
Data structures for electronic product catalogues for building services —

**Part 1:
Concepts, architecture and model**

Structures de données pour catalogues électroniques de produits pour les services du bâtiment —

iTeh STANDARD PREVIEW
Partie 1: Concepts, architecture et modèle
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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).

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).

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 59, *Buildings and civil engineering works*, Subcommittee SC 13, *Organization of information about construction works*.

ISO 16757 consists of the following parts under the general title *Data structures for electronic building services product catalogues*:

- *Part 1: Concepts, architecture and model*
- *Part 2: Geometry*

The following parts are planned:

- *Part 3: Script language and functions*
- *Part 4: Cooperation with building information modelling standards*
- *Part 5: Product catalogue exchange format*

Introduction

These Content Parts of this International Standard will define standardised properties for the product groups and the composition of the technical data model. Furthermore, they determine the specific programming function-interfaces to layout, calculate, and simulate the products.

There is a growing need for information about building services systems during the planning and design of buildings. The designers in building services have to execute detailed calculations and simulations to ensure saving of energy and to satisfy hygienic and comfort criteria in heating, ventilation, air conditioning, and sanitary plants. They have to provide better and better documentation to verify the compliance with these requirements. The resulting designs have to describe the complete plants without internal interference or intersection with the building.

These requirements can only be achieved with modern engineering applications like CAD- and CAE-systems, calculation programs, BIM tools, and management software. The software systems need exact data of the used plant components. Each component contributes to the performance data of the whole building.

There are many manufacturers, who provide products to certain sectors of building services (such as heating, ventilation, air conditioning, sanitary). Others provide only certain product groups (radiators, heaters, air condition equipment, air pipes, valves, devices).

Classical catalogues provide product data in tables and show the design algorithms in diagrams and design rules. In addition to the technical properties required for functional design and calculation (e.g. in the form of curve diagrams), such catalogues also contain the geometry data needed for dimensional design and construction (e.g. in the form of dimensional drawings with port details) and the descriptive objects serving for visualization (such as photos, video sequences, or acoustical sequences).

Additionally, nearly all big manufacturers provide their own software (mostly for free) as electronic catalogues to select, to design, and to calculate their products.

Unfortunately, none of these software solutions meets all the requirements of the planner. Needless to say, that each program contains only the product range of its manufacturer. So it is not possible to perform a continuous planning of the plant with products of different manufacturers.

Thus, it is desirable to provide engineering applications which are independent from the manufacturers. The next problem is that data files from different manufacturers — if available at all — are organized in different data formats, structures, and terminologies.

Independent CAD-systems and calculation software need to get data and algorithms in a uniform way. Only if product data and algorithms are automatically available, the calculation and simulation of a complete HVAC plant is possible.

Software providers cannot afford to provide all data from all product manufacturers in the format required by their system. Also, product manufacturers cannot provide current information about their products in the formats of all potential software systems. Thus, we have a typical situation where standardization is required to improve the exchange of information between business partners.

Within single product groups (e.g. radiators), national initiatives to standardize exchange formats have already been conducted. But there is a lack of unification of existing formats across all product groups.

Required is a uniform, internationally standardised definition for product catalogue data interchange.

Such a definition eliminates the need to manage different data formats and to use different software systems to deal with products of different manufacturers, and this leads to a significant reduction of costs for manufacturers and users. Integrating this data into BIM-systems (Building Information Modelling) allows data interchange between IT systems. In addition, to the benefit for planning, there will be an amount of advantages for other software solutions, e.g. facility management and life cycle management.

This International Standard offers for the first time an interface which allows the uniform handling of data about technical, commercial, maintenance, service, as well as geometry, images, video, and text information.

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ISO 16757 is a multi-part standard. Future parts will include:

- an overview of ISO 16757 and the rationale for its elements and organization;
- geometric elements which are used to represent the products in the catalogues of ISO 16757;
- definition of the script language used in ISO 16757 for various purposes;
- IDM descriptions for ISO 16757, including process descriptions for those processes which are to be supported by the standard and it comprises the rules for mapping of product and the property descriptions to IFC and for defining properties semantically with IFD;
- definition of an exchange format in XML by which electronic catalogues can be exchanged according to the definitions of ISO 16757. The exchange format will be specified as an XML Schema Definition (XSD).

