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BSI Standards Publication

Cutting tool data representation and exchange

Part 310: Creation and exchange of 3D models — Turning tools with carbide tips

bsi.

National foreword

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Représentation et échange des donnés relative aux outils coupants —

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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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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: 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.

Introduction

This document defines the concept, the terms and the definitions of how to design simplified 3D models of turning tools with carbide tips 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 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 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/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 310:
Creation and exchange of 3D models — Turning tools with carbide tips

1 Scope

This document specifies a concept for the design of tool items, limited to any kind of turning tools with carbide tips, together with the usage of the related properties and domains of values.

This document specifies a common way of designing simplified models that contain the following:

— definitions and identifications of the design features of turning tools with carbide tips, with a link to the properties used;

— definitions and identifications of the internal structure of the 3D model that represents features and properties of turning tools with carbide tips.

The following are outside the scope of this document:

— applications where these standard data can 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 document;

— 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 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/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:

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

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

4 Starting elements, coordinate systems, planes

4.1 General

The creation of 3D models shall be done by means of nominal dimensions. Some examples of nominal dimensions are given in Annex B.

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);

— **three orthogonal planes:** planes in the coordinate system that contain the axis of the system, namely "XY-plane" (XYP), "XZ-plane" (XZP) and "YZ-plane" (YZP);

— **three orthogonal axis:** axes built as intersections of the three orthogonal planes lines, namely "X-axis" (XA), "Y-axis" (YA) and "Z-axis" (ZA), respectively.

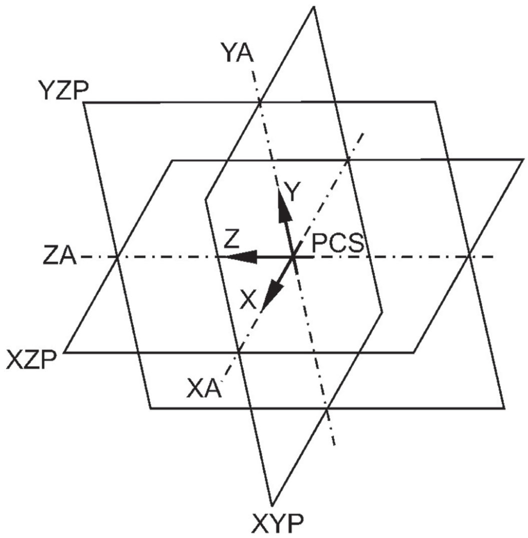


Figure 1 — Primary coordinate system

4.3 Tool item position

4.3.1 General

The definition of the tool position in 4.3.2 and 4.3.3 applies to right-handed tools. Left-hand items are as defined for right-hand items but mirrored through the YZ-plane, as specified in Annex A.

4.3.2 Prismatic tool position

A prismatic tool position identifies the location, as shown in Figure 2, on the coordinate reference system of a turning tool with planar sides and a rectangular cross-section where

— the base of the tool item shall be coplanar with the XZ-plane,

— the normal for the base of the item shall be in the negative 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 item shall be coplanar with the XY-plane,

— the normal for the end of the item shall be in the Z direction,

— the rake face of the primary cutting item shall be completely visible in the negative X-Z quadrant, and

— for cartridges, the top of the axial adjustment screw shall be coincident with the XY-plane.

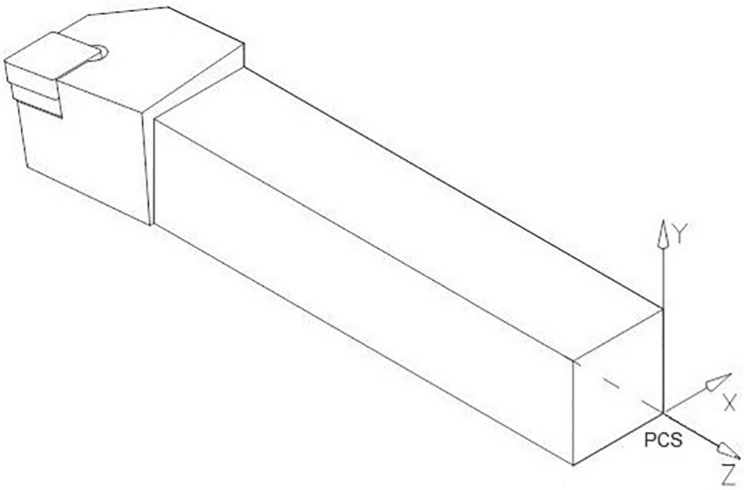


Figure 2 — Prismatic tool position

4.3.3 Round tool position

A round tool position, as shown in Figures 3 and 4, identifies the location on the coordinate reference system of a turning tool with non-planar sided cross-section where

— the axis of the tool item shall be collinear with the Z-axis,

— the vector of the shank that points in the negative 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 coupling, the gauge plane or the end of the cylindrical shank shall be coplanar with the XY-plane, and

— the rake face of the primary cutting item shall be visible in the negative X-Z quadrant.

If a bore is present, the vector of the bore of the item that points in the negative Z direction shall also point towards the workpiece side.

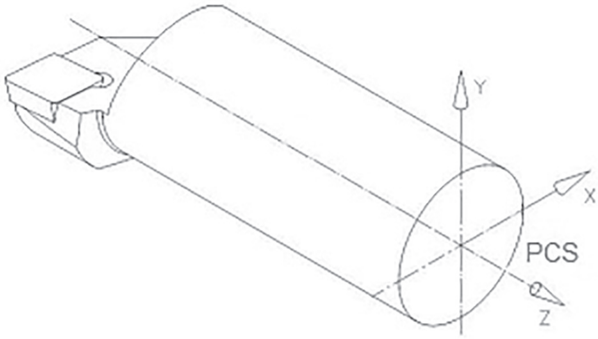


Figure 3 — Round tool position — Cylindrical shank

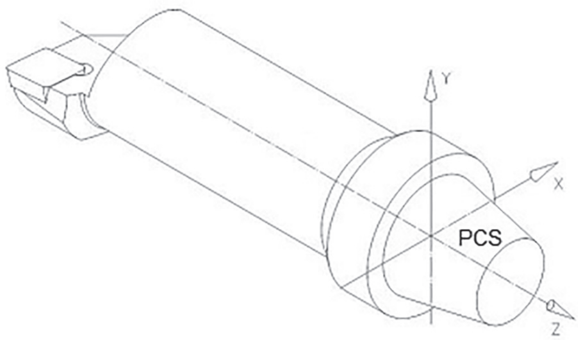


Figure 4 — Round tool position — Gauge plane or planar contact surface

4.4 Planes

The modelling shall take place based on planes according to Figure 5, which shall be 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 parameters 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 and so on.

For the 3D visualization of turning tools for indexable inserts, the general planes have to be determined as follows:

— "CDP" cutting depth plane: plane for the maximum cutting depth (CDX); based on "HEP";

— "HEP" head end plane: plane for most front point of the tool; based on either LPR for tools with gauge line or contact surface or OAL for tools without gauge plane or contact surface;

— "HFP" functional height plane: plane for the functional height (HF); based on the XZ-plane of PCS;

— "LSCP" clamping length plane: plane for the clamping length (LSC); based on the XY-plane of PCS;

— "LFP" functional length plane: plane for the functional length (LF); based on the XY-plane of PCS;

— "LHP" head length plane: plane for the head length (LH); based on "HEP";

— "TCEP" tool cutting edge plane: plane perpendicular to the XY-plane of a master insert through its major cutting edge;

— "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 HEP and TEP;

— "TFP" tool feed plane: plane perpendicular to the XZ-plane that is parallel to the primary feed direction of the tool and that is tangential to the cutting corner of the master insert;

— "TRP" tool rake plane: plane that contains the cutting edges of a master insert;

— "TSP" theoretical sharp point: the intersection in the tool rake plane of the two planes that are perpendicular to the XY-plane of the master insert through the major and minor cutting edges of the master insert;

— "WFP" plane for the functional width (WF); based on the YZ-plane of PCS.

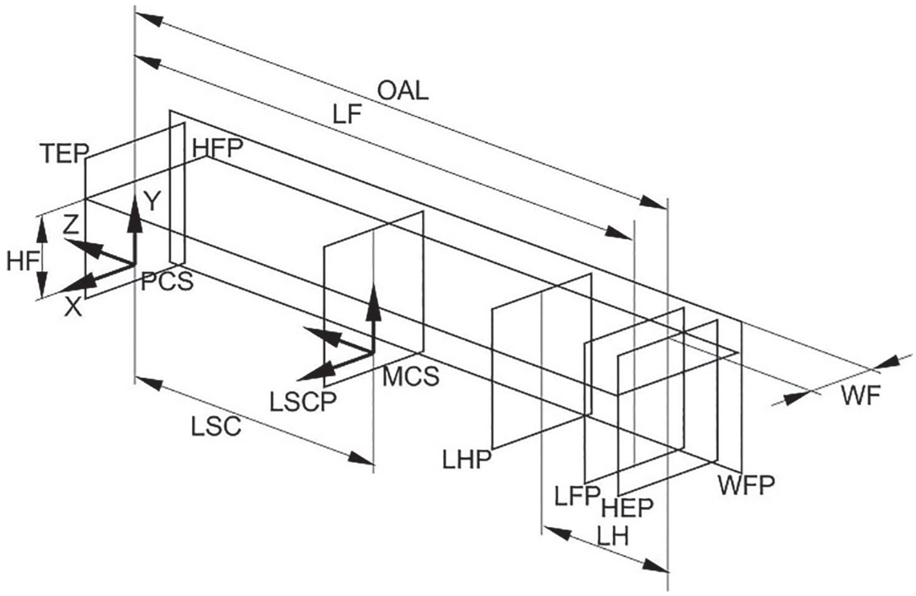


Figure 5 — Example of reference planes for design

4.5 Cutting reference point

The cutting reference point (CRP) is the theoretical point of the cutting tool from which the major functional dimensions are taken.

For turning tools with carbide tips, the CRP is the theoretical sharp point of the intersection of major cutting edge and minor cutting edge.

