GUIDE 77-3

Guide for specification of product properties and classes —

Part 3: Experience gained

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Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

Draft Guides adopted by the responsible Committee or Group are circulated to the member bodies for voting. Publication as a Guide requires approval by at least 75 % of the member bodies casting a vote.

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ISO/IEC Guide 77-3 was prepared by the Joint Technical Advisory Group of the ISO Technical Management Board and the IEC Standardization Management Board on product properties and families.

ISO/IEC Guide 77 consists of the following parts, under the general title *Guide for specification of product properties and classes*:

— *Part 1: Fundamental benefits*

— *Part 2: Technical principles and guidance*

— *Part 3: Experience gained*

Introduction

This part of ISO/IEC Guide 77 contains a number of experience reports about the development of reference dictionaries. It contains examples from ISO/TC 29 (on cutting tools), ISO/TC 184/SC 4 (on instrumentation and fasteners), and IEC/SC 3D (on the IEC reference dictionary).

The **common ISO 13584/IEC 61360 dictionary model** (2.1) and the methodology as described in ISO/IEC Guide 77-1 and ISO/IEC Guide 77-2 have been used and are being used as the basis for the development of reference dictionaries. To support future developers of reference dictionaries, this part of ISO/IEC Guide 77 describes the experiences gained in some projects over the last few years. The experiences reported are based on work from different standardization committees. The aim of this part of ISO/IEC Guide 77 is to give practical information, such as the following:

a) Which kind of procedures have been adopted for the creation of the different reference dictionaries?

b) What basic decisions have been taken in the creation process?

c) How much effort has been spent on these projects?

d) How have the resources of the common ISO/IEC data model been used?

e) How will the reference dictionaries be maintained?

The following International Standards are used as examples:

— ISO 13399, a reference dictionary for cutting tools developed by ISO/TC 29/WG 34;

— IEC 61360, the reference dictionary of components within the electrotechnical domain developed by IEC/SC 3D;

— ISO 13584-501, an initial reference dictionary content of laboratory and environment measuring instruments to be registered into ISO 13584-501RA (Registration Authority), developed by ISO/TC 184/SC 4/WG 2;

— ISO 13584-511, a reference dictionary of fasteners developed by ISO/TC 184/SC 4/WG 2 with support from ISO/TC 2.

The examples provided contain a variety of different approaches, based on different starting points and goals. Due to these different approaches, the clauses in this part of ISO/IEC Guide 77 describing each of the individual projects are not structured in the same way. Rather than following a uniform structure, they emphasize those aspects which were important for their specific development process. To give an initial overview, key points and common and differentiating aspects have been summarized in Clause 3. Clauses 4 to 7 contain the detailed reports about the development projects.

NOTE In the context of this part of ISO/IEC Guide 77, the term “reference dictionary” is used to refer to the data dictionaries that have been built in the above-mentioned technical standardization committees on the basis of the data model defined in ISO 13584 and IEC 61360. In other communities (e.g. in the semantic Web world), such a reference dictionary would be seen as a special case of an ontology.

Guide for specification of product properties and classes —

Part 3:
Experience gained

1 Scope

This part of ISO/IEC Guide 77 provides general advice and guidance for the description of products and their characteristics by the use of ISO 13584 and IEC 61360 for the creation of computer processable product libraries, catalogues and reference dictionaries. This description will provide the details of the products and their properties in an unambiguous manner, capable of computer communication in a form that is independent of any proprietary application software. The term “product” is taken to include devices, processes, systems, installations, etc. This part of ISO/IEC Guide 77 is intended to assist in the objective of enabling the flow of technical information between internal and external business partners in a cost effective and timely manner.

The guidance in this part of ISO/IEC Guide 77 is intended to assist the following groups:

— convenors and members of ISO technical committees;

— technical experts contributing their knowledge to the development of reference dictionaries, data bases and product libraries;

— information experts responsible for the generation of applications of ISO 13584, particularly related to standardized reference dictionaries;

— managers and technical experts in the manufacturing industry.