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Data structures for electronic product catalogues for building services —

Part 1: Concepts, architecture and model

1 Scope

The primary purpose of this International Standard is the provision of data structures for electronic product catalogues to transmit building services product data automatically into models of building services software applications. This includes a meta model for the specification of product classes and their properties and a meta model for the product data which is exchanged in product catalogues. Product data has to follow the specifications for their product groups.

The standard series is split into two areas:

- Basic concepts like conceptual models, languages, geometry representations, and XML schemas for data exchange are provided in the Conceptual Parts of the standard series (Parts with a one digit number).
- Using these resources, the Content Parts of this International Standard define for various product groups of building services concrete models for the description and the exchange of products.

The basic concepts which are provided by the standard series include the following:

- resources for the specification of selection properties and a selection property tree guiding the selection process to identify the appropriate product variant from a parametric electronic catalogue;
- resources for the specification of dependent properties and their computational functions to compute their values in dependency from installation parameters;
- resources for the specification of composition relationships between products which can be used to model structures like bill of materials or accessory relationships;
- resources for a parametric constructed solid geometry (CSG) based geometry representation containing specific CSG elements geometrical elements which are typical for building services products.

This part of ISO 16757 specifies

- the underlying concepts,
- a generic model specifying the available modelling elements and their relationships, and
- a framework for the specification of the Content Parts by describing the elements which are to be provided by these Parts.

Not in scope of this part of ISO 16757 are the following:

- a detailed description of the used geometrical primitives;

NOTE Geometry is described in ISO 16757-2.

- a specification of the script language used to exchange algorithms for computing the values of dependent and computable properties;

NOTE The script language is described in ISO 16757-3.

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— a specification of the XML Schema specifying the data structures for the catalogue exchange;

NOTE The XML schema is described in ISO 16757-5.

— a description of the relationships to standards of the area of buildingSMART;

NOTE The relationships to standards of the area of buildingSMART is described in ISO 16757-4.

— definition of models for specific product groups.

NOTE 1 Definitions of models for specific product areas are described in ISO 16757-10 et. seq., the Content Parts of ISO 16757.

NOTE 2 All parts are still under development.

2 Terms and definitions

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

2.1

accessory

product of the same or of different product groups, which can be attached to a product

Note 1 to entry: An accessory is not a different type of product, it plays an ancillary role to another product.

2.2

accessory hierarchy

representation of the dependencies between products and accessories

2.3

article number

manufacturer's reference number, GTIN, or other identifier identifying the product or constituents of a product

2.4

building information modelling

BIM

construction of a model that contains the information about a building for all phases of the building life cycle

Note 1 to entry: In many cases, the abbreviation BIM is also used for the result of the building information modelling, namely the building information model.

2.5

building services

utilities and installations supplied and distributed within a building such as electricity, gas, heating, water, and communications

[SOURCE: ISO 16484-2]

2.6

building services system

BSS

technical system that provides building services in a building

[SOURCE: ISO 16484-2]

2.7

BSS property

technical property that describes an aspect of the current state of a BSS

Note 1 to entry: A BSS property cannot get a value in a catalogue because the states of the building services system are not known and will vary according to the specific system and its various system states.

EXAMPLE In the example given in 2.10, 'media volume flow' and 'media density' are BSS properties.

2.8 catalogue metadata

data in the catalogue which contains data about the catalogue itself

EXAMPLE Catalogue metadata include standard numbers, data for version management, the manufacturer's name, and global location number, as well as file check details.

2.9 descriptive object

object giving descriptive and/or visual information about the product

EXAMPLE Descriptive objects are pictures, descriptions, videos, etc.

