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**Cutting tool data representation and  
exchange —**

Part 201:  
**Creation and exchange of 3D models  
— Regular inserts**

*Représentation et échange des données relatives aux outils  
coupants —*

*Partie 201: Création et échange de modèles 3D — Plaquettes  
régulières*





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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](http://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](http://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 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 301: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of thread-cutting taps, thread-forming taps and thread-cutting dies* [Technical Specification]
- *Part 302: Concept for the design of 3D models based on properties according to ISO/TS 13399-3: Modelling of solid drills and countersinking tools* [Technical Specification]

The following parts are under preparation:

- *Part 51: Designation system for customer solution cutting tools*
- *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 303: Creation and exchange of 3D models — Solid end mills* [Technical Specification]
- *Part 304: Creation and exchange of 3D models — Solid milling cutter with arbor hole* [Technical Specification]
- *Part 307: Creation and exchange of 3D models — End mills for indexable inserts* [Technical Specification]
- *Part 308: Creation and exchange of 3D models — Milling cutter 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]

## Introduction

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

A regular insert is used in combination with a cutting tool in a machine to remove material from a workpiece by a shearing action at the cutting edges of the tool. Cutting tool data that can be described by ISO 13399 include, but are not limited to, everything between the workpiece and the machine tool. Information about inserts, solid tools, assembled tools, adaptors, components, and their relationships can be represented by this part of ISO 13399. The increasing demand 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 ISO 13399 is to provide the means to represent the information that describes cutting tools in a computer sensible form that is independent from any particular computer system. The representation will facilitate the processing and exchange of cutting tool data within and between different software systems and computer platforms and support the application of this data in manufacturing planning, cutting operations, and the supply of tools. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and for archiving. The methods that are used for these representations are those developed by ISO TC184/SC4 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 TC184/SC4/WG2 “Standard for the neutral representation of standard parts” and IEC “International electro technical commission”, TC 3 “Information structures, documentation and graphical symbols”, SC3D “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 201:

# Creation and exchange of 3D models — Regular inserts

## 1 Scope

This part of ISO 13399 specifies a concept for the design of cutting items, limited to regular inserts, with the usage of the related properties and domains of values.

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

- definitions and identification of the design features of regular inserts, with a link to the properties used;
- definitions and identification of the internal structure of the 3D model that represents features and properties of regular inserts.

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

- 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 tool items;
- creation and exchange of simplified 3D models for other cutting items not described in this part of ISO 13399;
- creation and exchange of simplified 3D models for adaptive items;
- creation and exchange of simplified 3D models for assembly items and auxiliary items.

## 2 Normative references

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

ISO 1832, *Indexable inserts for cutting tools — Designation*

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

ISO/TS 13399-80<sup>1)</sup>, *Cutting tool data representation and exchange — Part 80: Concept for the design of 3D models based on properties according to ISO 13399: Overview and principles*

## 3 Starting elements, coordinate systems, planes

### 3.1 General

The creation of 3D models shall be done by means of nominal dimensions.

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1) To be published.

**WARNING** — There is no guarantee that the 3D model, created according to the methods described in this part of ISO 13399, is a true representation of the physical tool supplied by the tool manufacturer. If the models are used for simulation purposes, e.g. CAM simulation, it shall be taken into consideration that the real product dimensions can differ from those nominal dimensions.

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

## 3.2 Reference system

The reference system consists of the following standard elements:

- **standard coordinate system:** right-handed rectangular Cartesian system in three dimensional space, called “primary coordinate system” (PCS);
- **three orthogonal planes:** planes in the coordinate system that contain the axes of the system, named “XY plane” (XYP), “XZ plane” (XZP), and “YZ plane” (YZP);
- **three orthogonal axes:** axes built as intersections of the three orthogonal plane lines respectively, named “x-axis” (XA), “y-axis” (YA), and “z-axis” (ZA).

## 3.3 Coordinate systems

### 3.3.1 General

In principle, an insert has two coordinate systems:

- the primary coordinate system, which determines the insert position in space (see [Figure 1](#));
- the secondary coordinate system that helps to mount the insert on to a tool body (see [Figure 2](#)).

### 3.3.2 Coordinate system for insert location

The reference coordinate system “PCS” (primary coordinate system) defines the insert position in space. The determinations are as follows:

- the insert is located in the XY quadrant;
- the cutting edges are colinear with the XY plane;
- the major cutting edge is colinear with the positive x-axis;
- the theoretical sharp cutting point is on the y-axis;
- the direction of the insert thickness is parallel to the negative z-axis.

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



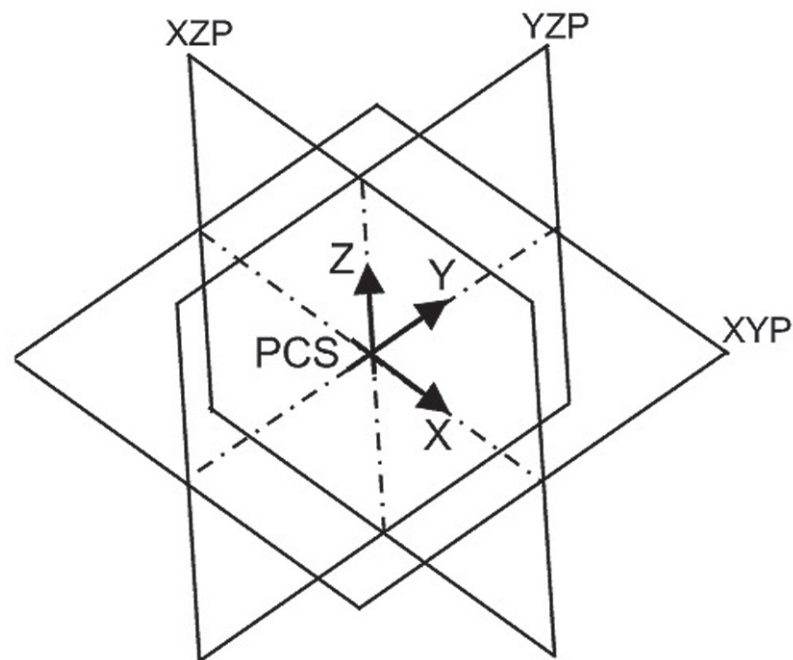


Figure 1 — Reference coordinate system “PCS”

### 3.3.3 Coordinate system for insert mounting

The reference coordinate system “MCS” (mounting coordinate system) is placed on the XY-plane of the PCS with the same orientation as the PCS, as in [Figure 2](#), with the following determinations:

- at the centre of the inscribed circle of all equilateral and equiangular inserts (styles T, S, O, P, H according to ISO 1832);
- at the centre of the inscribed circle of all equilateral but non-equiangular inserts (styles C, D, E, M, V, W according to ISO 1832);
- at the centre of the inscribed circle of all round inserts (style R according to ISO 1832);
- at the intersection of the two diagonal lines of all non-equilateral but equiangular inserts (style L according to ISO 1832) and of all non-equiangular and non-equilateral inserts (style A, B, K according to ISO 1832);
- if it is not possible to create the diagonal lines on the inserts of style A, B, K and L, the origin of the MCS shall be created by means of using reference planes that are perpendicular to the XY-plane and located in the middle of the insert length (INSL) and the insert width (W1) and parallel to them.

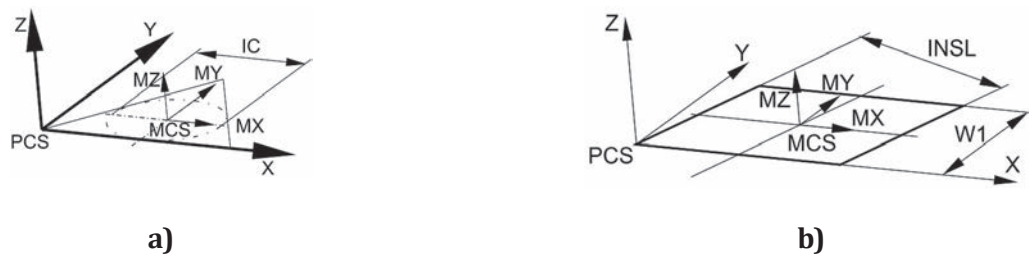


Figure 2 — Reference coordinate system “MCS”

If regular inserts have a specific design and are not interchangeable between vendors, the location of the MCS is at the manufacturer's discretion; either on the top face or on the bottom face. The orientation of the coordinate system shall follow the definitions in this part of ISO 13399.

### 3.4 Planes

To distinguish between the PCS and the MCS planes, the MCS planes shall be given the prefix "M":

- XYP (PCS) → MXYP (MCS)
- XZP (PCS) → MXZP (MCS)
- YZP (PCS) → MYZP (MCS)

## 4 Design of the model

The sketches (outline contour) and features of the basic model shall not contain details like chip breakers, face land geometry, or tipped cutting parts made of other cutting materials. Those features shall be designed as separate design elements after the basic geometry and shall be grouped as detail geometry, as described in [Clause 5](#).

The structure and sequence of the modelling shall be kept as described. The defined preferred symbols shall be taken as names for the variables.

The models of the regular inserts shall contain the following design features:

- basic geometry;
- corner configuration geometry;
- mounting geometry.

