



BSI Standards Publication

Data structures for electronic product catalogues for building services

Part 5: Product catalogue exchange format

National foreword

This British Standard is the UK implementation of EN ISO 16757-5:2025. It is identical to ISO 16757-5:2025.

The UK participation in its preparation was entrusted to Technical Committee B/555, Construction design, modelling and data exchange.

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

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English Version

Data structures for electronic product catalogues for
building services - Part 5: Product catalogue exchange
format (ISO 16757-5:2025)

Structures de données pour catalogues électroniques
de produits pour les services du bâtiment - Partie 5:
Format d'échange des catalogues de produits (ISO
16757-5:2025)

Datenstrukturen für elektronische Produktkataloge
der Technischen Gebäudeausrüstung - Teil 5:
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5:2025)

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN ISO 16757-5:2025) has been prepared by Technical Committee ISO/TC 59 "Buildings and civil engineering works" in collaboration with Technical Committee CEN/TC 442 "Building Information Modelling (BIM)" the secretariat of which is held by SN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2026, and conflicting national standards shall be withdrawn at the latest by April 2026.

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Endorsement notice

The text of ISO 16757-5:2025 has been approved by CEN as EN ISO 16757-5:2025 without any modification.

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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.

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This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 13, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 442, *Building Information Modelling (BIM)*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 16757 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Building information modelling (BIM) provides a means for describing and displaying information required throughout the asset life cycle. Increasingly this modelling approach is expanding to encompass all aspects of the built environment, including civil infrastructure, utilities and public space.

The ISO 16757 series provides the structure of a product catalogue model for data sharing and data exchange of product models in product catalogues. It contains specifications for:

- selection of products from different product classes and product variants;
- combining product components and accessories to products;
- geometrical representation in technical systems;
- connectivity to other products in models of technical systems;
- calculation of dynamic property values in accordance with the product behaviour in technical systems.

Specialist planners of complete systems for building services, for example, expect almost all of this data in the product catalogue, as they require the shape data for dimensioning and clash detection in addition to the technical design and setting of the products.

This data format provides the opportunity to search and select product data together with accessory data which can be read into software applications for planning, designing, calculating and simulating as well as for facility managing.

This document focuses only on the format of the data exchanged and not on how to process it. Notes on the implementation of the standard in application software can be found in [Annex B](#).

This document does not directly lead to an automatic selection of products.

The product catalogue does not contain any decision criteria for this. However, the data of a product catalogue can be searched by application programs looking for a suitable product size.

According to ISO 16757-4, this document does not provide a data template, as it assumes that these are already defined in data dictionaries according to ISO 12006-3.

Besides this document, the ISO 16757 series contains the following documents:

- ISO 16757-1 describes the fundamental concepts and assumptions about the creation of manufacturer-related product catalogues as BIM data exchange models. It describes the content of product catalogues and the mapping of the content to a data format.

This data format provides the opportunity to search and select product data together with accessory data which can be read into software applications for planning, designing, calculating and simulating as well as for facility management.

- ISO 16757-2 describes the concept of geometry of the building services product data of a product catalogue in form of 2D or 3D symbols and 3D shape models and specifies the required spaces and ports.

It contains the fundamental concepts and assumptions about the parametric geometry of special products, used in planning software applications, e.g. for air conditioning systems such as ducts and transitions between different forms. It also contains a concept for representing products as 3D solid models made from thin sheet metal.

- ISO 16757-4 describes the data structures that are required in a data dictionary to support the exchange of product data from manufacturers to designers of building services systems.

It defines subject kinds to distinguish subjects representing products from subjects representing features of products like ports and in/outlets, it defines relationship types and a number of property

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kinds, in particular dynamic properties for the description of the behaviour of a product under changing conditions. In addition, ISO 16757-4 defines a mapping to the dictionary model of ISO 12006-3.

Data structures for electronic product catalogues for building services —

Part 5: Product catalogue exchange format

1 Scope

This document describes how product catalogue data for building services products is exchanged by means of ISO 16739-1 (Industry Foundation Classes, IFC) and EN 17549-2 from manufacturers to designers of building services systems.