2.10 dynamic property

technical property, that reflects the product's behaviour under the operating conditions of the building services system in which the product is installed

EXAMPLE The dynamic property 'pressure loss of a pipe elbow' is dependent of the 'media volume flow' and the 'media density'. In a catalogue, the manufacturer of a pipe elbow has to provide a means to allow the determination of the actual 'pressure loss' for various values of 'media volume flow' and 'media density'

Note 1 to entry: A dynamic property does not get a value from a product catalogue because the value of a dynamic property is dependent on the state of the building services system into which the product will be integrated. Therefore, the value may vary according to the state. The catalogue normally contains some means which allow the product user to determine the value of that property in a given state of the building services system.

2.11 facility management

FM

all the services before, during and after utilisation of real estate properties and infrastructure based on a holistic (integral) strategy

[SOURCE: ISO 16484-2:2004]

2.12 function formula

algorithms and formulas for the calculation of computable product properties

Note 1 to entry: The representation of functions and formulae follows a simple program script syntax.

2.13 Global Trade Item Number

GTIN

identifier for trade items used to look up product information in a database GS1

2.14 product

orderable, technical entity

2.15 product catalogue

compilation of information about products

Note 1 to entry: A product catalogue can be related by its article numbers to price lists.

2.16 product group

set of products described by common properties

2.17

product index

compilation of references to all property values of a defined product, the product description, the product geometry, and the product article numbers

2.18

product series

types of products, defined by the manufacturer, which are commonly constructed and manufactured

2.19

property

defined parameter suitable for the description and differentiation of products

[SOURCE: ISO/TS 13399-5:2014]

Note 1 to entry: The description of a product is the description of its properties.

2.20

representation object

object that represents a product or a part of it as a whole

EXAMPLE Article numbers and geometry are representation objects.

2.21

static property

technical property that is independent of the operating conditions of the building services system in which the product is installed and which gets its fixed value from the catalogue

2.22

selection property

property which is used for the selection of a certain product from the product variants of the catalogue

2.23

technical property

property which is used to represent technical data and functions for designing, calculating, and simulating the product

Note 1 to entry: Technical properties comprise static and dynamic technical properties.

3 Requirements and fundamentals

The strategic interest of this International Standard is the provision of product data for design, calculation, and simulation of Building Services systems within engineering application models. This means it is necessary to exchange machine-readable product data from manufacturers to engineering applications and to building information models in an automatic way.

Basically, the products are described by three elements (see [Figure 1](#)):

- property values;
- representation objects (like geometry);
- descriptive objects (like text documents, pictures, etc.).

In addition, products can be supplemented by a number of accessories which can be optionally selected in addition to the product itself. Which and how many accessories belong to a product is described by specific rules.

The properties which are used to describe a product have to be defined in a standard (one exception are the catalogue-specific selection properties; see below). The purpose of the Content Parts of this International Standard is exactly the definition of these properties. In [Figure 1](#), which gives a high-

level overview about the modelling levels of this International Standard, the meta model on the left side specifies which kinds of properties can be defined for a product group. A Content Part of this International Standard for a product group has to specify which properties are required for the representation of products of this product group. Thus, it will define properties of the various kinds shown in [Figure 1](#); technically speaking, it will provide an instance of the meta model. The various kinds of properties are described below.

On the right side of [Figure 1](#), the elements are shown which make up an ISO 16757 product catalogue. All elements which belong to a product class are grouped under a ClassElements object which is related to the respective ProductClass (see [Figure 1](#)). The property values in the catalogue belong to a property which has been defined in the respective Content Part for the product group the product belongs to (not explicitly shown in [Figure 1](#)). Some (selection) properties are catalogue specific; their definition will be provided in the catalogue and they are only applicable for that catalogue.