The total amount of design features depends on the desired level of modelling and the complexity of the insert.

Within 3D CAD systems, the specified model structure of the basic shapes of the inserts are described in [Clause 5](#).

## 5 Detailed geometry

### 5.1 Equilateral and equiangular inserts and equilateral but non-equiangular inserts

#### 5.1.1 Necessary properties

This clause describes equilateral and equiangular inserts of the ISO shapes T, S, H, O, P and equilateral but non-equiangular inserts of the ISO shapes C, D, E, M, V, W. The modelling of the shapes C, D, E, M, V, and S is defined in this clause because of the special characteristic of the shape S (square) which is similar to the rhombic shape with an insert included angle (EPSR) of 90°.

For this group of inserts, the properties listed in [Table 1](#) are valid.

**Table 1 — Properties for the modelling of equilateral and equiangular inserts and equilateral but non-equiangular inserts**

Preferred name	Preferred symbol
clearance angle major	AN
clearance angle wiper edge	AS
corner chamfer length	BCH <sup>b</sup>
wiper edge length	BS <sup>c</sup>
insert included angle	EPSR
inscribed circle diameter	IC
corner chamfer angle	KCH <sup>b</sup>
cutting edge angle major	KRINS <sup>c</sup>
cutting edge length <sup>a</sup>	L <sup>a</sup>
corner radius	RE <sup>b</sup>
insert thickness	S
<sup>a</sup> Shall be calculated; is dependent on IC and EPSR. <sup>b</sup> Dependent on corner configuration, either rounded or chamfered. <sup>c</sup> Shall be used if a wiper edge is on the insert.	

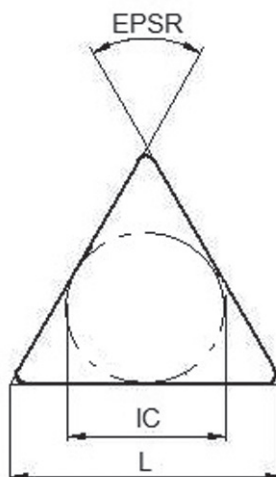
Information about the connection interface code shall be filed as properties within the model and is necessary for using the model.

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

## 5.1.2 Insert, triangular shape

### 5.1.2.1 General

[Figure 3](#) indicates the properties that shall be used for the modelling of triangular inserts.



**Figure 3 — Properties of triangular insert**

### 5.1.2.2 Basic geometry

The geometry shall be designed as a solid model, containing all design features within the primary coordinate system “PCS”. The position of the insert is according to ISO/TS 13399-2.

Design of the contour:

- A sketch without definition of the corner geometry shall be defined for the extrusion and the cutting edges shall be tangential to the inscribed circle; the model shall be designed with its theoretical sharp corners.
- Dimensioning shall be done with the listed properties (see [Table 1](#)).

The sketch shall be extruded with the property “insert thickness” (symbol “S”) along the negative z-axis, with a negative inclination of “clearance angle major” (symbol “AN”). The basic model is shown in [Figure 4](#).

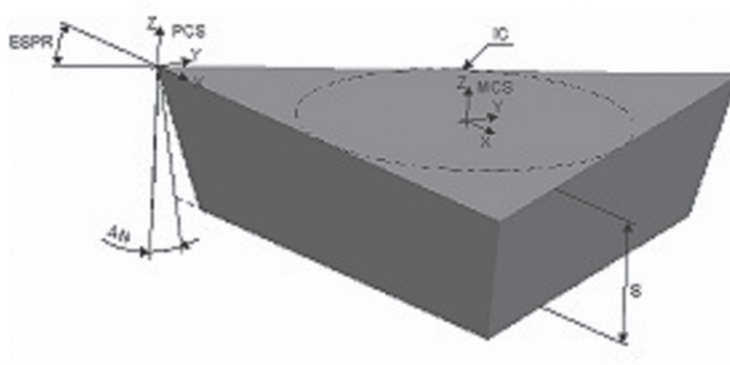


Figure 4 — Basic geometry of triangular insert

### 5.1.2.3 Detailed contour with corner geometry

#### 5.1.2.3.1 General

This geometry shall also be designed as solid model. It shall have the same determinations as described in [5.1.2.2](#).

Three different detailed contours are possible:

- contour with corner radius;
- contour with corner chamfer;
- contour with wiper edge and corner chamfer.

#### 5.1.2.3.2 Detailed contour with corner radius

The extrusion sketch shall contain all parameters describing the corner radius. The sketch shall be positioned with its theoretical sharp corner on the y-axis as defined in ISO/TS 13399-2.

The sketch shall be extruded as described in [5.1.2.2](#). Basic contour are illustrated in [Figure 5](#).

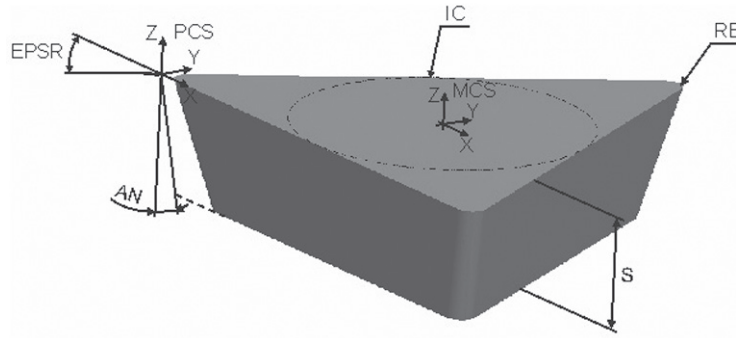


Figure 5 — Triangular insert with corner radius

5.1.2.3.3 Detailed contour with corner chamfer

The extrusion sketch shall contain all parameters describing the corner chamfer. The sketch shall be positioned with its theoretical sharp corner on the y-axis as defined in ISO/TS 13399-2.

The sketch shall be extruded as described in 5.1.2.2. Basic contour are illustrated in Figure 6.

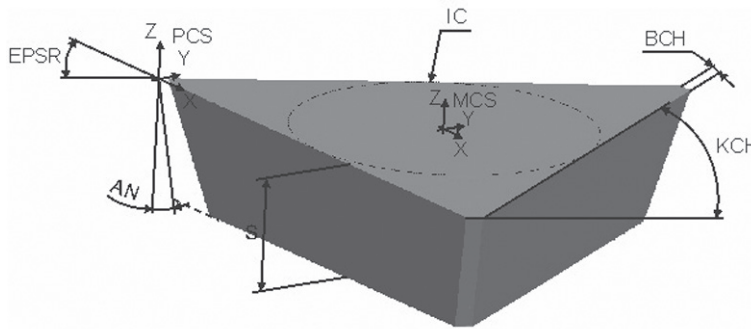


Figure 6 — Triangular insert with corner chamfer

5.1.2.3.4 Detailed contour with wiper edge and corner chamfer

The extrusion sketch shall contain all parameters describing the wiper edge and the corner chamfer. The sketch shall be positioned with its theoretical sharp corner on the y-axis as defined in ISO/TS 13399-2.

The sketch shall be extruded as described in 5.1.2.2. Basic contour are illustrated in Figure 7.

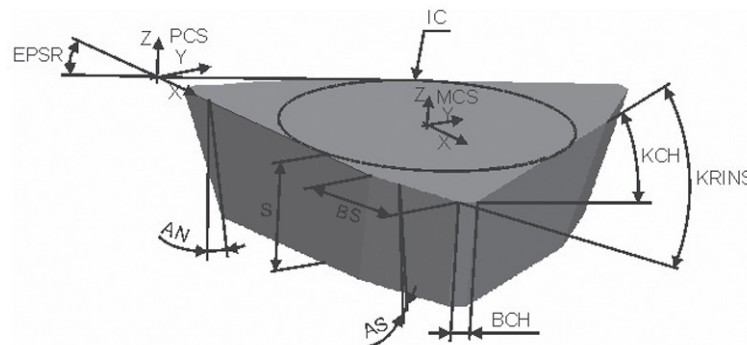


Figure 7 — Triangular insert with wiper edge and corner chamfer

5.1.3 Inserts, square and rhombic shapes

5.1.3.1 General

Figure 8 indicates the properties that shall be used for the modelling of square and rhombic inserts.

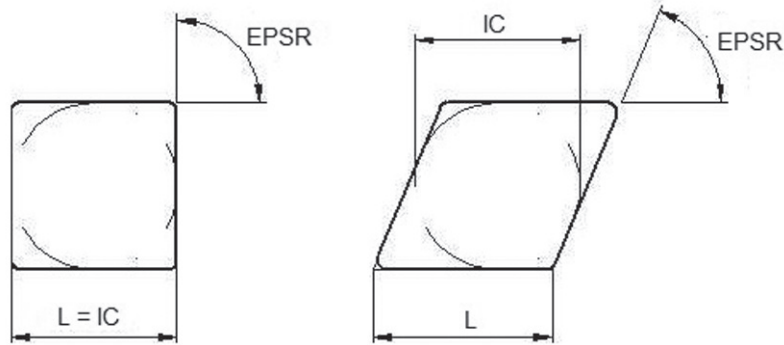


Figure 8 — Properties of insert of square or rhombic shape

5.1.3.2 Basic geometry

The structure is defined in 5.1.2.2 and the design is given in Figures 9 and 10.

