



GUIDE 77-2

Guide for specification of product properties and classes

Part 2: Technical principles and guidance

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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.

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 77-2 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

The capability to characterize products in an abstract way, independently of any particular manufacturer, is a fundamental aspect of engineering knowledge. Such a characterization is done by the name of a category of products that fulfils the same function, e.g. ball bearing, screw, capacitor. Such a category is called a characterization class. This first level of characterization is further detailed by means of some property-value pairs, which describe more precisely the target product within its characterization class. Examples of such properties are inner diameter, threaded length and capacitance.

Depending upon the context, products need to be characterized at various levels of accuracy. For example, in a preliminary engineering design phase, the need for a bearing with a particular inner diameter could be defined, with other properties of the bearing left unspecified. At a latter stage, it could be decided to use a ball bearing with a particular outside diameter and ball diameter; finally, a thrust angular contact ball bearing could be selected with contact angle equal to 80.

Consequently, characterization classes need to be defined at various levels of generality. A specialized class makes it possible to refine a requirement described in terms of a more general class. This generalization/specialization relationship between characterization classes builds up a hierarchy of characterization classes where each general class is refined into more specialized classes. The most specialized classes, called the leaf classes, are at the bottom of the hierarchy. In such a hierarchy, each class is associated with properties that can be used to characterize all the products belonging to this class. Note that a ball bearing being a bearing, all the properties applying to a bearing also apply to a ball bearing. Properties defined for more general classes can therefore also be used for all their specialized classes. Applicability of properties to classes is said to be inherited over the hierarchy.

Neither product characterization classes nor product properties are single words. They are concepts that belong to the engineering knowledge of specific engineering domains. These concepts exist independently of any particular language, and they can be referenced in various languages and technical jargons using various words. Usual word dictionaries are therefore inappropriate for describing such multilingual knowledge and for making it computer interpretable.

The goal of ISO/IEC Guide 77 is to describe how this knowledge can be modelled in a language-independent and computer interpretable way.

For each technical domain, the target result essentially consists of:

- a hierarchy (or a set of hierarchies) of characterization classes, each associated with a language-independent identifier and with a number of information elements, called attributes, that describe the corresponding concept, and
- a set of properties, each associated with a characterization class, that are inherited over the class hierarchy, and that have also language-independent identifier and descriptive attributes (name in various languages, domain of allowed values, etc.).

Such a structure is called a **product ontology** (see 2.17), to emphasize that it is a knowledge model that defines concepts and not words. In ISO/IEC Guide 77, each particular product ontology addressing a particular product domain that is designed in compliance with the common ISO 13584/IEC 61360 dictionary model for product ontology is called a **reference dictionary** (see 2.20) for that domain, keeping in mind that it is not a dictionary of words but a dictionary of concepts.

When an attempt is made to design or to use a reference dictionary for a particular domain (e.g. fasteners), a number of issues appear, notably including the following:

- which data to use for modelling characterization classes and product properties;

- how to represent characterization class hierarchies and relationships between classes and properties;
- how to avoid redefining properties that are already defined in other reference dictionaries;
- how to avoid a combinatorial blow-up when one tries to describe all the various categories of, for example, bolts and screws;
- how to extract from a standard reference dictionary only those properties that are useful for a particular company.

To answer these questions, a common information model for product ontologies, called the **common ISO 13584/IEC 61360 dictionary model** (see 2.6), has been developed as a joint effort of ISO/TC 184, *Automation systems and integration*, SC 4, *Industrial data*, WG 2, *Standard for the neutral representation of standard parts*, and of IEC/TC 3, *Information structures, documentation and graphical symbols*, SC 3D, *Data sets for libraries*.

This model has been defined in a formal data modelling language called EXPRESS. Thus, a number of software tools have been developed that support all the concepts of this model. These tools can be used by domain experts for building their own reference dictionaries without any knowledge about EXPRESS, while ensuring that the data representation of these reference dictionaries will be exchangeable in a standard way. The only prerequisite is to understand the concepts and mechanisms defined in the model: this part of ISO/IEC Guide 77 aims to provide this background.