This part of ISO/IEC Guide 77 is intended to provide practical information of the experience gained in the creation of product reference dictionaries within ISO and IEC. This part of ISO/IEC Guide 77 is intended for information only, in areas such as education.

The following are within the scope of this part of ISO/IEC Guide 77:

— experience of developing a reference dictionary for cutting tools;

— experience of developing a reference dictionary for electronic components;

— experience of creating a system for the maintenance of a reference dictionary for measuring instruments;

— experience of developing a reference dictionary for fasteners.

The following are outside the scope of this part of ISO/IEC Guide 77:

— an overview for ISO technical committees and industrial managers for the development of computer-processable product libraries, reference dictionaries and catalogues;

NOTE 1 An overview of the development of computer-processable product libraries, reference dictionaries and catalogues is provided in ISO/IEC Guide 77-1.

— technical guidance for the creation of product libraries and dictionaries.

NOTE 2 Technical guidance for the creation of product libraries and dictionaries is provided in ISO/IEC Guide 77-2.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
common ISO 13584/IEC 61360 dictionary model
data model for product ontology, using the information modelling language EXPRESS, resulting from a joint effort between ISO/TC 184/SC 4/WG 2 and IEC/SC 3D

[ISO/IEC Guide 77-2:—, 2.6]

2.2
is-a relationship
class inclusion relationship associated with inheritance

[ISO/IEC Guide 77-2:—, 2.9]

2.3
reference dictionary
product ontology compliant with the **common ISO 13584/IEC 61360 dictionary model** (2.1)

[ISO/IEC Guide 77-2:—, 2.21]

3 Overview

The initiators and drivers of the selected projects are quite different groups, as outlined below.

— ISO 13399 was developed by the leading manufacturers of cutting tools (AB Sandvik Coromant and Kennametal, Inc.).

— The IEC reference dictionary (IEC 61360) was initially based on the internal Philips model. Since 1989, the work has been handed over and further developed by the horizontal committee IEC/SC 3D in the IEC organization.

— ISO 13584-501 was developed in cooperation between an industrial association in Japan (JEMIMA, Japan Electric Measuring Instruments Manufacturers' Association) and a PLIB software provider (TOSHIBA Corporation).

— The fastener reference dictionary (ISO 13584-511) was developed by the Chinese National Institute of Standards with support of technical experts from China and from ISO/TC 2.

The reference dictionary of cutting tools supports an entity-relationship information model, which describes the assembly of the components of a modern cutting tool with defined cutting edges, whereas the other dictionaries are stand-alone reference dictionaries, which are not linked to an additional model.

The examples show different approaches to maintenance: ISO 13584-511 relies on the normal maintenance mechanisms defined for paper-based International Standards, whereas ISO 13399 and IEC 61360 have installed or will install a maintenance agency to maintain the **reference dictionary** (2.3) as a standard. The reference dictionary related to the maintenance procedure of ISO 13584-501 itself is not standardized. It is instead registered on behalf of ISO by a registration authority in accordance with maintenance procedures defined in ISO 13584-501. These procedures are similar to the procedures defined by IEC.

All projects were truly interdisciplinary efforts, in which experts of the modelling methodology were involved alongside the technical experts. In addition, software engineers have developed various tools to support the development process, and they also implemented prototype applications to ensure the usability of the reference dictionaries in actual applications. It was even suggested to involve marketing experts, in order to ensure that information about new products and new applications are considered in the reference dictionary.

All projects reported the importance of software tools to support the development process. This includes editors for capturing information, tools for checking the correctness of data, means for distributing information, etc. Three reference dictionaries are published in the STEP file format (ISO 10303-21). IEC has decided to make IEC 61360 available in this format as well in the near future.

For the reference dictionary of cutting tools, a specific convention for the creation of names and definitions was defined. Some of the standards use conventions for the generation of identifiers (e.g. to distinguish between identifiers for classes and properties.

