TECHNICAL SPECIFICATION

ISO/TS 13399-401

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Cutting tool data representation and exchange —

Part 401:
Creation and exchange of 3D models — Converting, extending and reducing adaptive items

Représentation et échange des données relatives aux outils coupants —

Partie 401: Création et échange de modèles 3D — Conversion, extension et réduction relatif aux attachements

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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/TS 13399 consists of the following parts, under the general title *Cutting tool data representation and exchange*:

— *Part 1: Overview, fundamental principles and general information model*

— *Part 2: Reference dictionary for the cutting items* [Technical Specification]

— *Part 3: Reference dictionary for tool items* [Technical Specification]

— *Part 4: Reference dictionary for adaptive items* [Technical Specification]

— *Part 5: Reference dictionary for assembly items* [Technical Specification]

— *Part 50: Reference dictionary for reference systems and common concepts* [Technical Specification]

— *Part 60: Reference dictionary for connection systems* [Technical Specification]

— *Part 80: Creation and exchange of 3D models — Overview and principles* [Technical Specification]

— *Part 100: Definitions, principles and methods for reference dictionaries* [Technical Specification]

— *Part 150: Usage guidelines* [Technical Specification]

— *Part 201: Creation and exchange of 3D models — Regular inserts* [Technical Specification]

— *Part 202: Creation and exchange of 3D models — Irregular inserts* [Technical Specification]

— *Part 203: Creation and exchange of 3D models — Replaceable inserts for drilling* [Technical Specification]

— *Part 204: Creation and exchange of 3D models — Inserts for reaming* [Technical Specification]

— *Part 301: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of thread-cutting taps, thread-forming taps and thread-cutting dies* [Technical Specification]

- *Part 302: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of solid drills and countersinking tools* [Technical Specification]
- *Part 303: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of end mills with solid cutting edges* [Technical Specification]
- *Part 304: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of milling cutters with arbor hole and solid cutting edges* [Technical Specification]
- *Part 307: Creation and exchange of 3D models — End mills for indexable inserts* [Technical Specification]
- *Part 308: Creation and exchange of 3D models — Milling cutters with arbor hole for indexable inserts* [Technical Specification]
- *Part 309: Creation and exchange of 3D models — Tool holders for indexable inserts* [Technical Specification]
- *Part 311: Creation and exchange of 3D models — Solid reamers* [Technical Specification]
- *Part 312: Creation and exchange of 3D models — Reamers for indexable inserts* [Technical Specification]
- *Part 401: Creation and exchange of 3D models — Converting, extending and reducing adaptive items* [Technical Specification]
- *Part 405: Creation and exchange of 3D models — Collets* [Technical Specification]

The following parts are under preparation:

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

Introduction

This part of ISO/TS 13399 defines the concept, the terms and the definitions on how to design simplified 3D models of converting, extending and reducing adaptors used together with 3D models of cutting tools 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 adaptors and cutting tool itself.

An adaptive item 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/TS 13399 (all parts) include, but are not limited to, everything between the workpiece and the machine tool. Information about inserts, solid tools, assembled tools, adaptors, components and their relationships can be represented by ISO/TS 13399 (all parts). The increasing demand providing the end user with 3D models for the purposes defined above is the basis for the development of this series of International Standard.

The objective of ISO/TS 13399 (all parts) 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 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 401:
Creation and exchange of 3D models — Converting, extending and reducing adaptive items

1 Scope

This part of ISO/TS 13399 specifies a concept for the design of adaptive items, limited to any kind of converters, extenders and reducers, together with the usage of the related properties and domains of values.

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

— definitions and identifications of the design features of converting, extending and reducing adaptors, with an association to the used properties;

— definitions and identifications of the internal structure of the 3D model that represents the features and the properties of converting, extending and reducing adaptors.

The following are outside the scope of this part of ISO/TS 13399:

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

— concept of 3D models for cutting tools;

— concept of 3D models for cutting items;

— concept of 3D models for tool items;

— concept of 3D models for other adaptive items not described in the scope of this part of ISO/TS 13399;

— concept of 3D models for assembly items and auxiliary items.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10889-1, *Tool holders with cylindrical shank — Part 1: Cylindrical shank, location bore — Technical delivery conditions*

ISO 12164-1, *Hollow taper interface with flange contact surface — Part 1: Shanks — Dimensions*

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 13399-50, *Cutting tool data representation and exchange — Part 50: Reference dictionary for reference systems and common concepts*

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*

ISO 26622-1, *Modular taper interface with ball track system — Part 1: Dimensions and designation of shanks*

ISO 26623-1, *Polygonal taper interface with flange contact surface — Part 1: Dimensions and designation of shanks*

ISO 26623-2, *Polygonal taper interface with flange contact surface — Part 2: Dimensions and designation of receivers*

3 Starting elements, coordinate systems, planes

3.1 General

The modelling of the 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/TS 13399, is a true representation of the physical tool supplied by the tool manufacturer. If the models are used for simulation purposes, e.g. CAM simulation, it shall be taken into consideration that the real product dimensions can differ from those nominal dimensions.

3.2 Reference system (PCS — primary coordinate system)

NOTE 1 Some of the definitions have been taken from ISO/TS 13399-50.

The reference system as shown in Figure 1 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 axis of the system, named “xy-plane” (XYP), “xz-plane” (XZP) and “yz-plane” (YZP);

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

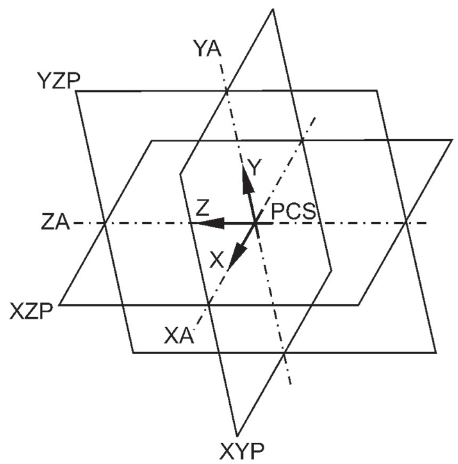

Figure 1 — Primary coordinate system

3.3 Adaptive item position

3.3.1 General

The definition of the adaptive item position — also “PCS” location — in 3.3.1 and 3.3.2 applies to right-handed items. Left hand items are as defined for right hand items but mirrored through the yz-plane.

3.3.2 Prismatic adaptive position

The prismatic adaptive position shall be as follows.

— The base of the adaptive item shall be coplanar with the xz-plane.

— The normal for the base of the tool shall be in the −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 tool shall be coplanar with the xy-plane.

— The normal for the end of the adaptive item shall be in the +z-direction.