This document specifies how the product catalogue structures and content are set up using the definitions stored in a data dictionary.

In scope of this document are:

- processes for the provision and exchange of product catalogues;
- rules for the geometrical representation of products;
- representation of products, product classes, ports, in/outlets, components and accessories by using IFC;
- representation of properties in IFC and the use of IFC constraints for the representation of product variants;
- representation of parametric geometry and the generation of IFC geometries for selected variants;
- calculation of article number.

The resulting product catalogue can be used by designers to select the desired products and integrate them into their model of the building services system.

The expected audience of this document are software providers for the built environment sector and professionals working in the sector who create product catalogues or use product catalogues by means of software tools.

Not in scope of this document is the representation of properties in data dictionaries. The use of data dictionaries is described in ISO 16757-4.

2 Normative references

The following document is referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 16757-1, *Data structures for electronic product catalogues for building services — Part 1: Concepts, architecture and model*

ISO 16757-4, *Data structures for electronic product catalogues for building services - Part 4: Data dictionary structures for product catalogues*

ISO 23386:2020, *Building information modelling and other digital processes used in construction — Methodology to describe, author and maintain properties in interconnected data dictionaries*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16757-1, ISO 16757-4, ISO 6707-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 object

any part of the perceivable or conceivable world

Note 1 to entry: An object is something abstract or physical toward which thought, feeling, or action is directed.

[SOURCE: ISO 12006-2:2015, 3.1.1]

3.2 attribute

data element for the computer-sensible description of a property, a relation or a class

[SOURCE: ISO 22274:2013, 3.2, modified — EXAMPLE has been removed.]

3.3 constraint

logical expression that restricts the possible values for one or several properties

3.4 data dictionary

centralized repository of data about data or data elements such as meaning, relationships to other data, origin, usage, and format

[SOURCE: ISO 23386:2020, 3.9, modified — The words "information about data" have been replaced with "data about data or data elements"; note 1 to entry has been removed.]

3.5 function

modular unit of programming code to perform specific tasks with algorithms and formulae for the calculation of computable, dynamic properties

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

3.6 technical system

interconnected products for the supply and disposal of materials and energy to buildings

4 Overview of supported processes

4.1 General

This document describes the definition and handling of product catalogues that use IFC as their basic exchange format. In the following these product catalogues are referred to as IFC catalogues. The main processes, supported by the ISO 16757 series, are the definition of product catalogues as IFC catalogues with content from the manufacturer's catalogue, selection of individual products and insertion into the BIM project model (see [Figure 1](#)).

