TECHNICAL SPECIFICATION

ISO/TS 13399-3

Second edition
2014-02-15

Cutting tool data representation and exchange —

Part 3: Reference dictionary for tool items

Représentation et échange des données relatives aux outils coupants —

Partie 3: Dictionnaire de référence pour les éléments relatifs aux outils

Reference number
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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*.

This second edition cancels and replaces the first edition (ISO/TS 13399-3:2007), which has been technically revised.

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

— *Part 150: Usage guidelines* [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 80: Concept for the design of 3D models based on properties according to* ISO 13399*: Overview and principles* [Technical Specification]
- *Part 201: Concept for the design of 3D models based on properties according to* ISO/TS 13399-2*: Modelling of regular inserts* [Technical Specification]
- *Part 202: Concept for the design of 3D models based on properties according to* ISO/TS 13399-2*: Modelling of irregular inserts* [Technical Specification]
- *Part 203: Concept for the design of 3D models based on properties according to* ISO/TS 13399-2*: Modelling of exchangeable inserts for drilling* [Technical Specification]
- *Part 204: Concept for the design of 3D models based on properties according to* ISO/TS 13399-2*: Modelling of inserts for reaming* [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 non-indexable 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 non-indexable cutting edges* [Technical Specification]
- *Part 307: Concept for the design of 3D models based on properties according to* ISO/TS 13399-3*: Modelling of end mills for indexable inserts* [Technical Specification]
- *Part 308: Concept for the design of 3D models based on properties according to* ISO/TS 13399-3*: Modelling of milling cutter with arbor hole for indexable inserts* [Technical Specification]
- *Part 309: Concept for the design of 3D models based on properties according to* ISO/TS 13399-3*: Tool holders for indexable inserts* [Technical Specification]
- *Part 311: Concept for the design of 3D models based on properties according to* ISO/TS 13399-3*: Modelling of solid reamers* [Technical Specification]
- *Part 312: Concept for the design of 3D models based on properties according to* ISO/TS 13399-3*: Modelling of reamers for indexable inserts* [Technical Specification]
- *Part 401: Concept for the design of 3D models based on properties according to* ISO/TS 13399-4*: Modelling of converting, extending and reducing adaptive items* [Technical Specification]
- *Part 405: Concept for the design of 3D models based on properties according to* ISO/TS 13399-4*: Modelling of collets* [Technical Specification]

Introduction

This part of ISO 13399 defines the terms, properties, and definitions for those portions of a cutting tool that support one or more cutting items with defined cutting edges. Tool items include, but are not limited to, turning tools, milling tools, drilling tools, threading tools, etc. The purpose of this part of ISO 13399 is to provide a reference dictionary to support the use of the general information model defined in ISO 13399-1.

A cutting tool with defined cutting edges is used on 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 (all parts) include, but are not limited to, everything between the workpiece and the machine tool. Information about inserts (e.g. regular and irregular shaped replaceable cutting items), solid tools (e.g. solid drill and endmill), assembled tools (e.g. boring bars, indexable drills, and indexable milling cutters), adaptors (e.g. milling arbor and drilling chuck), components (e.g. shims, screws, and clamps), and their relationships can be represented by ISO 13399 (all parts). Possible assemblies of the components of a cutting tool are illustrated in Figure 1.

The objective of ISO 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 used for these representations are those developed by ISO/TC 184/SC 4 for the representation of product data by using standardized information models and reference dictionaries.

An information model is a formal specification of types, ideas, facts, and processes which together describe a portion of interests of the real world and which provides an explicit set of interpretation rules. Information is knowledge of ideas, facts, and/or processes. Data are symbols or functions that represent information for processing purposes. Data are interpreted to extract information by using rules for how that should be done and a dictionary to define the terms that identify the data items. Everyone in a communication process is expected to use the same information model, the same set of explicit rules, and the same dictionary in order to avoid misunderstanding. If an information model and its dictionary are written in a computer-sensible language, then there is the additional benefit that they can be computer processable.

An engineering information model is therefore a specification for data that establishes the meaning of that data in a particular engineering context. A model has to be developed by formal methods to ensure that it meets the needs of the situation that it represents. An engineering information model defines the information objects that represent the concepts in an engineering application, the attributes of the objects, their relationships, and the constraints that add further meaning. An information model is an abstract concept that can be used repeatedly for any example of the real-world situation that it represents. An instance of the model is created when it is populated with the data items and their values that are applicable to a particular example of that situation.