3.3.3 Round adaptive position

The round adaptive position shall be as follows.

— The axis of the adaptive item shall be collinear with the z-axis.

— The vector of the shank that points in the −z-direction shall also point towards the workpiece side.

— The cutting height shall be measured from the xz-plane.

— The drive slots or clamping flats, if present, shall be parallel with the xz-plane.

— The contact surface of the coupling and the gauge plane or the end of the cylindrical shank shall be coplanar with the xy-plane.

— If there is a bore, then the vector of the bore that points in the −z-direction shall also point towards the workpiece side.

3.4 Adjustment coordinate system at workpiece side

3.4.1 General

Additional coordinate systems named “CSWx_y” (coordinate system workpiece side) for mounting other adaptive items or tool items shall be defined according to ISO/TS 13399-50.

3.4.2 Designation of coordinate systems at workpiece side

The designation of the coordinate system workpiece side shall be done as follows.

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

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

Case 3 Multiple coordinate systems on one level and different angles at workpiece side: 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 counter-clockwise direction while looking towards the machine spindle (positive z-axis).

Case 4 Multiple coordinate systems on one level, one angle and different diameters at workpiece side: The designation shall be the same as defined in case 3. The counting shall start at the smallest diameter.

Case 5 Multiple coordinate systems on different levels, different angles and different diameters at workpiece side: The designation shall be the same as defined in case 3. The counting shall start at the smallest diameter and at the three o’clock position.

Figure 2 shows an example of the arrangement of coordinate systems on workpiece side.

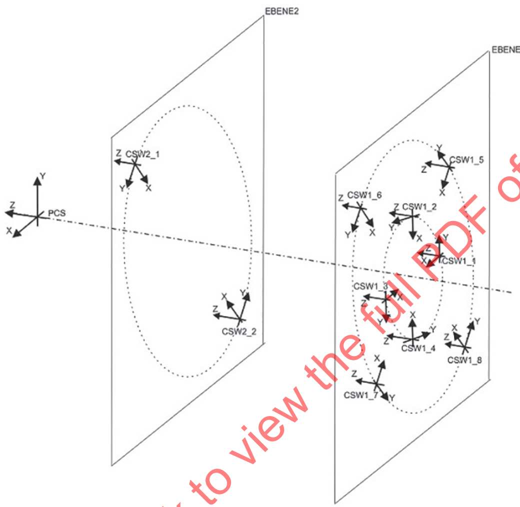

Figure 2 — Adjustment of coordinate system at workpiece side

3.4.3 Arrangement of coordinate system workpiece side

The CSWx_y can be arranged in relation to the PCS by means of using the six degrees of freedom.

- Rotation about
  - the x-axis by the angle rho (“RHO”);
  - the y-axis by the angle kappa (“KAP”);
  - the z-axis by the angle phi (“PHI”);
- Distance from the PCS origin perpendicular
  - to xyw-plane by XYWD;
  - to xzw-plane by XZWD;
  - to yzw-plane by YZWD.

The orientation and location of CSW is shown in Figure 3.

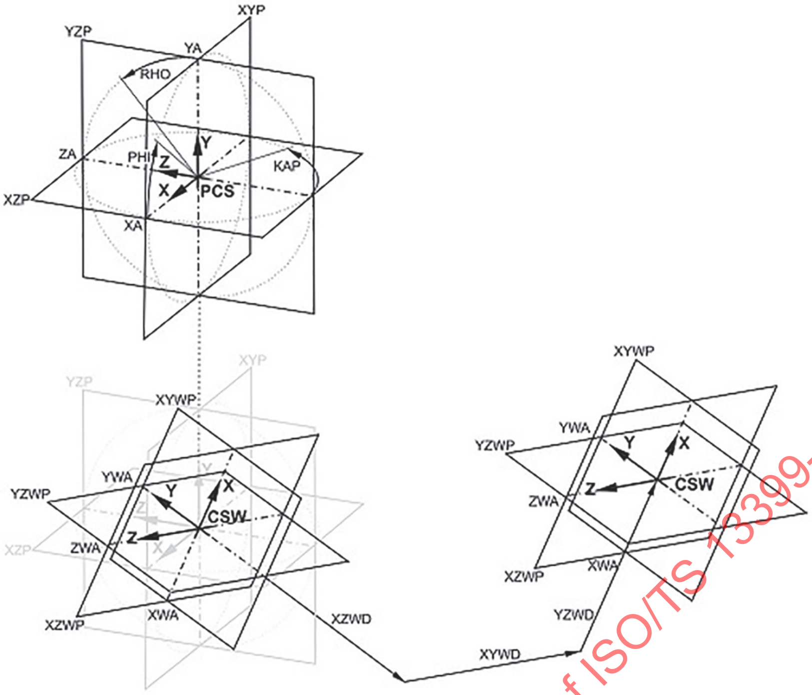

Figure 3 — Coordinate system at workpiece side: Orientation

The appropriate properties shall be indexed in the same logic as described in the different cases of the coordinate system workpiece side designations.

3.5 Mounting coordinate system

An additional reference system shall be defined for virtually mounting adaptive items on to another adaptive item to create a complete cutting tool or directly into the machine tool. This reference system is called "mounting coordinate system" (MCS). It is located at the starting point of the protruding length of the adaptive item. This point is located at the contact surface of the coupling or the gauge plane or at the standardized shank length of a cylindrical shank.

Figure 4 shows an example of the location of the MCS in relation to the PCS.

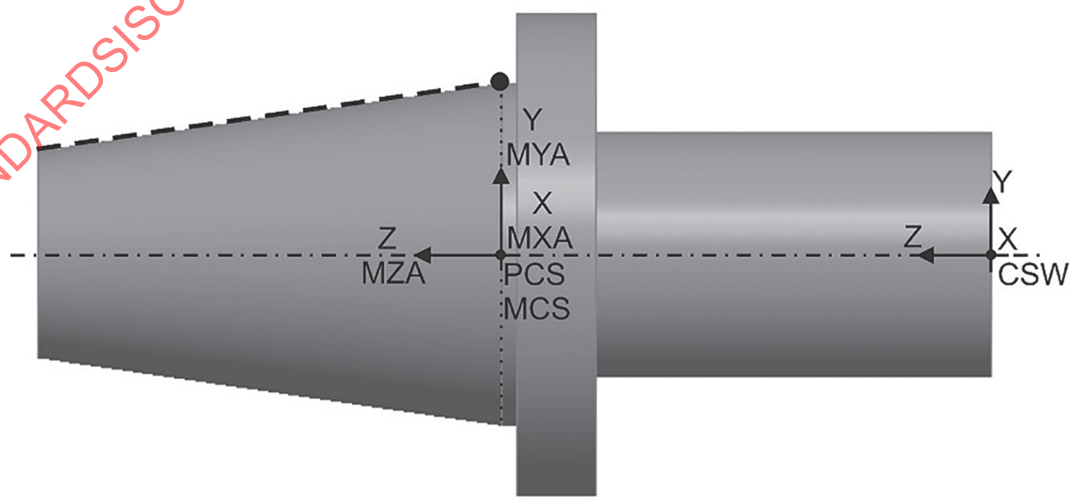

Figure 4 — Example of orientation and location of PCS, MCS and CSW

3.6 Planes

The modelling takes place based on planes, according to Figure 4, which are 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 visualization of this kind of adaptive items defined in the scope, the general planes shall be determined as follows:

