TECHNICAL SPECIFICATION

ISO/TS 13399-313

First edition
2019-04

Cutting tool data representation and exchange —

Part 313: Creation and exchange of 3D models — Burrs

Représentation et échange des données relatives aux outils coupants —

Partie 313: Création et échanges de modèles 3D — Fraises-limes

Reference number
ISO/TS 13399-313:2019(E)

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Published in Switzerland

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 29 *Small tools*.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document defines the concept of how to design simplified 3D models of burrs that can be used for NC-programming, simulation of the manufacturing processes and the determination of collision within machining processes. It is not intended to standardize the design of the cutting tool itself.

A cutting tool is used in a machine to remove material from a workpiece by a shearing action at the cutting edges of the tool. Cutting tool data that can be described by the ISO 13399 series include, but are not limited to, everything between the workpiece and the machine tool. Information about inserts, solid tools, assembled tools, adaptors, components and their relationships can be represented by this document. The increasing demand for providing the end user with 3D models for the purposes defined above is the basis for the development of this series of International Standards.

The objective of the ISO 13399 series is to provide the means to represent the information that describes cutting tools in a computer sensible form that is independent from any particular computer system. The representation will facilitate the processing and exchange of cutting tool data within and between different software systems and computer platforms and support the application of this data in manufacturing planning, cutting operations and the supply of tools. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and for archiving. The methods that are used for these representations are those developed by ISO/TC 184, *Automation systems and integration*, SC 4, *Industrial data*, for the representation of product data by using standardized information models and reference dictionaries.

Definitions and identifications of dictionary entries are defined by means of standard data that consist of instances of the EXPRESS entity data types defined in the common dictionary schema, resulting from a joint effort between ISO/TC 184/SC 4 and IEC/TC 3/SC 3D, *Product properties and classes and their identification*, and in its extensions defined in ISO 13584-24 and ISO 13584-25.

Cutting tool data representation and exchange —

Part 313:
Creation and exchange of 3D models — Burrs

1 Scope

This document defines the concept of how to design tool items, limited to any kind of burrs, together with the usage of the related properties and domains of values.

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

The following are outside the scope of this document:

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

— creation and exchange of 3D models for cutting tools;

— creation and exchange of 3D models for cutting items;

— creation and exchange of 3D models for other tool items not described in the scope of this document;

— creation and exchange of 3D models for adaptive items;

— creation and exchange of 3D models for assembly items and auxiliary items.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/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 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 Abbreviated terms

APMX	depth of cut maximum
BSU	basic semantic unit
CIP	coordinate system in process
CLP	plane (cutting length plane) for the APMX, based on CIP
CSWx_y	coordinate system workpiece side
DC	cutting diameter
DCONMS	connection diameter
DN	neck diameter
HEP	plane for the OAL, based on TEP
LH	head length
LHP	plane for the LH, based on HEP
LPR	protruding length
LPRP	plane for the LPR, based on HEP
LS	shank length
LSP	plane for the LS, based on TEP
MCS	mounting coordinate system
MN_0001	temporary property used as function of cutting edge height, normal clearance angle major
MXA	x-axis of MCS
MYA	y-axis of MCS
MZA	z-axis of MCS
OAL	overall length
PCS	primary coordinate system
PRFA	profile angle
PRFRAD	profile radius
TEP	plane for the tool end, based on PCS
XA	x-axis
YA	y-axis
ZA	z-axis

XYP xy-plane

XZP xz-plane

YZP yz-plane

5 Starting elements, coordinate systems, planes

5.1 General

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

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

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

5.2 Reference system (PCS)

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 PCS;

— 3 orthogonal planes: planes in the coordinate system that contain the axis of the system, named XYP, XZP and YZP;

— 3 orthogonal axes: axes built as intersections of the 3 orthogonal planes lines respectively, named XA, YA and ZA.

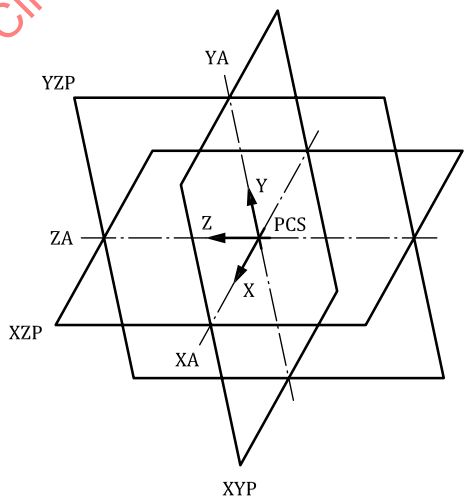


Figure 1 — Primary coordinate system

For virtually mounting of end mills onto an adaptive item, an additional reference system shall be defined. This reference system shall be called MCS. It is located at the starting point of the protruding length of a tool item. The orientation is shown in Figure 2.

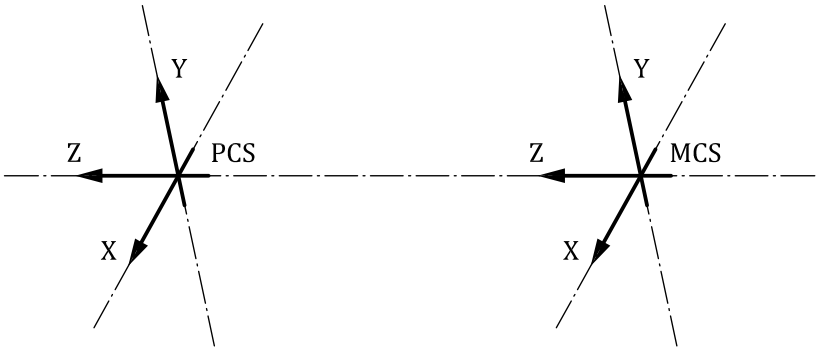


Figure 2 — Orientation of MCS

5.3 Coordinate system at the cutting part

For NC-programming an additional coordinate system, called CIP, shall be necessary. This CIP has a defined distance from the PCS and shall be oriented as follows:

— z-axis of the CIP points to the PCS;

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

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

Figure 3 shows an example of the orientation and location of PCS, MCS and CIP.