This part of ISO 13399 uses the following International Standards developed by ISO/TC 184/SC 4:

— the EXPRESS language defined in ISO 10303-11 for defining the information model in ISO 13399-1;

— the file format for data exchange derived from the model and defined in ISO 10303-21;

— the data dictionary defined in the ISO 13584 series.

The ISO 13399 series is intended for use by, among others, tool producers and vendors, manufacturers, and developers of manufacturing software. ISO 13399 provides a common structure for exchanging

data about cutting tools with defined cutting edges. ISO 13399 is intended to provide for, or improve, several manufacturing activities, including

— the integration and sharing of data for cutting tools and assemblies between different stages of the manufacturing cycle and between different software applications,

— the direct import of data from cutting tool suppliers into a customer's database, and

— the management of cutting tool information from multiple sources and for multiple applications.

Different companies use different business models to determine their need for the communication of information about their products. For example, one cutting tool manufacturer can regrind its customers' tools while another could allow its customers to do the regrinding and provide the information to enable them to do so. Therefore, the two cutting tool manufacturers can have a different set of cutting tool properties to communicate using the information model and dictionaries provided in ISO 13399.

ISO 13399 defines only the information that could be communicated, but does not specify what information shall be communicated.

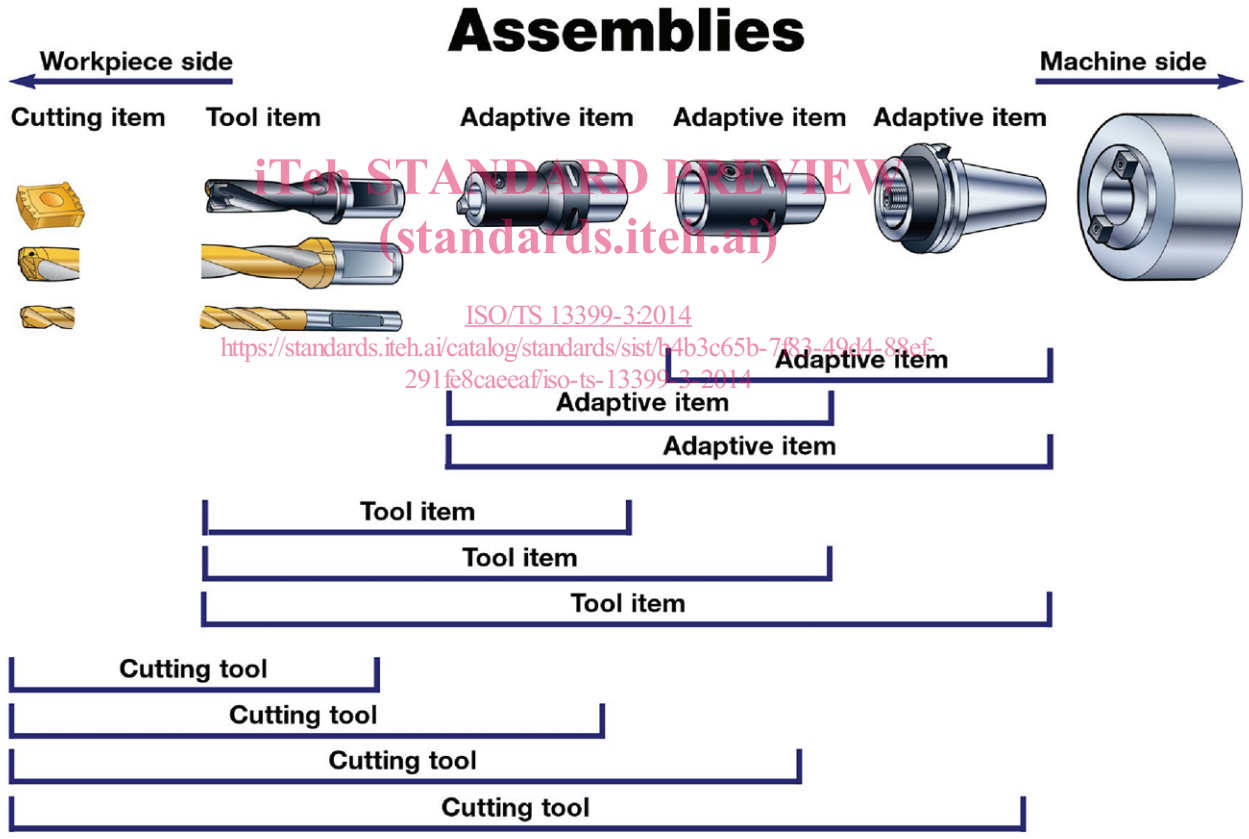

Figure 1 — Possible assemblies of the components of a cutting tool

Since the content of those dictionaries evolves according to industrial innovations and constant improvement of technology in cutting tools, a Maintenance Agency has been established for the purposes of

— correcting errors in the entries of existing classes and properties,

— adding new properties to existing classes,

— adding new classes and their properties,

— managing the status of those properties and classes, and

— migrating the dictionary to subsequent editions of ISO 13399 (all parts).