4.6 Design of the pocket of the tip

4.6.1 General

The final position of the pocket shall be designed by means of designing a tip. This feature shall be used for subtraction from the tool body. The design of the tip shall follow the same procedures as described in ISO/TS 13399-201. Table 1 lists the necessary properties for the tips.

Table 1 — Properties for the modelling of carbide tips

Preferred name	Preferred symbol
Clearance angle major	AN
Clearance angle minor	ANN
Insert included angle	EPSR
Insert length	INSL
Mating radius	RCON
Cutting edge length	L
Insert thickness	S
Insert width	W1
NOTE INSL = L. In the following clauses, the property cutting edge length is used to identify the length of cutting portion of the tool holder.	

4.6.2 Design of the body of the tip

The tip shall be designed as a solid without any details like rounding, chamfers and other specific features. The "PCS" defines the position of the tip in the space. The determinations are as follows:

— the tip is located in the X-Y quadrant;

— the cutting edges are collinear with the XY-plane;

— the major cutting edge is collinear with the positive X-axis;

— the theoretical sharp cutting point is on the Y-axis;

— the direction of the tip thickness is parallel to the negative Z-axis.

These determinations are valid for right-handed or neutral tips. Left-handed tips shall be mirrored through the YZ-plane.

NOTE The mounting coordinate system of the tip is identical with the PCS in position and direction of the axis.

Based on ISO 242, the five possible types of tips are shown in Figures 6 to 10.

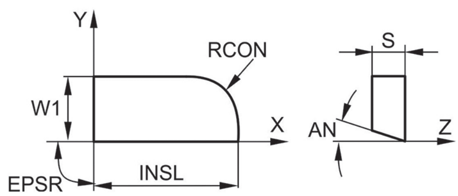


Figure 6 — Tip of type A (right-handed)

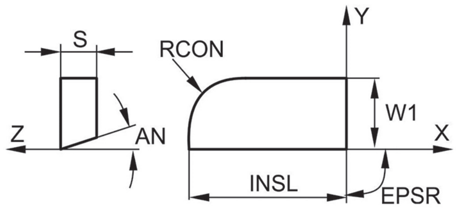


Figure 7 — Tip of type B (left-handed)

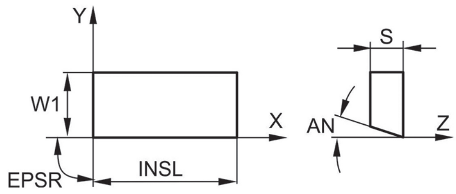


Figure 8 — Tip of type C (neutral)

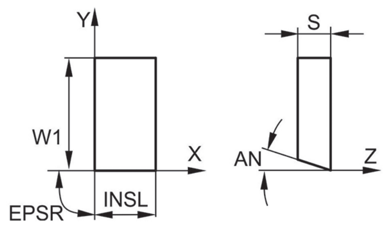


Figure 9 — Tip of type D (neutral)

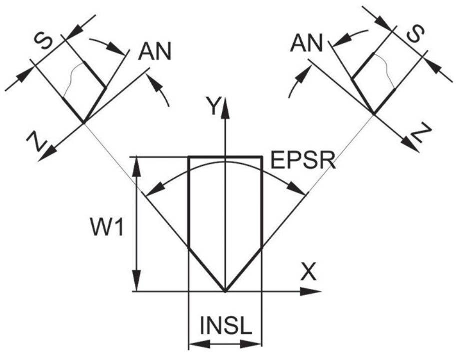


Figure 10 — Tip of type E (angular)

Each of the shape shall be created as a sketch (outline contour) and extruded with the dimension "S" that represents the thickness of the tip. The clearance angle major cutting edge (AN) can be designed by means of using the trim functionality of the CAD system. The example in Figure 11 shows a tip of type "A"; the other types of tips shall be designed in the same way.

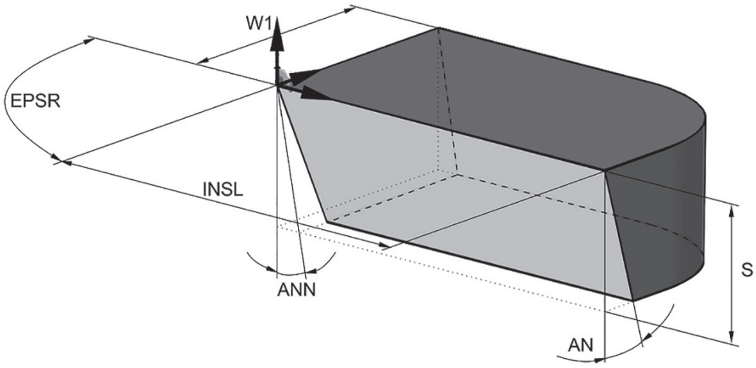


Figure 11 — Body of a type “A” tip

Positioning of the insert into the functional location shall be done as follows:

— Design with end cutting edge angle applies to right-handed tools No. 2 and 5.

a) Only those tips shall be used that are located in the second quadrant of the primary coordinate system of the tip – also called “left-handed” tips.

b) The tip shall be rotated by 90-KAPR degrees in mathematic positive direction (counterclockwise) about the Y-axis of PCS_TOOL, as shown in Figure 12.

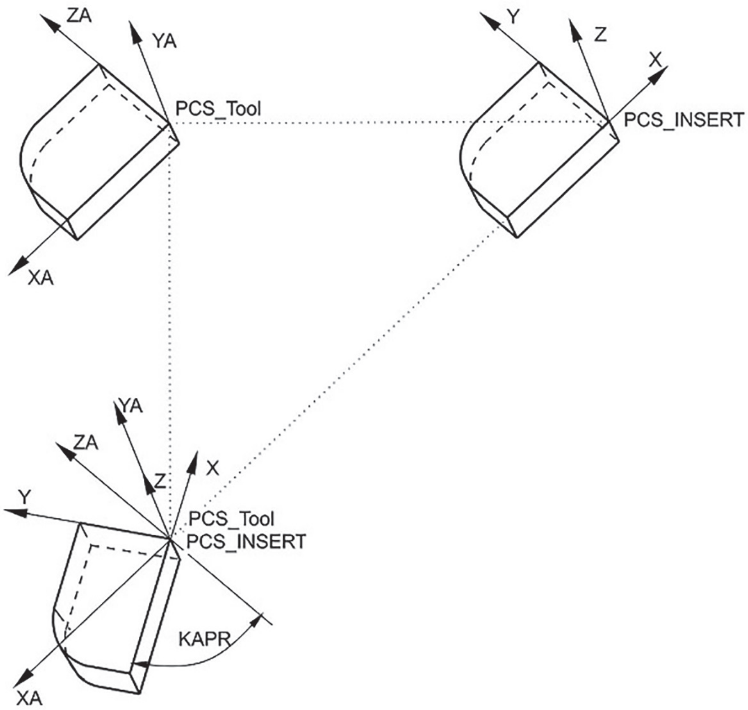


Figure 12 — Orientation of PCS_INSERT and PCS_Tool

c) The cutting reference point “CRP” is the origin point of PCS_Tool.

d) If the tool is defined with an orthogonal rake angle and an inclination angle that are unequal 0 degree, the insert has to be rotated about its CRP, as shown in Figure 13.

1) To define the orthogonal rake angle (GAMO) on the tool, the tip has to be rotated about the X-axis of PCS_INSERT; if GAMO is smaller than 0 (zero) degree, the rotation has to be done

in mathematic positive direction; if GAMO is greater than 0 (zero) degree, the rotation has to be done in mathematic negative direction.

2) To define the inclination angle (LAMS) on the tool, the tip has to be rotated about the Y-axis of PCS_INSERT; if LAMS is smaller than 0 (zero) degree, the rotation has to be done in mathematic positive direction; if LAMS is greater than 0 (zero) degree, the rotation has to be done in mathematic negative direction.

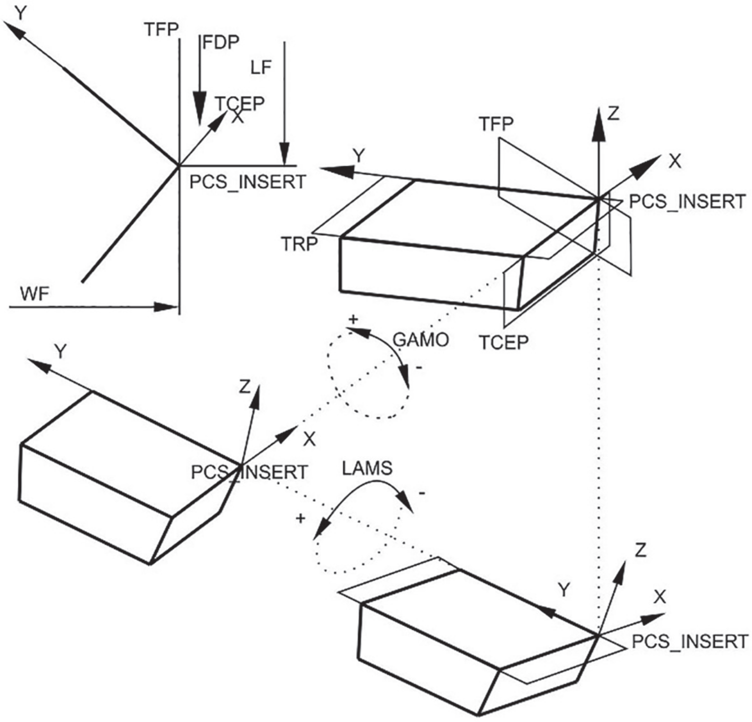


Figure 13 — Orthogonal angle and inclination angle on tips

— Design with side cutting edge angle on a right-handed tool.

a) Only those inserts shall be used that are located in the first quadrant of the primary coordinate system of the tip — also called “right-handed” or “neutral” tips.

b) The tip shall be rotated by KAPR degrees in mathematic positive direction (counterclockwise) about the Y-axis of PCS_TOOL.

c) The cutting reference point “CRP” is the point where the functional dimensions are based.

d) Orientation of GAMO and LAMS (see above).