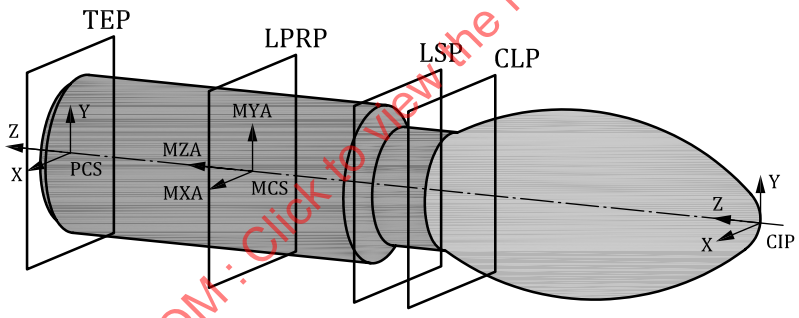


Figure 3 — Connection between PCS, MCS and CIP

5.4 Planes

The modelling shall take place based on planes according to Figure 4, used as reference if applicable. Therefore, the model shall be able to vary or single features of independent design features shall be deleted by means of changing the value of one or more parameter of the model design. Furthermore, the identification of the different areas shall be simplified in using the plane concept, even if they contact each other with the same size, e.g. chip flute, shank.

For the 3D visualisation of burrs, the general planes shall be determined as follows:

— CLP plane (cutting length plane) for the APMX, based on CIP;

— HEP plane for the OAL, based on TEP;

— LHP plane for the LH, based on HEP;

— LSP plane for the LS, based on TEP;

— LPRP plane for the LPR, based on HEP;

— TEP plane for the tool end, based on PCS.

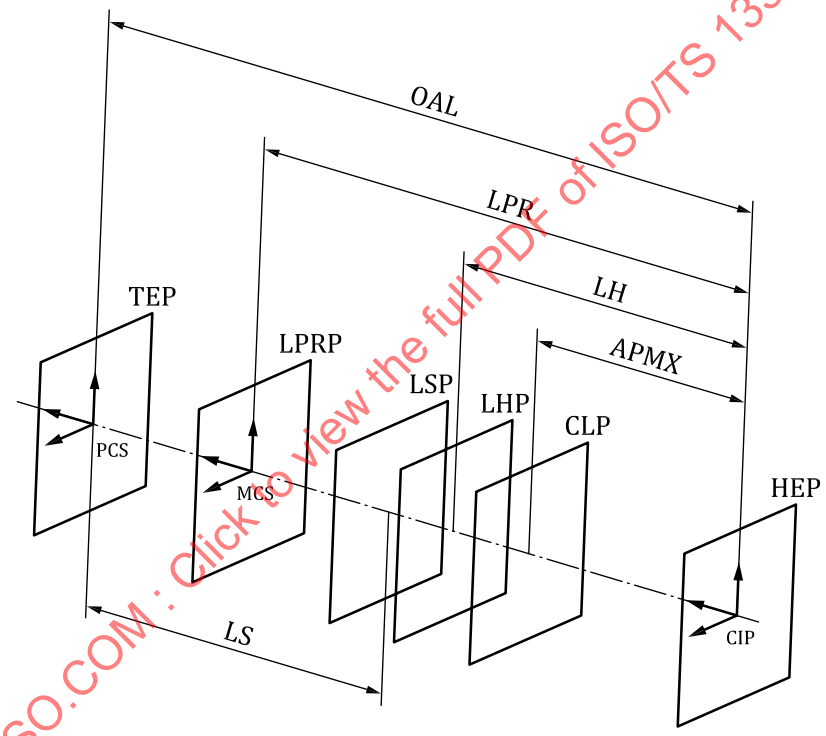


Figure 4 — Planes for design

6 Design of the model

6.1 General

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

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

End mills with non-indexable cutting edges shall be built as rotational symmetric design 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.

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

The section of CUT area ends at the CLP.

The different styles of burrs, which are described individually in Clause 7, shall be in accordance with Table 1.

Table 1 — Styles of burrs and the related burr type code

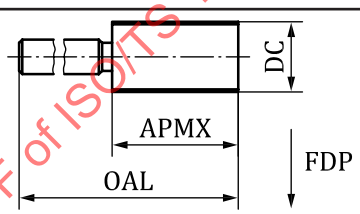
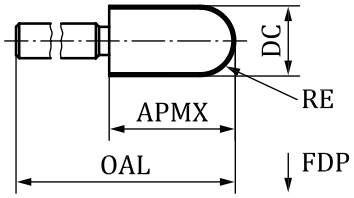
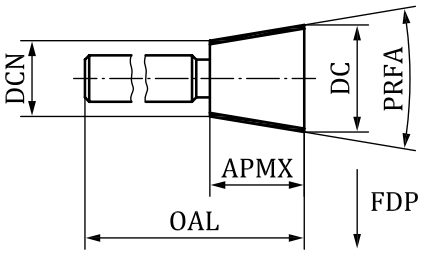
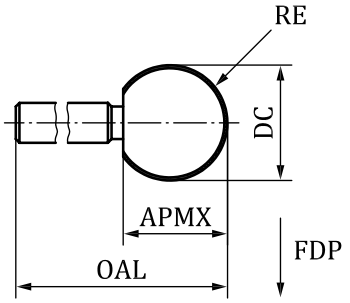
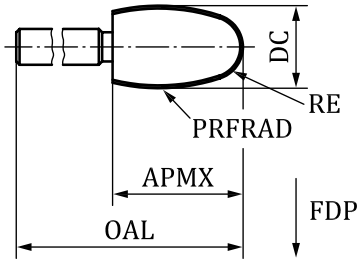
Burr type code (BTC)	Description	Figure
01	Cylindrical burr	
02	Cylindrical round-(ball-) nose burr	
07	Inverted cone burr	
08	Spherical burr	
10, 11, 12 and 18	Ball nose profile burr	

Table 1 *(continued)*

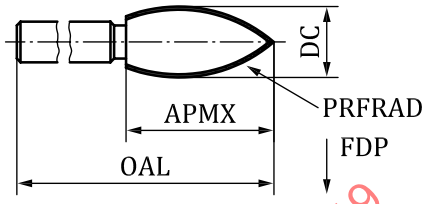
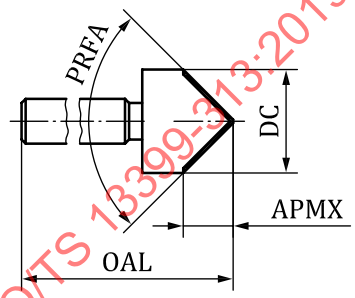
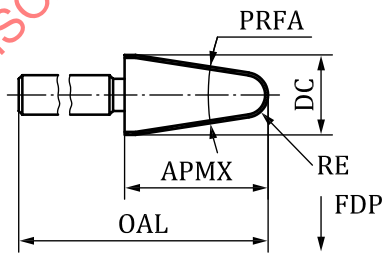
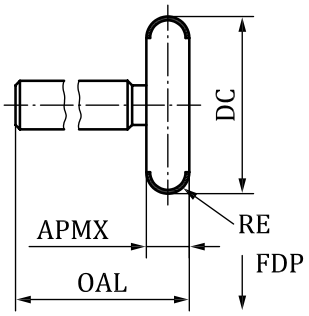
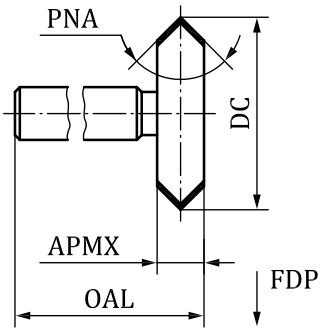
Burr type code (BTC)	Description	Figure
09, 13, 14 and 17	Arch pointed nose burr	
03, 05, 06 and 15	Conical burr	
04 and 16	Conical round-(ball-)nose burr with cylindrical cutting part	
19	Disc shaped full-rounded burr	
20	Disc shaped pointed nose burr	