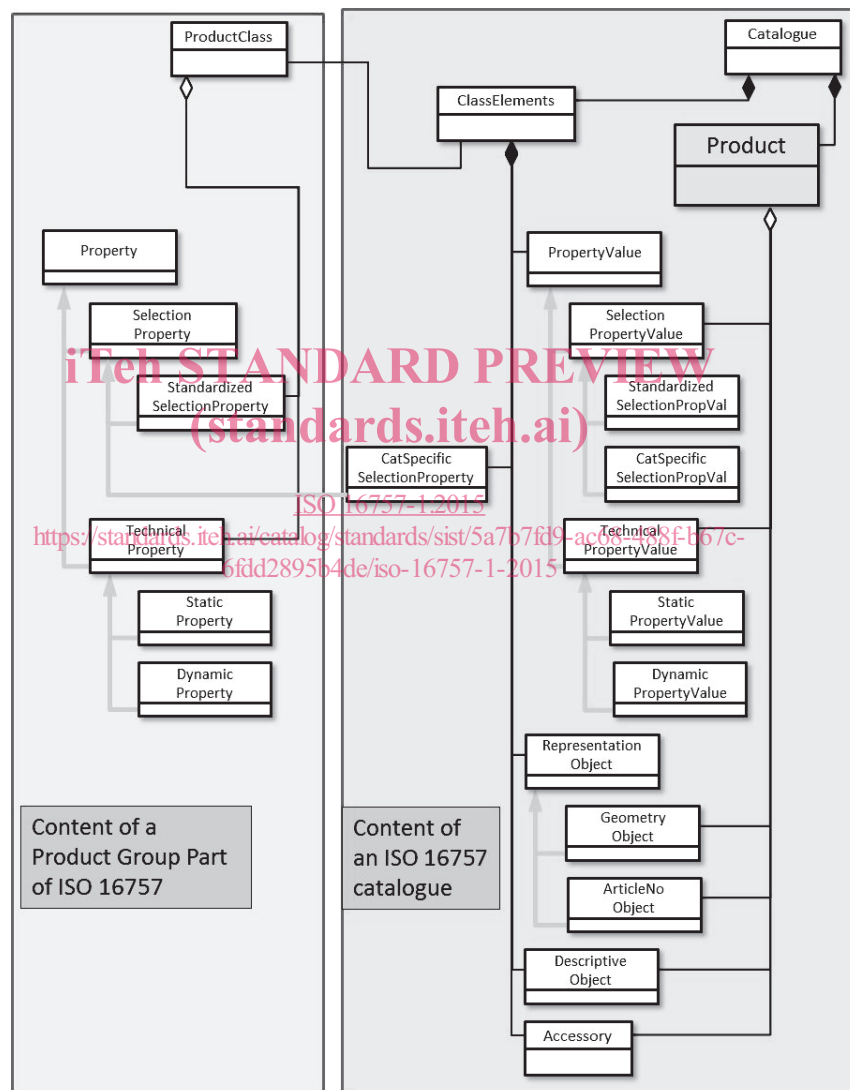


Figure 1 — Overview about the elements of a catalogue and the kinds of properties

The diagram in [Figure 1](#), as well as the diagrams in a number of further figures, is drawn by use of the Unified Modelling Language (UML) class diagrams (see ISO/IEC 19505-1). The following semantics is assumed for the relationships:

← Subclass relationship (is-a)



Composition relationship (sub-object belongs physically to the upper object)



Aggregation relationship (sub-object belongs logically to the upper object)

Properties of different kinds have different roles:

- Technical properties describe those values which are used as basic parameters in the simulation and the design of building services systems. Technical properties can be **static** or **dynamic**, i.e. dependent of parameters of the building service system in which the product is being installed. Dynamic properties provide a function specification giving the parameters from which the actual value of the property depends.
- Selection properties are used to select a single product from a catalogue which often contains more than a million products of similar kind. By specifying all applicable selection properties, a product has been identified. Selection properties might be catalogue specific.
- Information about the catalogue itself and its administration is transmitted by values of **catalogue metadata** (not shown in [Figure 1](#)).

These different kinds of properties and the related objects will be described in more detail in the following clauses. In this clause, the decisions taken for the definition of these properties and objects will be motivated.

3.1 Content of a catalogue

An ISO 16757 catalogue (in the following just called a catalogue) is an electronic catalogue containing at least one product, but normally many products. The product groups which can be transmitted in ISO 16757 catalogues will be defined in ISO 16757-10 et seq., the Content Parts.