4.7 Adjustment coordinate system on workpiece side

4.7.1 General

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

4.7.2 Designation of the coordinate system workpiece side

Case 1 One coordinate system at the workpiece side shall be designated as “CSW”.

Case 2 One coordinate system at workpiece side on different levels shall be designated as “CSWx”, e.g. “CSW1”, “CSW2”. The numbering shall start at the workpiece side and ends at the machine side in the direction of the positive Z-axis.

Case 3 Multiple coordinate systems at one level, but different angles and not at the centre of the tool axis shall be designated with “CSWx_y”, where the “x” defines the level and the “y” defines the number of the coordinate system itself. The counting shall start at the three o’clock position counting in counterclockwise direction while looking towards the machine spindle (positive Z-axis).

Case 4 Multiple coordinate systems at one level, one angle and different diameters shall be designated as described in case 3. The counting shall start at the smallest diameter.

Case 5 Multiple coordinate systems at one level, different angles and different diameters shall be designates as described in case 3. The counting shall start at the smallest diameter and at the three o’clock position counting in counterclockwise direction while looking towards the machine spindle (positive Z-axis).

Figure 14 shows the adjustment coordinate system on the workpiece side.

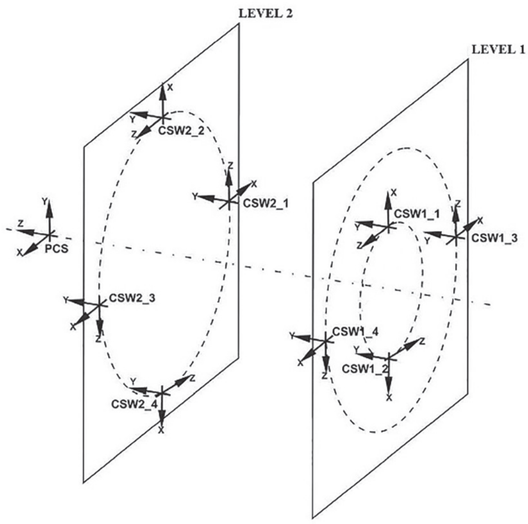


Figure 14 — Adjustment coordinate system on workpiece side (exemplarily)

The PCS_INSERT shall be placed onto the CSWx_y of the tool, as shown in Figure 15, with determinations as follows:

— the X-axis of PCS_INSERT is colinear to the X-axis of CSWx_y;

— the Y-axis of PCS_INSERT is colinear to the Y-axis of CSWx_y;

— the Z-axis of PCS_INSERT is colinear to the Z-axis of CSWx_y.

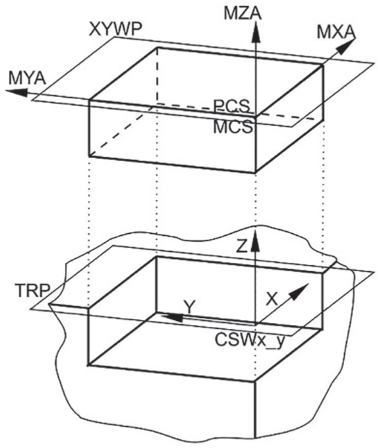


Figure 15 — Placing tip on to pocket seat

5 Design of the model

5.1 General

The sketches (outline contours) and features (model objects) of the crude model may not contain details like slots, chamfers, rounding and grooves. Those features shall be designed as separate design elements after the crude geometry and shall be grouped as detail geometry. Based on the non-cutting features (group “NOCUT”), the cutting features shall be loaded as assembly parts (group “CUT”) into the basic model; for the group “DETAILS”, see Clause 15. The sequence of the model structure has to be kept as described. No references between the connection and the basic body. Only the group “DETAILS” may contain references to other design features.

Turning tools with carbide tips, differentiated as tool holders and boring bars, shall be designed as features:

— basic geometry containing tool head and shank;

  — as extrusion sketch for tools with rectangular shank;

  — as rotational sketch for boring bars;

— chip space and pocket seat;

— details (chamfers, roundings, slots, etc.);

— assembly (mating of spare parts);

  — tips shall be assembled as individual part with its reference of MCS/CSW;

  — spare parts which can collide with the workpiece — shims, coolant supply parts shall not be part of the simplified model.

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

The specific model structure of the different shapes of tool holders with carbide tips is described in the next clauses of this document.

5.2 Necessary parameters for the connection interface feature

Information about the connection interface code has to be filed as properties within the model and being named as parameters as shown in Table 2.

Table 2 — Parameter 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 short name of subtype of connection_interface_feature	feature_class
CCFMS	connection code form machine side	ISO/TS 13399-60 number of the variant of the subtype of connection_interface_feature	feature_class
CZCMS	connection size code machine side	connection size code (dependent on side)	71FC193318002

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

6 Turning tool No. 1 — Straight design

6.1 General

Figure 16 determines the properties that shall be needed for the design.

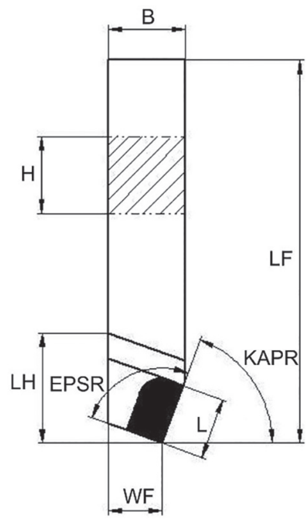


Figure 16 — Determination of properties for turning tool No. 1 (straight design)

6.2 Necessary properties

Table 3 lists the necessary properties for the design of the model.

Table 3 — Properties for the modelling of a turning tool No. 1 (straight design)

Preferred name	Preferred symbol
Shank width	B
Cutting edge angle type code	CEATC
Included angle	EPSR
Orthogonal rake angle	GAMO
Shank height	H
Hand	HAND
Functional height	HF
Tool cutting edge angle	KAPR
Cutting edge length	L
Inclination angle	LAMS
Functional length	LF
Head length	LH
Shank cross section shape code	SX
Tool holder shape code	THSC
Functional width	WF

6.3 Basic geometry

The basic design of the model is a sketch for extrusion function for models with rectangular shank, which contains all elements between the plane "TEP" and the plane "HEP".

The sketch includes all the real measure elements listed in Table 3 and shall be designed on the XZ-plane of the PCS. The tool axis shall be the standard Z-axis.

Design of the sketch:

— The sketch shall be determined as a full section from top view (parallel to Y-axis of PCS).

— The sketch shall be constrained to the coordinate system "PCS" and to the planes "TEP" and "HEP". 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 planes.

— The dimensioning shall be done with the appropriate properties listed in Table 3.

— The sketch shall be extruded along the Y-axis.

Figure 17 represents the sketch of a turning tool with side cutting edge angle.

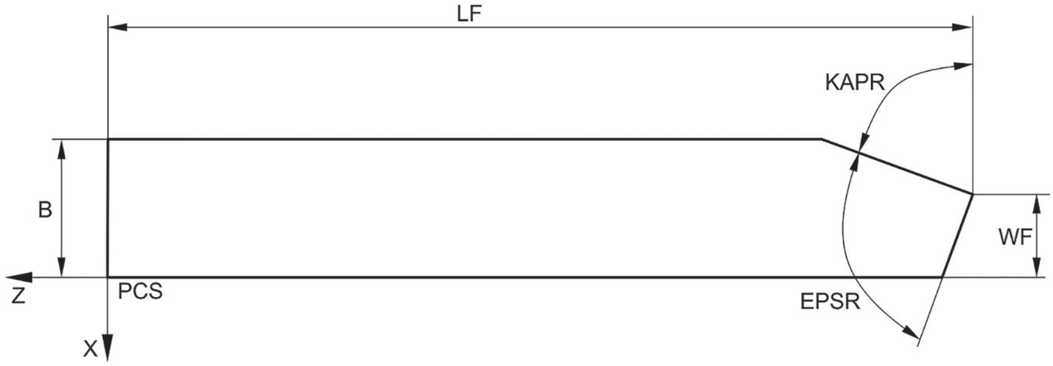


Figure 17 — Sketch of turning tool No. 1 (straight design)

6.4 Turning tool No. 1 — Solid body

For the extrusion, the value of shank height shall be taken. Then, the top surface offset shall be subtracted from the body. The clearance angles of major and minor cutting edge shall be added by means of using the CAD trim functions. After the completion of the turning tool body, the tip shall be placed to its right position. Figure 18 shows the complete turning tool with the tip.

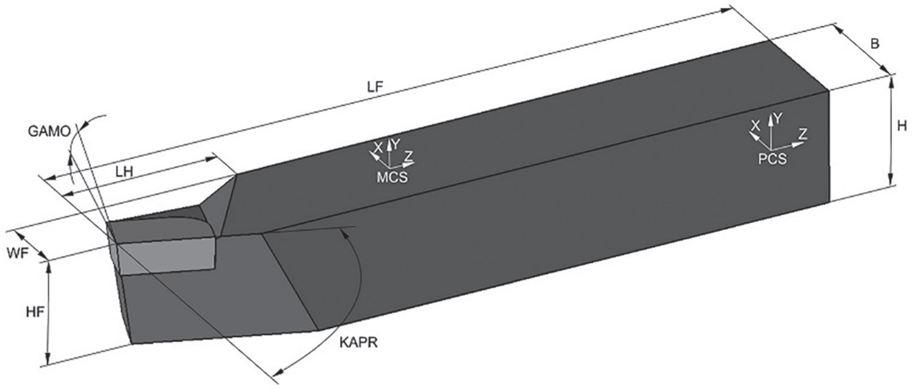


Figure 18 — Complete turning tool No. 1

7 Turning tool No. 2 — Bent design

7.1 General

Figure 19 determines the properties that shall be needed for the design.