The secretariat of this Maintenance Agency has been assigned to

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by the ISO Technical Management Board.

The website of the Maintenance Agency is available at: http://www.unm.fr/main/core.php?pag_id=135

The reference dictionaries are available in the form of EXPRESS files on the website of the Maintenance Agency. These files are considered complementary to this part of ISO 13399; they can be freely downloaded and used for cutting tool data representation and exchange.

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Cutting tool data representation and exchange —

Part 3:
Reference dictionary for tool items

1 Scope

This part of ISO 13399 specifies a reference dictionary for tool items, together with their descriptive properties and domains of values.

This part of ISO 13399 specifies a reference dictionary containing:

— definitions and identifications of the classes of tool items and their features, with an associated classification scheme;

— definitions and identifications of the data element types that represents the properties of tool items and their features;

— definitions and identifications of domains of values for describing the above-mentioned data element types.

Each class, property, or domain of values of this application domain constitutes an entry of the reference dictionary defined in this part of ISO 13399. It is associated with a computer-sensible and human-readable definition, and with a computer-sensible identification. Identification of a dictionary entry allows unambiguous reference to it from any application that implements the information model defined in ISO 13399-1.

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 SC3D, and in its extensions defined in ISO 13584-24 and ISO 13584-25.

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

— standard data that represent the various classes of tool items and tool item features;

— standard data that represent the various properties of tool items and tool item features;

— standard data that represent domains of values used for properties of tool items and tool item features;

— definition of cutting operations;

— definitions of reference systems for tool items and their properties;

— one implementation method by which the standard data defined in this part of ISO 13399 can be exchanged.

NOTE 1 The implementation method by which the standard data defined in this part of ISO 13399 can be exchanged is specified in ISO 10303-21.

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

— specialized or expert knowledge in the design and use of cutting tools;

— rules to determine what information should be communicated;

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

— implementation methods other than the one defined in this part of ISO 13399 by which the standard data can be exchanged and referenced;

— information model for cutting tools;

— definitions of classes and properties for cutting items;

— definitions of classes and properties for adaptive items;

— definitions of classes and properties for assembly items;

— definitions of classes and properties for connection systems;

— definitions of classes and properties for reference systems.

NOTE 2 The information model for cutting tools is defined in ISO 13399-1.

NOTE 3 The definitions of classes and properties for cutting items, adaptive items, and assembly items are provided in ISO/TS 13399-2, ISO/TS 13399-4, and ISO/TS 13399-5, respectively.

NOTE 4 The definitions of classes and properties for connection systems and reference systems are provided in ISO/TS 13399-50.

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 13584-1:2001, *Industrial automation systems and integration — Parts library — Part 1: Overview and fundamental principles*

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/TS 13399-100:2008, *Cutting tool data representation and exchange — Part 100: Definitions, principles and methods for reference dictionaries*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/TS 13399-100 (structure and contents of the dictionary) and the following apply.

NOTE The main collection of the terms and their definitions that relate to adaptive items and their properties is provided in Annexes B to D.

3.1
applicable property
property that is defined for some family of items and that shall apply to any member of this family

[SOURCE: ISO 13584-24:2003]

3.2
basic semantic unit
entity that provides an absolute and universally unique identification of a certain object of the application domain that is represented as a dictionary element

[SOURCE: ISO 13584-42:2010, 3.4]

3.3
chip
material removed from a workpiece by a cutting process

[SOURCE: ISO/TS 13399-2:2014, 3.3]

3.4
cutting tool
device or assembly of items for removing material from a workpiece through a shearing action at the defined cutting edge or edges of the device

[SOURCE: ISO 13399-1:2006, 3.1]

Note 1 to entry: A cutting tool could be an assembly of one or more adaptive items, a tool item, and several cutting items on a tool item. See Figure 1.