— “TEP” tool end plane 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;

— “HEP” head end plane located with the distance of “OAL” from “TEP”;

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

If necessary, other planes are defined in the appropriate clauses. Figure 5 shows an example of determined planes for the design.

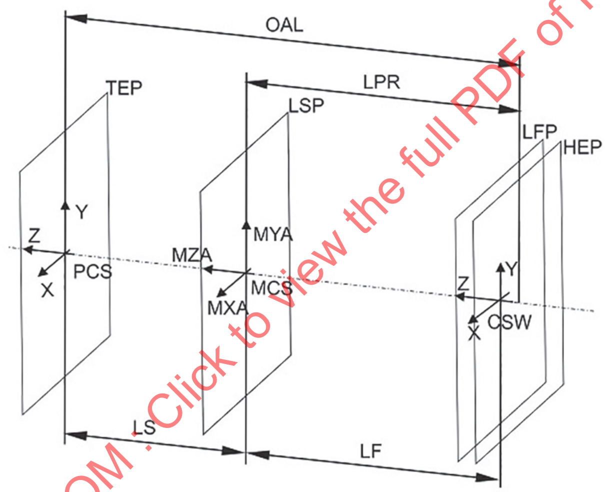

Figure 5 — Example of planes for the design

4 Design of the model

4.1 General

The sketches and contours of the crude geometry do not contain any details, such as grooves, chamfers, rounding. These details are 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.

Adaptive items shall be built either as rotational symmetric design elements, if they are revolving about their axis, or as extrusion design, if they are designed non-symmetrically, both based on properties in accordance with ISO/TS 13399-4. It depends on the geometry of the non-cutting part, including the connection interface, if applicable.

NOTE 1 The part is coloured as defined in Clause 11.

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

Within the following clauses, the specific structure of the model of the defined basic shapes of converting, extending and reducing adaptive items is described.

4.2 Necessary properties for the connection interface feature

Information about the connection interface code shall be filled as properties within the model and named as parameters as listed in Table 1.

Table 1 — 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 of side)	71FC193318002
CCWS	Connection code workpiece side	ISO/TS 13399-3 and ISO/TS 13399-4	71D102AE8A5A9
CCTWS	Connection code type workpiece side	ISO/TS 13399-60 Short name of subtype of connection_interface_feature	feature_class
CCFWS	Connection code form workpiece side	ISO/TS 13399-60 Number of the variant of the subtype of connection_interface_feature	feature_class
CZCWS	Connection size code workpiece side	Connection size code (dependent of side)	71FC193318002

The information given in Table 1 and other relevant properties shall be incorporated into the model as parameters or shall be taken as a separate file.

5 Converter, rotationally symmetric

5.1 General

Converter is an adaptive item with a different connection type, style and size on the machine side from the workpiece side.

Figure 6 shows the properties used for identification and classification of converters. The example shows a connecting adaptor with 7/24 taper shank according to ISO 7388-1 and for flatted cylindrical shanks according to ISO 5414-1.

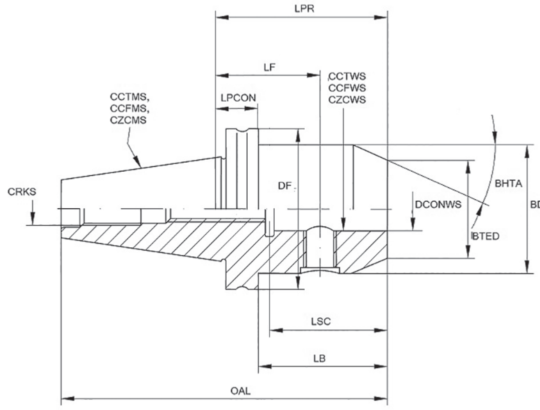

Figure 6 — Converter, rotationally symmetric — Determination of properties

5.2 Necessary properties

Table 2 shows the properties needed for the example of modelling of a converter as described in 5.1.

Table 2 — Properties for the modelling of a rotationally symmetric converter

Preferred name	Preferred symbol
Body diameter	BD
Body half taper angle	BHTA
Body taper end diameter	BTED
Connection retention knob thread size	CRKS
Connection diameter workpiece side	DCON_WS
Flange diameter	DF
Body length	LB
Functional length	LF
Connection protruding length	LPCON
Protruding length	LPR
Clamping length	LSC
Overall length	OAL

5.3 Basic geometry

The basis of that part is a rotational design feature which shall contain all elements between the plane “TEP” and the plane “HEP”.

The sketch includes the real measure elements above and shall be designed on the xz-plane of the “PCS”.

The design of the sketch shall be 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 “HEP” according to Figure 5. 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 about the z-axis by 360°.

To be more flexible using different connections on the machine side, it is also allowed to start the sketch on the connection protruding length “LPCON”.

After creating the basic body, the body of the connection of the machine side shall be mated to the basic body and united.

Figures 7 and 8 show the sketches of the connection and the basic body.

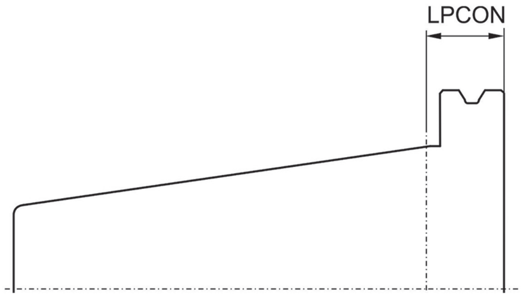

Figure 7 — Sketch of the connection

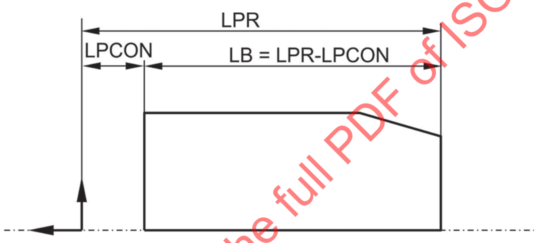

Figure 8 — Sketch of the basic body

Figures 9 and 10 show the features of the connection part and the basic body of the converter.