Table 1 *(continued)*

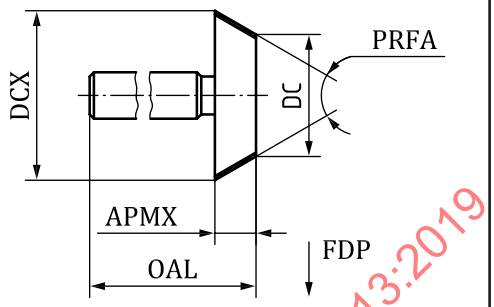
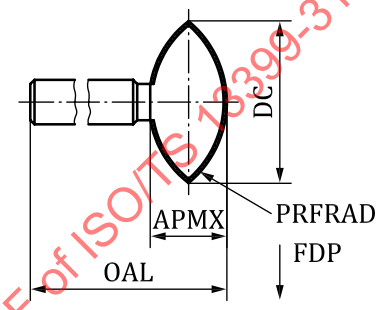
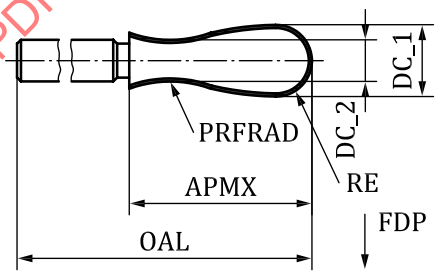
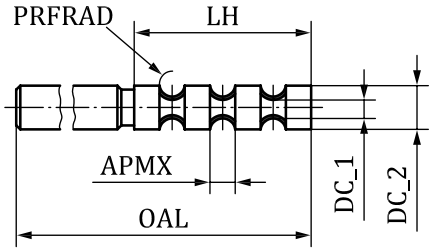
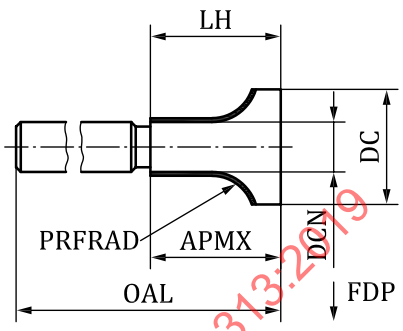
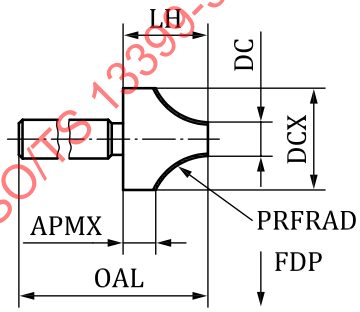
Burr type code (BTC)	Description	Figure
21	Disc shaped angular burr	
22	Disc lens shaped burr	
23	Oval burr with curved exit	
24	Multi curved burr	

Table 1 *(continued)*

Burr type code (BTC)	Description	Figure
25	Inverted concave rounded burr	
26	Concave rounded burr	
99	Special designs	—

6.2 Necessary parameters for the connection interface feature

Information about the connection interface code shall be filled as properties within the model and be named as parameters as defined in Table 2.

Table 2 — Parameter list for connection interface feature

Preferred symbol	Description	Source of symbol	BSU code within the ISO 13399 series
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	feature_class
CCFMS	Connection code form machine side	Short name of subtype of connection_interface_feature	feature_class
CZCMS	Connection size code machine side	Connection size code (dependent of side)	71FC193318002

The information given in Table 2 and other relevant properties shall be incorporated into the model as parameters or shall be taken as a separate file.

7 Design of burrs

7.1 General

Figure 5 shows the properties for the identification and classification of burrs. Additional properties shall be shown in the appropriate clause, if applicable and necessary.

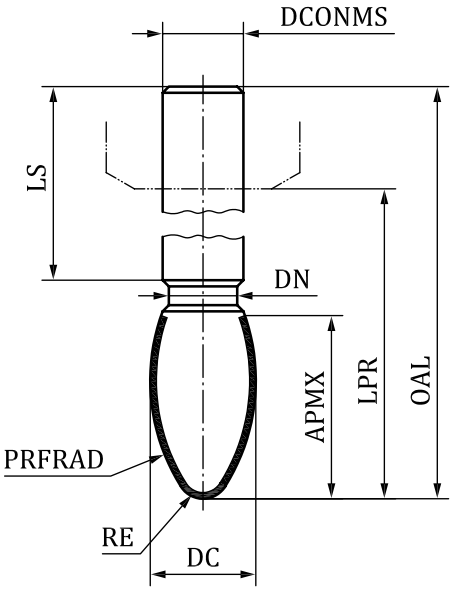


Figure 5 — Determination of general properties for burrs

If more than one PRFRAD are needed for the design of the model, the property should be indexed.

7.2 Geometry of the non-cutting part inclusively the connection

The basic of that part of the model is a rotational design feature which contains all elements between the plane TEP and the separation plane CLP to the cutting part.

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

The design of the sketch shall be done 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 according to Figure 6. 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 Clause 4.