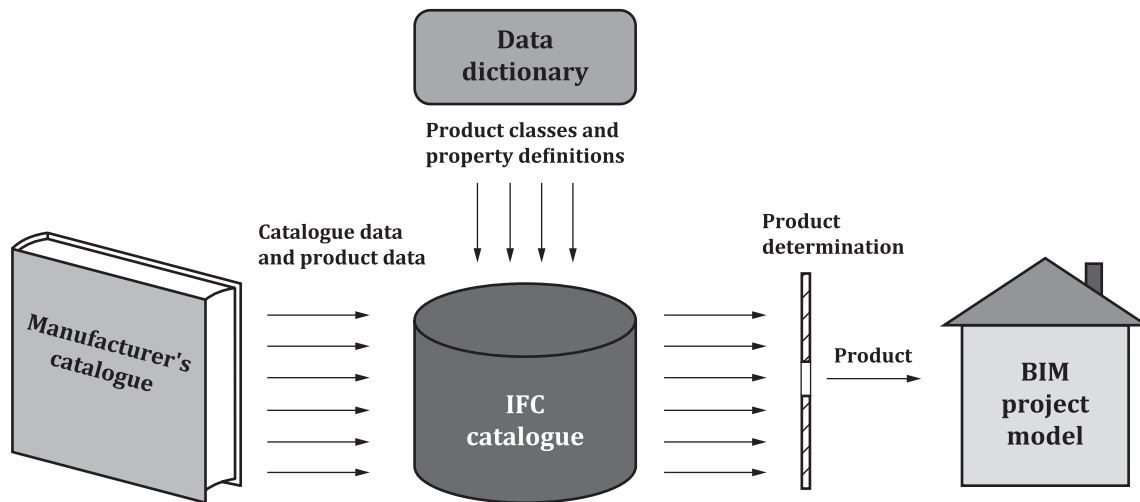


Figure 1 — Main processes supported by the ISO 16757 series

The definitions of product classes (in ISO 16757-4 called product subjects), product properties and property attributes shall be organized in accordance with ISO 23386:2020, Clauses 5 and 6, by commissions of experts. This also includes the definitions of the functions for calculating the values of dynamic properties. The elements defined in the commissions of experts can be provided in list form.

Experts introduce the product classes and their properties into data dictionaries according to ISO 12006-3 and ISO 16757-4. This can be done via the special user interfaces of the dictionaries or by transferring the list of elements via provided application programming interfaces (API).

Three roles can be described for the creation, provision and use of product catalogues:

- a) product manufacturer (possibly supported by service providers);
- b) catalogue provider;
- c) end user.

4.2 Creation of product catalogues using the definitions in the data dictionary

The required definitions of product classes and related properties as well as the classes of ports and in/outlets can be read from the central data dictionary via an API.

The hierarchy of product classes and product property classes is also specified by the definitions in the data dictionary.

The data dictionary contains also the defined names and parameter list of all needed functions.

The responsibilities of product manufacturers or their service providers are:

- to define the products of their product catalogues, including their variants and the grouping of variants;
- to define the properties of their products and their values or domains of values;
- to translate these values or domains of values in appropriate languages (if necessary), re-using as much as possible translated lists of values provided by the dictionary;
- to define the constraints between properties;
- to define the formulas that will allow the calculation of values of dynamic properties (e.g. pressure loss) on selected products;
- to generate a meta-object file describing each configurable product, using its preferred file format;

- to code a JavaScript function that will transform the meta-object into an IFC file;
- to provide to product catalogue providers the 3 elements that define each product: EN 17549-2:2023 properties and constraints, a geometrical meta-object and a JavaScript function to transform it into IFC files.

4.3 Provision of the product catalogue

On web portals, realised by product catalogue providers, manufacturers present their main product classes with possible areas of application, boundary conditions and special property values and offer the product data exchange files for download. Special web applications can be used for the presentation.

The responsibilities of product catalogue providers are:

- to collect product catalogues conforming to this document from multiple manufacturers into a database (EN 17549-2 properties, meta-objects, JavaScript functions that will transform the meta-object into an IFC file);
- to allow end-users to interact with data dictionaries to retrieve semantics of properties, product classes, relationships;
- to provide a search mechanism to browse product catalogues from multiple manufacturers;
- to provide a decision support mechanism to help end-users configure the products;
- Once the end-user has configured the product:
 - to generate the configured EN 17549-2 file;
 - to generate the IFC file describing the geometric representation of the configured product, by running the JavaScript function provided by the manufacturer;
- to provide a download mechanism for the end-user.

4.4 Product determination in the product catalogue

Planning and other software applications guide the user (designer) in determining a single product and/or in assembling a product group of components and accessories based on product classes and product property values.

Based on the determined product classes, product property values, components and accessories, the software applications create the corresponding article numbers.

The responsibilities of product catalogue end-users are:

- to perform end-user search through multiple product catalogues;
- to configure the product by assigning values to variable properties;
- to download the configured product (EN 17549-2 properties and IFC geometric representation);
- to integrate the configured product into their data base.

4.5 Product integration into the technical system model

The software applications that use prefabricated product catalogues can be planning systems, CAD systems, calculation systems or combinations of these, for example. They read the product catalogue data into their own data structure and integrate it into their system model. CAD systems create the product-related graphical symbol, design and connection data for the determined products.