Accessories normally belong to a different product group as the main product. They can be described in separate product catalogues. Products outside the catalogue can be referenced from inside the catalogue. Therefore, the identification and the name of the data entity (e.g. the data file) of the external catalogue has to be included into the reference. It is always assumed that the name is unique in the current context of the catalogue. More information will be given in ISO 16757-5 where the concrete exchange of product catalogues is described.

A product may consist of several articles which build the product. The division of products into different articles with several article numbers is depending on manufacturers' conventions and has no technical influence.

EXAMPLE Fire dampers have to be checked in certain time intervals. They can be activated manually or by a separate control device. For one manufacturer, the combination of the fire damper together with its control device is a single article with a single article number. Other manufacturers provide them as a product, consisting of two articles with two different article numbers.

3.2 Manufacture vs. user view of a catalogue

Catalogue providers and catalogue users can have different interests and they use catalogues with different intentions.

NOTE 1 The user's goal is to get information in a way which makes the products of different manufactures comparable based on standardised terminology and definitions. This would help users to find the best fitting products at lowest prices.

NOTE 2 This International Standard does not standardize the exchange of price information or any other commercial information. This information may supplement an ISO 16757 compliant catalogue, but its format is not in the scope of this International Standard.

NOTE 3 Many manufacturers are not willing to produce product catalogues which make them easily comparable with other manufacturers. They argue, when all products were comparable, the specific product differences became invisible. In addition, new developments and inventions would not have a chance to be communicated unless the new concepts are incorporated into the standardised terminology. In fact, manufacturers have the motivation to present their products as positive as possible. Besides, they are responsible for their data. Ownership and copyright of catalogues is with the manufacturers. Therefore, the product catalogues are manufacturer-related and they are produced by the manufacturers themselves.

To support both views, this International Standard follows two principles:

- a) ISO 16757 provides technical properties which are needed for calculation, representation, ordering, and simulation in different application cases in a standardised form. These properties will be imported into application systems on the user's site like engineering applications, simulation tools, etc. These properties shall be standardised in the Content Parts of this International Standard for the relevant product classes.
- b) ISO 16757 allows manufacturers to use their internal terms for the description of products. This can be done by providing standard properties without determining the allowed set of values (e.g. for colours, so that manufacturers can use their own colour coding) or by allowing manufacturers to define catalogue-specific properties which have a specific place in the selection process (and are thus still useable in a computer-supported variant selection process).

One of the main use cases for many properties is the selection of a specific variant among its many similar variants. This will be explained below in more detail. The properties which are supposed to be used in this process are called **selection properties** in this International Standard.

Normally, selection properties are standardised in the Content Parts of ISO 16757 to enable consistent product selection as far as possible. In addition, ISO 16757 allows manufacturers to specify catalogue-specific selection properties. The definition of these properties shall be provided in the catalogue.

As a conclusion, the following main kinds of properties are provided by this International Standard:

- standardised selection properties;
- catalogue specific selection properties;
- technical properties for technical calculation and design.

It is possible that sometimes the content of selection properties and the content of technical properties seem to be redundant. But in fact, in most cases for selection and for calculation, different views on a property are necessary. A very obvious example is the car battery: it has a nominal voltage of 12 V, but the real value of a fully charged battery is around 13 V. Whereas for the selection, a nominal value is most important, for the calculation, the real value is necessary which can deviate from the nominal value. Thus, sometimes the same property name can be used, but they convey different semantics (which in some other approaches is distinguished by different qualifiers for property values). In this International Standard, these different properties shall be identified by different identifiers.

3.3 Parametric representation of catalogue data

Based upon the process in which the provision, exchange, and use of standardised product data are performed, a product catalogue may contain a single product or a number of products. To deal with a big number of products, one essential part of the catalogue structure of this International Standard are mechanisms to represent similar products in a compact way. That means, the products are not described separately in the structure but each potential property value and each technical property element is available only once in the structure. To isolate a single product, a configuration mechanism allows the selection of values and elements which describe exactly this product.

Product representation objects like geometry are also organized in a parameterized way. Most product series define shapes, which are geometrically the same for all variants of that product series. They only differ in their dimensions. In the same way as the data management uses the same property data for different products, the same basic geometry can be used to describe similar shapes. Dimensions are