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

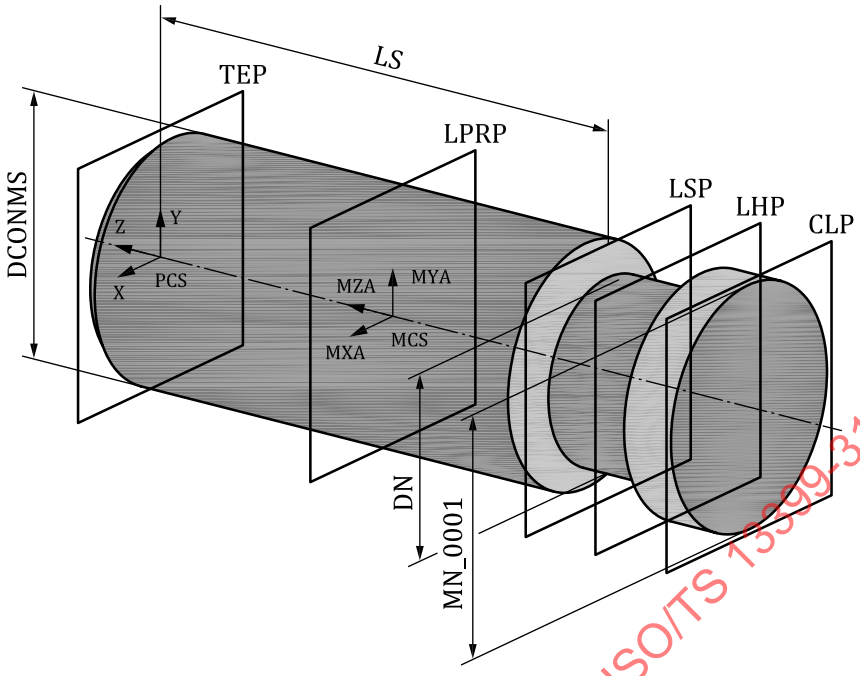


Figure 6 — Non-cutting part including shank

7.3 Geometry of the cutting part

7.3.1 General

The geometry of the cutting part shall be designed as a sketch in the front view YZ plane of the PCS with reference to the coordinate system CIP and the plane CLP.

The rotational axis is the standard z-axis.

The design of the sketch shall be done 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 shall be in conjunction with the defined datum planes.

— The dimensioning shall be done with the appropriate properties listed in Clause 4.

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

7.3.2 Cylindrical burr (BTC: 01)

Figures 7 and 8 illustrate the sketch of the cutting part and the revolved body of the cutting part.

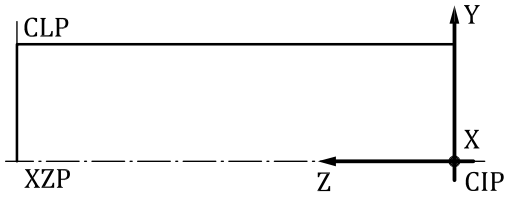


Figure 7 — Sketch of the cutting part

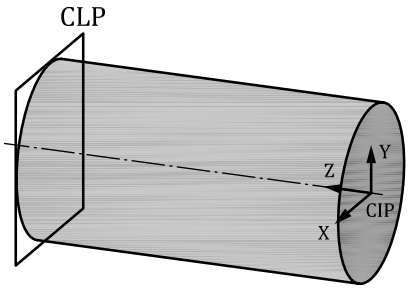


Figure 8 — Revolved body of the cutting part

Figure 9 shows the completed cylindrical burr after mating the cutting part to the non-cutting part.

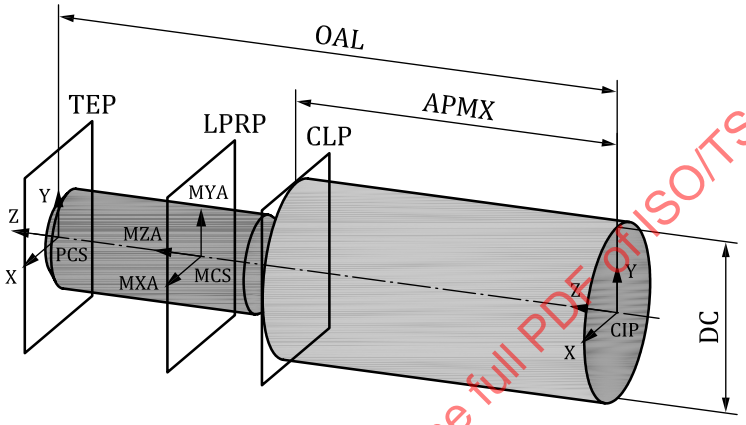


Figure 9 — Completed cylindrical burr

7.3.3 Cylindrical round-(ball-)nose burr (BTC:02)

Figures 10 and 11 illustrate the sketch of the cutting part and the revolved body of the cutting part.

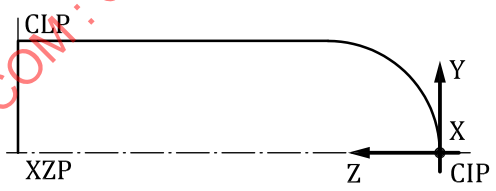


Figure 10 — Sketch of the cutting part

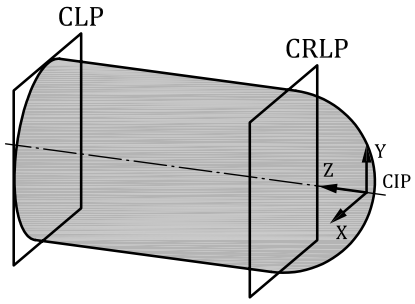


Figure 11 — Revolved body of the cutting part

Figure 12 shows the completed cylindrical ball-nose burr after mating the cutting part to the non-cutting part.

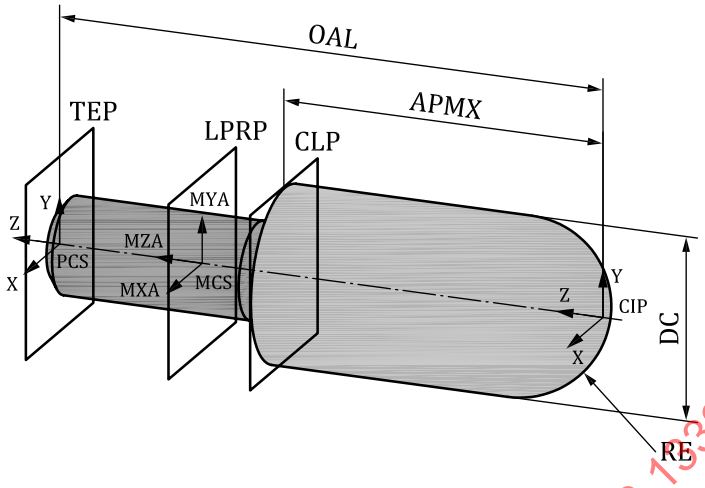


Figure 12 — Completed cylindrical ball-nose burr

7.3.4 Inverted cone burr (BTC: 07)

Figures 13 and 14 illustrate the sketch of the cutting part and the revolved body of the cutting part.

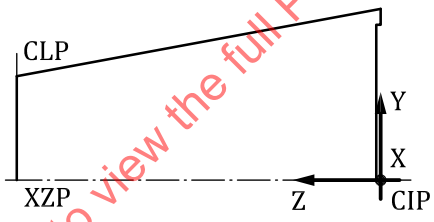


Figure 13 — Sketch of the cutting part

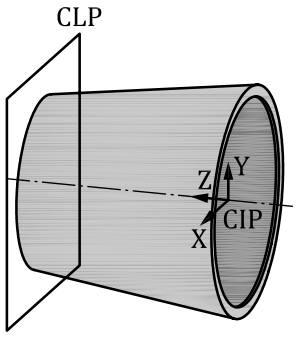


Figure 14 — Revolved body of the cutting part

Figure 15 shows the completed inverted cone burr after mating the cutting part to the non-cutting part.