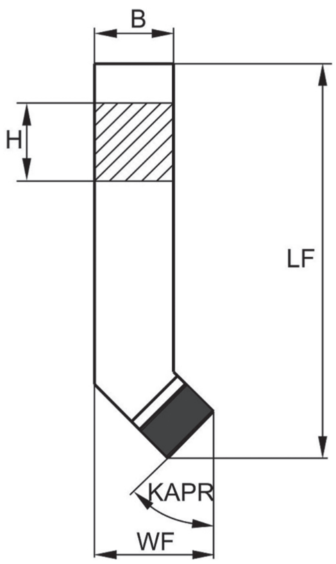


Figure 19 — Determination of properties for turning tool No. 2 (bent design)

7.2 Necessary properties

See Table 3 for necessary properties

7.3 Basic geometry

See 6.3 for the basic design.

Figure 20 represents the sketch of a turning tool of bent design with end cutting edge angle.

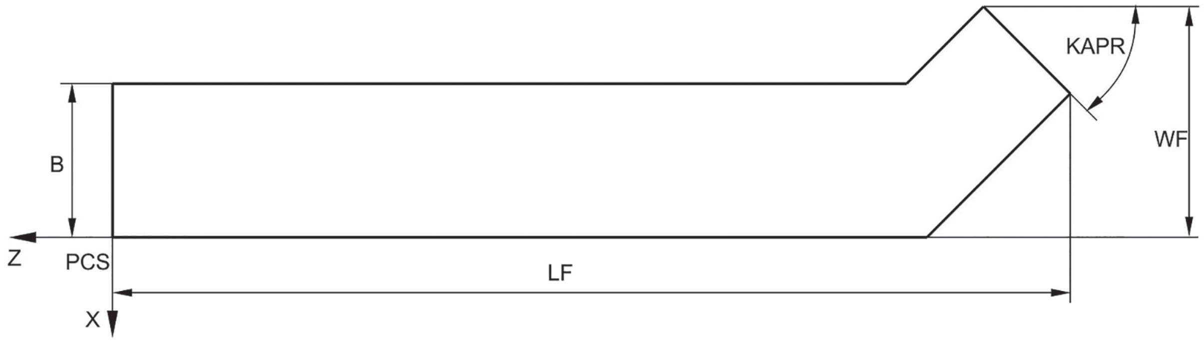


Figure 20 — Sketch of turning tool No. 2 (bent design)

7.4 Turning tool No. 2 — Solid body

See 6.4 for the design.

Figure 21 shows the complete turning tool with the tip.

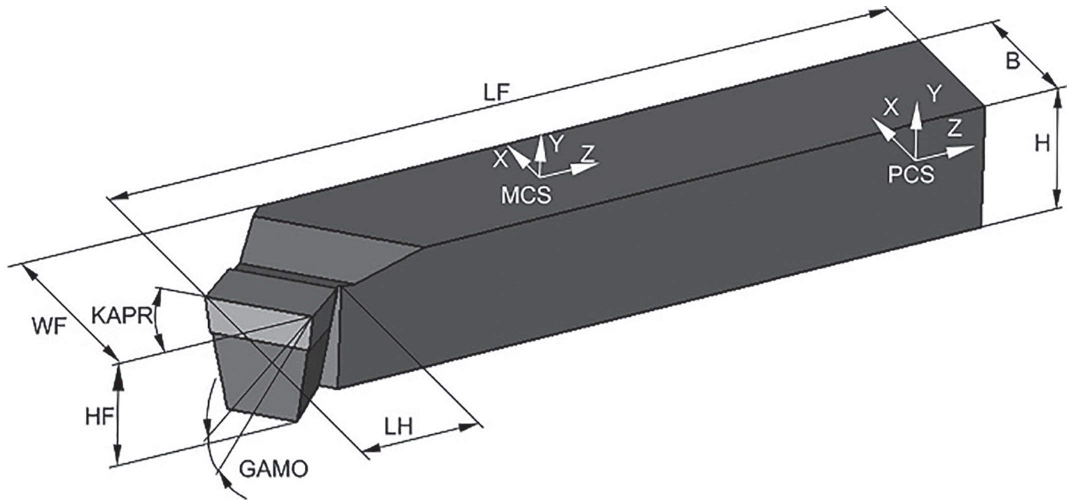


Figure 21 — Complete turning tool No. 2

8 Turning tool No. 3 and 6 — Offset side cutting design

8.1 General

Figure 22 determines the properties that shall be needed for the design.

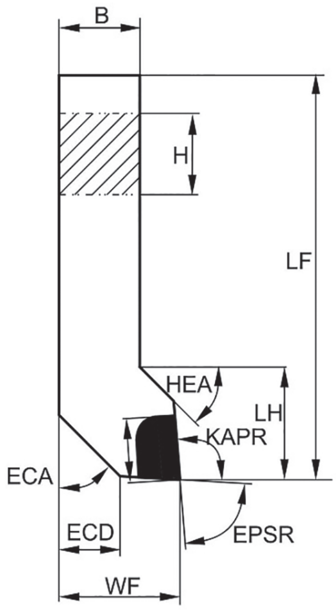


Figure 22 — Determination of properties for turning tool No. 3 and No. 6 (offset side cutting design)

8.2 Necessary properties

Table 4 lists the necessary properties for the design of the model.

Table 4 — Properties for the modelling of a turning tool No. 3 and 6 (offset side cutting design)

Preferred name	Preferred symbol
Shank width	B
Cutting edge angle type code	CEATC
End chamfer	EC
End chamfer angle	ECA
End chamfer distance	ECD
Included angle	EPSR
Orthogonal rake angle	GAMO
Shank height	H
Hand	HAND
Head end angle	HEA
Functional height	HF
Tool cutting edge angle	KAPR
Cutting edge length	L
Inclination angle	LAMS
Functional length	LF
Head length	LH
Shank cross section shape code	SX
Tool holder shape code	THSC
Functional width	WF

8.3 Basic geometry

See 6.3 for the basic design.

Figure 23 represents the sketch of a turning tool of offset design with side cutting edge angle.

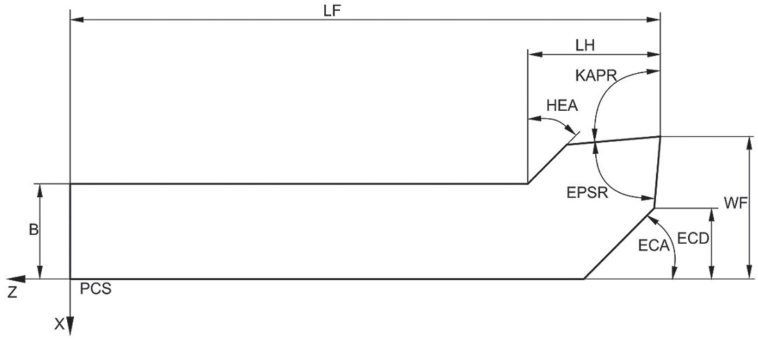


Figure 23 — Sketch of turning tool No. 3 and 6 (offset side cutting design)

8.4 Turning tool No. 3 and 6 — Solid body

See 6.4 for the design.

Figure 24 shows the complete turning tool with the tip.

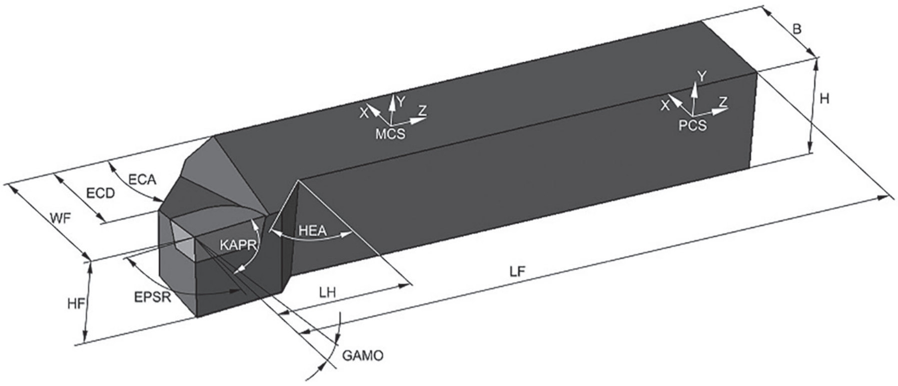


Figure 24 — Complete turning tool No. 3 and 6

9 Turning tool No. 4 — Straight grooving design

9.1 General

Figure 25 determines the properties that shall be needed for the design.

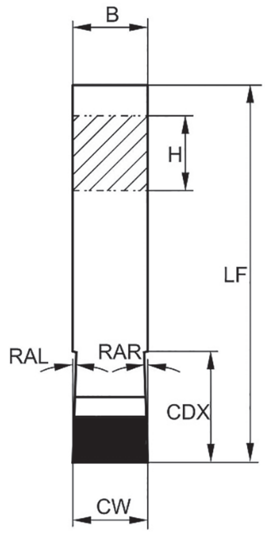


Figure 25 — Determination of properties for turning tool No. 4 (straight grooving design)

9.2 Necessary properties

Table 5 lists the necessary properties for the design of the model.

Table 5 — Properties for the modelling of a turning tool No. 4 (straight grooving design)

Preferred name	Preferred symbol
Shank width	B
Cutting depth maximum	CDX
Cutting width	CW
Orthogonal rake angle	GAMO
Shank height	H
Hand	HAND
Head end angle	HEA
Functional height	HF
Tool cutting edge angle	KAPR
Inclination angle	LAMS
Functional length	LF
Relief clearance angle left hand	RAL
Relief clearance angle right hand	RAR
Shank cross section shape code	SX
Tool holder shape code	THSC

9.3 Basic geometry

See 6.3 for the basic design.

Figure 26 represents the sketch of a turning tool of straight grooving design.

