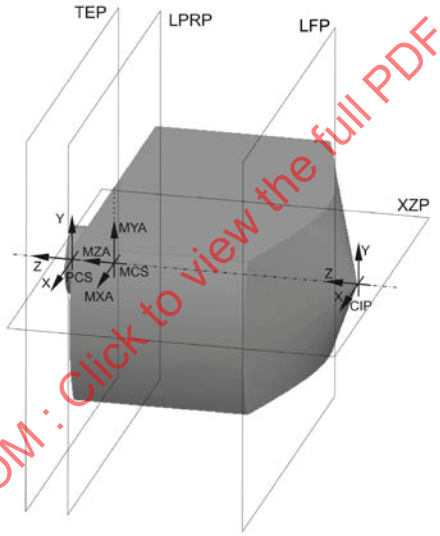

Figure 17 — Basic geometry: body

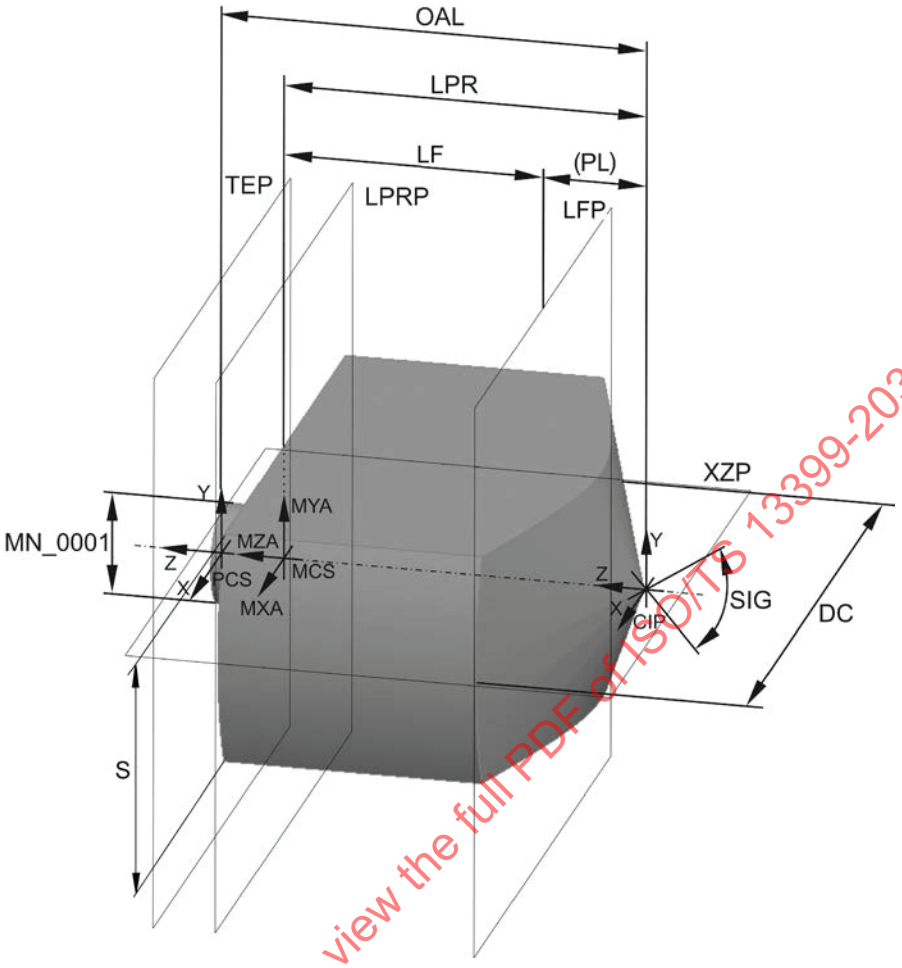

Figure 18 — Flatted, replaceable insert with chip flutes: Basic body, complete

8 Design of details

8.1 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.

8.2 Contact/clamping surfaces — Orientation

Clamping surfaces that shall be visualized within the cutting item model shall 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".

8.3 Chamfers, rounding, others

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