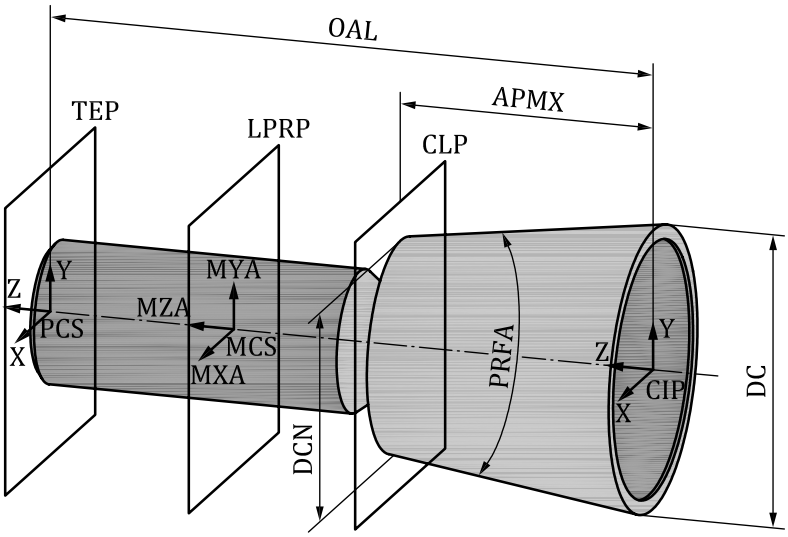


Figure 15 — Completed inverted cone burr

7.3.5 Spherical burr (BTC: 08)

Figures 16 and 17 illustrate the sketch of the cutting part and the revolved body of the cutting part.

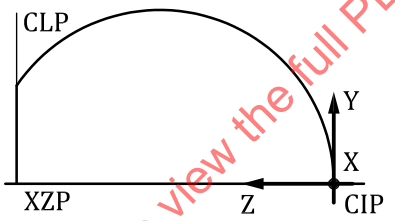


Figure 16 — Sketch of the cutting part

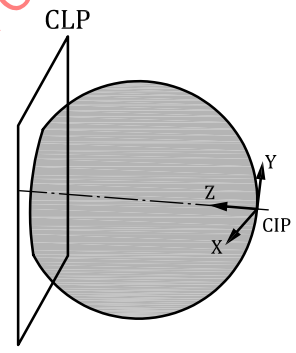


Figure 17 — Revolved body of the cutting part

Figure 18 shows the completed spherical cone burr after mating the cutting part to the non-cutting part.

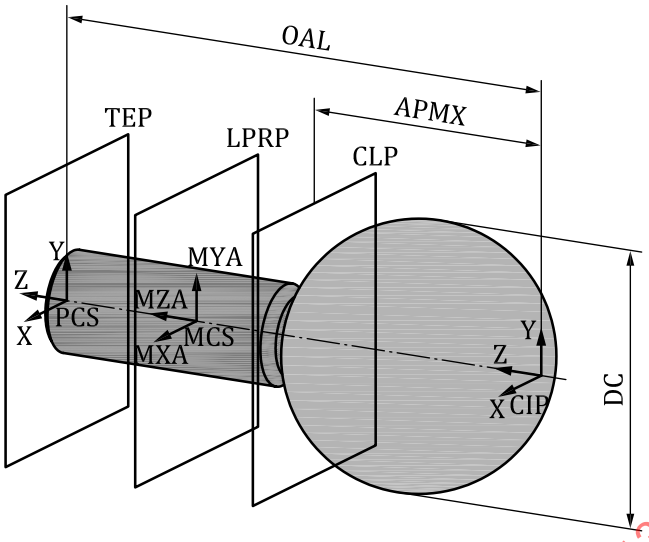


Figure 18 — Completed spherical burr

7.3.6 Ball nose profile burr (BTC: 10, 11, 12 and 18)

Figures 19 and 20 illustrate the sketch of the cutting part and the revolved body of the cutting part.

Figure 19 — Sketch of the cutting part

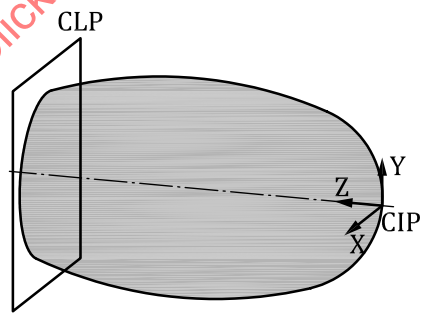


Figure 20 — Revolved body of the cutting part

Figure 21 shows the completed oval or flame burr after mating the cutting part to the non-cutting part.

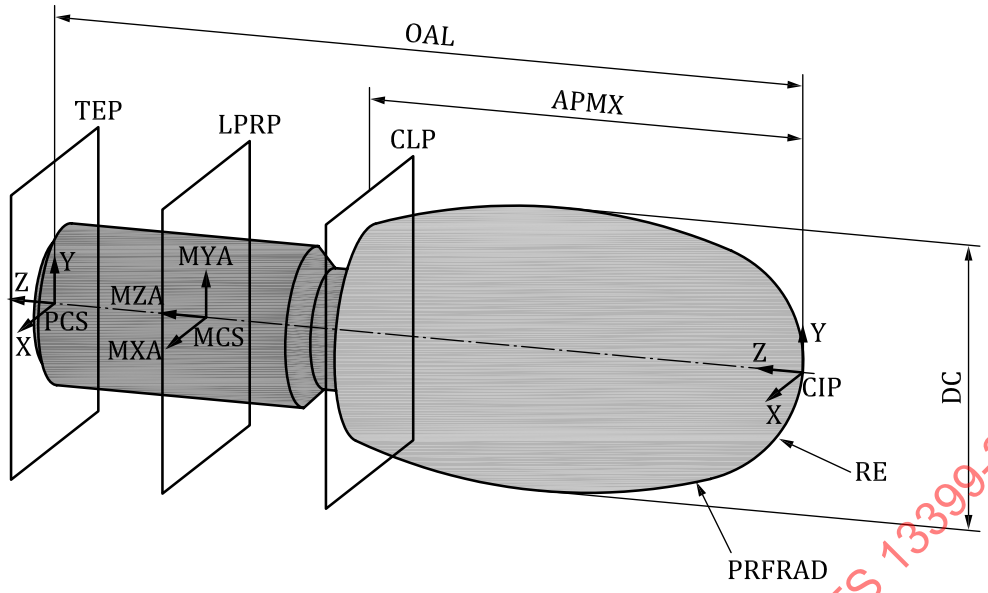


Figure 21 — Ball nose profile burr

7.3.7 Arch pointed nose burr (BTC: 09, 13, 14 and 17)

Figures 22 and 23 illustrate the sketch of the cutting part and the revolved body of the cutting part.