The software applications can calculate and simulate the behaviour of the products in building services systems with the help of the property values and the calculation of dynamic properties based on the technical rules specified by the product manufacturer.

4.6 Data exchange of the technical system model

Software applications can transfer with the technical system model the links to the product classes, the product property values, components and accessories as well as the corresponding article numbers of the products via IFC for further (actual) data exchange with external software applications.

4.7 Use of product catalogues according to the ISO 16757 series

The way in which end users use product catalogues according to the ISO 16757 series depends on the orientation of the software systems they use.

Pure CAD systems that do not have the option of calculating building services may only be able to display the geometry of the products from the product catalogues. This may, for example, already fulfil the requirements of the preliminary planning of technical systems. Using the product catalogues automatically ensures that the shapes and dimensions of products exist.

Pure calculation software, on the other hand, are interested in certain dimensions (pipe lengths, heater surfaces) from the product catalogue. If the CAD pre-planning described above exists, the correct dimension values can be taken from there. Dynamic properties, using manufacturer-related algorithms and values, can enlarge the features of calculation systems.

The more planning and calculation are coordinated in integrated software systems, the greater the benefit of using the product catalogues according to the ISO 16757 series.

5 Product representation

5.1 Part numbers

Every deliverable product has a combination of property values. But not all theoretically possible combinations of values lead to a deliverable product. Some combinations contradict each other (tiny radiator with very large heat radiation, large valve with very small ports); some combinations are not producible.

To determine and order a specific product from a product catalogue, it is generally sufficient to specify one or several part numbers.

For configurable products, the part numbers are defined on the basis of the values of specific properties, from which the part numbers can be calculated. The following types of products in product catalogues can be distinguished:

a) Configured products

For these products, part numbers are clearly assigned in the product catalogue. The quantity of property values is manageable.

b) Configurable products

The (descriptive) part numbers for these products are only generated when the order is placed by combining property values. Depending on the number of property value lists that can be combined, billions of possible variants are conceivable in practice. It is possible that some part numbers are never generated for certain combinations of property values.

5.2 Geometry

The content of an electronic product catalogue also includes the geometry of the products. The geometry shall be usable as a model for planning in CAD systems and for calculations (e.g. in pressure loss calculation, heat transfer and sound emission).

As the geometry cannot be defined in a data dictionary according to ISO 16757-4, the mapping of the geometry in an electronic product catalogue is described in this subclause.

Every product has geometric data - at least it can be represented by a graphic symbol.

The geometry from product catalogues is not used for product manufacture and therefore has no production-relevant data such as demolding slopes or punching radii.

Therefore, a pure constructive solid geometry (CSG) description of the product geometry is usually sufficient. Basic geometric elements such as lines, circles and arcs and geometric solids such as cuboids, cylinders, spheres, cones and Boolean operations are usually sufficient to describe the representation of products.

This applies in particular to the geometry of configurable products such as pipes, air ducts, radiators, silencers or fire dampers, for which arbitrary dimensions can sometimes be specified.

In most cases, an overly realistic geometric representation (see [Figure 2](#)) is not desired, as thousands of similar but not equal, elaborately represented products can be used in a building model. This results in a high loss of performance. In addition, these detailed geometries become colour-filled patches in the scales of overview representations, which no longer allow the user to differentiate between them.

