PD ISO/TS 13399-202:2015

BSI Standards Publication

Cutting tool data representation and exchange

Part 202: Creation and exchange of 3D models — Irregular inserts

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A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 81566 9

ICS 25.100.01; 35.240.50

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 August 2015.

Amendments issued since publication

Date	Text affected

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Full document details: PD ISO/TS 13399-202:2015

TECHNICAL SPECIFICATION

ISO/TS 13399-202

First edition
2015-08-15

Cutting tool data representation and exchange —

Part 202: Creation and exchange of 3D models — Irregular inserts

Représentation et échange des données relatives aux outils coupants —

Partie 202: Création et échange de modèles 3D — Plaquettes irrégulières

Reference number
ISO/TS 13399-202:2015(E)

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CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
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Contents

Page

Foreword ... **iv**
Introduction ... **vi**
1 Scope ... **1**
2 Normative references ... **1**
3 Starting elements, coordinate systems, planes ... **1**
3.1 General ... 1
3.2 Reference system ... 2
3.3 Coordinate system ... 2
3.3.1 General ... 2
3.3.2 Coordinate system for insert location ... 2
3.3.3 Coordinate system for insert mounting ... 3
3.4 Planes ... 4
4 Design of the model ... **4**
5 Geometrical determination of the insert ... **4**
5.1 Basic shapes of the cutting profile ... 4
5.2 Necessary properties ... 7
5.2.1 Necessary properties for the design of the cutting profile ... 7
5.2.2 Necessary properties for the design of the insert body ... 8
5.3 Design of the cutting profile ... 9
6 Inserts for grooving and parting ... **10**
6.1 Necessary properties for the profile of grooving and parting inserts ... 10
6.2 Insert, one cutting edge for grooving, screw mounting ... 11
6.3 Insert, one cutting edge for grooving and parting, self-clamping ... 14
6.4 Insert, two cutting edges for grooving and parting, self-clamping ... 15
6.5 Insert, two cutting edges for parting, self-clamping ... 17
6.6 Insert, two cutting edges for profiling and partial threading ... 19
6.7 Insert, two cutting edges for profiling ... 21
6.8 Insert, multiple cutting edges for grooving and parting ... 23
7 Inserts for threading ... **25**
7.1 Necessary properties for the profile of threading inserts ... 25
7.2 Lay-down threading insert, triangle shape, three cutting edges, one tooth ... 26
7.3 Lay-down threading insert, triangle shape, three cutting edges, three teeth ... 28
7.4 Threading insert with two cutting edges ... 31
7.5 Thread chaser ... 32
8 Fixing hole geometry of the inserts ... **34**
8.1 General ... 34
8.2 Fixing hole styles ... 36
8.3 Fixing hole model ... 36
9 Attributes of surfaces — Visualization of the model features ... **37**
10 Structure of the design elements (tree of model) ... **37**
10.1 General ... 37
11 Data exchange model ... **38**
Bibliography ... **39**

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 29, *Small tools*.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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— *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* [Technical Specification]

— *Part 70: Graphical data layout — Layer settings for tool designs* [Technical Specification]

— *Part 71: Graphical data layout — Creation of documents for the standardized data exchange — Graphical product information* [Technical Specification]

— *Part 72: Creation of documents for the standardized data exchange — Definition of properties for drawing header and their XML-data exchange* [Technical Specification]

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

— *Part 303: Creation and exchange of 3D models — Solid end mills* [Technical Specification]

— *Part 304: Creation and exchange of 3D models — Solid milling cutter with arbor hole [Technical Specification]*

— *Part 307: Creation and exchange of 3D models — End mills for indexable inserts* [Technical Specification]

— *Part 308: Creation and exchange of 3D models — Milling 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]

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Introduction

This part of ISO 13399 defines the concept, terms and definitions regarding the creation and exchange of simplified 3D models of irregular 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.

An irregular 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/TC 184/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/TC 184/SC4/WG 2, *Standard for the neutral representation of standard parts* and IEC/TC 3, *Information structures, documentation and graphical symbols*, SC 3D, *Product properties and classes and their identification*, and in its extensions defined in ISO 13584-24 and ISO 13584-25.

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Cutting tool data representation and exchange —

Part 202: Creation and exchange of 3D models — Irregular inserts

1 Scope

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

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

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

— definitions and identification of the internal structure of the 3D model that represents the features and the properties of irregular inserts.