Some interesting aspects concerning the use of the underlying data model are outlined below.

a) Reuse of properties across reference dictionaries: the use of the is-case-of mechanism for this purpose is illustrated in Clause 4 in the context of the reference dictionary for cutting tools which uses entries for some nuts and bolts from ISO 13584-511.

b) Visible and applicable properties: the reference dictionary of cutting tools and the IEC reference dictionary make all properties visible at the root class and apply them to different classes in their class hierarchies. This has the advantage that a property can be applied to multiple classes in the hierarchy in various branches. The properties defined in the IEC reference dictionary include in their definition the classes for which the property is defined – this concept was used already before the concept of visible properties was introduced into the PLIB data model. The reference dictionaries developed under ISO 13584 use the visible properties to define the property domain, i.e. the definition of the property is linked to the definition class for which it is visible. This makes it possible to tailor the property definition to its domain and to take special aspects of the domain into account.

c) The reference dictionary for fasteners clusters various properties in the form of features. Such a feature can be associated as a whole to a class (in the sense of a complex property). This allows for structuring the set of properties and for a special organization of the characterization class hierarchy.

An important aspect for quality assurance is the possibility to formally validate exchange files. In view of the use of reference dictionaries in computer-to-computer communication, e.g. as database schemas, it is of the utmost importance to ensure the correctness of data. Dictionary providers may be made liable for the correctness of their data.

Lastly, the reports show that the development of formal reference dictionaries requires a significant effort. Some of the projects took several years and involved a number of man years. It is important to plan such a project accordingly, i.e. to establish the necessary environment with respect to resources, liaisons and cooperation with relevant technical committees. In addition, the maintenance process should be considered from the start.

NOTE Annex C contains a Web site address providing links to organizations responsible for the maintenance of reference dictionaries. Another address points to a Web site with links to various tools that are useful for the development of reference dictionaries, including those tools that have been used by the projects described in this part of ISO/IEC Guide 77.

4 Developing a PLIB reference dictionary for ISO 13399

4.1 General

ISO 13399 provides a reference dictionary for cutting tools data representation and exchange. The development of ISO 13399 was carried out by cooperation between the world's largest manufacturers of machine cutting tools in a project that lasted for more than 5 years (see 4.12).

The reasons for the development of ISO 13399 were:

— cutting tools with defined cutting edges have become more complex with multiple replaceable inserts to perform the cutting operation;

— the use of cutting tools has become more adaptable following the changes in design of machine tools able to use the same tool for many different operations;

— the existing standard, ISO 3002, only defined cutting tools with brazed cutting items for single operations;

— the reference system in ISO 3002 was not adequate to define all the properties of all the components of a modern cutting tool (see Figure 1);

— customers increasingly require that cutting tool data should be supplied in computer processable form and the suppliers need to have one method for supplying this data to reduce their costs and complexity;

— the main method of supplying data for modern cutting tool components and assemblies is intended to be the information model of ISO 13399-1;

— the reference dictionary of classes and properties for cutting tools was therefore developed as a separate part of ISO 13399 to allow for the incorporation of new developments and new requirements without the need to change the information model. In this case, just an update of the reference dictionary would be required.

4.2 Determining the scope of the development project

The development project was to produce a new reference dictionary for ISO 13399. The main role of the reference dictionary is to support the entity relationship information model (the information model) specified in ISO 13399-1. The information model provides the resources to represent component parts of a modern cutting tool and the assembly of parts to form a complete tool. The information model also enables parts to be identified by using standardized labels from the reference dictionary, or to be referred to by their aliases using the labels used by particular companies.

The main activities in the development of the reference dictionary were therefore to develop the class hierarchy of items within the domain of machine cutting tools and to define the properties of these classes.

The scope of the domain is indicated in Figure 1. A modern cutting tool is an assembly of four main parts, as follows:

— cutting item: removes material from the work piece by a shearing action at defined cutting edges;

— tool item: supports the cutting item or items in the cutting operation;

— adaptive item: provides the connection between the tool item and the machine tool;

— assembly item: provides the forces to hold the cutting item on the tool item.

These four parts were the starting basis for the class hierarchy. The cutting item may be a detachable insert capable of being repositioned to bring different cutting edges into use, or permanently attached by means of a brazed joint, or part of a solid tool.