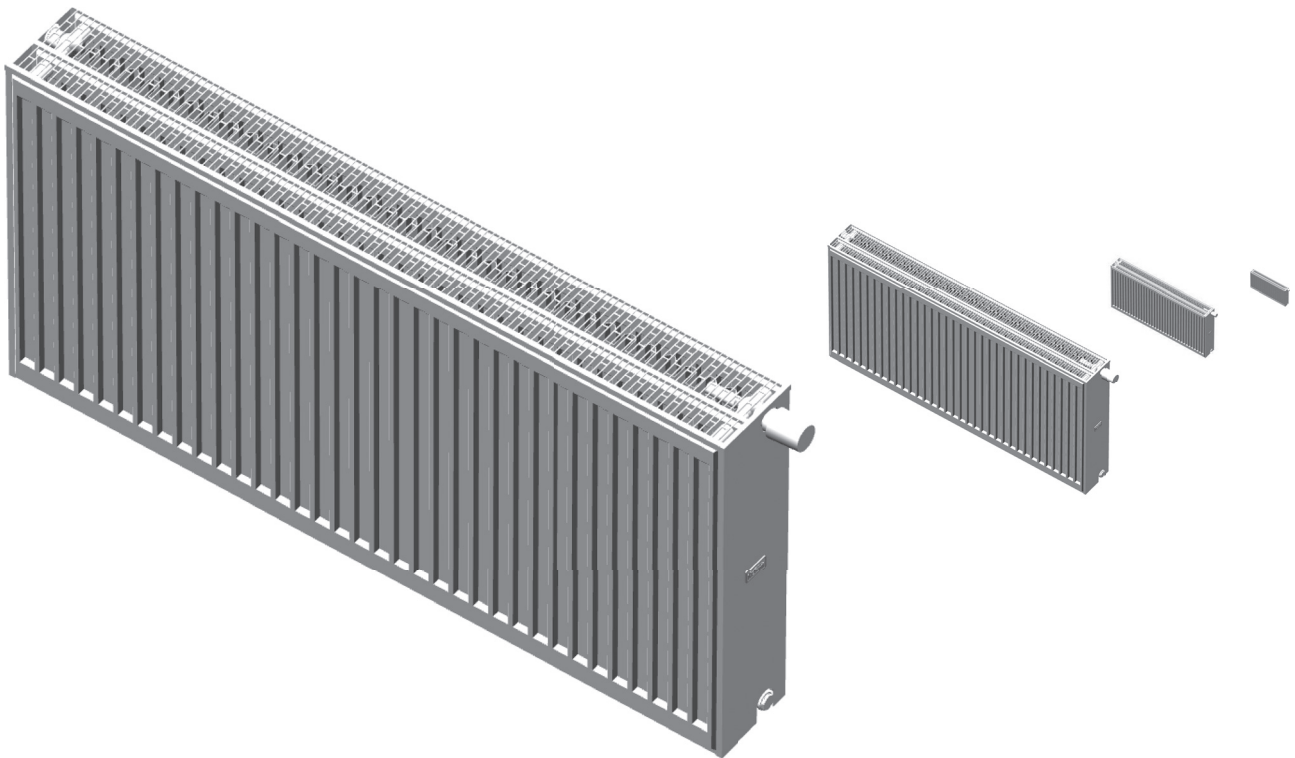


Figure 2 — Overly realistic geometric representation

Depending on the level of information need, the user can request differently detailed geometries according to the ISO 7817 series.

Levels of geometry that can be defined individually by the user require not only a great deal of effort on the part of the user, but also a further examination of the result and possibly a repeated readjustment of the level of geometry in dialogue with the creator of the model.

For the user of a product catalogue, on the other hand, it is important to be able to directly address certain predefined types of more or less detailed geometries.

For this purpose, 14 types of geometric representation are defined and shall be used in product catalogues:

- Symbolic geometry (see [5.3](#)):
 - Type 1: Symbolic geometry (normal)
It represents the main function of a product.
 - Type 2: Symbolic geometry (detailed)
It represents the explicit main and sub functions of a product.
 - Type 3: Symbolic geometry (port)
The location and direction in piping and instrumentation diagram (P & ID) (the ISO 10628 series) can be recognized.
 - Type 4: Symbolic geometry (in/outlet)
The location and direction in P & ID (the ISO 10628 series) can be recognized.
- Shape geometry (see [5.4](#)):
 - Type 5: Shape geometry (minimized)
The main product class can be recognized.
 - Type 6: Shape geometry (normal)
The product direction for installation (front/backside) can be recognized.
 - Type 7: Shape geometry (realistic)
All main geometric properties of a product can be recognized.
- Port geometry (see [5.5](#)):
 - Type 8: Shape geometry (port)
Location and direction at the shape geometry can be recognized.
- In/outlet geometry (see [5.6](#)):
 - Type 9: Shape geometry (in/outlet)
Location and direction at the shape geometry can be recognized.
- Space geometry (see [5.7](#))
 - Type 10: Overall space
3D shape of space that includes the entire product space and all other spaces.
 - Type 11: Operation space
3D shape of space that enables the product to be operated.
 - Type 12: Access space
3D shape of space that enables the product to be accessed.
 - Type 13: Transportation space
3D shape of space that enables the product to be transported.