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

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

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

— creation and exchange of simplified 3D models for tool items;

— creation and exchange of simplified 3D models for other cutting items not described in this part of ISO 13399;

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

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

2 Normative references

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

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

ISO 10303-242, *Industrial automation systems and integration — Product data representation and exchange — Part 242: Application protocol: Managed model-based 3D engineering*

ISO/TS 13399-80, *Cutting tool data representation and exchange — Part 80: Creation and exchange of 3D models — 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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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 the *primary coordinate system* (PCS);

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

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

3.3 Coordinate system

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 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 cutting profile points in the negative Y direction

— the forward extremity of the cutting profile is on the positive x-axis

— the side extremity of the insert is on the positive y-axis

— the direction of the insert thickness is parallel to the negative z-axis

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

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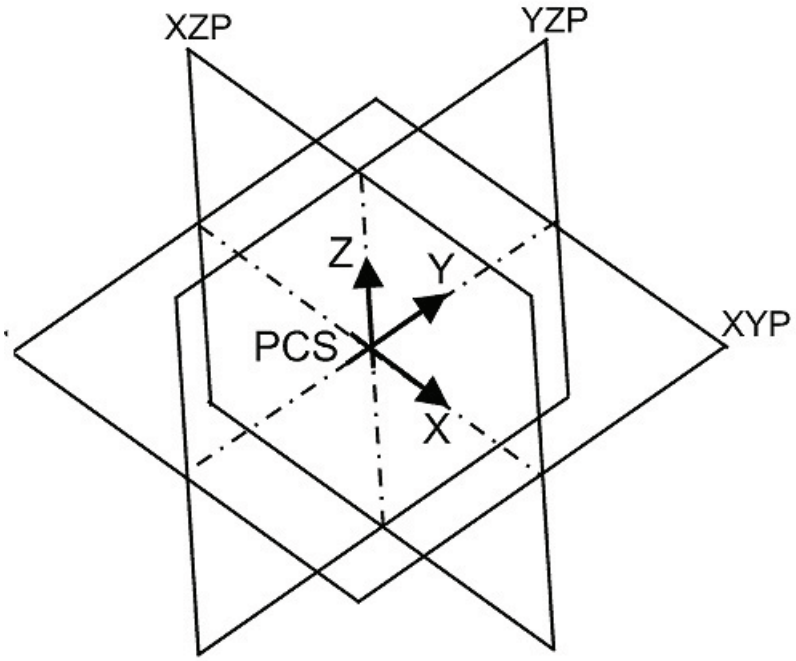

Figure 1 — Reference system PCS

3.3.3 Coordinate system for insert mounting

Due to the very different shapes of the irregular inserts, the location of the mounting coordinate system (MCS) will be defined in the appropriate clauses individually.

The MCS shall have the same orientation as the PCS.

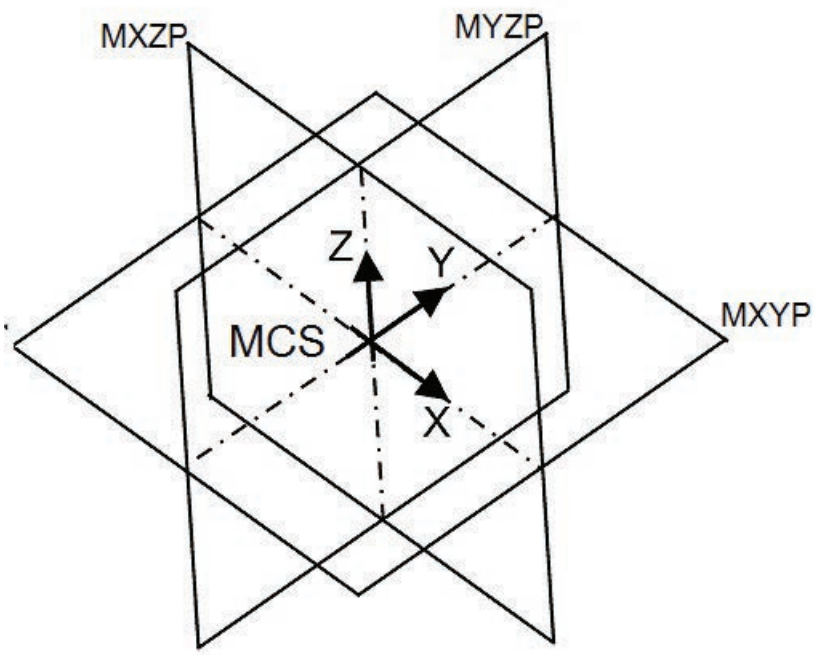

Figure 2 — Mounting coordinate system (MCS) — Orientation

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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