The convention adapted for the scope was that the classes and their properties applied to the “tool in the hand”. The alternative convention is for the “tool in use”. The “tool in use” convention will require additional classes and properties which will be the subject of a subsequent project.

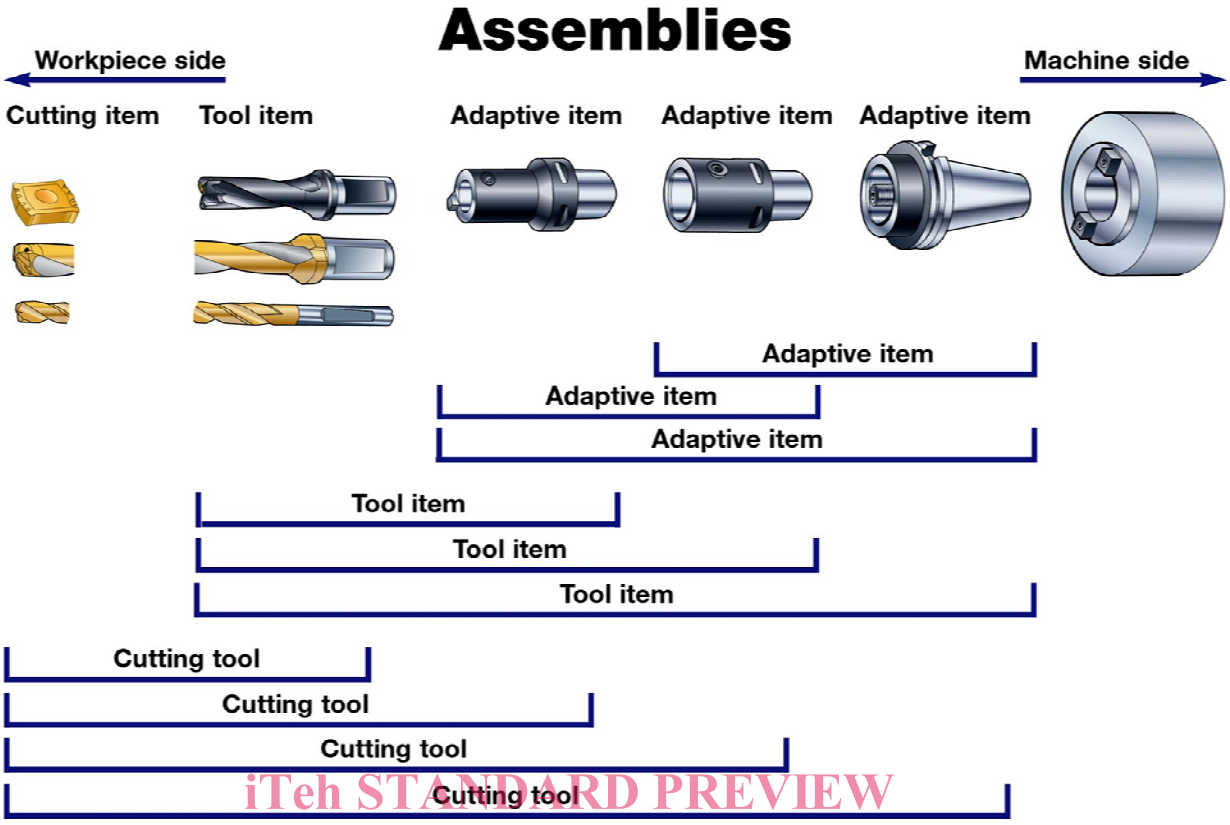

Figure 1 — Scope of the domain of cutting tools

4.3 Selection of the project team

The selection of the project team is an important component of the development and depends on the scope of the project. It should always include domain experts and information modellers. However, the ISO 13399 project did not include marketing experts or software developers. While these omissions could be justified in the earlier phases, once the development reached the point where the technical outcome was clear, the extension of the scope of the project team to include marketing and software experts would have been valuable.