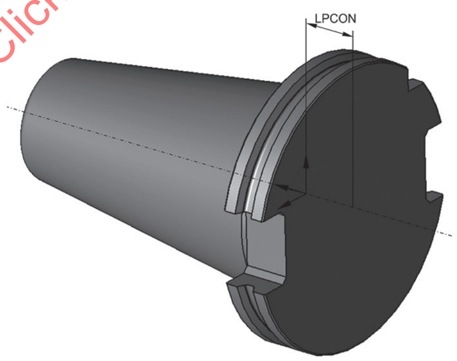

Figure 9 — Revolved body of connection

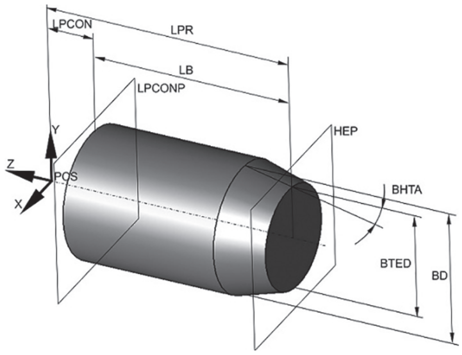

Figure 10 — Revolved body of the basic geometry

After the two features have been mated, the basic body of the example shall look like Figure 11.

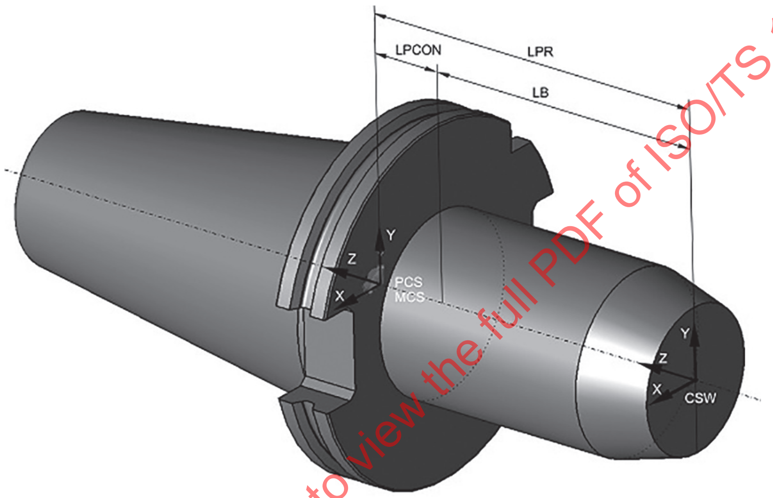

Figure 11 — Basic body

After completion of the basic geometry, the connection on the workpiece side is positioned. Therefore, the connection on workpiece side as a solid body is created and it shall be either subtracted from or mated to the basic body.

5.4 Connection on workpiece side

For example, the receiver for a flatted cylindrical shank is shown in Figures 12 and 13.

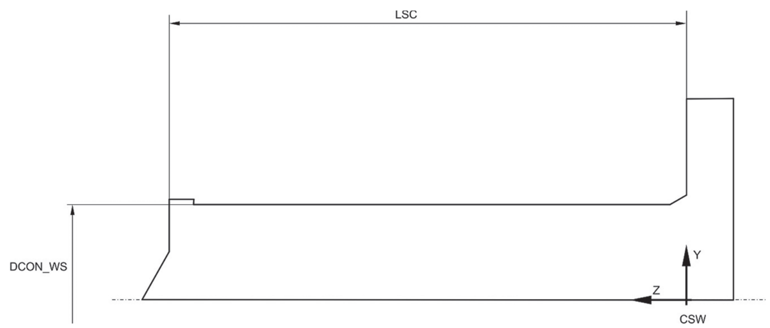

Figure 12 — Sketch of connection workpiece side

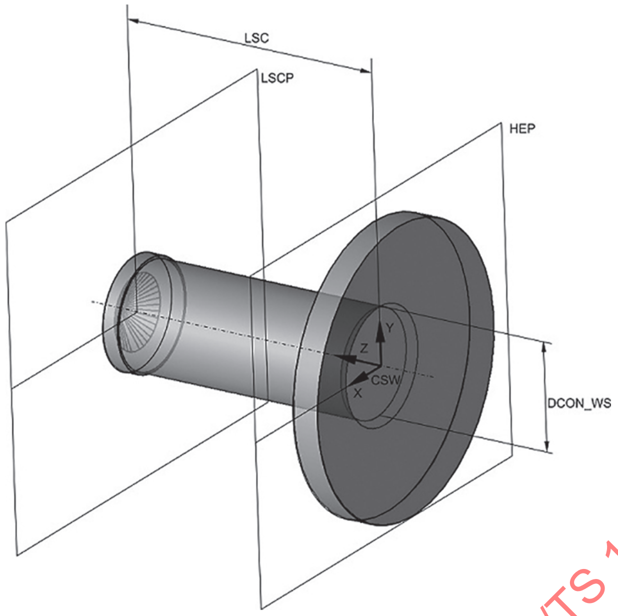

Figure 13 — Revolved body of connection workpiece side

To have also the thread for the clamping screw on the connection workpiece side, the revolved body of the connection shall be completed with the simplified thread, which is created by means of the core diameter of the thread. Figure 14 shows the complete connection body, which shall be used for subtraction from the basic body of the converter.

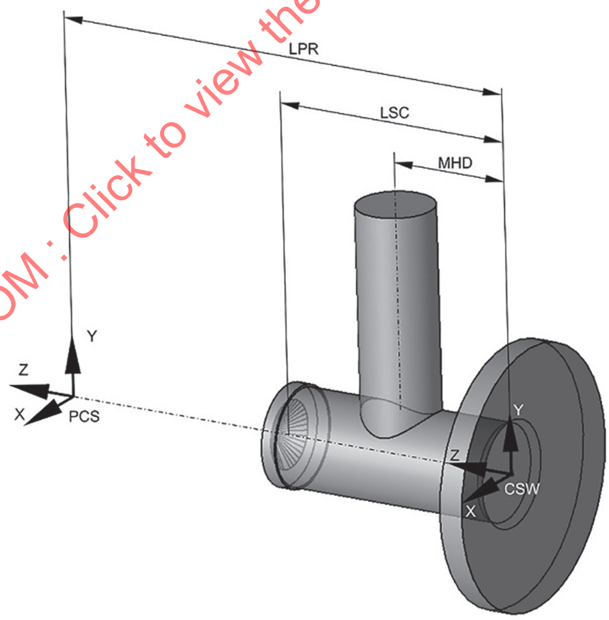

Figure 14 — Connection workpiece side, complete

5.5 Rotational symmetric converter, complete

After connection on workpiece side is subtracted, the completed converter looks like Figure 15.