3.5
data
representation of information in a formal manner suitable for communication, interpretation, or processing by human beings or computers

[SOURCE: ISO 10303-1:1994, 3.2.14]

3.6
data element type
unit of data for which the identification, description, and value representation have been specified

[SOURCE: ISO 13584-42:2010, 3.13]

3.7
data exchange
storing, accessing, transferring, and archiving of data

[SOURCE: ISO 10303-1:1994, 3.2.15]

3.8
data type
domain of values

[SOURCE: ISO 10303-11:2004, 3.3.5]

3.9
dictionary
table consisting of a series of entries with one meaning corresponding to each entry in the dictionary and one dictionary entry identifying a single meaning

[SOURCE: ISO 13584-511:2006, 3.1.9]

Note 1 to entry: In the ISO 13399 series, a dictionary is a formal and computer-sensible representation of ontology.

3.10
entity
class of information defined by its attributes that establishes a domain of values defined by common attributes and constraints

[SOURCE: ISO/TS 13399-2:2014, 3.10]

3.11
entity data type
representation of an entity

[SOURCE: ISO/TS 13399-2:2014, 3.11]

3.12
entity instance
named unit of data that represents a unit of information within the class defined by an entity

Note 1 to entry: An entity instance is a member of the domain established by an entity data type.

[SOURCE: ISO/TS 13399-2:2014, 3.12]

3.13
family of products
set of products represented by the same characterization class

[SOURCE: ISO 13584-42:2010, 3.16]

3.14
implementation method
means for computers to exchange data

[SOURCE: ISO/TS 13399-2:2014, 3.14]

3.15
information
facts, concepts, or instructions

[SOURCE: ISO 10303-1:1994, 3.2.20]

3.16
information model
formal model of a bounded set of facts, concepts, or instructions to meet a specific requirement

[SOURCE: ISO 10303-1:1994, 3.2.21]

3.17
machine side
identification of a direction pointing towards the machine

3.18
machined surface
desired surface produced by the action of the cutting tool

[SOURCE: ISO 3002-1:1982, 3.1.2]

3.19
mirror plane
xz-plane in the coordinate axis system

[SOURCE: ISO/TS 13399-50:2013, 5.3.7]

3.20
ontology
explicit and consensual specification of concepts of an application domain independent of any use of these concepts

[SOURCE: ISO 13584-511:2006, 3.1.20]

Note 1 to entry: In the ISO 13399 series, a dictionary is the formal and computer-sensible representation of ontology.

3.21
primary coordinate system
right-handed rectangular Cartesian coordinate system in three-dimensional space with three principal axes labelled X, Y, X

[SOURCE: ISO/TS 13399-50:2013, 5.3.1]

3.22
property
defined parameter suitable for the description and differentiation of products

[SOURCE: ISO 13584-42:2010, 3.37]

3.23
transient surface
part of the surface which is formed on the workpiece by the cutting edge and removed during the following cutting stroke, during the following revolution of the tool or workpiece, or by the following cutting edge

[SOURCE: ISO 3002-1:1982, 3.1.3]

3.24
visible property
property that has a definition meaningful in the scope of a given characterization class, but that does not necessarily apply to the various products belonging to this class

[SOURCE: ISO 13584-42:2010, 3.46]

3.25
workpiece
object on which a cutting action is performed

[SOURCE: ISO/TS 13399-2:2014, 3.24]

3.26
workpiece side
identification of a direction pointing towards the workpiece

3.27
xy-plane
plane in the coordinate axis system that contains the X and Y axes with the normal of the plane in the positive Z direction

[SOURCE: ISO/TS 13399-50:2013, 5.3.18]

3.28
xyw-plane
plane in the coordinate axis system related to the xy-plane by the rotation angle PHI about the X axis in an anticlockwise (counter clockwise) direction and by a distance located at a distance XYWD from the origin of the coordinate axis system

[SOURCE: ISO/TS 13399-50:2013, 5.3.19]

3.29
xz-plane
plane in the coordinate axis system that contains the X and Z axes with the normal of the plane in the positive Y direction

[SOURCE: ISO/TS 13399-50:2013, 5.3.20]

3.30
xzw-plane
plane in the coordinate system related to the xz-plane by the rotation angle KAPPA about the *Z* axis in a counter clockwise direction and located at a distance XZWD from the origin of the primary coordinate system

[SOURCE: ISO/TS 13399-50:2013, 5.3.21]

3.31
yz-plane
plane in the coordinate system that contains the Y and Z axes with the normal of the plane in the positive X direction

[SOURCE: ISO/TS 13399-50:2013, 5.3.22]

3.32
yzw-plane
plane in the coordinate system related to the yz-plane by the rotation angle RHO about the Y axis in a counter clockwise direction and located at a distance YZWD from the origin of the primary coordinate system

[SOURCE: ISO/TS 13399-50:2013, 5.3.23]

Note 1 to entry: The xzw-plane, the xyw-plane, and the yzw-plane are mutually perpendicular.