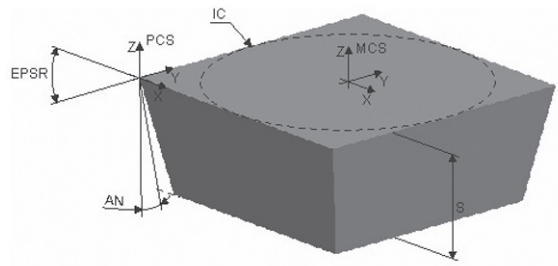


Figure 9 — Basic geometry of square insert

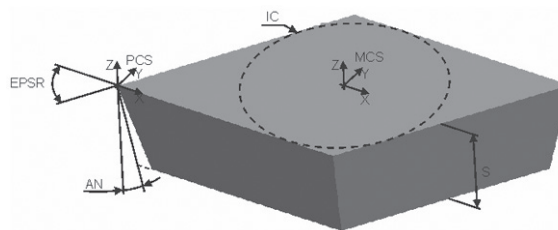


Figure 10 — Basic geometry of rhombic insert

5.1.3.3 Detailed contour with corner geometry

5.1.3.3.1 General

The structure and design are defined in 5.1.2.2.

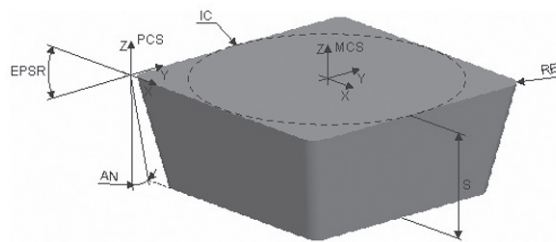
For the design of rhombic inserts, three additional properties describing the geometry of the corner on the minor cutting edge are needed, as indicated in Table 2.

**Table 2 — Properties for the determination of the corner geometry on the minor cutting edge**

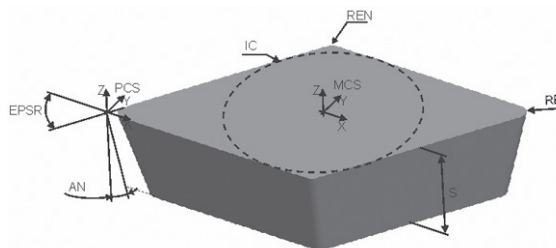
Preferred name	Preferred symbol
corner chamfer length minor	BCHN <sup>a</sup>
corner chamfer angle minor	KCHN <sup>a</sup>
corner radius minor	REN <sup>a</sup>
<sup>a</sup> Dependent on the corner configuration, either rounded or chamfered corner.	

**5.1.3.3.2 Detailed contour with corner radius**

The structure is defined in 5.1.2.3.2 and the design of the contour with corner radius is given in Figures 11 and 12.



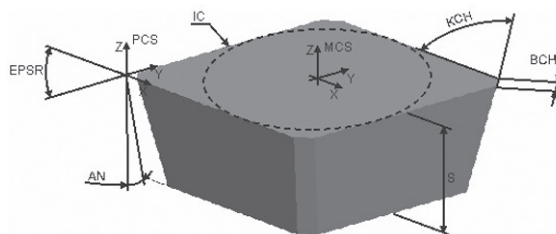
**Figure 11 — Square insert with corner radius**



**Figure 12 — Rhombic insert with corner radius**

**5.1.3.3.3 Detailed contour with corner chamfer**

The structure is defined in 5.1.2.3.3 and the design of the contour with corner chamfer is given in Figures 13 and 14.



**Figure 13 — Square insert with corner chamfer**

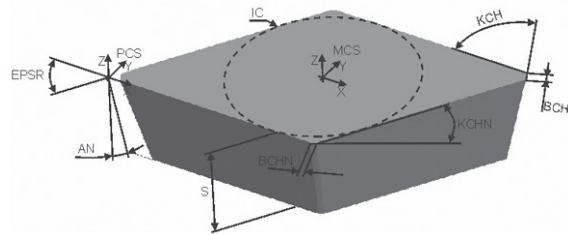


Figure 14 — Rhombic insert with corner chamfer

#### 5.1.3.3.4 Detailed contour with wiper edge and corner chamfer

The structure is defined in 5.1.2.3.4 and the design of the contour with wiper edge and corner chamfer is given in Figures 15 and 16.

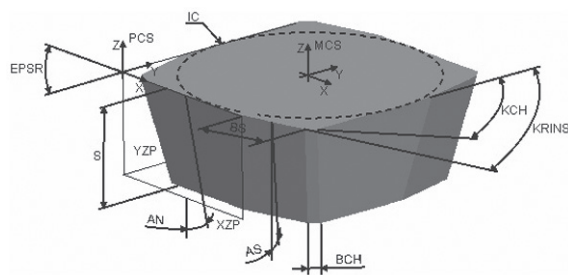


Figure 15 — Square insert with wiper edge and corner chamfer

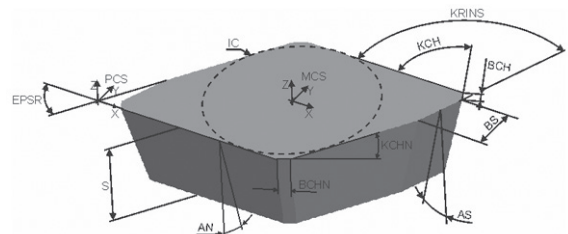


Figure 16 — Rhombic insert with wiper edge and corner chamfer

### 5.1.4 Pentagonal, hexagonal, and octagonal inserts

#### 5.1.4.1 General

Figure 17 indicates the properties used for modelling pentagonal, hexagonal, and octagonal inserts.



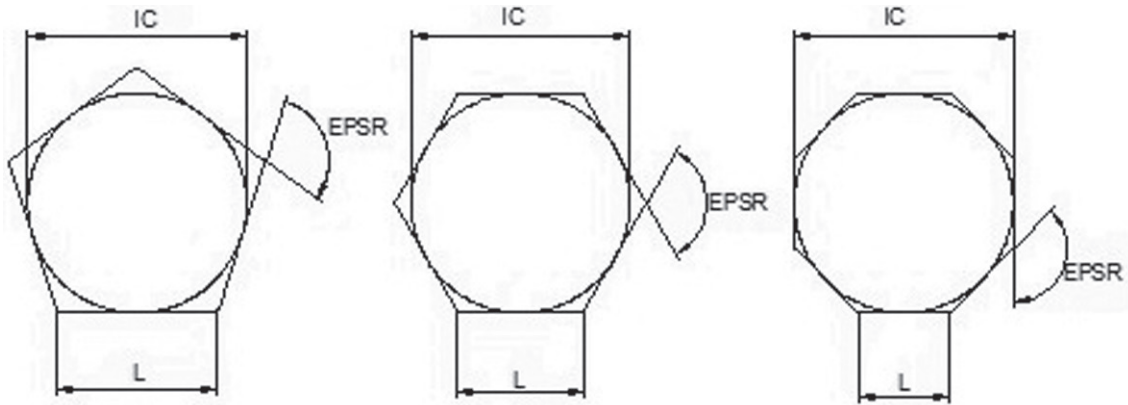


Figure 17 — Properties of pentagonal, hexagonal, and octagonal inserts

#### 5.1.4.2 Basic geometry

The structure is defined in [5.1.2.2](#) and the design is given in [Figures 18, 19, and 20](#).

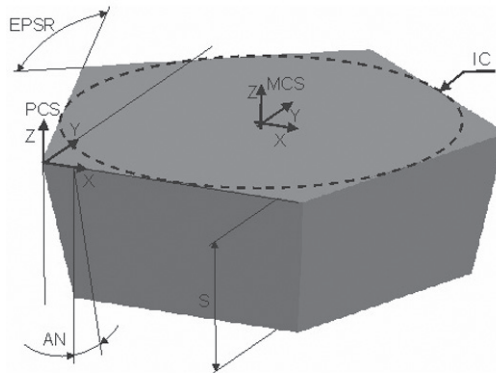


Figure 18 — Basic geometry for pentagonal insert

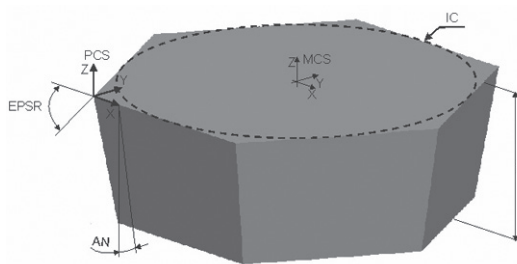


Figure 19 — Basic geometry for hexagonal insert

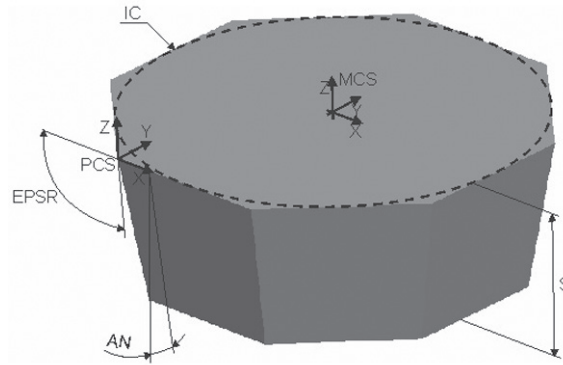


Figure 20 — Basic geometry for octagonal insert

### 5.1.4.3 Detailed contour with corner geometry

#### 5.1.4.3.1 General

The structure and design are defined in [5.1.2.2](#).