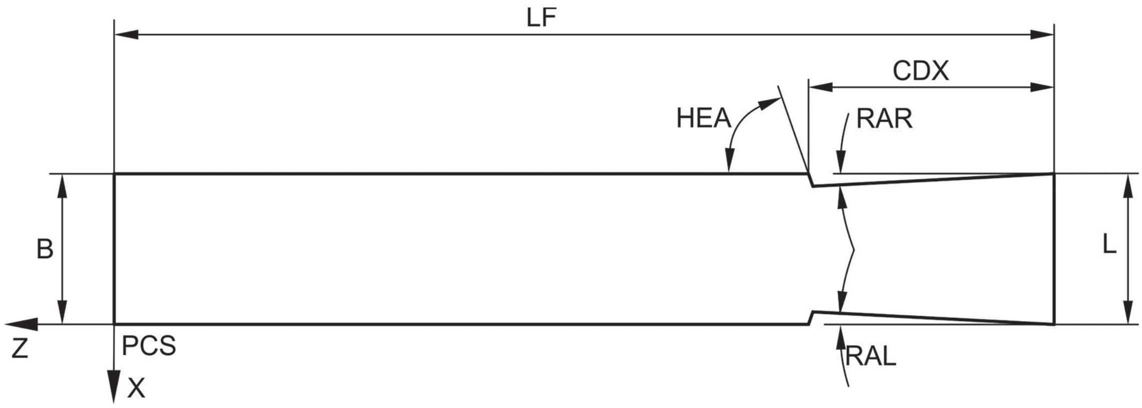


Figure 26 — Sketch of turning tool No. 4 (straight grooving design)

9.4 Turning tool No. 4 — solid body

See 6.4 for the design.

Figure 27 shows the complete turning tool with the tip.

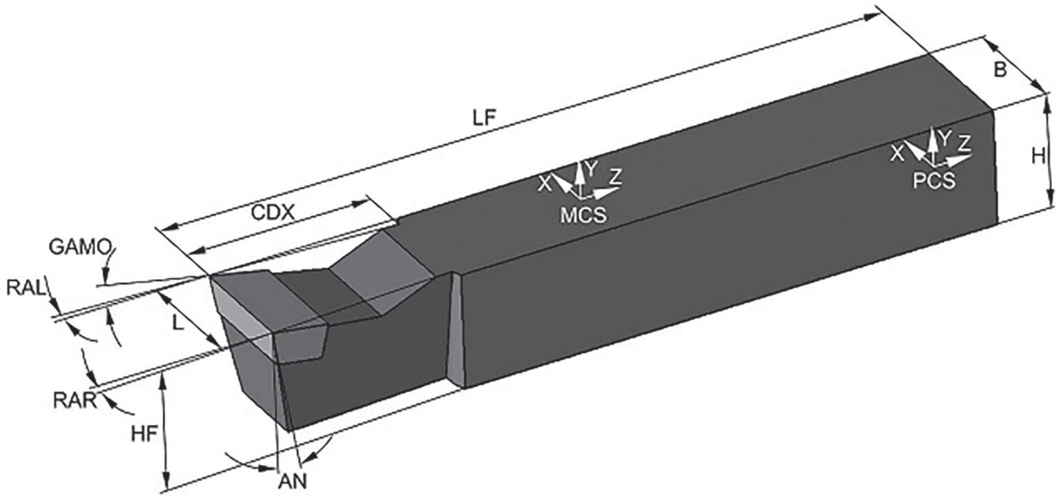


Figure 27 — Complete turning tool no 4

10 Turning tool No. 5 — Offset end cutting design

10.1 General

Figure 28 determines the properties that shall be needed for the design.

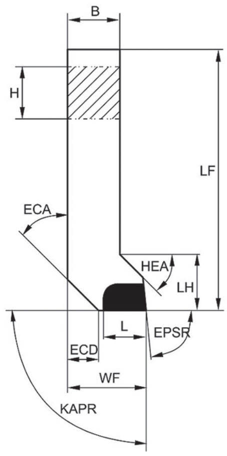


Figure 28 — Determination of properties for turning tool No. 5 (offset end cutting design)

10.2 Necessary properties

See Table 4 for necessary properties.

10.3 Basic geometry

See 6.3 for the basic design.

Figure 29 represents the sketch of a turning tool of offset face design.

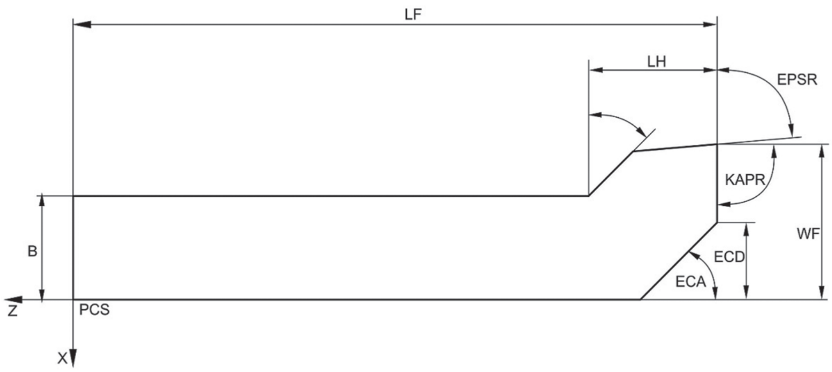


Figure 29 — Sketch of turning tool No. 5 (offset end cutting design)

10.4 Turning tool No. 5 — Solid body

See 6.4 for the design.

Figure 30 shows the complete turning tool with the tip.

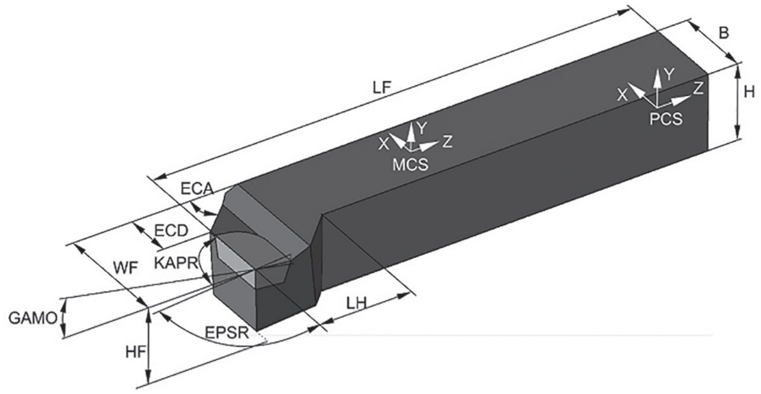


Figure 30 — Complete turning tool No. 5

11 Turning tool No. 7 — Grooving and cut-off design

11.1 General

Figure 31 determines the properties that shall be needed for the design.

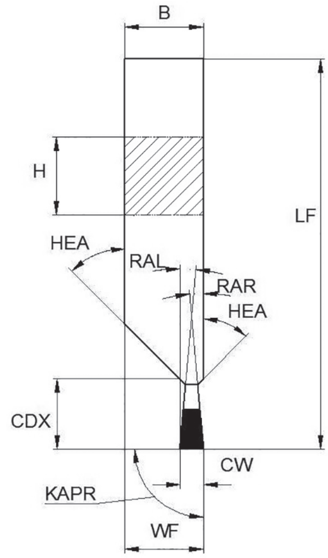


Figure 31 — Determination of properties for turning tool No. 7 (grooving and cut-off design)

11.2 Necessary properties

See Table 5 for necessary properties.

11.3 Basic geometry

See 6.3 for the basic design.

Figure 32 represents the sketch of a turning tool of grooving and cut-off design.

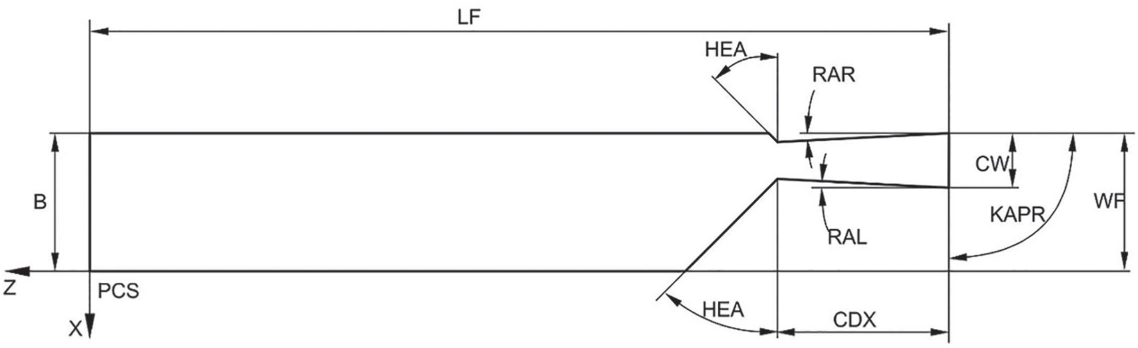


Figure 32 — Sketch of turning tool No. 7 (grooving and cut-off design)

11.4 Turning tool No. 7 — Solid body

See 6.4 for the design.

Figure 33 shows the complete turning tool with the tip.

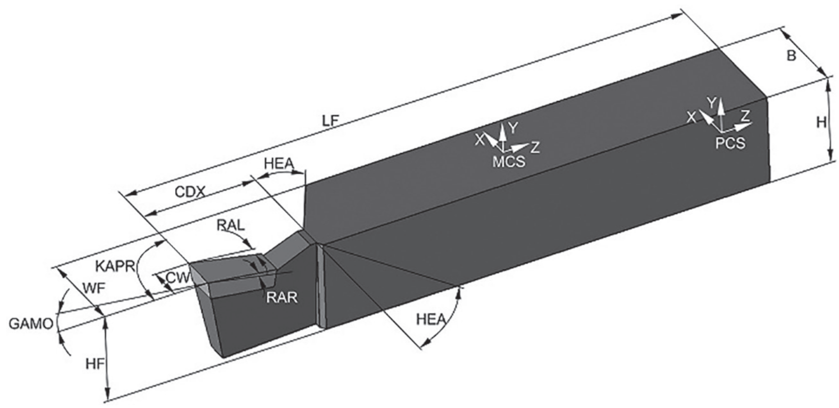


Figure 33 — Complete turning tool No. 7

12 Turning tool — Pointed straight design

12.1 General

Figure 34 determines the properties that shall be needed for the design.