Due to the diversity of industrial sectors and of engineering disciplines, creating reference dictionaries that cover the whole technical domain is a huge task that can only be performed by a number of parallel groups and projects. To ensure interoperability of the developed reference dictionaries, it is crucial that the same data model be used. It is also crucial that some mechanisms be used to connect the various reference dictionaries and to reuse in each reference dictionary the relevant properties that are already defined in some other reference dictionary. For these reasons, the ISO Technical Management Board and the IEC Standards Management Board decided to establish ISO/IEC/JWG 1. Its role has been to produce a guide for specification of product properties and families on the basis of the common ISO 13584/IEC 61360 dictionary model, and to produce recommendations and guidelines on how to monitor consistency of the work items produced in accordance with the guide across all ISO/IEC Technical Committees. These guidelines are documented in this multi-part ISO/IEC Guide 77. ISO/IEC Guide 77 is not only of interest to ISO and IEC Technical Committees for developing standard reference dictionaries, it can also be useful to any group, consortium or industrial organization that needs to develop interoperable reference dictionaries.

Developing reference dictionaries is a design task. It is based on a number of design choices and decisions that need to be agreed upon in a consensual way to ensure acceptability of the developed reference dictionary. These choices are largely domain-dependent, therefore no universal and systematic methodology can be built. To help domain experts in the process, ISO/IEC Guide 77-3 provides some reports of previous experience in the use of the common ISO 13584/IEC 61360 dictionary model in reference dictionary design.

Guide for specification of product properties and classes

Part 2: Technical principles and guidance

1 Scope

ISO/IEC Guide 77 provides general advice and guidance for the description of products and their characteristics by the use of the ISO 13584 and IEC 61360 series of standards for the creation of computer-processable 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 from any proprietary application software.

NOTE 1 The term “product” is taken to include devices, processes, systems, installations, etc.

ISO/IEC Guide 77 is intended to assist the objective of enabling the flow of technical information between internal and external business partners in a cost-effective and timely manner.

The guidance given in this part of ISO/IEC Guide 77 contains technical recommendations intended to assist standardization committees and technical experts contributing their knowledge to the development of standard reference dictionaries compliant with the common ISO 13584/IEC 61360 dictionary model.

It might also be useful for information experts responsible for the exchange of technical information between business partners or for the generation of applications of ISO 13584 and IEC 61360.

This part of ISO/IEC Guide 77 is intended to support the achievement of industrial benefits of applications of the common ISO 13584/IEC 61360 dictionary model. The following are within the scope of this part of ISO/IEC Guide 77:

- general principles of product description and characterization;
- presentation of the concepts of product characterization classes, product properties, product ontology and reference dictionaries for products;
- universal identification of classes and properties;
- presentation of the modelling constructs that can be used for building reference dictionaries conforming to the common ISO 13584/IEC 61360 dictionary model;
- rules and principles for developing standard reference dictionaries;
- rules and principles for connecting standard reference dictionaries to avoid duplication and overlap;
- rules and principles for developing user-defined reference dictionaries and for connecting user-defined reference dictionaries to standard reference dictionaries;
- formats and mechanisms for exchanging reference dictionaries;
- mechanisms for connecting reference dictionaries to classification systems.

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

- an overview for ISO and IEC Technical Committees and industrial managers for the development of computer-processable product libraries, reference dictionaries and catalogues;

NOTE 2 An overview of the development of computer-processable product libraries, reference dictionaries and catalogues is provided in ISO/IEC Guide 77-1.

- case studies from experiences in the creation of reference dictionaries of product information in industrial practice;

NOTE 3 Experience gained in the creation of reference dictionaries of product information in industrial practice is provided in ISO/IEC Guide 77-3.

- categorization of products for purposes other than product characterization.