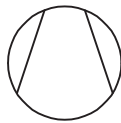
— Type 14: Installation space

3D shape of space that enables the product to be installed.

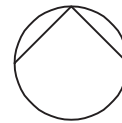
5.3 Symbolic geometry

Graphical symbols represent the technical functions of a product. There are two levels of graphical symbols, less detailed graphical symbols (normal) (see [Figure 3](#)) and high detailed graphical symbols (see [Figure 4](#)). In addition, graphical symbols for ports (see [Figure 5](#)) and in/outlets (see [Figure 6](#)) can be attached to graphical symbols of products.

All graphical symbols shall be represented as 3D geometry. They are designed with X-Y coordinates and a Z-component of zero. Thus, they can be used in a CAD application not only in P & ID schemas but also in isometric drawings.

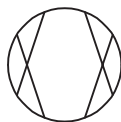


a) Compressor general (ISO 14617-2-2302)

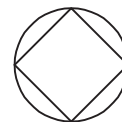


b) Pump general (ISO 14617-2-2301)

Figure 3 — Examples of symbolic geometry representing the main function of a product



a) Compressor with alternative directions (ISO 14617-2-2304)



b) Compressor with alternative directions (ISO 14617-2-2303)

Figure 4 — Examples of symbolic geometry representing the explicit main- and sub-functions of a product



Figure 5 — Example of geometric types: graphical symbol: ports at a pump symbol (application of ISO 14617-2-2303)

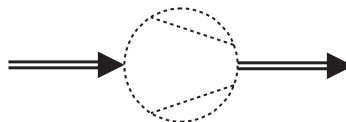


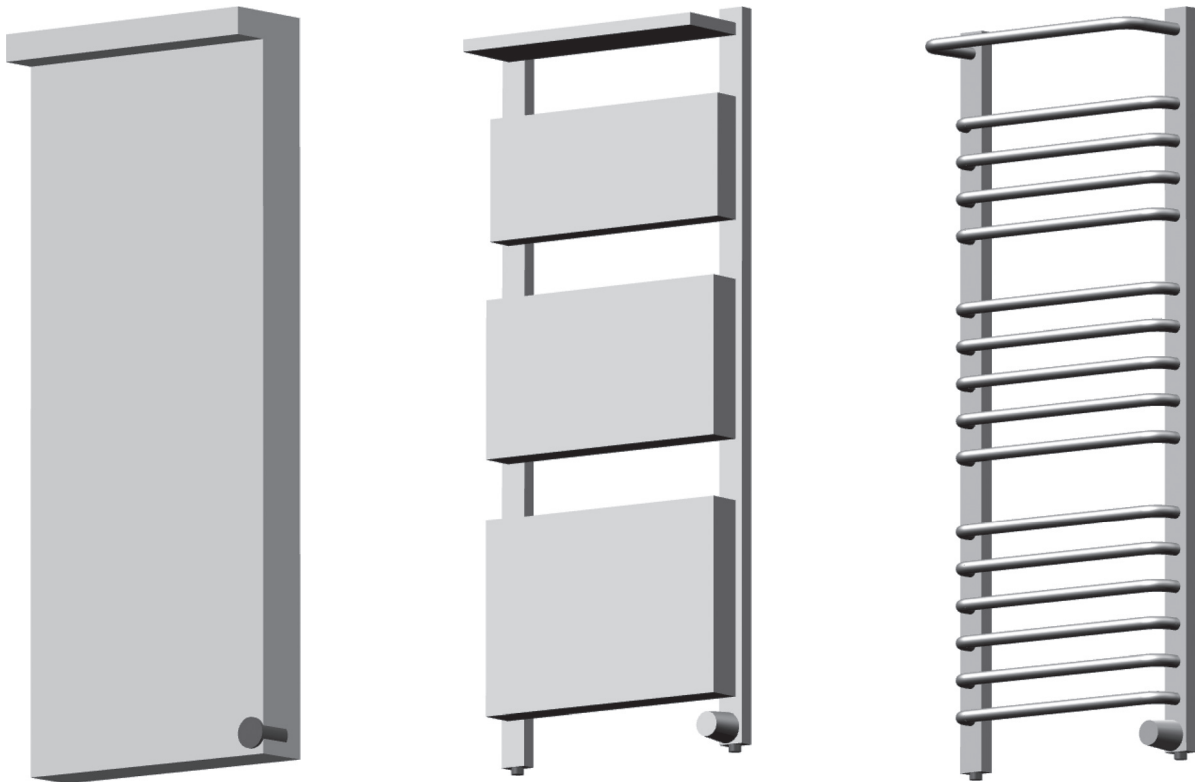
Figure 6 — Example of geometric type: graphical symbol: in/outlets at a compressor symbol (application of ISO 14617-2-2302)