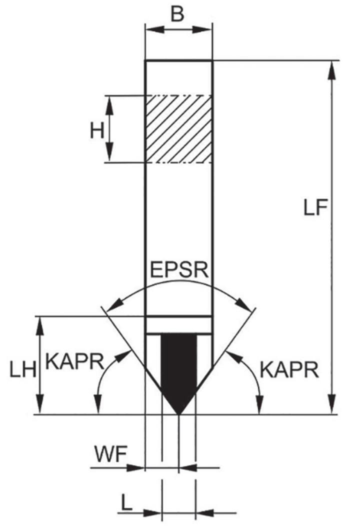


Figure 34 — Determination of properties for turning tool (pointed straight design)

12.2 Necessary properties

See Table 3 for necessary properties.

12.3 Basic geometry

See 6.3 for the basic design.

Figure 35 represents the sketch of a turning tool of pointed straight design.

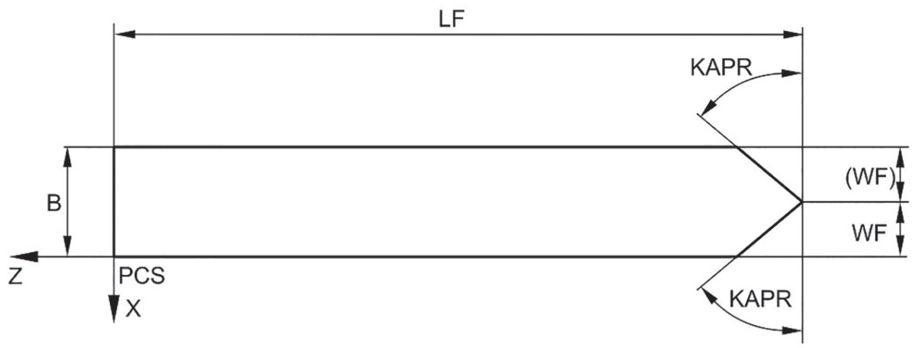


Figure 35 — Sketch of turning tool (pointed straight design)

12.4 Turning tool — Solid body

See 6.4 for the design.

Figure 36 shows the complete turning tool with the tip.

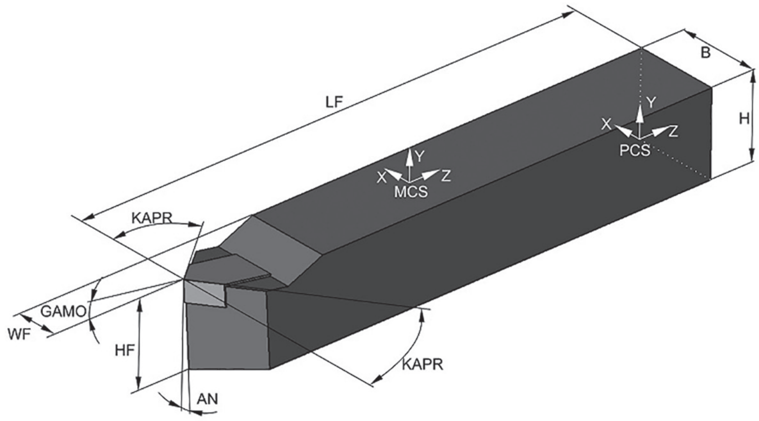


Figure 36 — Complete turning tool of pointed straight design

13 Internal turning tool No. 8 — Offset end cutting design

13.1 General

Figure 37 determines the properties that shall be needed for the design. The tool shall be designed either with round or square shank cross section.

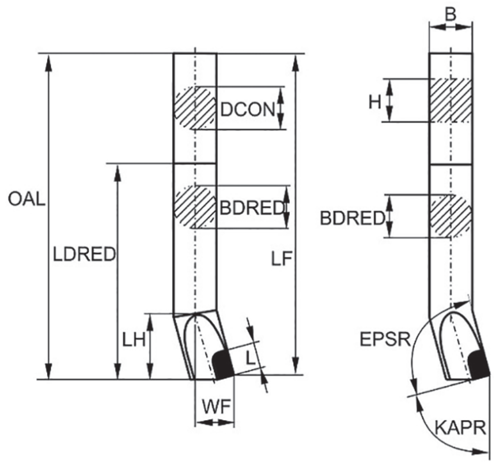


Figure 37 — Determination of properties for internal turning tool (offset end cutting design)

13.2 Necessary properties

Table 6 lists the necessary properties for the design of the model.

Table 6 — Properties for the modelling of an internal turning tool (offset end cutting design)

Preferred name	Preferred symbol
Shank width	B
Body diameter, reduced	BDRED
Cutting edge angle type code	CEATC
Minimum bore diameter	DMIN
Insert included angle	EPSR
Orthogonal rake angle	GAMO

Table 6 *(continued)*

Preferred name	Preferred symbol
Shank height	H
Hand	HAND
Insert hand	IH
Functional height	HF
Tool cutting edge angle	KAPR
Cutting edge length	L
Inclination angle	LAMS
Length body diameter, reduced	LDRED
Functional length	LF
Head length	LH
Overall length	OAL
Shank cross section shape code	SX
Tool holder shape code	THSC
Functional width	WF

13.3 Basic geometry

The basic design of the model is a sketch for revolving function for models with cylindrical shank, which contains all elements between the plane “TEP” and the plane “HEP”.

The sketch includes all the real measure elements listed in Table 6 and shall be designed on the XZ-plane of the PCS. The tool axis shall be the standard Z-axis.

Design of the sketch:

— The sketch shall be determined as a half section from top view (parallel to Y-axis of PCS).

— The sketch shall be constrained to the coordinate system “PCS” and to the planes “TEP” and “HEP”. 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 planes.

— The dimensioning shall be done with the appropriate properties listed in Table 6.

— The sketch shall be revolved about the Z-axis.

Figure 38 shows the basic body after revolving the sketch.

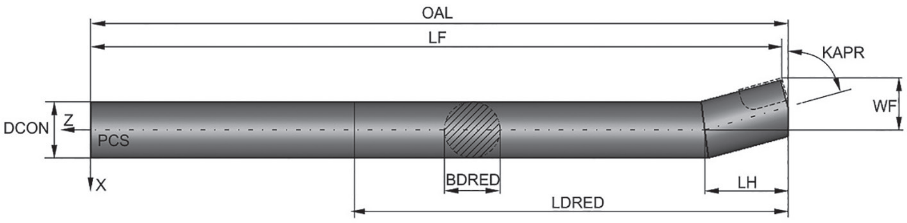


Figure 38 — Basic body of internal turning tool

13.4 Complete internal offset end cutting turning tool

The top surface offset built as chip flute shall be subtracted from the body. The clearance angles of major and minor cutting edge shall be added by means of using the CAD trim functions. After the completion of the turning tool body, the tip shall be placed to its right position. Figure 39 shows the complete internal turning tool with the tip.

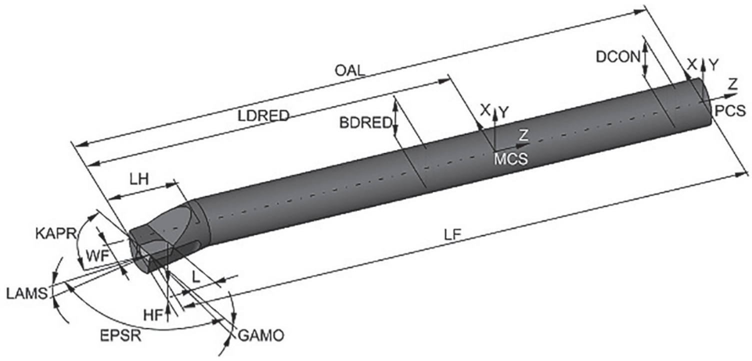


Figure 39 — Complete internal turning tool of offset end cutting design

14 Internal turning tool No. 9 — Offset side cutting design

14.1 General

Figure 40 determines the properties that shall be needed for the design. The tool shall be designed either with round or square shank cross section.

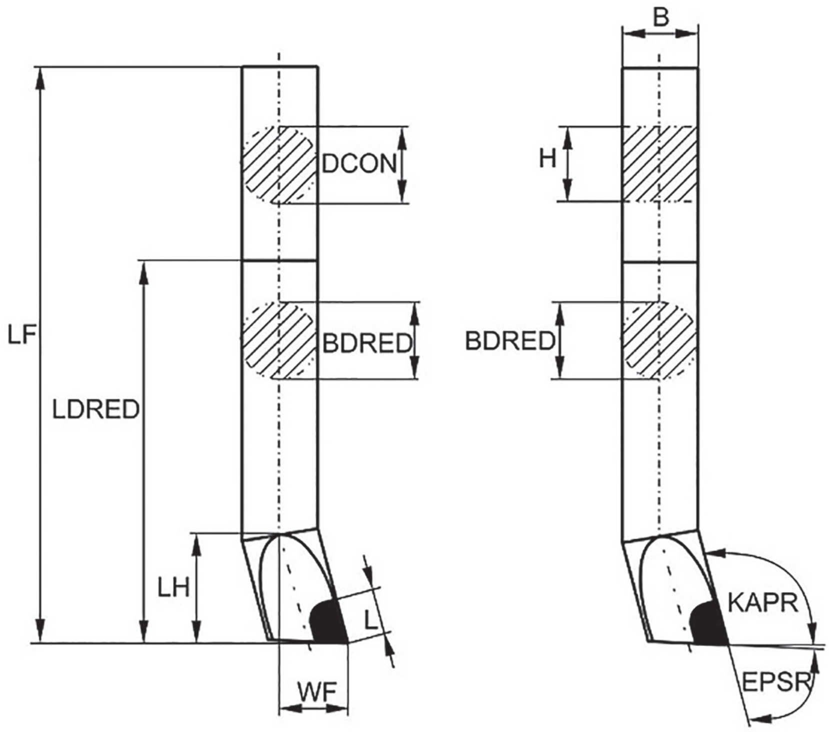


Figure 40 — Determination of properties for internal turning tool (offset side cutting design)

14.2 Necessary properties

See Table 6 for necessary properties.

14.3 Basic geometry

See 13.3 for the basic design.

14.4 Complete internal offset side cutting turning tool

See 6.4 for the design.

Figure 41 shows the complete turning tool with the tip.

For more clarity, the dimensions "HF", "GAMO" and "LAMS" are not shown in Figure 41, but can be seen in Figure 39 for example.