The role of the domain experts was to input their knowledge from their companies' products, as well as to generalize them to a neutral representation that could be applicable to all products in the cutting tool industry. The domain experts were also familiar with both the existing standard (ISO 3002) in this domain and what was now needed as a result of new developments in the technology of cutting tools.

The role of the information modellers was to interpret the ISO 13584 standard model and ensure that the requirements of the domain experts could be met by the provisions of the standard. It is important that the information modellers are conversant with the development of ISO 13584 and aware of any changes that have occurred or are planned. This requires an active liaison between the project and the WG 2 of ISO/TC 184/SC 4.

If software developers are included in the project team, then their role would be to anticipate what the implementation issues could be and to input new ideas in the functionality of software that would use ISO 13399.

The role of marketing experts would be to provide a bridge between the needs of customers and the developers of ISO 13399, and to input information on new product types and new applications to extend its scope.

4.4 Supporting software

The development of a reference dictionary requires software to support the activities. The software needed to support the development of the reference dictionary for ISO 13399 was:

— an editor for the compilation of the reference dictionary;

— ISO STD2 Template for the production of the standard documents;

— software to convert the reference dictionary file to a printable version;

— CAD software to create the diagrams to support the definitions of properties;

— a database to provide a searchable record of the content and provide checks against duplication of names, etc.;

— spreadsheet software to provide complete lists of classes and properties.

It was necessary to train the members of the project team in the use of the software that was appropriate to their roles.

4.5 PLIB information model

The PLIB information model used for this project was ISO 13584-25. This model was further constrained to limit the meaning of the data types used in the reference dictionary:

— the classes used were item classes and feature classes only;

NOTE In ISO 13584-42, only these kinds of classes exist.

— some of the data types were constrained to use only a limited number of data formats.

The scope and constraints on the model were described in ISO/TS 13399-100 by adopting the diagrammatic presentation methods used in IEC 61360-2.

The domain experts were provided with some training in the use of ISO 13584 by using the editor software. It was not necessary to refer directly to the information model for the reference dictionary. The domain experts soon understood the principles of the development and were very comfortable with compiling the reference dictionary by using the editor software.

4.6 Establishment of liaisons

ISO/TC 29 was the technical committee responsible for ISO 13399 and an official liaison was established between ISO/TC 29 and ISO/TC 184/SC 4. This relationship was essential to provide access to the latest development in the technology and standards for product data representation.

4.7 Development of the classification

4.7.1 Main classes

The main sections of the class hierarchy were initially identified as:

a) cutting items: the portion of the cutting tool in contact with the workpiece;

b) tool items: the assembly that is the support for the cutting item;

c) adaptive items: the components that connect the tool item to the machine tool;

d) accessory items: items that hold the cutting item to the tool item and items that are used to create the assembly.

The root class was an item class and the main classes were either item classes or feature classes, where a feature was an aspect of an item class that could not exist in isolation.

As the development of the reference dictionary proceeded, changes to this initial division needed to be made:

— accessory items were restricted to assembly items to hold the cutting item in place on the tool item;

— further main classes were identified as:

  — reference systems to provide a coordinate axis system for the definition of angles and lengths;

  — classes that were common to several of the original sections;

  — classes of connection systems.

The classes were either item classes or feature classes. Every effort was made to keep the class hierarchy with as few subsidiary levels as possible and to avoid information modelling in the class hierarchy.

4.7.2 References to other dictionaries

As the reference dictionary neared to completion, it was realized that two of the classes in ISO 13399 were the same concepts as classes in ISO 13584-511:

— threaded fasteners as a subclass in the assembly item class;

— thread as a common feature of several classes.

The class of externally threaded item was copied from ISO 13584-511 and was defined as an item_class_case_of in ISO 13399. Then a reference was made from ISO 13399 to the class with the same name in ISO 13584-511. The properties for this class in ISO 13399 were imported from ISO 13584-511 (by use of the “Add dictionary” function in the dictionary editor). By this means, the contents of the externally threaded item class from ISO 13584-511 are known to the reference dictionary in ISO 13399. There are some special threaded fasteners particular to the assembly of cutting tools that are not standardized in the sources from which ISO 13584-511 is derived. These special items were created in ISO 13399 as subclasses of externally threaded item. The illustration of the reference to externally threaded item is shown in Figure 4.