Due to the high variety of the designs of the basic shapes of irregular inserts, it is not possible to create design guidelines for this object group. The shapes of the irregular inserts are at the manufacturers discretion, but the manufacturers shall supply the geometrical data as a 3D file with the format in accordance with ISO 10303-242, which replaced ISO 10303-214, well known as the STEP AP 214 file. The level of detail shall be provided either with modifications to the native 3D file or with a newly designed simplified model, e.g. the chip former removed, if it is classified as propriety information. In any case, the cutting edge line shall be part of the exchange model.

For irregular inserts the basic shapes of the profile style is illustrated in Clause 5.

5 Geometrical determination of the insert

5.1 Basic shapes of the cutting profile

Example cutting profiles are shown in Figure 3.

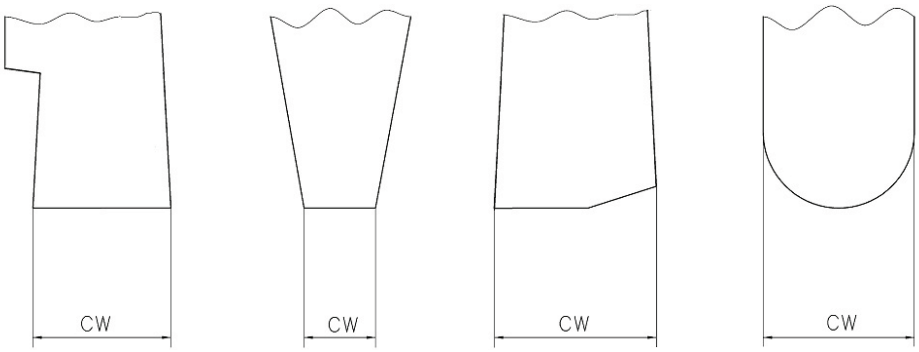

Figure 3 — Nominal dimension of the cutting width

Figure 4 shows the determination of thread pitch and profile included angle.

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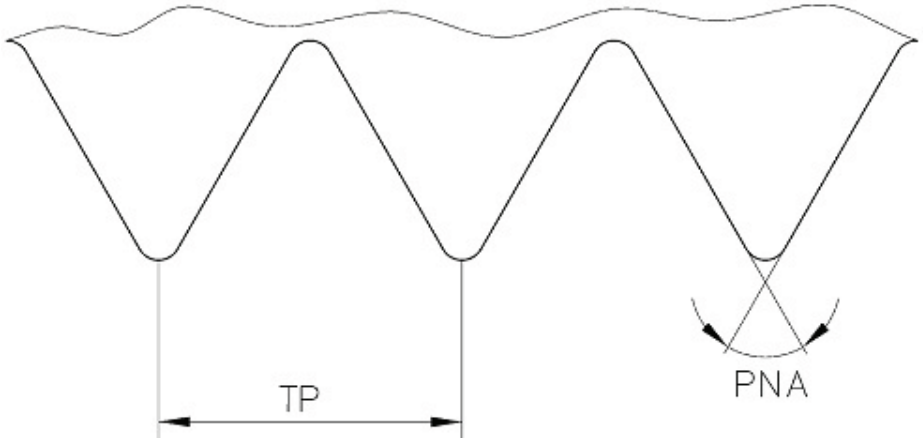

Figure 4 — Thread pitch

The properties for threads per inch (TPI) can be applied for inch threads. If the cutting profile is to be used as partial thread form for a range of thread pitches, the properties thread pitch minimum (TPN), thread pitch maximum (TPX), threads per inch minimum (TPIN) and threads per inch maximum (TPIX) shall be added to the list of properties.

Figure 5 shows the properties defining the profile angle right hand, profile angle left hand and their respective clearance angles.