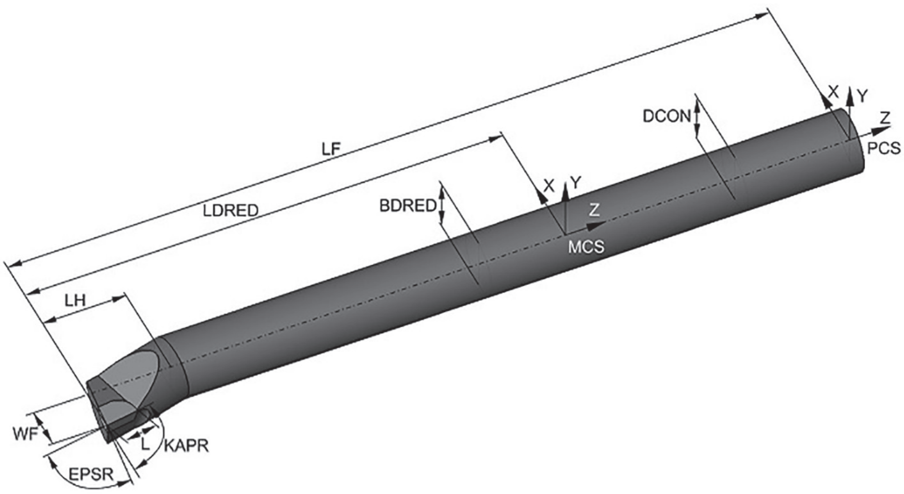


Figure 41 — Complete internal turning tool of offset side cutting design

15 Design of details

15.1 Basics for modelling

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

15.2 Contact surfaces/location flats — Orientation

Contact surfaces and location flats that shall be visualized within the model have to be oriented by means of a unique orientation. Location flats shall be parallel to the XZ-plane of PCS.

15.3 Chamfers, rounding, others

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

16 Attributes of surfaces — Visualization of the model features

The colour settings as part of the attributes of the surfaces shall be taken in accordance with 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, to be able to address the surface attributes to each of these features, a revolved design feature is 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 parts and is placed at the end of the tree.

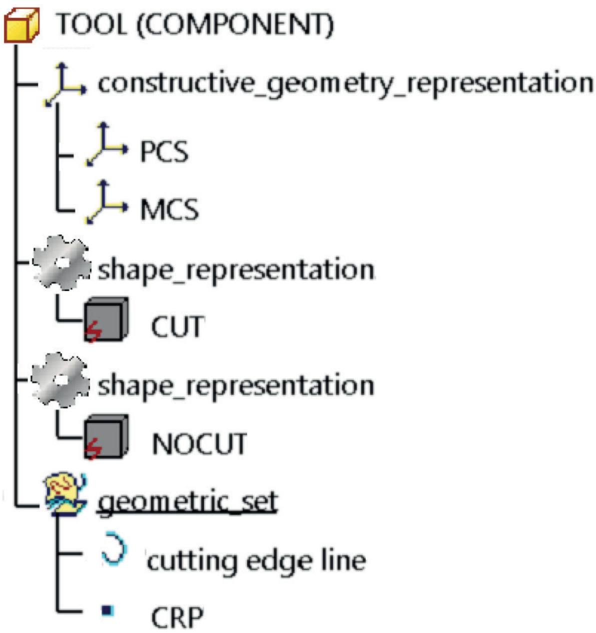
Some CAD systems give the possibility to use the available lines of the main sketches for the creation of the “CUTTING_SURFACE”. Hereby, the datum plane “LSCP” and others shall be used as references. With the suppression of the main design elements, all referenced design elements are also supressed.

17 Data exchange model

For turning tools with carbide tips, the carbide tips shall be defined as “CUT” features and the body shall be defined as “NOCUT” feature. These features may be deactivated separately, without a mutual impact.

If more than one tip exists, each tip is defined as a “CUT” feature and it will be named “CUT1”, “CUT2”, “CUT1_1”, CUT1_2”, similar to common CSW naming procedure cases 1 to 5 under 4.7.2.

The structure of a turning tool detailed and basic models shall be as indicated in Figure 42.



NOTE For extended STP diagram structure, see ISO/TS 13399-305:2017, Annex B.

Figure 42 — Structure of a turning tool with one carbide tip

The models for turning tool shall contain the features defined in Table 7.

Table 7 — Features contained in models for turning tool

Component		Features	Basic STP	Detailed STP
Tool name (component)	i	Solid body	NOCUT	NOCUT
		(shape_representation)	CUT	CUT
	ii	Axis system	PCS	PCS
		(constructive_geometry_representation)	MCS	MCS
	iii	Geometric set	cutting edge line	cutting edge line
			CRP (point)	CRP (point)

The basic STP model for turning tools is built as one component object (see Figure 43 and Figure 44), containing the following:

a) tool (component):

   1) solid body: NOCUT;

   2) solid body: CUT;

   3) axis system:

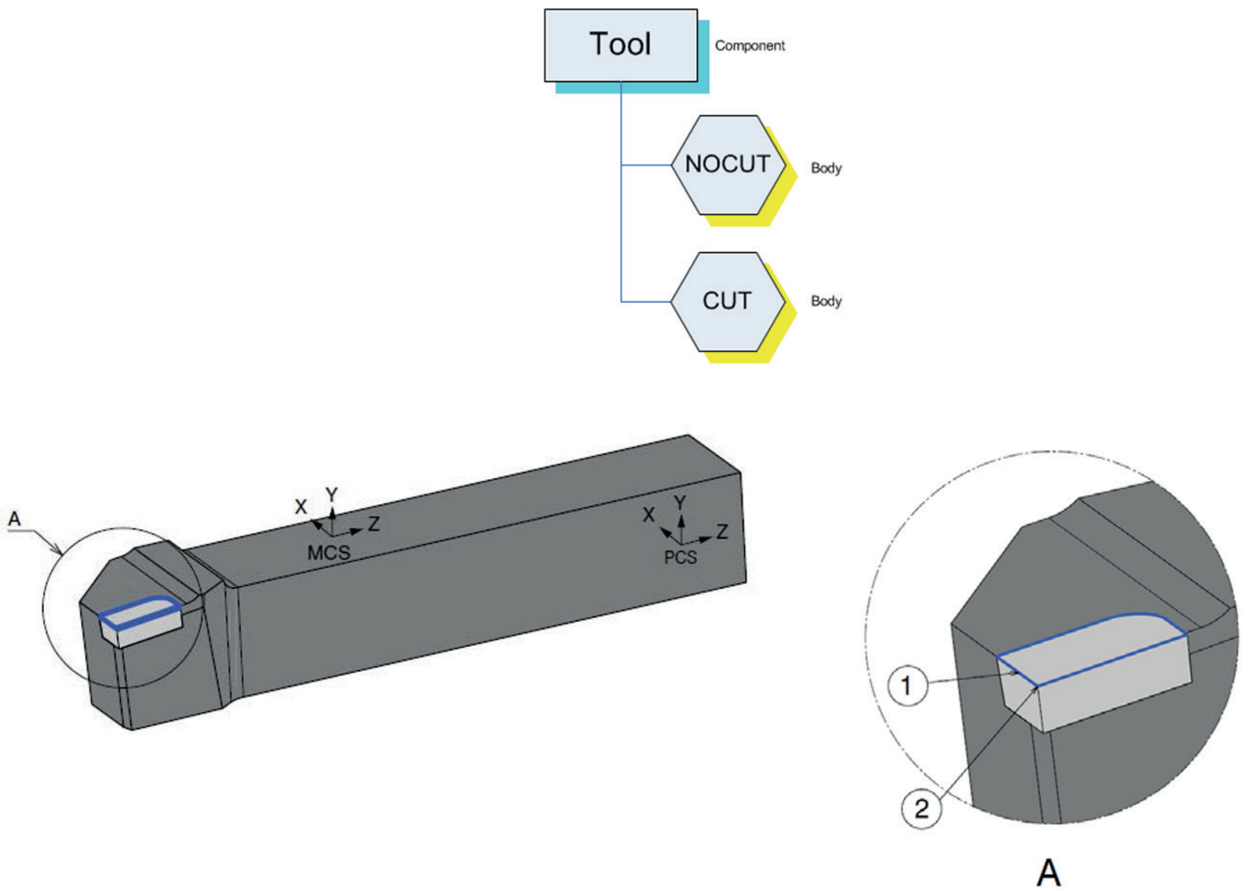
      i) PCS;

      ii) MCS;

   4) geometric set:

      i) cutting edge line;

      ii) CRP.

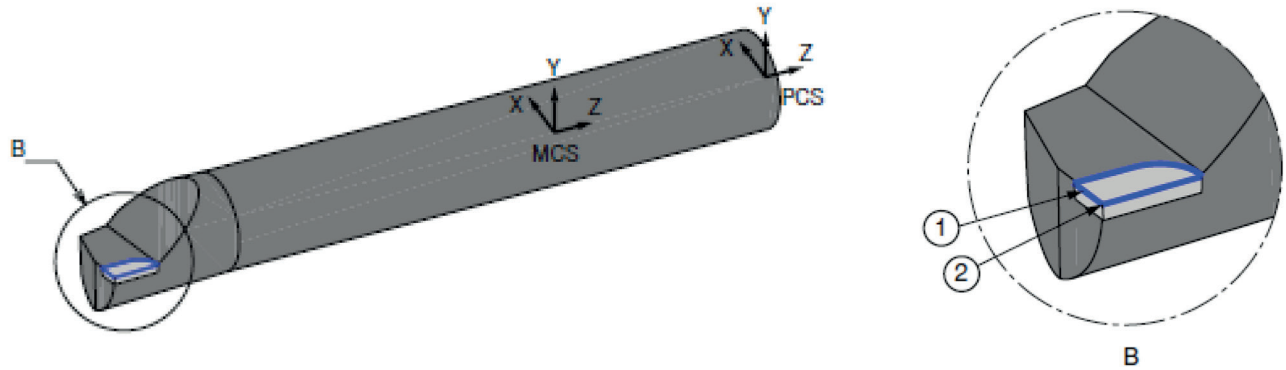


Key

1 cutting edge line

2 CRP (point)

Figure 43 — Basic STP model for turning tool with one carbide tip for OD turning



Key

1 cutting edge line

2 CRP (point)

Figure 44 — Basic STP model for turning tool with one carbide tip for ID turning

The detailed STP model for turning tools is built as one component object (see Figure 45 and Figure 46), containing the following:

a) tool (component):