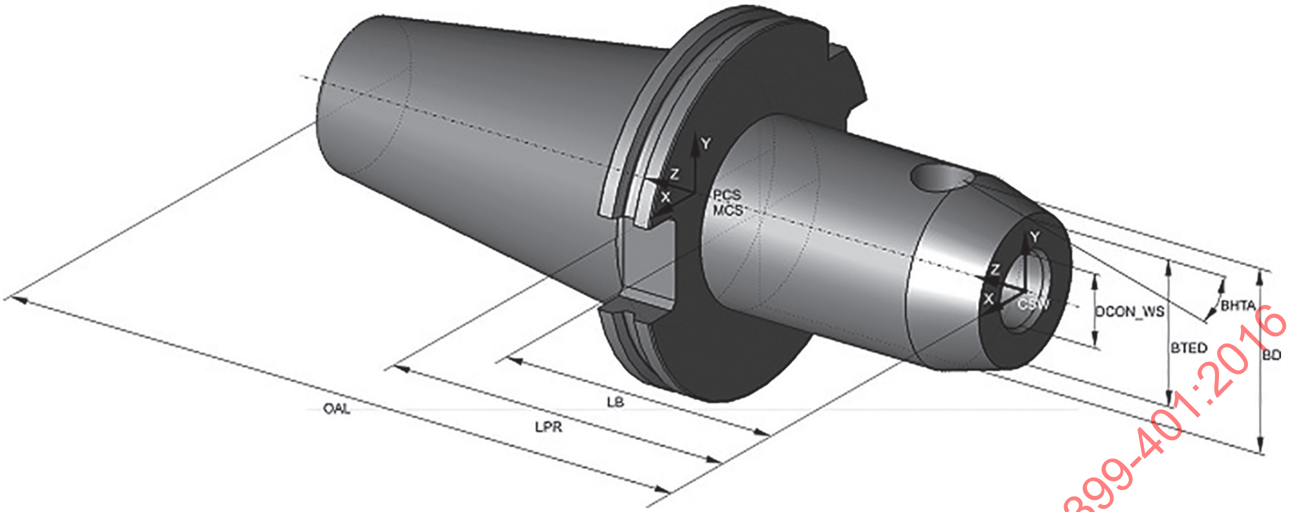

Figure 15 — Rotational symmetric converter, complete

6 Converter, stationary

6.1 General

Figure 16 shows the properties used for identification and classification of converters. The example shows a connecting adaptor with cylindrical shank according to ISO 10889-1 and a rectangular radial seat according to ISO 10889-3.

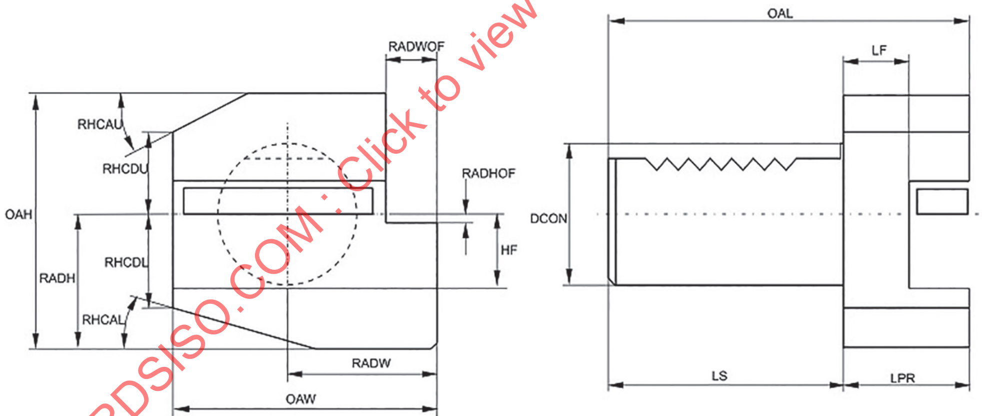

Figure 16 — Converter, stationary — Determination of properties

6.2 Necessary properties

Table 3 shows the properties needed for the example of modelling of a stationary converter as described in 6.1.

Table 3 — Properties for the modelling of a stationary converter

Preferred name	Preferred symbol
Connection diameter	DCON
Functional height	LH
Functional length	LF
Protruding length	LPR
Shank length	LS
Radial height	RADH
Radial height offset	RADHOF
Radial width	RADW
Radial width offset	RADWOF
Overall height	OAH
Overall length	OAL
Overall width	OAW
Radial height chamfer angle lower	RHCAL
Radial height chamfer angle upper	RHCAU
Radial height chamfer distance lower	RHCDL
Radial height chamfer distance upper	RHCDU

6.3 Basic geometry

The basis of that part is an extruded design feature, which shall contain all elements between the xy-plane of PCS and the plane "HEP".

The sketch includes the real measure elements above and shall be designed on the xy-plane of the "PCS".

The design of the sketch shall be as follows.

— The sketch shall be determined as a full section view.

— The sketch shall be constrained to the coordinate system "PCS" as shown in Figure 17. 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 extruded along the z-axis by the dimension LPR.

After creating the basic body, the body of the connection of the machine side shall be mated to the basic body and united.

Figures 17 and 18 show the sketch and the extrusion of the basic body.

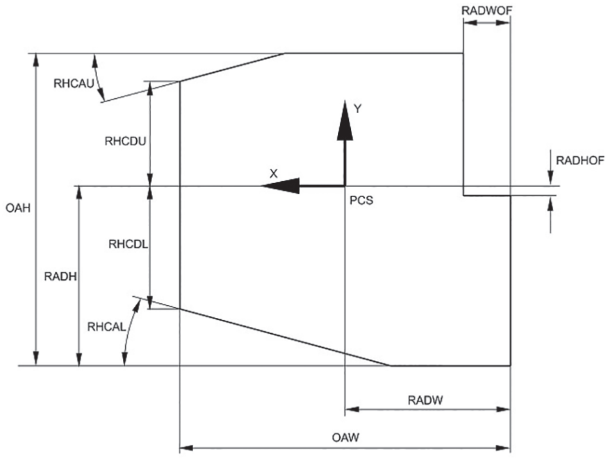

Figure 17 — Sketch of the basic body

After extrusion of the sketch along the -z-axis with the extrusion length of the value of protruding length, the solid body looks like Figure 18.