5.4 Shape geometry

ISO 16757-2 defines for one geometric product model the following kinds of shape geometry (see [Figure 7](#)):

— Geometric type 5: 3D less detailed (minimized)

- Geometric type 6: 3D more detailed (normal)
- Geometric type 7: 3D highly detailed (realistic)



a) Less detailed (minimized)

b) More detailed (normal)

c) Highly detailed (realistic)

Figure 7 — Examples of geometric type: shape

The types of shape geometry shall meet the following requirements:

Type 5 is a less detailed 3D shape geometry. It shall be elaborated so far that the main classification into a product class is possible.

EXAMPLE A type 5 geometry makes it possible to distinguish, for example, a fire damper from a duct, a radiator from a boiler, a bathtub from a sink and a valve from a pressure gauge.

Geometries of this level shall fulfil two objectives:

- The first objective is to prevent product geometries in overview displays from leading to an accumulation of strokes that result in 'black' spots.
- The second objective is to minimize the number of geometric elements to ensure the best performance for CAD systems.

To ensure these objectives, a type 5 geometry of a product shall be limited to three geometric elements.

Type 6 is a more detailed 3D shape geometry. It shall be elaborated so far that a differentiation between products of different manufacturers is possible. The main geometric differences in the shape design shall be displayed. The direction of mounting shall be visible.

Type 7 is a highly detailed 3D shape geometry. It shall be elaborated so far that all main geometric properties of a product are visible. It shall provide a nearly photorealistic view of the product without representing details of lower interest such as rivets or flat sheet metal seams.

The main target of this level is to present particular products to end users or to create detailed visualizations in order to highlight particular instances of products in building services system models. The provision of such detailed geometry is optional.

A product catalogue shall contain at least a type 5 geometry of any product.

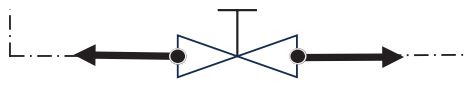
See ISO 16757-2 for a detailed description of shape geometry.

5.5 Ports

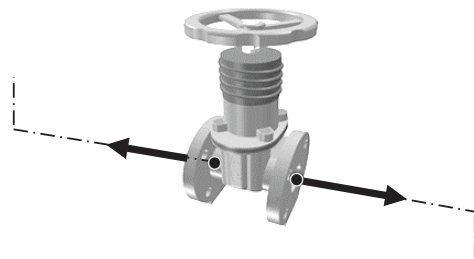
In the system model, product ports can be connected to ports of other products. They are used from and to the product for the transfer of substances, energy, forces and signals. For more information about ports see ISO 16757-4:2025, 4.3.4.2.