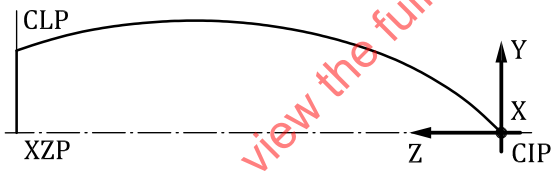


Figure 22 — Sketch of the cutting part

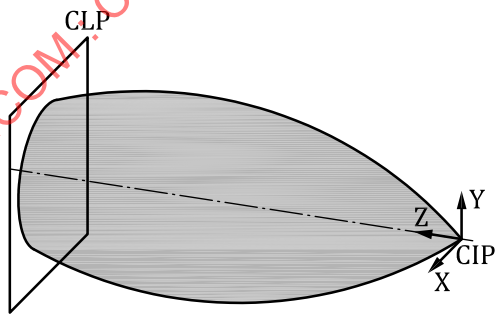


Figure 23 — Revolved body of the cutting part

Figure 24 shows the completed oval or flame pointed nose burr after mating the cutting part to the non-cutting part.

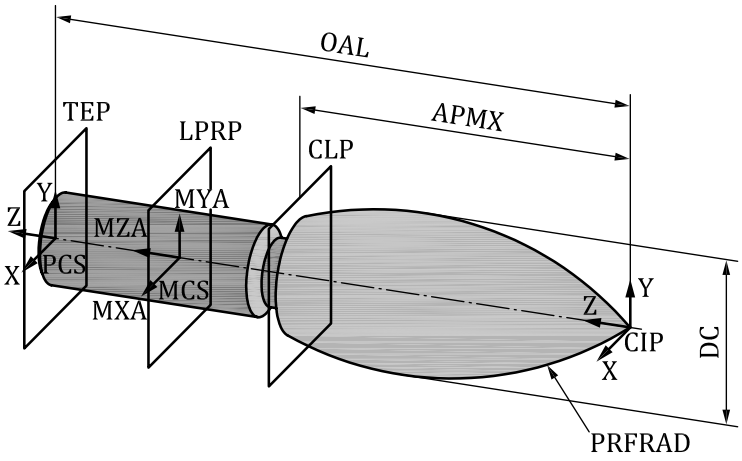


Figure 24 — Arch pointed nose burr

7.3.8 Conical burr (BTC: 15)

Figures 25 and 26 illustrate the sketch of the cutting part and the revolved body of the cutting part.

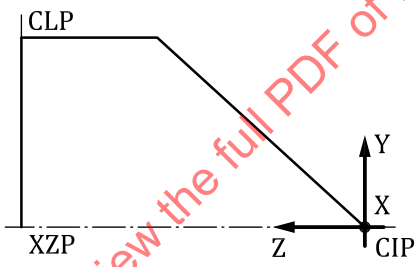


Figure 25 — Sketch of the cutting part

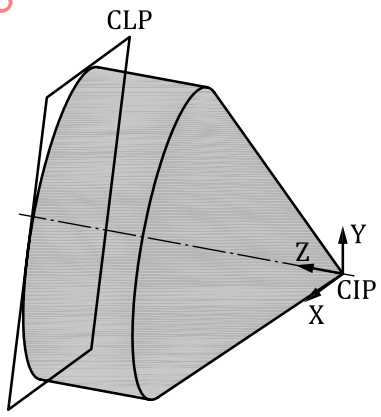


Figure 26 — Revolved body of the cutting part

Figure 27 shows the completed conical burr with cylindrical cutting part after mating the cutting part to the non-cutting part.

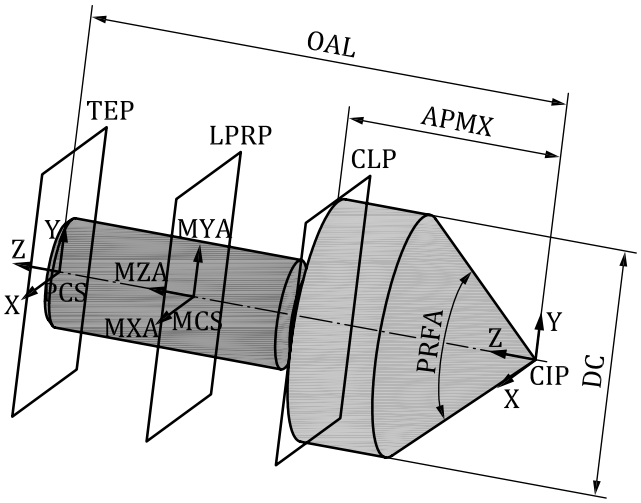


Figure 27 — Completed conical burr

7.3.9 Conical round-(ball-)nose burr (BTC: 04 and 16)

Figures 28 and 29 illustrate the sketch of the cutting part and the revolved body of the cutting part.

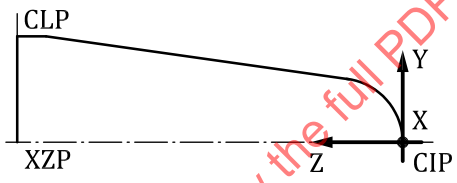


Figure 28 — Sketch of the cutting part

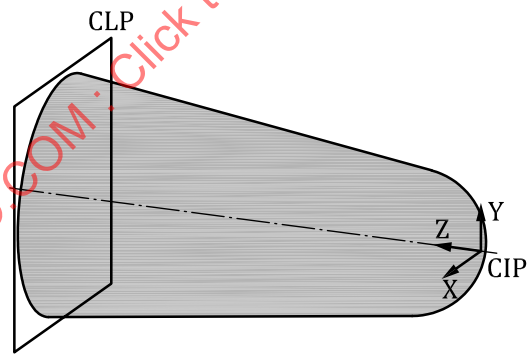


Figure 29 — Revolved body of the cutting part

Figure 30 shows the completed conical round-(ball-)nose burr with cylindrical cutting part after mating the cutting part to the non-cutting part.