#### 5.1.4.3.2 Detailed contour with corner radius

The structure is defined in [5.1.2.3.2](#) and the design of the contour with corner radius is given in [Figures 21, 22, and 23](#).

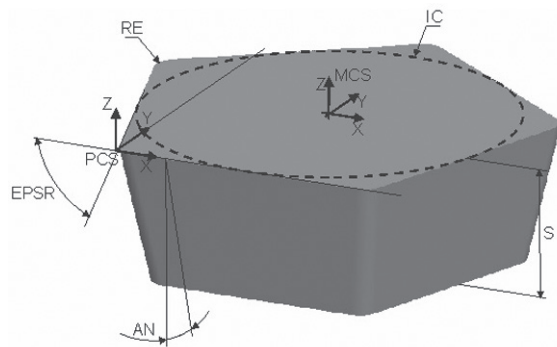


Figure 21 — Pentagonal insert with corner radius

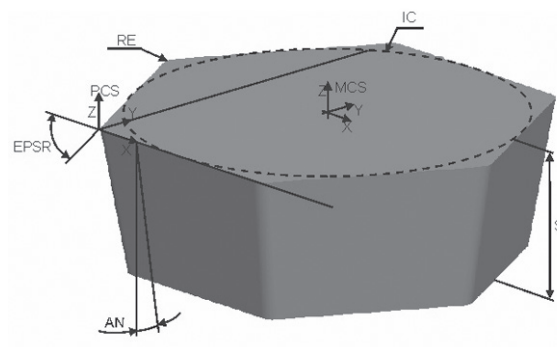
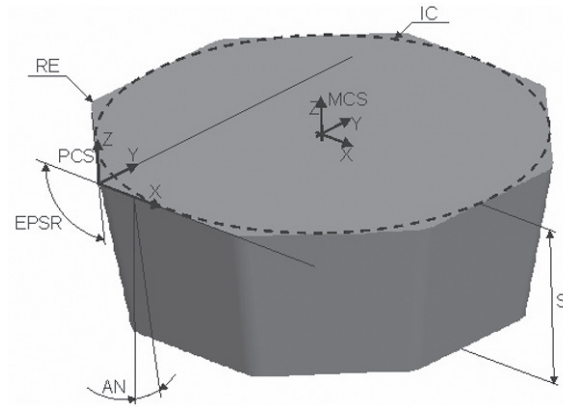


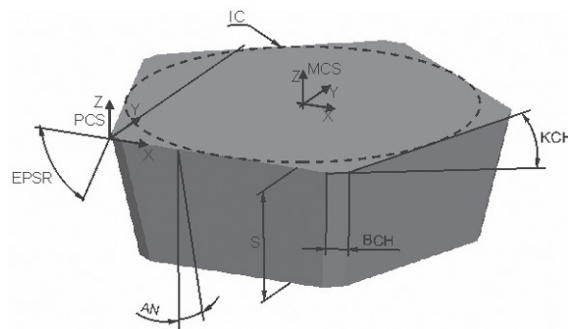
Figure 22 — Hexagonal insert with corner radius



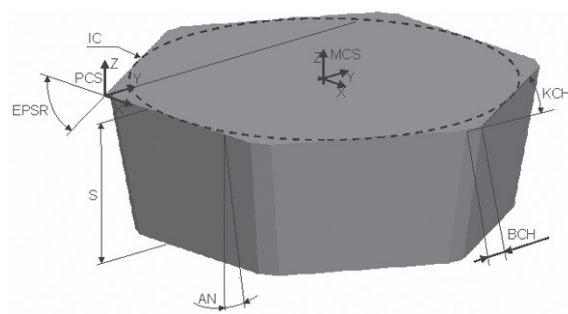
**Figure 23 — Octagonal insert with corner radius**

#### 5.1.4.3.3 Detailed contour with corner chamfer

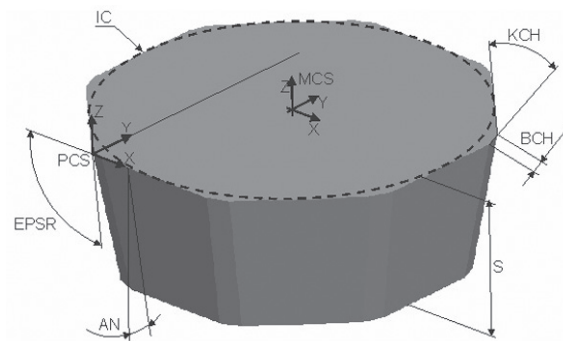
The structure is defined in [5.1.2.3.3](#) and the design of the contour with corner chamfer is given in [Figures 24, 25, and 26](#).



**Figure 24 — Pentagonal insert with corner chamfer**



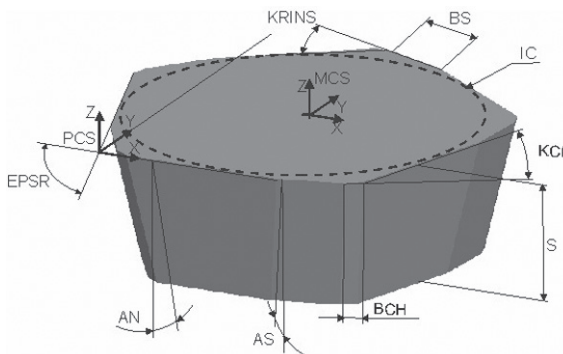
**Figure 25 — Hexagonal insert with corner chamfer**



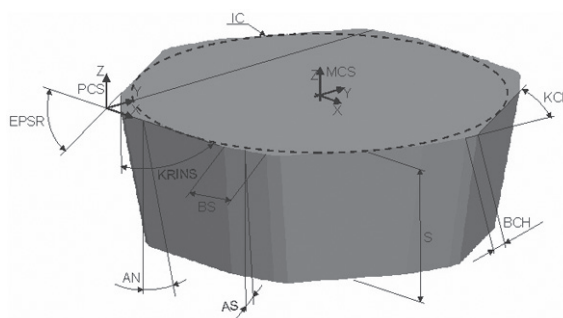
**Figure 26 — Octagonal insert with corner chamfer**

#### 5.1.4.3.4 Detailed contour with wiper edge and corner chamfer

The structure is defined in 5.1.2.3.4 and the design of the contour with wiper edge and corner chamfer is given in Figures 27, 28, and 29.



**Figure 27 — Pentagonal insert with wiper edge and corner chamfer**



**Figure 28 — Hexagonal insert with wiper edge and corner chamfer**

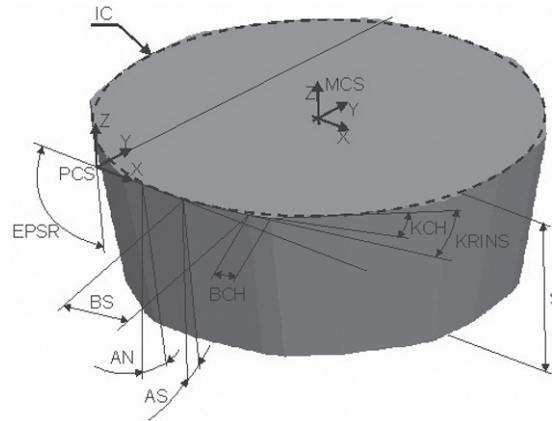


Figure 29 — Octagonal insert with wiper edge and corner chamfer

5.1.5 Insert, trigon shape (triangular with enlarged included angle)

5.1.5.1 General

Figure 30 indicates the properties used for modelling trigon inserts.

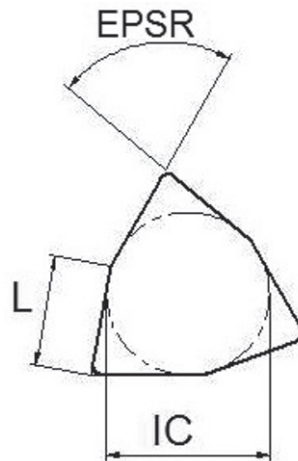


Figure 30 — Properties of trigon inserts

5.1.5.2 Basic geometry

For the design of trigon inserts, an additional property describing the minor cutting edge angle is needed, as indicated in Table 3.

Table 3 — Property for the determination of the included angle of the minor cutting edge

Preferred name	Preferred symbol
insert included angle minor	EPSRN

The structure is defined in 5.1.2.2 and the design of the basic geometry is given in Figure 31.