Thread, as a feature of an object, is a common feature of several items in the domain of ISO 13399 and so it was made a feature class with no superclass, other the root class. Care was taken to ensure that the properties of thread did not include any properties related to the cutting of the thread, which are properties of some types of cutting item. The feature class of thread in ISO 13584-511 did not include all the types of thread and all the properties of a thread that were thought to be necessary for ISO 13399. Cooperation with the developers of ISO 13584-511 was therefore established to extend ISO 13584-511 to meet the requirements of ISO 13399 and when this is completed the reference can be made from ISO 13399 to ISO 13584-511 in the same manner as for the externally threaded item.

4.7.3 Feature classes

ISO 13584 makes it possible to organize features into a class hierarchy, where a feature is defined as a class of objects that cannot exist in isolation, e.g. a cutting edge is a feature of a cutting item. This aspect of the class hierarchy is needed to avoid repetition, e.g. to avoid having to define a subclass of cutting edge for every class of cutting item. It is also necessary to be able to assign properties to a feature as a class.

In ISO 13399, the association between an object and a feature was made by assigning a property to the item class that indicates by its value whether the object possesses the feature. The data type for this kind of property was Boolean, e.g. a cutting item may or may not have a chip breaker as part of its design. The Boolean property “chip breaker property” was made applicable to the cutting item class and the value of the property will indicate whether or not an instance of a cutting item has a chip breaker. The properties of the chip breaker itself are then made applicable to the chip breaker feature class.

However, ISO 13584 does not provide the means to identify the item class of which the feature class is a part: Only the forward association can be identified by the method described above. The correct association between a feature and the object of which it is a part would have to be achieved in a software implementation of the reference dictionary.

4.7.4 Assigning class names

Class names were devised by the domain experts based on common industrial practice, where possible. Differences between the class names used for the same concept in the companies that participated in the project team were resolved by choosing either one of the alternatives, or by devising independent names for use in ISO 13399. The convention adopted for long names was to use only lower case letters with no joining character between multiple words. Where groups of classes were associated with an aspect of a cutting tool, the names were devised with common elements to identify the association.

The convention adopted for short names was to use lower case letters in a truncated form of the long name. The compilation of the classes in a data base was used to verify that there was no repetition of names or short names.

4.7.5 Assigning definitions

Definitions were derived from other International Standards, wherever possible, and in these cases the source was identified. However, much of the content of the reference dictionary was new material that needed original definitions. Whenever it was possible, a diagram was produced to support the definition.

4.7.6 Assigning identification codes

The assignation of an identification code to a class is a fundamental feature of the PLIB method. For ISO 13399, each identification code was a random number that was generated by the editor software. The benefit was to assign no meaning to the code so that the position of a class could be changed if it was necessary to change the class hierarchy as the reference dictionary developed.

4.7.7 Assigning applicable properties

Properties were selected from the list of visible properties (see 4.8) to be applicable to the appropriate level of the class hierarchy. This was the important contribution from the domain experts and also resulted in changes to the class hierarchy to reflect the grouping of classes and their properties.

4.7.8 Examples of the classification

A high level view of the class hierarchy in ISO 13399 is shown in Figure 2. Note that there is an additional library from ISO 13584-511.