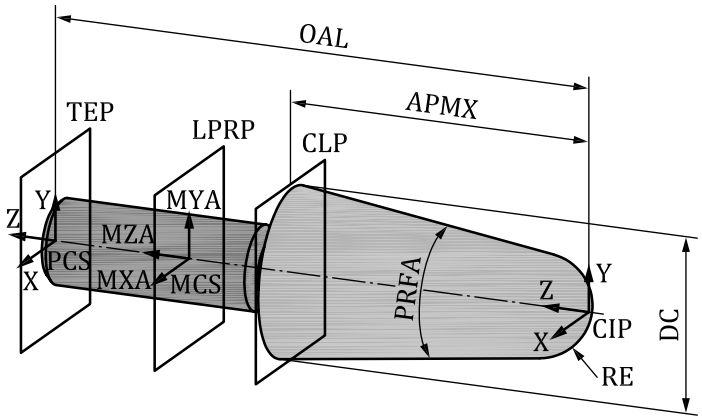


Figure 30 — Completed conical round-(ball-)nose burr

7.3.10 Full rounded disc burr (BTC: 19)

Figures 31 and 32 illustrate the sketch of the cutting part and the revolved body of the cutting part.

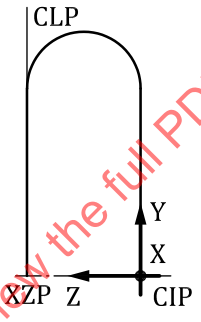


Figure 31 — Sketch of the cutting part

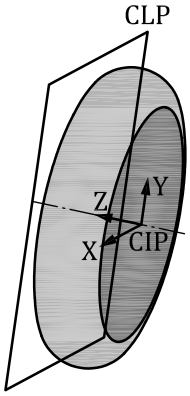


Figure 32 — Revolved body of the cutting part

Figure 33 shows the completed full rounded disc burr after mating the cutting part to the non-cutting part.

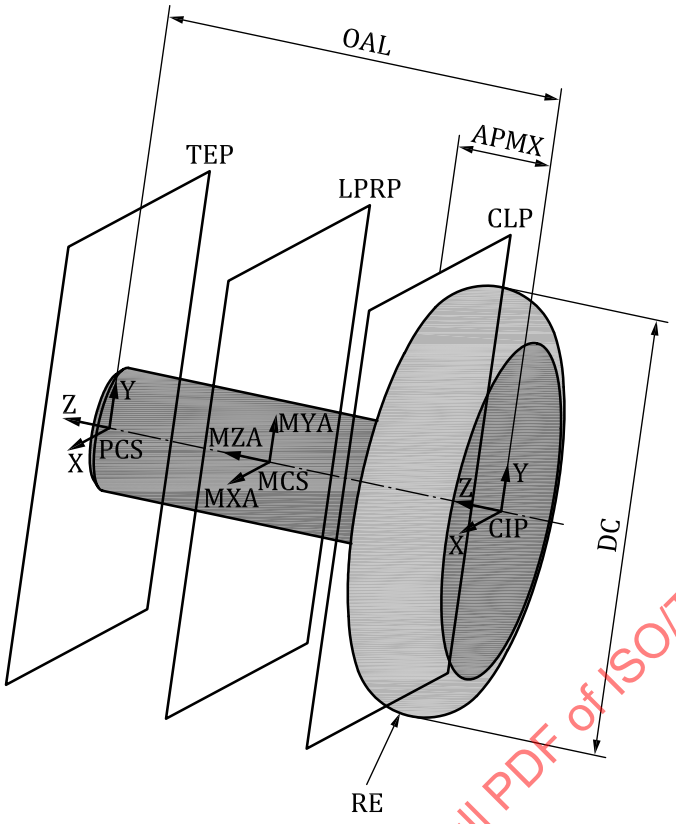


Figure 33 — Completed full rounded disc burr

7.3.11 Disc pointed nose shaped burr (BTC: 20)

Figures 34 and 35 illustrate the sketch of the cutting part and the revolved body of the cutting part.

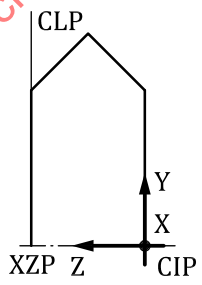


Figure 34 — Sketch of the cutting part

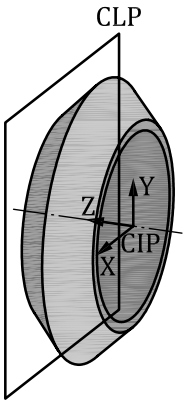


Figure 35 — Revolved body of the cutting part

Figure 36 shows the completed pointed nose disc burr after mating the cutting part to the non-cutting part.

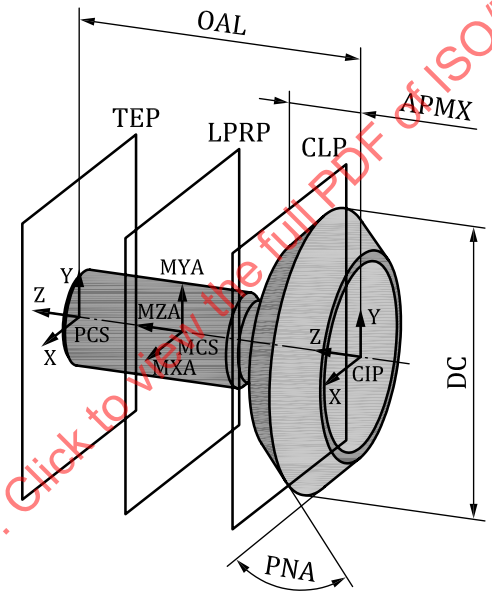


Figure 36 — Completed pointed nose disc burr

7.3.12 Angular disc burr (BTC: 21)

Figures 37 and 38 illustrate the sketch of the cutting part and the revolved body of the cutting part.

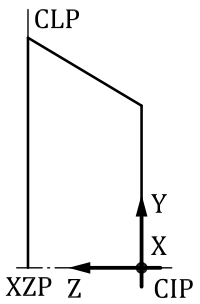


Figure 37 — Sketch of the cutting part

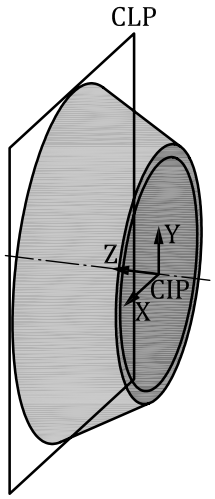


Figure 38 — Revolved body of the cutting part

Figure 39 shows the completed angular disc burr after mating the cutting part to the non-cutting part.