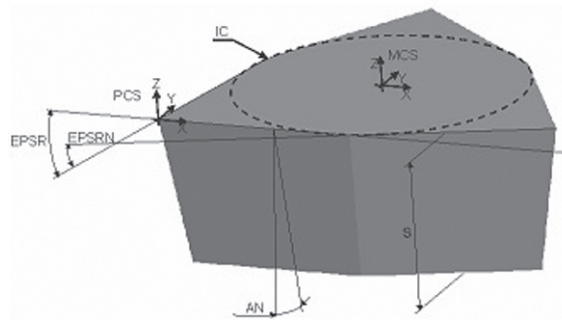


Figure 31 — Basic geometry of trigon insert

### 5.1.5.3 Detailed contour with corner geometry

#### 5.1.5.3.1 General

The structure and design are defined in [5.1.2.2](#).

#### 5.1.5.3.2 Detailed contour with corner radius

The structure is defined in [5.1.2.3.2](#) and the design of the contour with corner radius is given in [Figure 32](#).

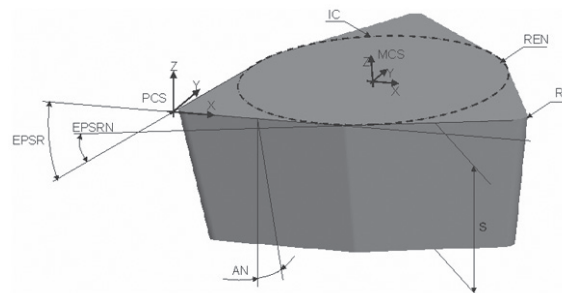


Figure 32 — Trigon insert with corner radius

#### 5.1.5.3.3 Detailed contour with corner chamfer

The structure is defined in [5.1.2.3.3](#) and the design of the contour with corner chamfer is given in [Figure 33](#).

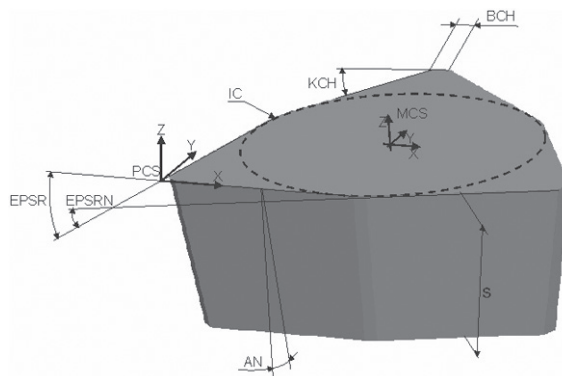


Figure 33 — Trigon insert with corner chamfer

5.1.5.3.4 Detailed contour with wiper edge and corner chamfer

The structure is defined in 5.1.2.3.4 and the design of the contour with wiper edge and corner chamfer is given in Figure 34.

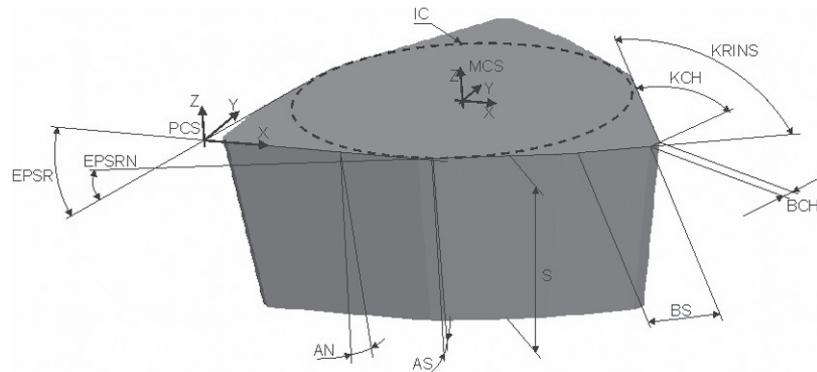


Figure 34 — Trigon insert with wiper edge and corner chamfer

5.2 “Non-equilateral but equiangular” and “non-equilateral and non-equiangular” inserts

5.2.1 Necessary properties

This clause describes “non-equilateral but equiangular” inserts of the shape L and “non-equilateral and non-equiangular” inserts of the shapes A, B, K. The modelling of the shapes A, B, K, and L is defined in one clause because of the special characteristic of the shape L (rectangular) which is equivalent to the parallelogram-shaped insert with an insert included angle (EPSR) of 90°.

Figure 35 indicates the properties needed for the design.

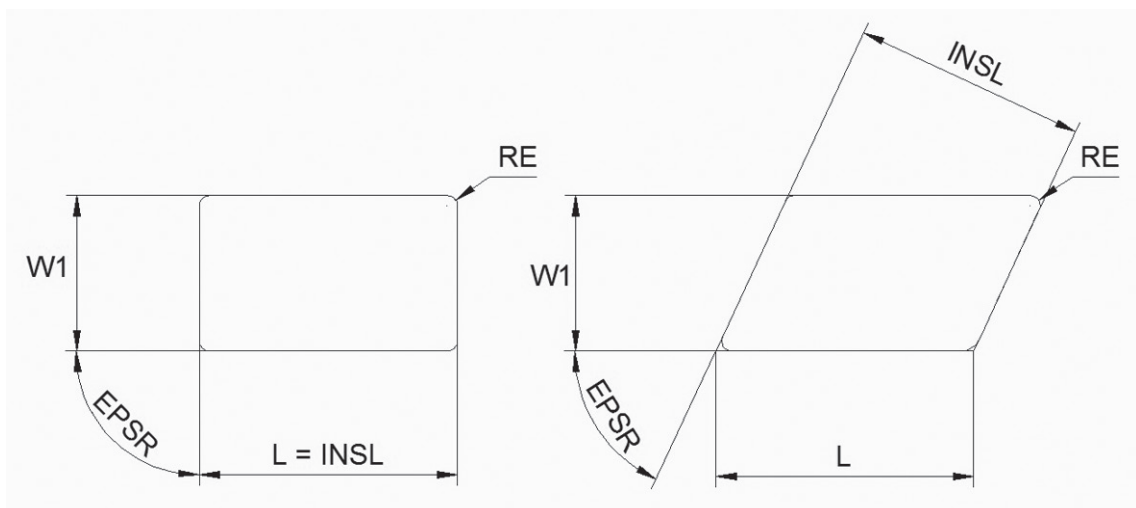


Figure 35 — Properties of rectangular and parallelogram-shaped inserts

For this group of inserts, the properties listed in Table 4 are valid.

**Table 4 — Properties for the modelling of “non-equilateral but equiangular” and “non-equilateral and non-equiangular” inserts**

Preferred name	Preferred symbol
clearance angle major	AN
clearance angle minor	ANN
clearance angle wiper edge	AS
corner chamfer length	BCH <sup>b</sup>
corner chamfer length minor	BCHN <sup>b</sup>
wiper edge length	BS <sup>c</sup>
insert included angle	EPSR
insert length	INSL
corner chamfer angle	KCH <sup>b</sup>
corner chamfer angle minor	KCHN <sup>b</sup>
cutting edge angle major	KRINS <sup>c</sup>
cutting edge length	L <sup>a</sup>
corner radius	RE <sup>b</sup>
corner radius minor	REN <sup>b</sup>
insert thickness	S
insert width	W1
<sup>a</sup> Shall be calculated; is dependent on INSL and EPSR. <sup>b</sup> Dependent on the corner configuration, either rounded or chamfered corner. <sup>c</sup> Shall be used if a wiper edge is on the insert.	

Information about the connection interface code shall be filed as properties within the model and is necessary for using the model.

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

## 5.2.2 Inserts, parallelogram non-equilateral shape

### 5.2.2.1 General

The geometry shall be designed as a solid model, containing all design features within the primary coordinate system “PCS”. The position of the insert is according to ISO/TS 13399-2.

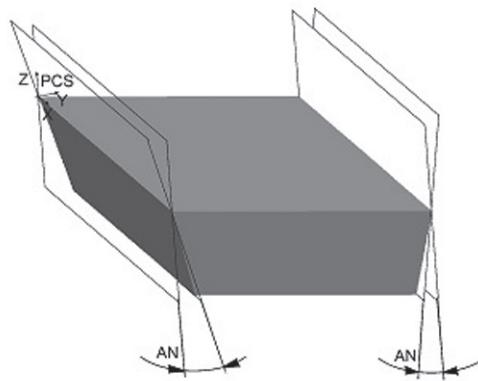
Design of the contour:

- a sketch without definition of the corner geometry shall be defined for the extrusion and the model shall be designed with its theoretical sharp corners;
- dimensioning shall be done with the listed properties (see [Table 4](#)).

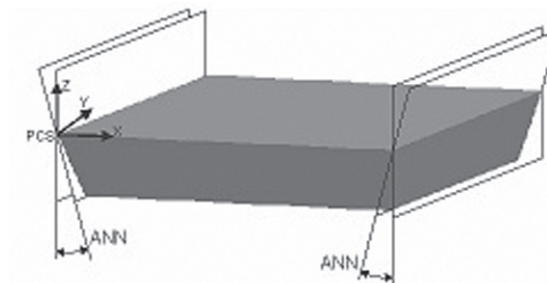
### 5.2.2.2 Insert, parallelogram non-equilateral shape — basic geometry

The sketch shall be extruded with the property “insert thickness” (symbol “S”) along the negative z-axis. Because of the possible different clearance angles on the major and minor cutting edges, the solid shall be trimmed by placing datum planes representing the clearance angles. The corner radii shall also be created with the appropriate trimming function of the CAD system. [Figures 36](#) and [37](#) show the basic geometry with the defined planes for trimming.