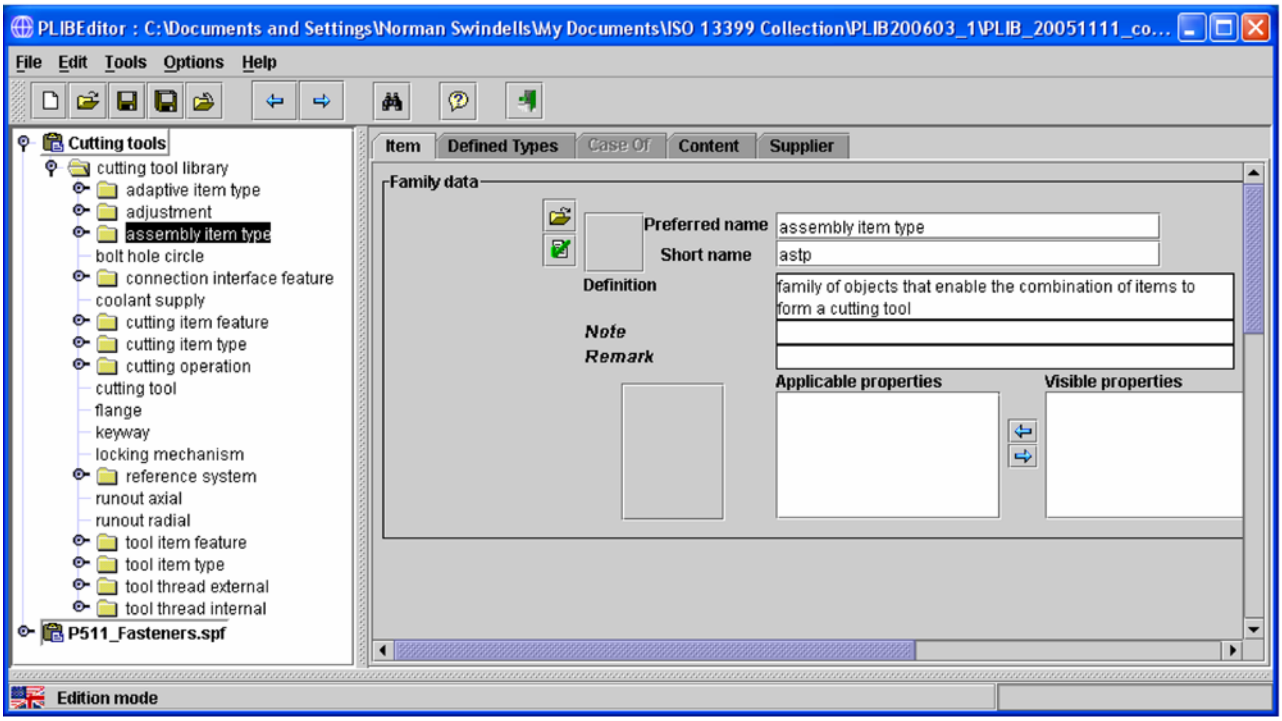
PLIBEditor : C:\Documents and Settings\Norman Swindells\My Documents\ISO 13399 Collection\PLIB200603_1\PLIB_20051111_co...
File Edit Tools Options Help
Cutting tools
cutting tool library
adaptive item type
adjustment
assembly item type
bolt hole circle
connection interface feature
coolant supply
cutting item feature
cutting item type
cutting operation
cutting tool
flange
keyway
locking mechanism
reference system
runout axial
runout radial
tool item feature
tool item type
tool thread external
tool thread internal
P511_Fasteners.spf
Item
Defined Types
Case Of
Content
Supplier
Family data
Preferred name
assembly item type
Short name
astp
Definition
family of objects that enable the combination of items to form a cutting tool
Note
Remark
Applicable properties
Visible properties
Edition mode

Figure 2 — The main classes in the ISO 13399 reference dictionary

An expanded section of the classification that defines the cutting item feature class is shown in Figure 3, together with the definition of cutting edge major and its applicable properties.