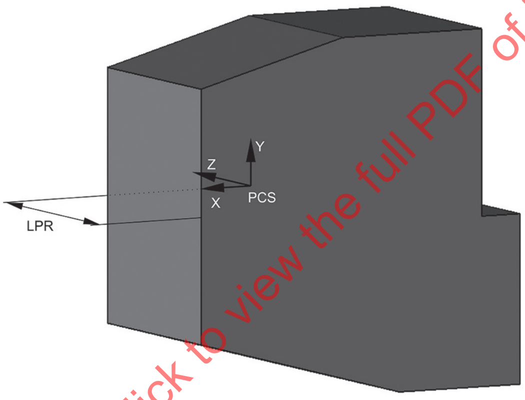

Figure 18 — Solid basic body

To get the crude solid model, the connection on machine side shall be mated on to the basic body. Figure 19 shows the appropriate connection on machine side according to ISO 10889-1.

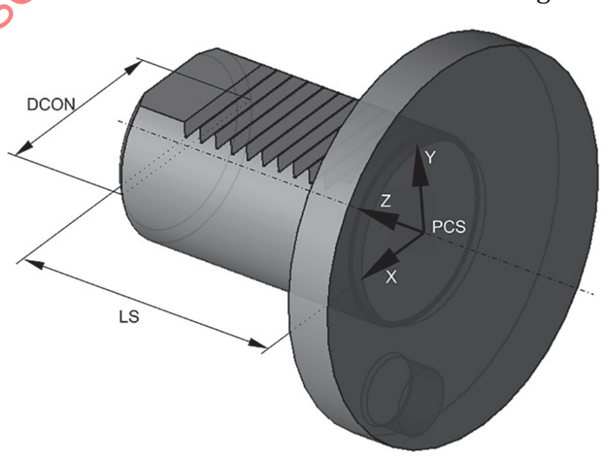

Figure 19 — Connection machine side, complete

After mating the basic body on to the connection machine side, the adaptive item shall look like Figure 20.

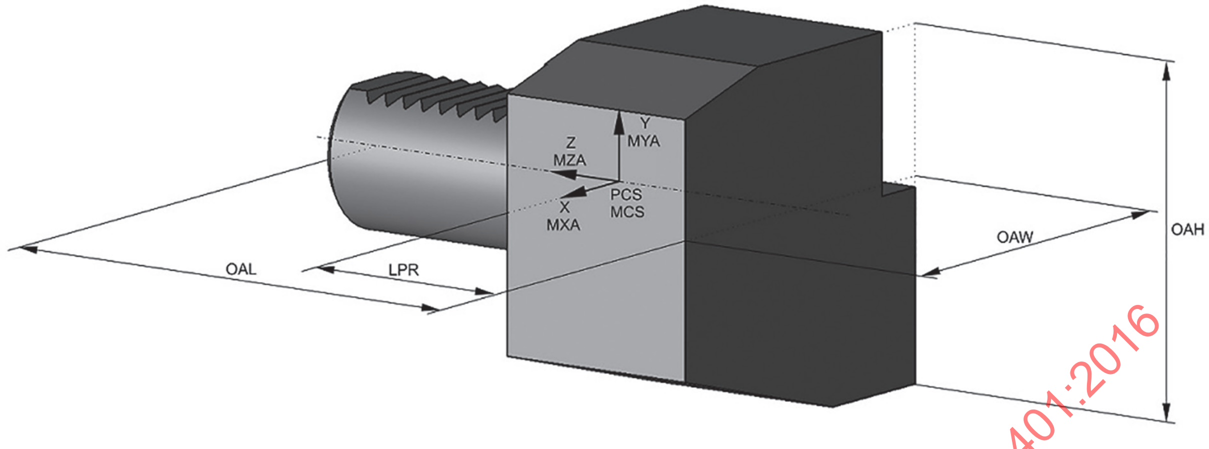

Figure 20 — Basic body

6.4 Connection on workpiece side

For this kind of converters, the connection on workpiece side shall be the rectangular connection "VKT", as defined in ISO/TS 13399-60.

The connection is described with the properties "shank height, H" and "shank width, B". After creating a cuboid with the properties "B", "H", "OAW" and positioning with the properties "LF, functional length", "HF, functional height" and "RADW, radial width" to its final position, the cuboid shall be subtracted from the basic body.

6.5 Stationary converter, complete

Figure 21 shows the complete stationary converter. The view is from the -x-axis for a better visualization of the right hand adaptive item with its CSW1.

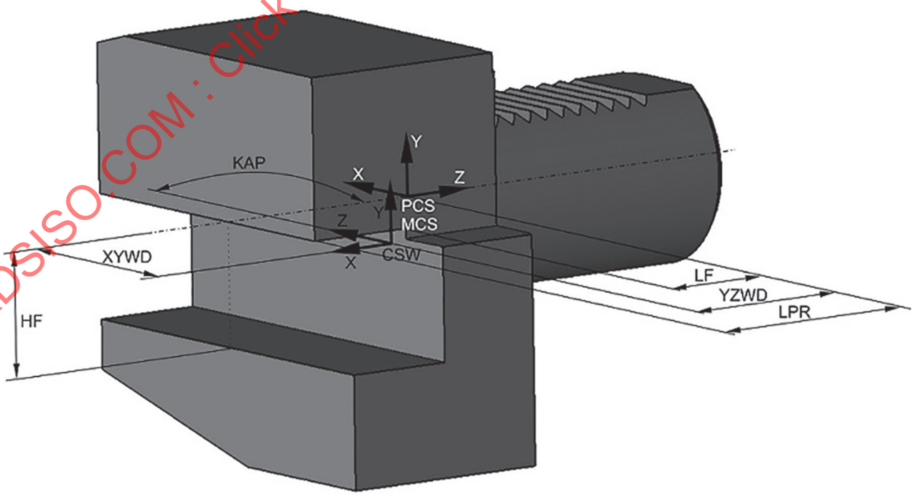

Figure 21 — Stationary converter, complete

The properties XYWD and YZWD can be calculated as follows.

XYWD = RADW.

YZWD = LF + B/2.

7 Extender

7.1 General

Extender is an adaptive item with the same connection type, style and size on both the machine side and workpiece side.

Figure 22 shows the properties used for identification and classification of extenders. The example shows an extending adaptor with polygonal taper shank according to ISO 26623-1 and a polygonal taper receiver according to ISO 26623-2.