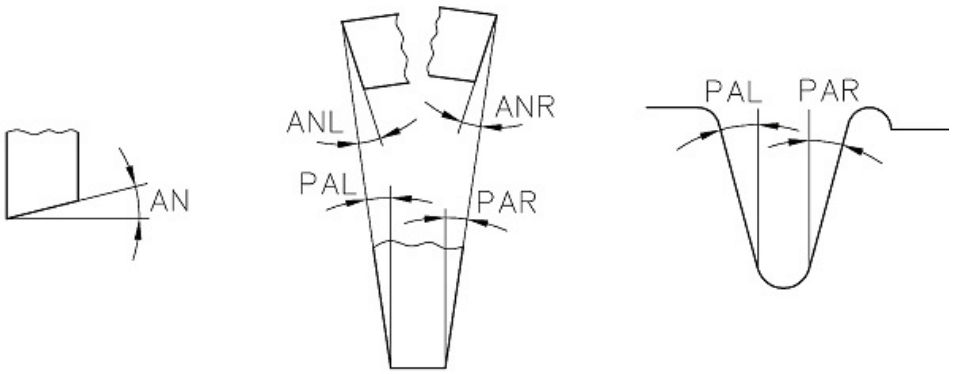

Figure 5 — Relief angle, clearance angle major cutting edge, relief clearance angle

In Figure 6 the properties defining the profile distances in X- and Y- direction to the origin point and the profile depth are shown.

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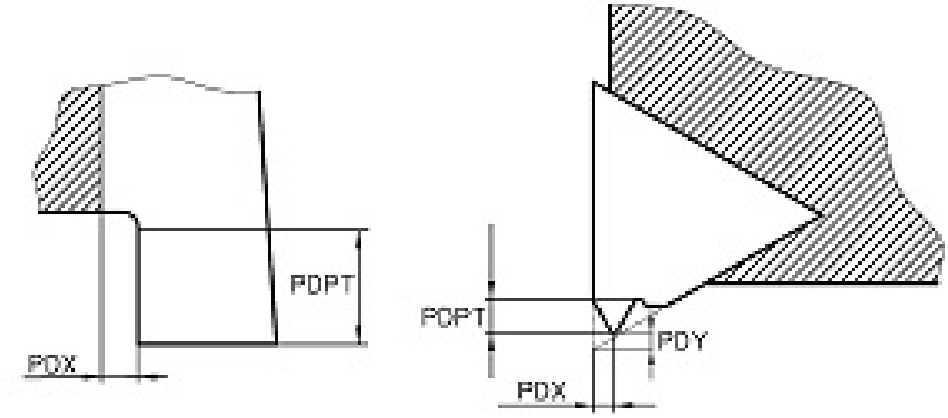

Figure 6 — Profile depth, profile distance x, profile distance y

Figure 7 illustrates the relief angles on the cutting profile as well as the both possible directions of the major cutting edge angle, if the angle is not perpendicular to the primary feed direction.

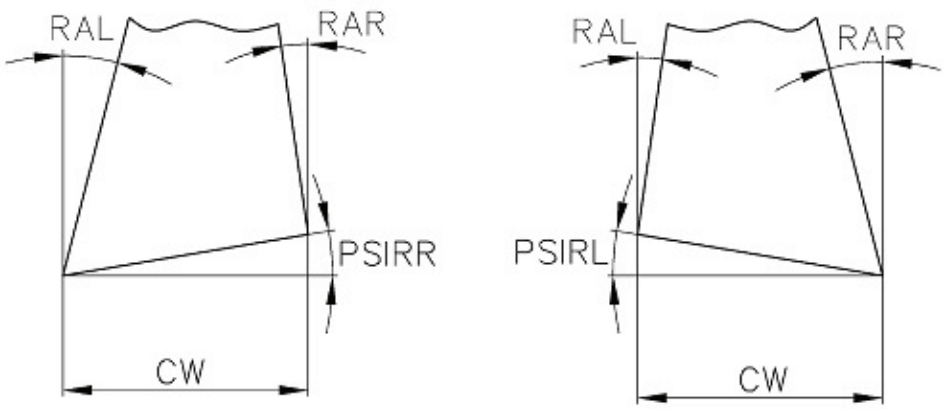

Figure 7 — Major cutting edge angle

The possible profiles of an irregular insert can have either roundings or chamfers on each corner. Figures 8, 9 and 10 show the graphical definition of the appropriate properties.