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

BSU basic semantic unit

DET data element type

5 Representation of the ontology concepts as dictionary entries

5.1 General

In the following subclauses, a concept in the ontology is identified by a name in lower-case characters. The name of a class that represents the concept in the dictionary is identified by bold, lowercase characters with multiple words joined by an underscore character.

EXAMPLE "tool item type" is the name of a concept in the ontology. **tool_item_type** is the identifier of the class in the dictionary that represents the concept.

Data for tool items are grouped into two main classes: **tool_item_feature** and **tool_item_type**. The items in the classification of **tool_item_type** are identified by a label that is derived from the main application of a tool. However, it should be recognized that a tool can be used for more than one type of cutting operation. A **tool_item_feature** is an aspect of a **tool_item_type** that could not exist in isolation from the **tool_item_type**. A classification of cutting operations is also provided for completeness and to aid definitions.

Some of the definitions of properties that are applicable to tool items are defined in terms of a primary coordinate system. The coordinate system is the same for adaptive items, cutting items, and tool items and is defined in ISO/TS 13399-50. The applications of this coordinate system to tool items are described in this part of ISO 13399. All functional dimensions of a tool item that uses replaceable cutting items are defined on the assembly of the tool item and the master insert. The convention followed is "the tool in hand".

Each entry in the dictionary, either a class or a property, is identified with a numerical code (BSU) that is generated at random when the dictionary is compiled. A BSU can be made unique by the addition of a code that is a reference to the supplier of the dictionary. Each classified item in 5.2, 5.3, and 5.4 is associated with its definition from the dictionary.

The structure of the classification is summarized in Annex B. The complete definitions of the tool item classes are provided in Annex C. The properties applicable to tool item classes are defined in Annex D.

5.2 Reference systems for tool items

The primary coordinate system used for tool items in this part of ISO 13399 is the same coordinate system as is defined in ISO/TS 13399-50. The additional reference entities relevant for tool items are as follows:

— **cutting_reference_point**;

— **feed_direction_primary**;

— **master_insert**;

— **prismatic_tool_item_position**;

— **round_tool_item_position**;

— **tool_cutting_edge_plane**;

— **tool_feed_plane**;

— **tool_rake_plane**.

5.2.1 cutting_reference_point is the theoretical sharp point of the cutting tool from which the major functional dimensions are taken.

NOTE 1 For the calculation of this point the following cases apply:

Case 1: For a tool cutting edge angle less than or equal to 90°, the point is the intersection of the **tool_cutting_edge_plane**, the **tool_feed_plane**, and the **tool_rake_plane**.

Case 2: For a tool cutting edge angle greater than 90°, the point is the intersection of the **tool feed_plane**, a plane perpendicular to the **tool_feed_plane** and tangential to the cutting corner, and the **tool_rake_plane**.

Case 3: For ISO tool styles D and V with only axial rake, the point is the intersection of a plane perpendicular to the primary feed direction and tangential to the cutting edge (tangential point), a plane parallel to the feed direction through the tangential point, and the **tool_rake_plane**.

Case 4a: For round inserts with one feed direction parallel to the tool axis, the point is the intersection of a plane perpendicular to the primary feed direction and tangential to the cutting edge (tangential point), a plane parallel to the feed direction through the tangential point, and the **tool_rake_plane**.

Case 4b: For round inserts with two feed directions, one parallel to the tool axis and one perpendicular to the tool axis with two **cutting_reference_point**, each point is the intersection of a plane perpendicular to its feed direction and tangential to the cutting edge (tangential point), a plane parallel to the feed direction through the tangential point, and the **tool_rake_plane**.

NOTE 2 In Case 3, the theoretical sharp corner of the insert and the **cutting_reference_point** are on the plane that is perpendicular to the **tool_feed_plane**.

5.2.2 feed_direction_primary is the direction of movement of a cutting tool to achieve the main cutting function of the tool.

5.2.3 master_insert is a nominal, replaceable cutting item that is used for defining the dimensions of a cutting tool.