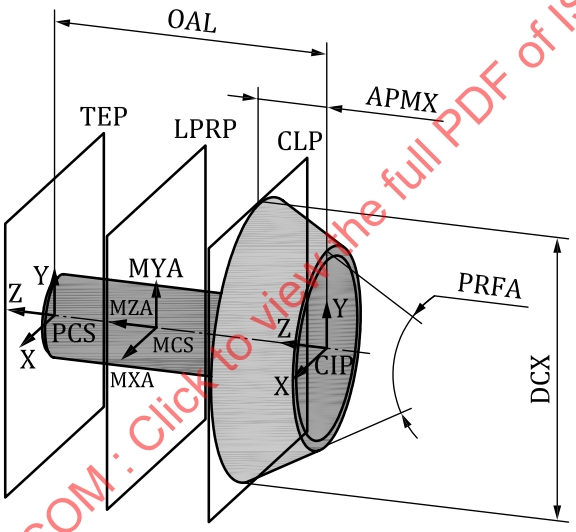


Figure 39 — Completed angular disc burr

7.3.13 Lens shaped disc burr (BTC: 22)

Figures 40 and 41 illustrate the sketch of the cutting part and the revolved body of the cutting part.

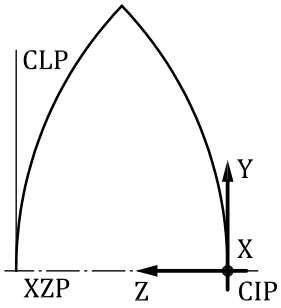


Figure 40 — Sketch of the cutting part

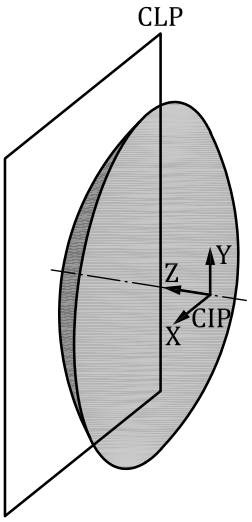


Figure 41 — Revolved body of the cutting part

Figure 42 shows the completed lens shaped disc burr after mating the cutting part to the non-cutting part.

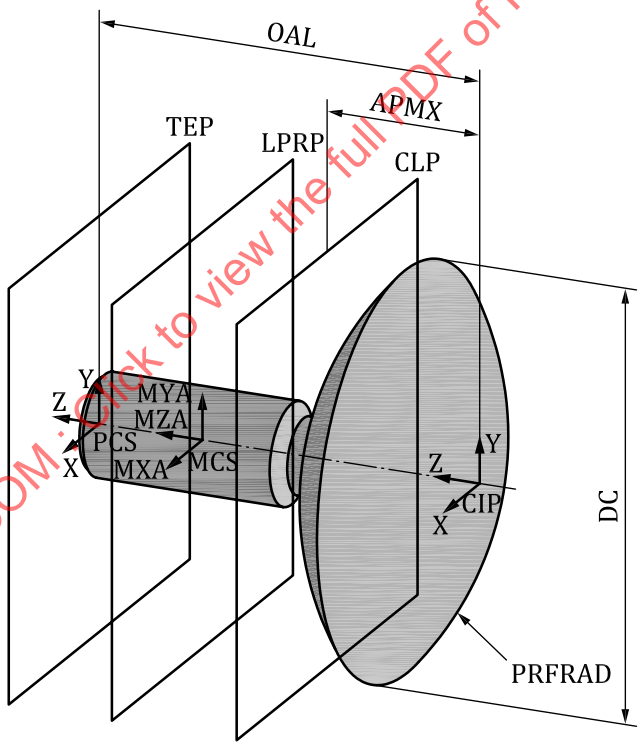


Figure 42 — Completed lens shaped disc burr

7.3.14 Oval burr with curved exit (BTC: 23)

Figures 43 and 44 illustrate the sketch of the cutting part and the revolved body of the cutting part.

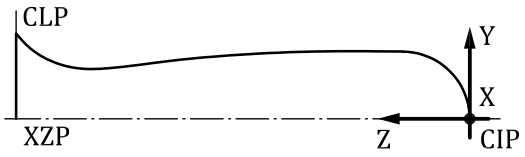


Figure 43 — Sketch of the cutting part

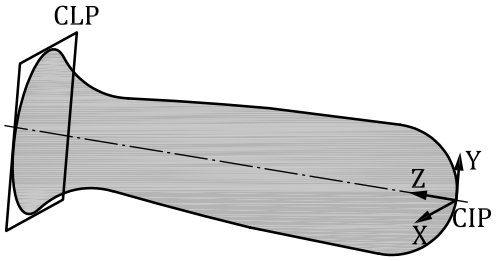


Figure 44 — Revolved body of the cutting part

Figure 45 shows the completed oval burr with curved exit after mating the cutting part to the non-cutting part.

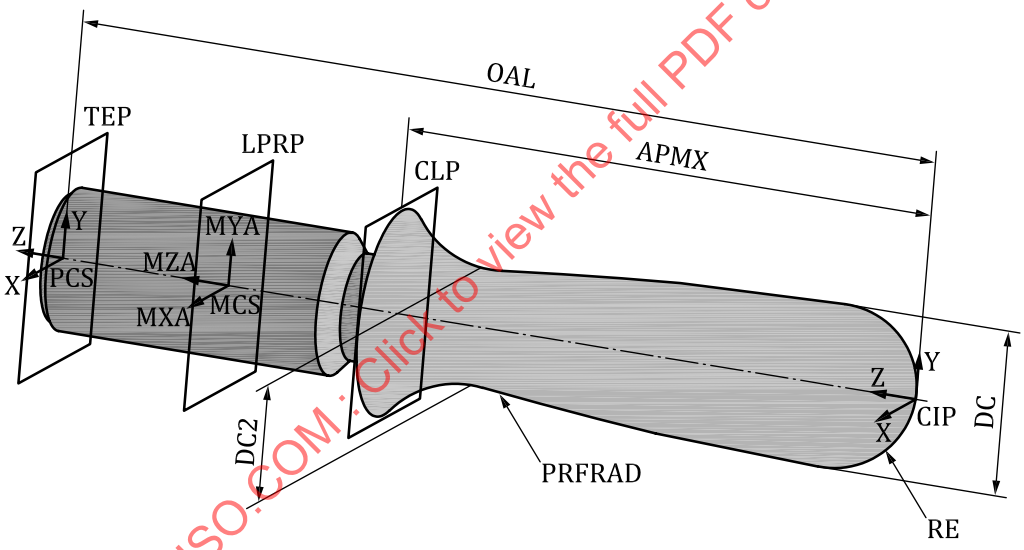


Figure 45 — Completed oval burr with curved exit

7.3.15 Multi curved burr (BTC: 24)

Figures 46 and 47 illustrate the sketch of the cutting part and the revolved body of the cutting part.

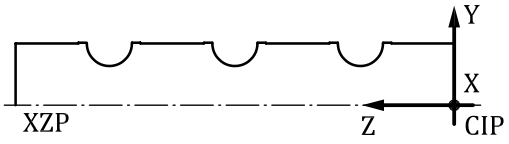


Figure 46 — Sketch of the cutting part