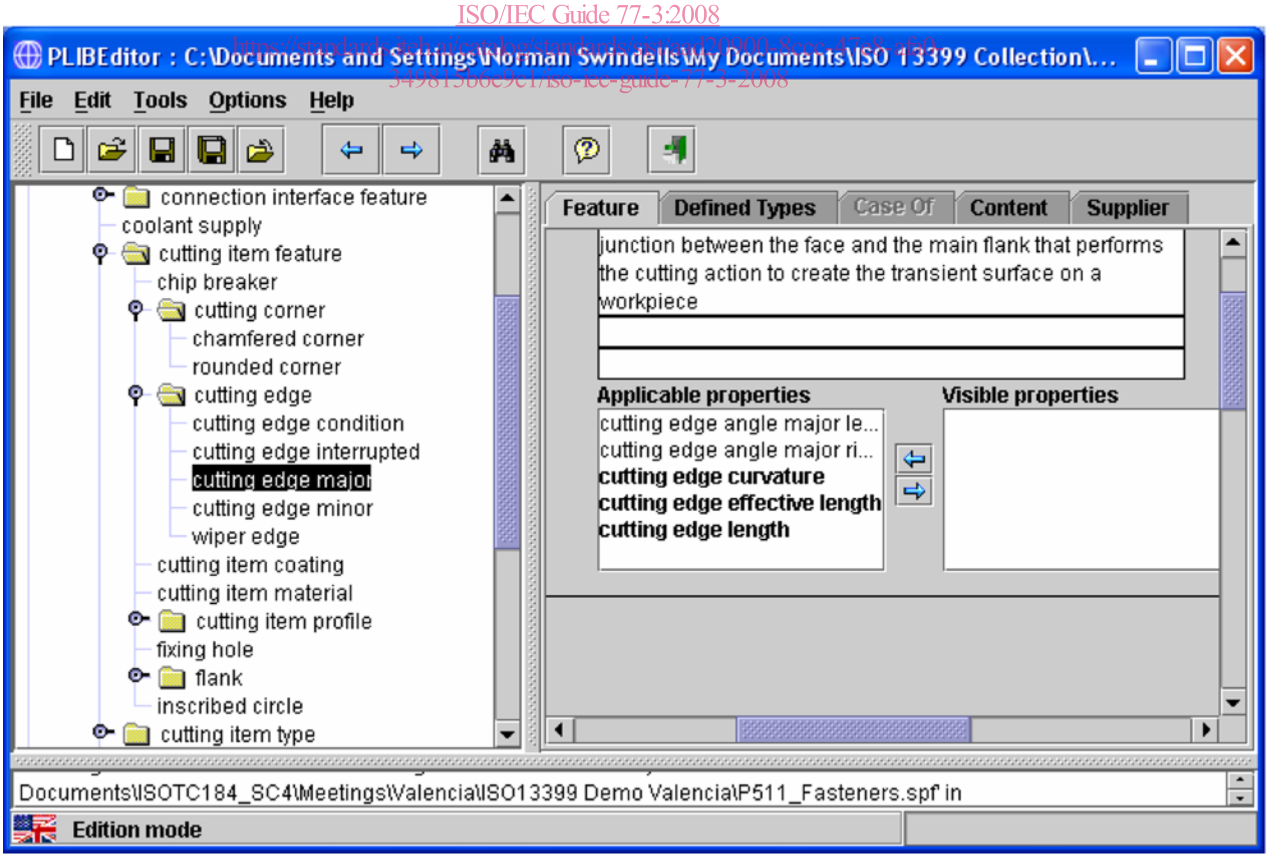
PLIBEditor : C:\Documents and Settings\Norman Swindells\My Documents\ISO 13399 Collection\...
File Edit Tools Options Help
connection interface feature
coolant supply
cutting item feature
chip breaker
cutting corner
chamfered corner
rounded corner
cutting edge
cutting edge condition
cutting edge interrupted
cutting edge major
cutting edge minor
wiper edge
cutting item coating
cutting item material
cutting item profile
fixing hole
flank
inscribed circle
cutting item type
Feature
Defined Types
Case Of
Content
Supplier
junction between the face and the main flank that performs the cutting action to create the transient surface on a workpiece
Applicable properties
Visible properties
cutting edge angle major le...
cutting edge angle major ri...
cutting edge curvature
cutting edge effective length
cutting edge length
Documents\ISOTC184_SC4\Meetings\Valencia\ISO13399 Demo Valencia\P511_Fasteners.spf in
Edition mode

Figure 3 — Part of the classification of cutting item features