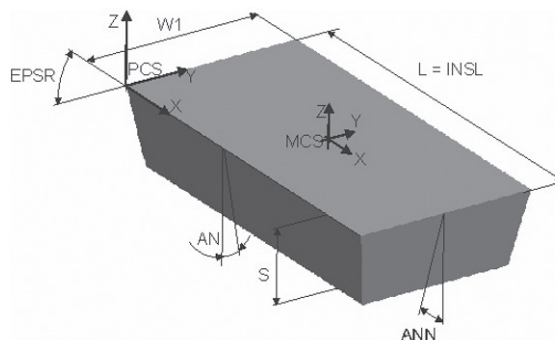


**Figure 36 — Parallelogram non-equilateral shaped insert with trim planes for major clearance angles**



**Figure 37 — Parallelogram non-equilateral shaped insert with trim planes for minor clearance angles**

Figures 38 and 39 show the trimmed basic geometry.



**Figure 38 — Basic geometry of rectangular insert**

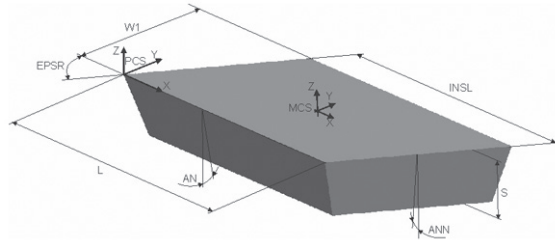


Figure 39 — Basic geometry of parallelogram non-equilateral shaped insert

### 5.2.2.3 Detailed contour with corner geometry

#### 5.2.2.3.1 General

This geometry shall be designed as a solid model, with the properties described in 5.2.1.

Three different detailed contours are possible:

- contour with corner radius (Figure 40);
- contour with corner chamfer (see Figure 41);
- contour with wiper edge and corner chamfer (see Figure 42).

For the properties of the cutting corner at the minor cutting edge, see 5.2.1 and Table 4.

#### 5.2.2.3.2 Detailed contour with corner radius

To start the design, the basic geometry shall be as defined in 5.2.1 and modified accordingly. Because of possible different clearance angles on the major and minor cutting edges, the CAD function “fillet” shall be used for rounding.

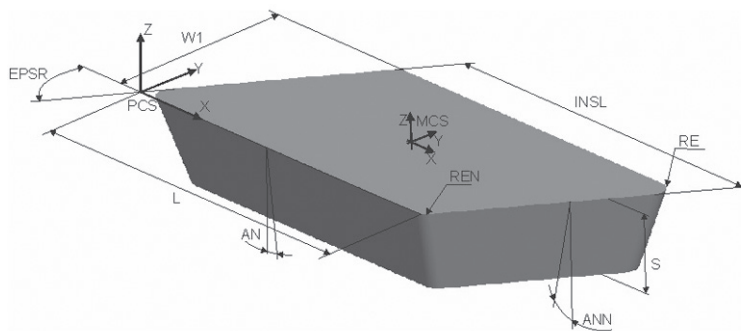
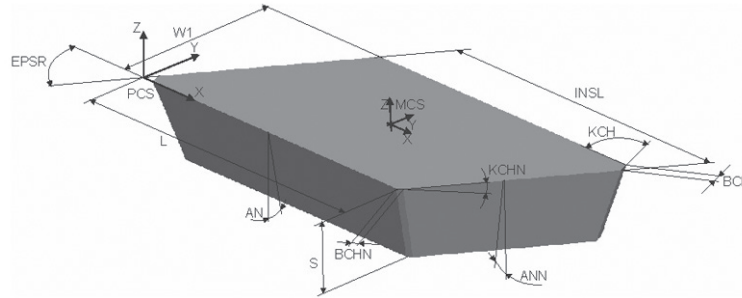


Figure 40 — Parallelogram non-equilateral shaped insert with corner radius

#### 5.2.2.3.3 Detailed contour with corner chamfer

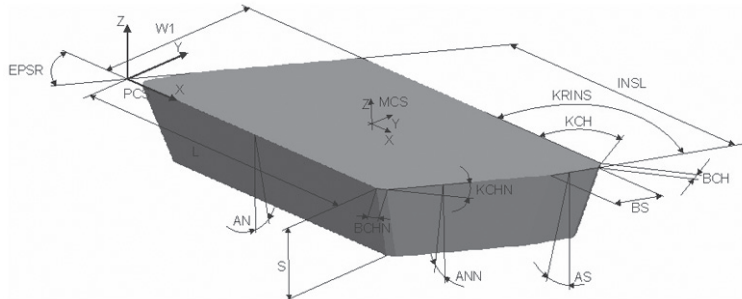
To start the design, the basic geometry shall be as defined in 5.2.1 and modified accordingly. Because of possible different clearance angles on the major and minor cutting edges, the chamfer shall be placed on the cutting corner by using datum planes to trim the body, which shall be positioned accordingly.



**Figure 41 — Parallelogram non-equilateral shaped insert with corner chamfer**

#### 5.2.2.3.4 Detailed contour with wiper edge and corner chamfer

The structure and design of parallelogram non-equilateral shaped inserts are given in [5.2.2.2](#).

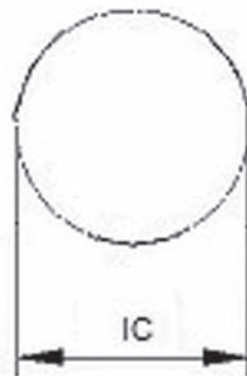


**Figure 42 — Parallelogram non-equilateral shaped insert with wiper edge and corner chamfer**

### 5.3 Round inserts

#### 5.3.1 General

[Figure 43](#) indicates the properties needed for the design of round inserts.



**Figure 43 — Properties of round inserts**

For this group of inserts, properties listed in [Table 5](#) are valid.

**Table 5 — Properties for the modelling of round inserts**

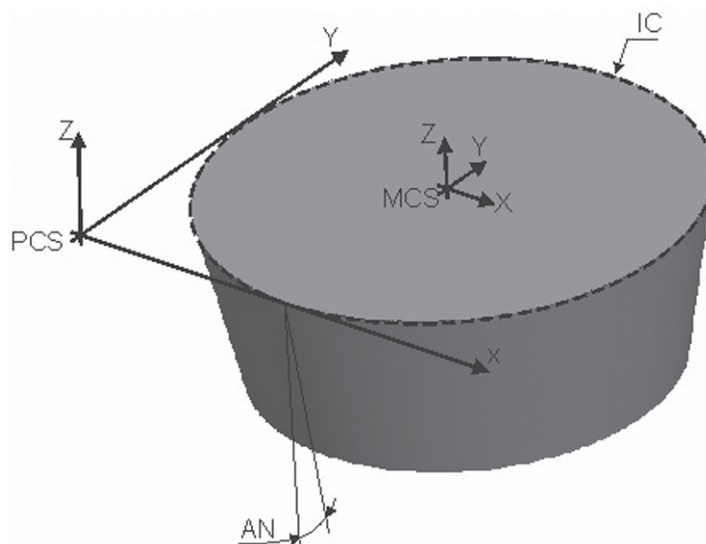
Preferred name	Preferred symbol
clearance angle major	AN
inscribed circle diameter	IC
insert thickness	S
insert thickness total	S1

Information about the connection interface code shall be filed as properties within the model and are necessary for using the model.

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

**5.3.2 Basic shape of round insert**

The structure is defined in 5.1.1.1 and the design is given in [Figure 44](#).



**Figure 44 — Basic and detailed geometry of a round insert**

**5.4 Fixing hole geometry of the inserts**

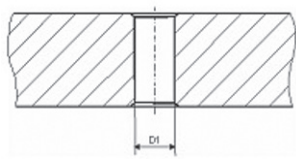
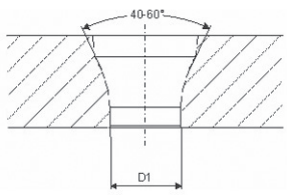
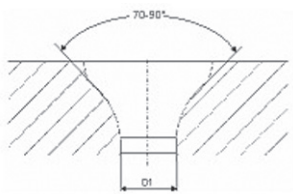
The geometry of the fixing hole is dependent on the property “insert mounting style code” with the preferred symbol “IFS”.

All insert shapes can have one of the geometries described in [Table 6](#).

**Table 6 — Insert mounting style code**

Code	Picture	Mounting style
1		without fixing hole

Table 6 (continued)

Code	Picture	Mounting style
2		cylindrical hole
3		partly cylindrical hole with 40° to 60° countersunk
4		partly cylindrical hole with 70° to 90° countersunk

When a mounting hole is defined, the properties listed in [Table 7](#) shall be used.

Table 7 — Fixing hole properties

Preferred name	Preferred symbol
fixing hole diameter	D1
insert mounting style code	IFS

In order to design a fixing hole with the properties shown in [Table 7](#), more properties are necessary. These additional properties shall not be part of the data exchange and representation, but shall be labelled as shown in [Table 8](#).