  1) solid body: NOCUT;

  2) solid body: CUT;

  3) axis system:

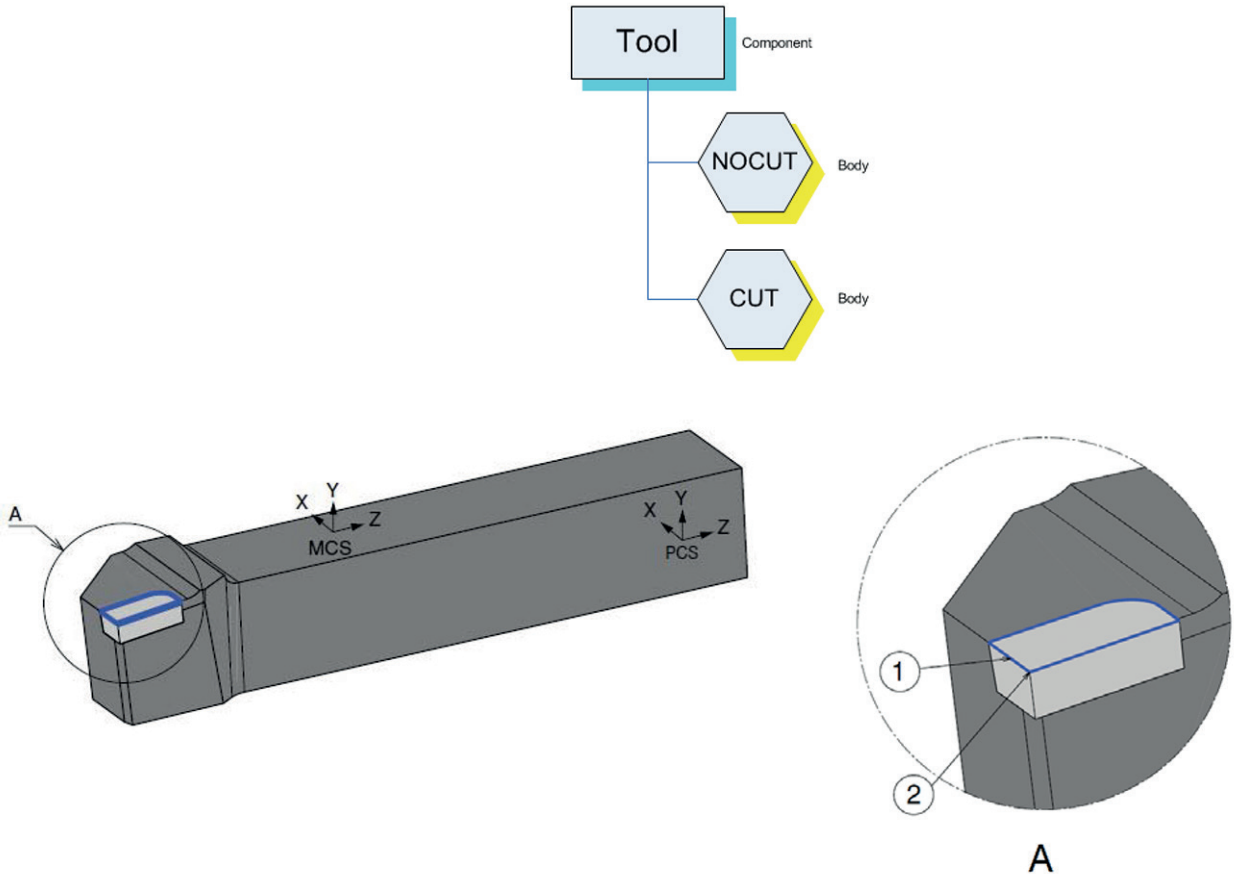
    i) PCS;

    ii) MCS;

  4) geometric set:

    i) cutting edge line;

    ii) CRP.

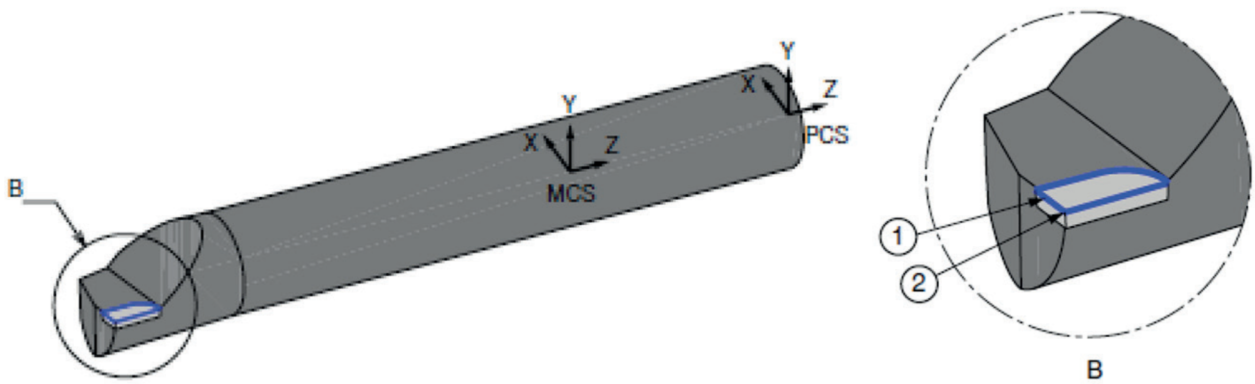


Key

1 cutting edge line

2 CRP (point)

Figure 45 — Detailed STP model for turning tool with one carbide tip for OD turning



Key

1 cutting edge line

2 CRP (point)

Figure 46 — Detailed STP model for turning tool with one carbide tip for ID turning

Annex A
(normative)

Mirror plane for left-handed tools

Figure A.1 and Figure A.2 show the location of right-handed and left-handed tools. The mirror plane is determined as the YZ-plane of the primary coordinate system.

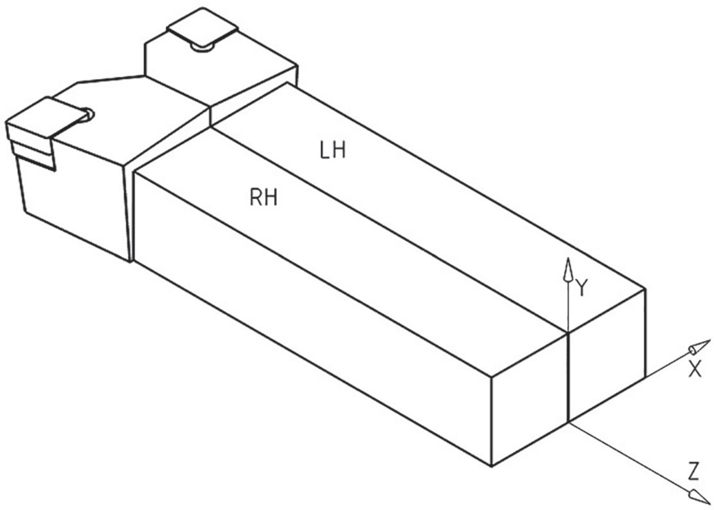


Figure A.1 — Orientation of the primary coordinate system PCS on square shank tool holders

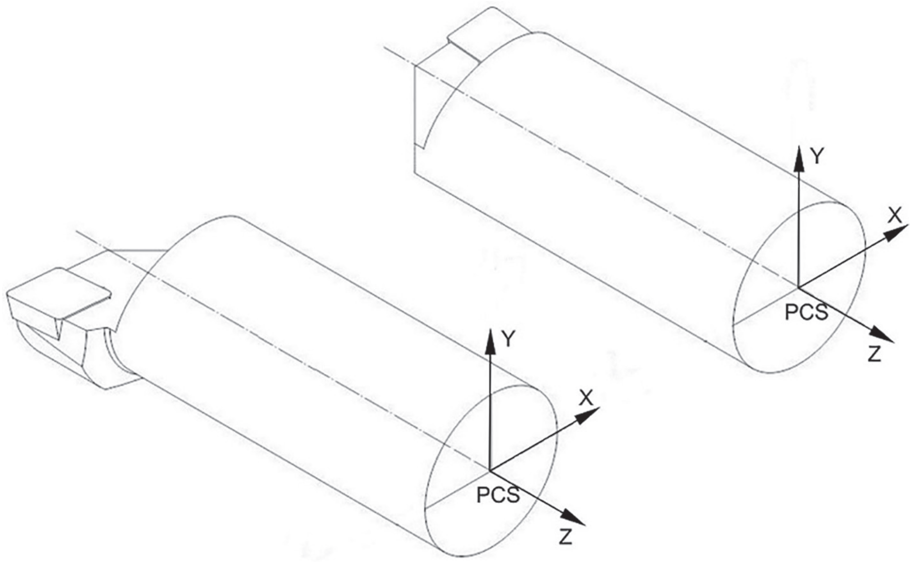


Figure A.2 — Orientation of the primary coordinate system PCS on round shank tool holders

Annex B
(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 may not match any dimension of the product, but within the domain of that product, the nominal size may correspond to a large number of highly standardized dimensions and tolerances. A nominal size may 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 B.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	25	g7	24,972	24,993	25,000
Square shank size h × b	32 × 25	h13	31,61 × 24,67	32 × 25	32 × 25

Bibliography

[1] ISO 242, *Carbide tips for brazing on turning tools*

[2] ISO 243, *Turning tools with carbide tips — External tools*

[3] ISO 514, *Turning tools with carbide tips — Internal tools*

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

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

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

[7] ISO/TS 13399-305:2017, *Cutting tool data representation and exchange — Part 305: Creation and exchange of 3D models — Modular tooling systems with adjustable cartridges for boring*

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