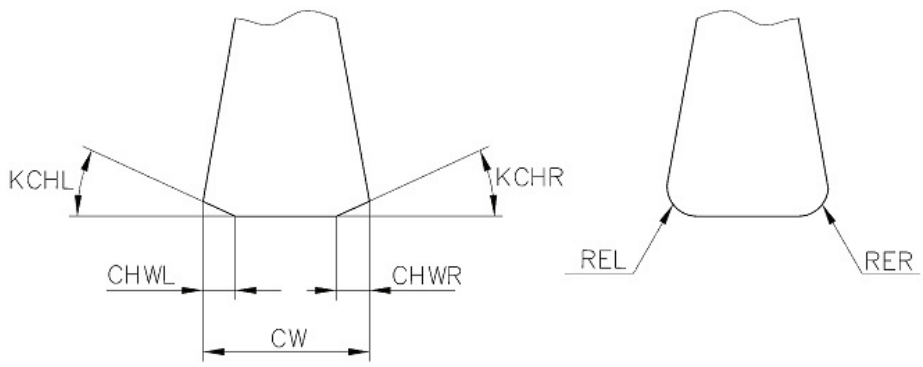

Figure 8 — Corner chamfer width, corner chamfer angle, corner radius

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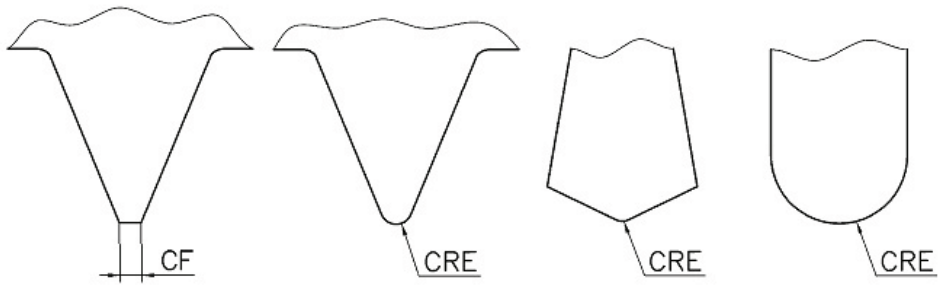

Figure 9 — Spot chamfer, spot radius

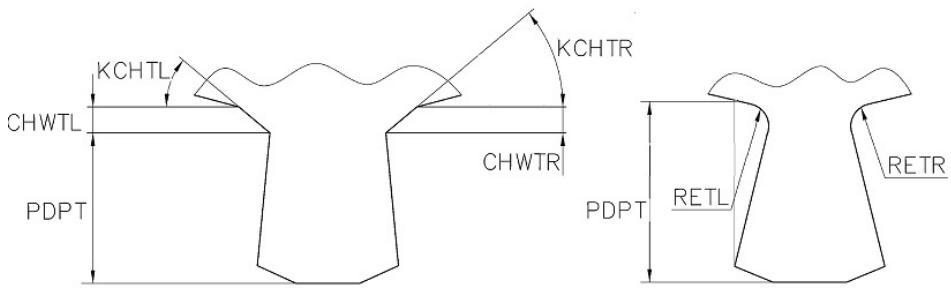

Figure 10 — Flank chamfer angle, flank chamfer width, flank radius, profile depth

5.2 Necessary properties

5.2.1 Necessary properties for the design of the cutting profile

To design the cutting profile of an irregular insert, properties in Table 1 shall be applied to the simplified model.

Table 1 — Properties for the modelling of cutting profiles on irregular inserts

Preferred name	Preferred symbol
Clearance angle major	AN
Clearance angle flank left hand	ANL
Clearance angle flank right hand	ANR
Spot chamfer	CF
Corner chamfer width left hand	CHWL
Corner chamfer width right hand	CHWR
Flank chamfer width left hand	CHWTL
Flank chamfer width right hand	CHWTR
Spot radius	CRE
Cutting width	CW
Corner chamfer angle left hand	KCHL
Corner chamfer angle right hand	KCHR
Flank chamfer angle left hand	KCHTL

[a] Property "threads per inch-TPI" shall be used for the calculation of the distance between two equivalent thread flanks of a non-metric thread that does not use the property "thread pitch-TP" to design the thread profile.

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