Table 8 — Additional fixing hole properties

Preferred name	Preferred symbol
fixing hole chamfer angle	FHCA
fixing hole countersunk angle	FHCSA
fixing hole countersunk diameter	FHCSD
fixing hole countersunk depth	FHCSDP
fixing hole countersunk radius	FHCSR
fixing hole chamfer width	FHCW

#### 5.4.1 Fixing hole styles

[Figure 45](#) indicates the properties that are needed for the design of a cylindrical fixing hole. [Figure 46](#) indicates the properties needed for the design of a partly cylindrical fixing hole classified with the insert mounting style code “3” or “4” defined in [Table 6](#).

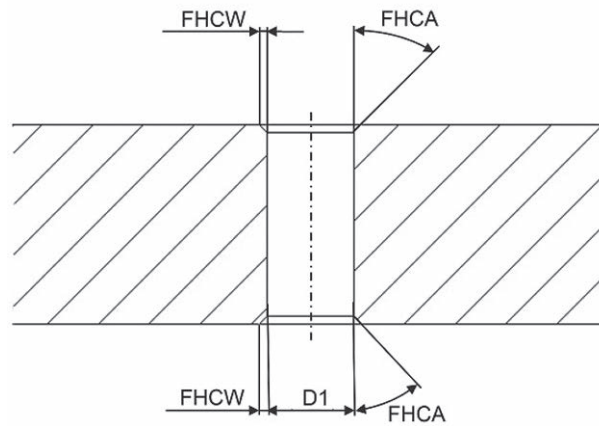


Figure 45 — Cylindrical fixing hole

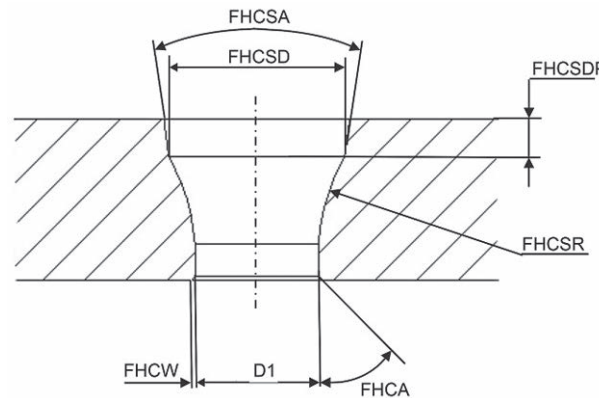


Figure 46 — Partly cylindrical fixing hole, insert mounting style code 3 or 4

5.4.2 Fixing hole model

The model shall be designed by revolving a sketch 360 about its axis and locating it on the MCS of the insert. The sketch need not contain any proprietary information, but shall be as detailed as necessary for mounting information. The height of the model is dependent on the property “insert thickness” or the property “insert thickness total”. The fixing hole insert mounting style code can also be valid for inserts having the countersunk geometry on both sides. See letter symbol “Q”, “U”, “C”, or “J” in Table 6 of ISO 1832:2012.

5.5 Insert thickness total

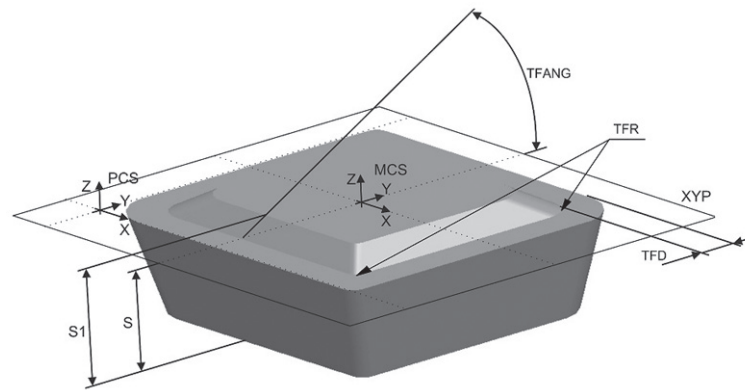
Typically, the “insert thickness total” (S1) is identical to the “insert thickness” (S). There are inserts available with a top face above the cutting edge, in which case a top face shall be designed and added to the insert model, but the original location shall be kept – no change on PCS and MCS. Therefore, three additional properties are necessary.

Table 9 — Top face properties

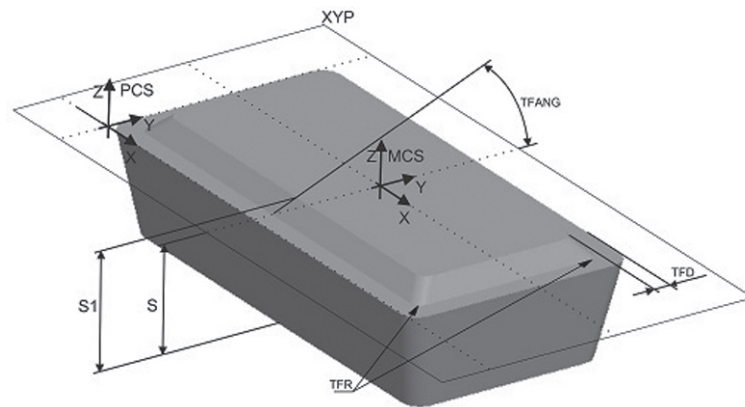
Preferred name	Preferred symbol
top face distance	TFD
top face rounding	TFR
top face rake angle	TFANG

The distance from the cutting edge shall be defined with TFD as shown in [Figures 47, 48, and 49](#).

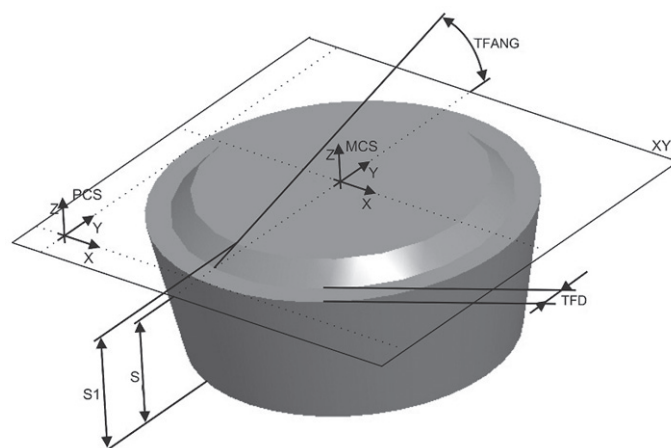
NOTE Only one figure for each insert class is shown as example.



**Figure 47 — Top face of “equiangular and equilateral” insert**



**Figure 48 — Top face of “equiangular but non-equilateral” insert**



**Figure 49 — Top face of round insert**

## 6 Attributes of surfaces — visualization of the model features

The colour attributes of surfaces shall be according to ISO/TS 13399-80.

## 7 Structure of design elements (tree of model)

### 7.1 General

The solid body of a regular insert shall be named as “cutting part” and included in the group “CUT”.

The insert shall be designed in a simplified manner, resulting in an approximate cutting edge. From this approximate cutting edge, a cutting edge line shall be created with the appropriate CAD function. This cutting edge line can be either an open or a closed polyline.

The group “DETAILS” is not necessary if the CAD system allows suppression of the detailed geometry of the regular insert, depending on the parameters and design elements.

### 7.2 Examples of the model structure

Three different structures are possible:

- for “equilateral and equiangular” and “equilateral but non-equiangular” inserts (see [5.1](#));
- for “non-equilateral but equiangular” and “non-equilateral and non-equiangular” inserts (see [5.2](#));
- for round inserts (see [5.3](#)).

[Figures 50](#), [51](#), and [52](#) show a possible structure of each of the classes mentioned above.



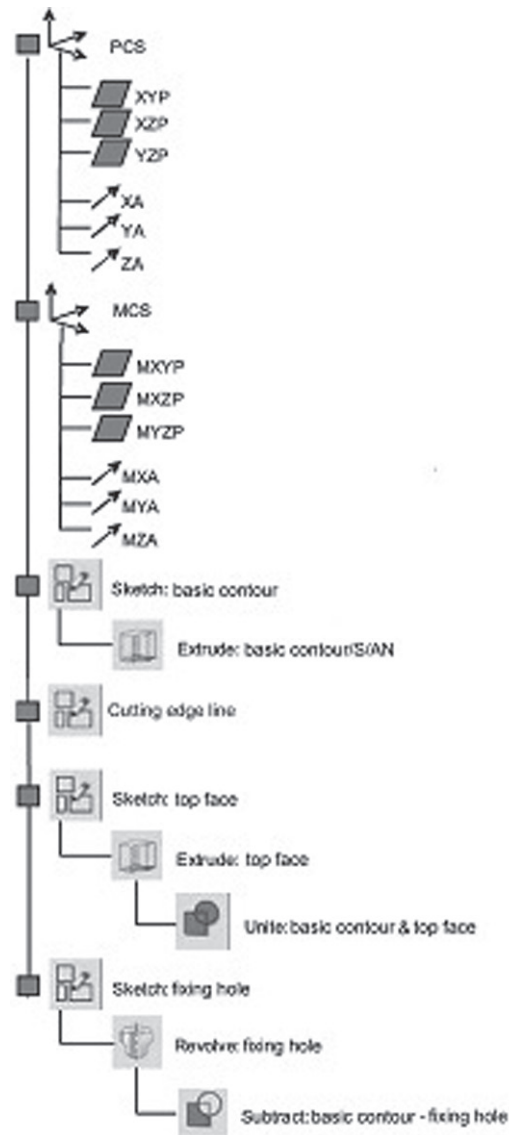


Figure 50 — Example structure of “equilateral and equiangular” and “equilateral but non-equiangular” inserts