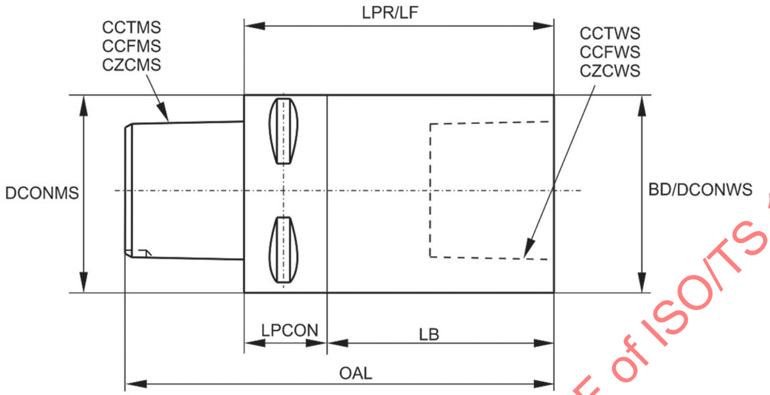

Figure 22 — Extender — Determination of properties

7.2 Necessary properties

Table 4 shows the properties needed for the example of modelling of an extender as described in 7.1.

Table 4 — Properties for the modelling of an extender

Preferred name	Preferred symbol
Body diameter	BD
Connection diameter	DCON
Body length	LB
Functional length	LF
Connection protruding length	LPCON
Protruding length	LPR
Overall length	OAL

7.3 Basic geometry

The basis of that part is a rotational design feature which shall contain all elements between the plane “TEP” and the plane “HEP”.

The sketch includes the real measure elements above and shall be designed on the xz-plane of the “PCS”.

The design of the sketch shall be 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 “HEP”, according to Figure 5. 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 4.

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

To be more flexible using different connections on the machine side, it is also allowed to start the sketch on the connection protruding length "LPCON".

After creating the basic body, the body of the connection of the machine side shall be mated to the basic body and united.

The basic body shown in Figure 23 can also be designed by means of using the CAD function "cylinder".

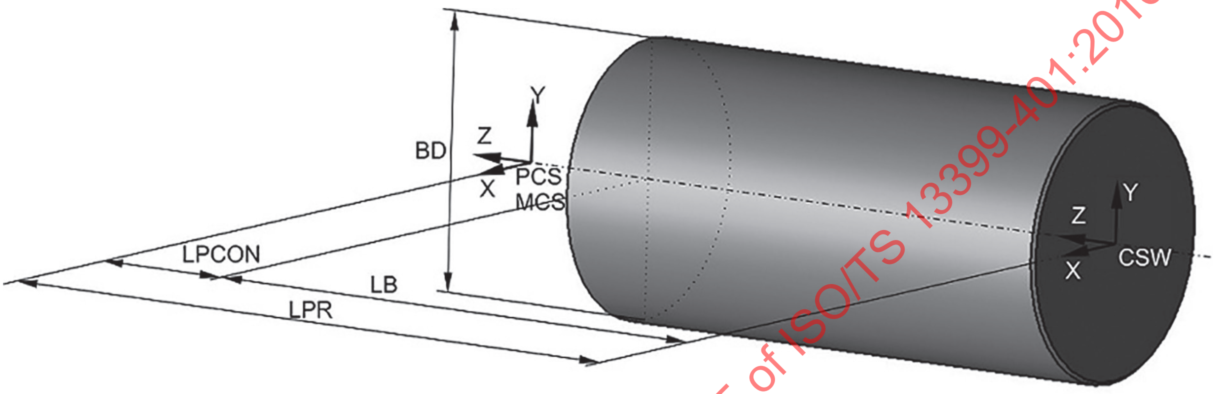

Figure 23 — Basic body

To get the crude solid model, the connection on machine side shall be mated on to the basic body. Figure 24 shows the appropriate connection on machine side according to ISO 26623-1.

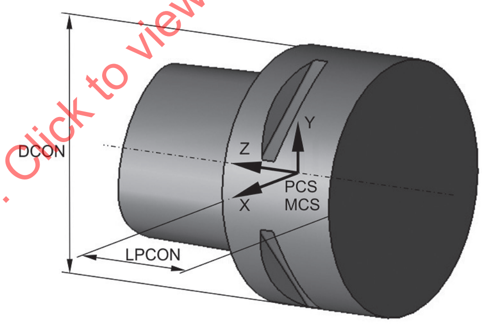

Figure 24 — Connection machine side, complete

7.4 Connection on workpiece side

For extenders, the connection on workpiece side shall be the same as on machine side. However, it shall be built as solid model for subtraction. The connection shall contain all the elements being subtracted from the basic body.

Figure 25 shows the example of the receiver of polygonal taper interface with contact surface. The model shall be placed on its final position for subtraction.

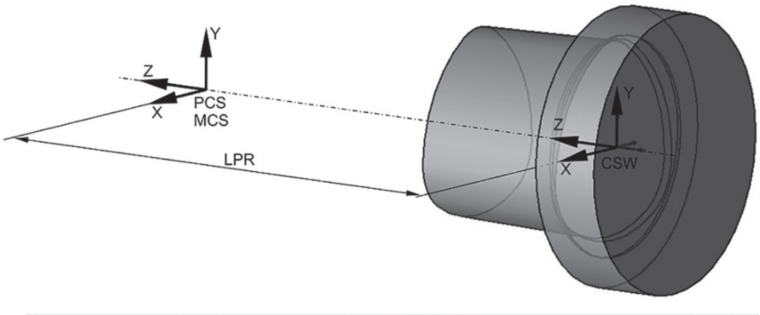

Figure 25 — Body of connection workpiece side

7.5 Extender, complete

After mating the basic body on to the connection machine side and subtracting the connection on workpiece side, the adaptive item shall look like Figure 26.

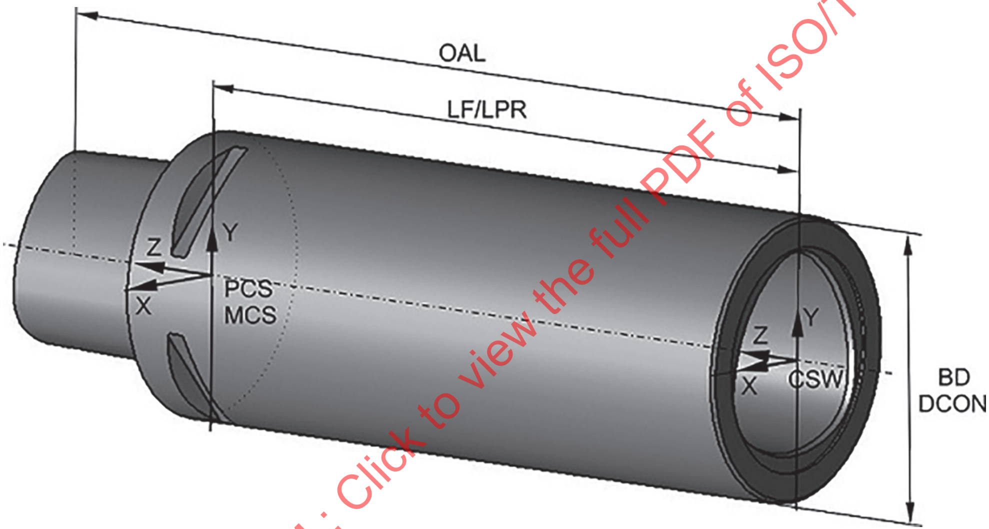

Figure 26 — Extender, complete

8 Reducer, primary design

8.1 General

Reducer is an adaptive item with the same connection type and style on both the machine side and workpiece side, but with different sizes.

The connections on either side of an item shall be different in gender, i.e. male and female. Primarily, a reducer is smaller in size on the workpiece side. But a reducer can also be built in vice versa direction (see Clause 9).

Figure 27 shows the properties used for identification and classification of reducers.

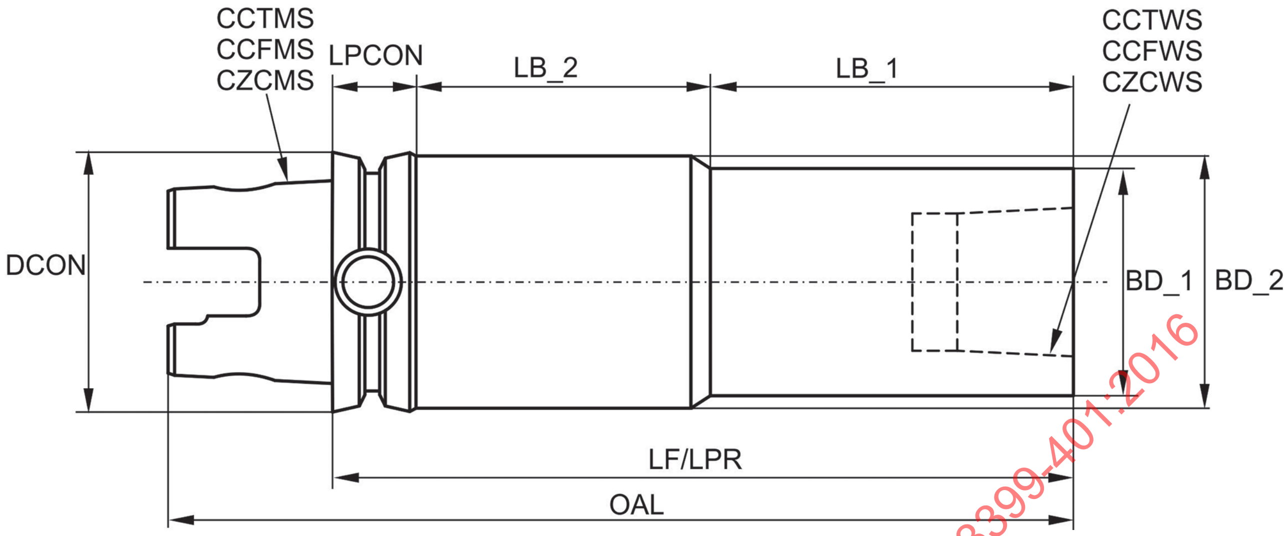

Figure 27 — Reducer, primary direction — Determination of properties

8.2 Necessary properties

Table 5 shows the properties needed for the example of modelling of a reducer as described in 8.1.

Table 5 — Properties for the modelling of a reducer

Preferred name	Preferred symbol
Body diameter 1	BD_1
Body diameter 2	BD_2
Connection diameter	DCON
Body length 1	LB_1
Body length 2	LB_2
Functional length	LF
Connection protruding length	LPCON
Protruding length	LPR
Overall length	OAL

8.3 Basic geometry

See 7.3 for the design of the basic geometry.

Figure 28 shows the revolved body of the sketch of the primary designed reducer.

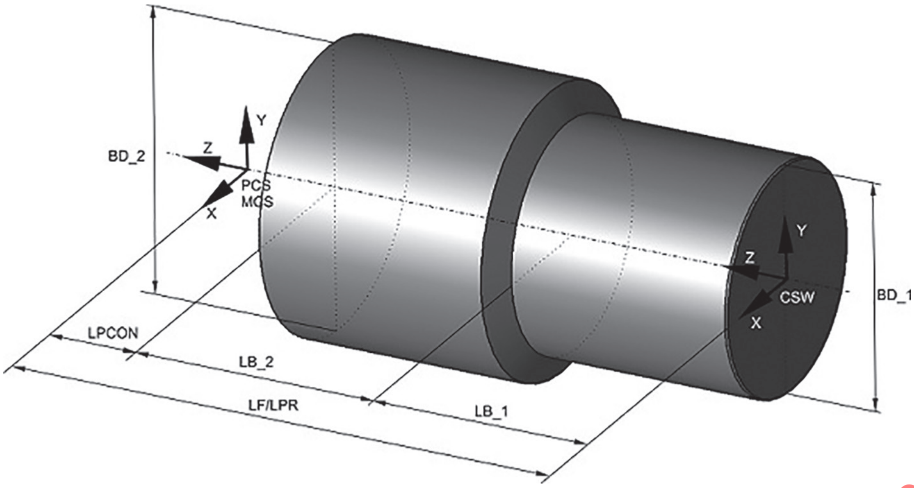

Figure 28 — Basic body, primary design

To get the crude solid model, the connection on machine side shall be mated on to the basic body. Figure 29 shows the appropriate connection on machine side according to ISO 26622-1.

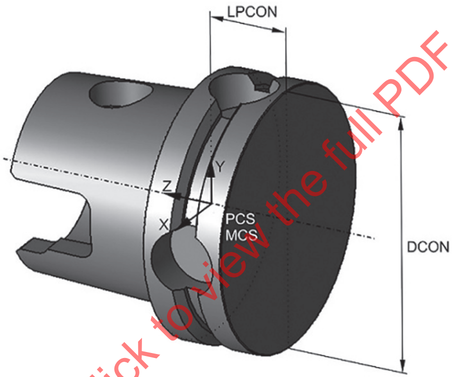

Figure 29 — Connection machine side, complete

8.4 Connection on workpiece side

For reducers with primary design, the connection on workpiece side shall have a smaller size as on machine side. But it shall be built as a solid model for subtraction. The connection shall contain all the elements being subtracted from the basic body.

Figure 30 shows the example of the receiver of modular taper interface with ball track system. The model shall be placed on its final position for subtraction.