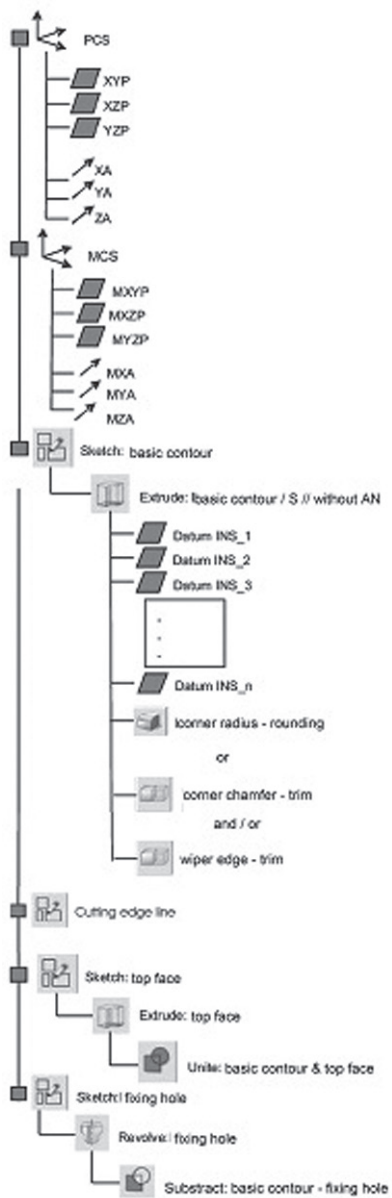


Figure 51 — Example structure of “non-equilateral but equiangular” and “non-equilateral and non-equilateral” inserts

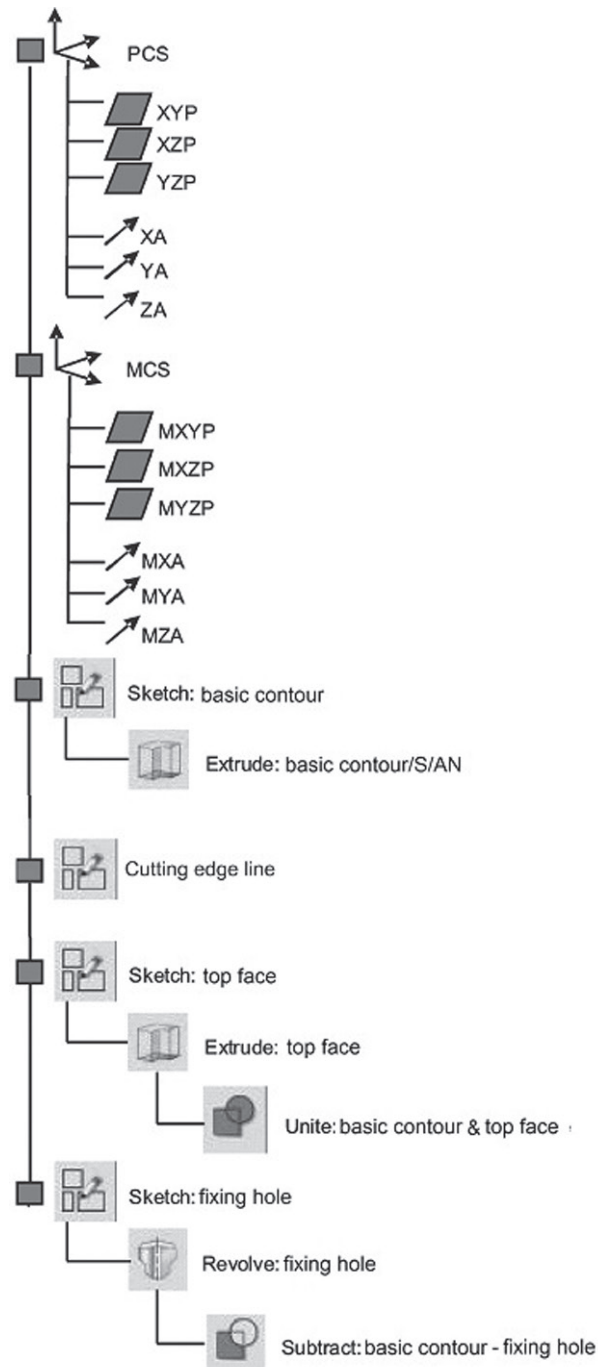
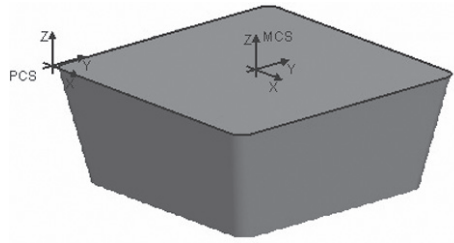


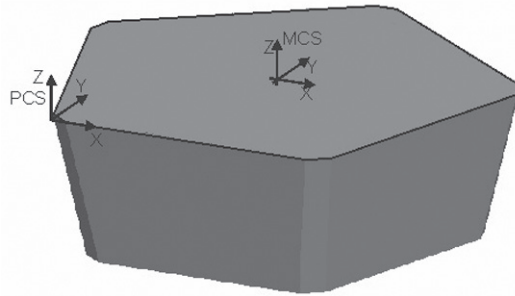
Figure 52 — Example structure of round inserts

## 8 Data exchange model

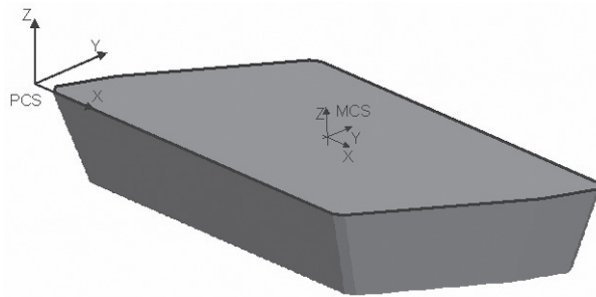
Models for the three main classes of inserts (see [5.1](#), [5.2](#), [5.3](#)) for data exchange are illustrated in [Figures 53](#) to [55](#). Models shall contain the geometrical features, primary coordinate system “PCS”, mounting coordinate system “MCS” and the cutting edge line.



**Figure 53 — Square insert with corner radius**



**Figure 54 — Pentagonal insert with corner chamfer**



**Figure 55 — Parallelogram non-equilateral shaped insert with wiper edge and corner chamfer**

## Annex A (informative)

### Information about nominal dimensions

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

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

**Table A.1 — Examples of nominal dimensions/sizes**

Description	Value	Tolerance	Lower limit	Upper limit	Nominal dimension/size
Morse taper size 5	MT5	—	—	—	5
Internal diameter	∅ 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 883, *Indexable hardmetal (carbide) inserts with rounded corners, without fixing hole — Dimensions*
- [2] ISO 3364, *Indexable hardmetal (carbide) inserts with rounded corners, with cylindrical fixing hole — Dimensions*
- [3] ISO 3365, *Indexable hardmetal (carbide) inserts with wiper edges, without fixing hole — Dimensions*
- [4] ISO 6987, *Indexable hard material inserts with rounded corners, with partly cylindrical fixing hole — Dimensions*
- [5] ISO 9361-1, *Indexable inserts for cutting tools — Ceramic inserts with rounded corners — Part 1: Dimensions of inserts without fixing hole*
- [6] ISO 9361-2, *Indexable inserts for cutting tools — Ceramic inserts with rounded corners — Part 2: Dimensions of inserts with cylindrical fixing hole*
- [7] ISO 10910, *Classification and designation of approximate chip control zones for indexable inserts with chipbreakers*
- [8] ISO 13399-1, *Cutting tool data representation and exchange — Part 1: Overview, fundamental principles and general information model*
- [9] ISO 16462, *Cubic boron nitride inserts, tipped or solid — Dimensions, types*
- [10] ISO 16463, *Polycrystalline diamond inserts, tipped — Dimensions, types*
- [11] ISO/TS 13399-3, *Cutting tool data representation and exchange — Part 3: Reference dictionary for tool items*
- [12] ISO/TS 13399-4, *Cutting tool data representation and exchange — Part 4: Reference dictionary for adaptive items*
- [13] ISO/TS 13399-5, *Cutting tool data representation and exchange — Part 5: Reference dictionary for assembly items*
- [14] ISO/TS 13399-50, *Cutting tool data representation and exchange — Part 50: Reference dictionary for reference systems and common concepts*
- [15] ISO/TS 13399-60, *Cutting tool data representation and exchange — Part 60: Reference dictionary for connection systems*