Ports shall be set up independently for (see [Figure 8](#)):

- the symbolic geometry in geometric type 1 and 2;
- the shape geometry in type 5, 6 and 7.



a) Symbolic geometry
(application of ISO 7000-1852)



b) Shape geometry

Figure 8 — Examples: different port positions at symbolic (type 3) and at shape (type 8) geometry

Ports shall be positioned geometrically in the 2D plane or in 3D space only with the port position and port directions.

No geometric shape data shall be assigned to ports. The shape, for example, of flanges is part of the product shape.

During operation, the technical values of the media flowing through (volume flow, pressure, temperature, flow velocity) are assigned to the ports. The values at the connections are taken from the mating connections of the connected products or used for the subsequent calculations.

The graphical representation of ports lies in the responsibility of the respective CAD system. Connected ports are not normally shown in the design. A CAD system can provide a graphic warning for connections that do not match.

In the case of connections between ports, arrow symbols in certain colours, for example, can convey important, agreed upon information. The flows, pressures, temperatures and speeds of the media can also be temporarily displayed using text panels.

See ISO 16757-2 for a detailed description of geometry.

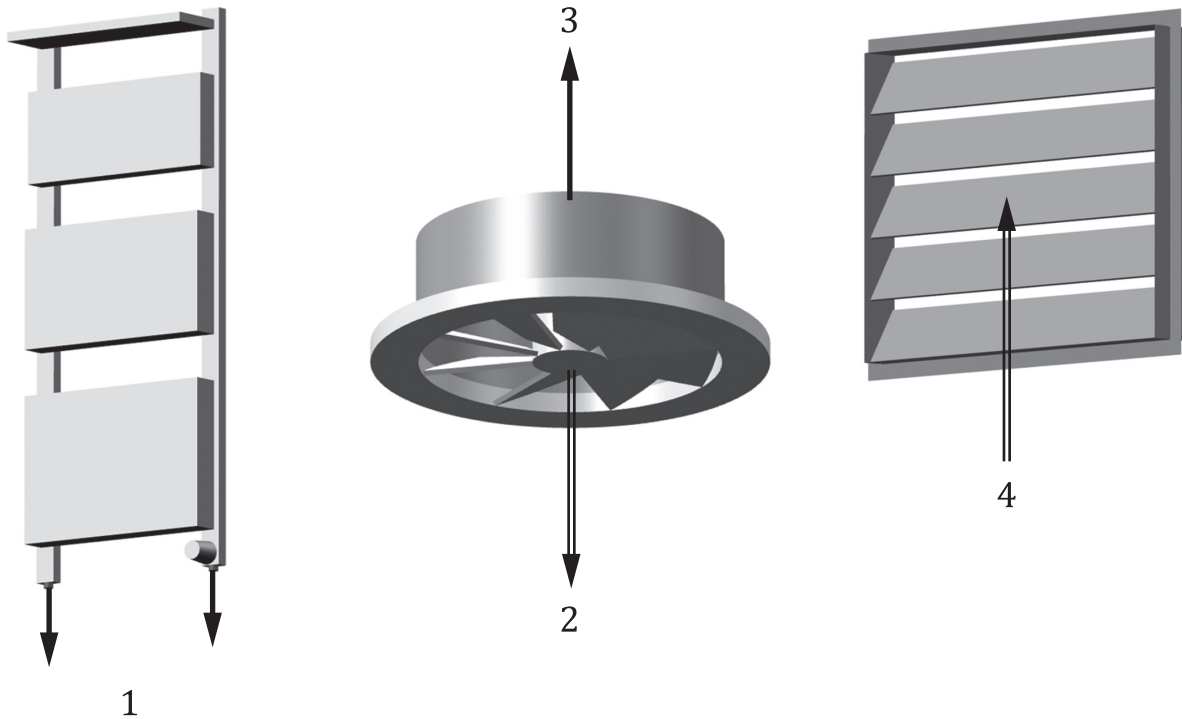
5.6 In/outlets

In the building services system model, there are products that have inlets or outlets to or from the rooms or the building environment (see [Figure 9](#)).

The in/outlets are used to transmit substances, energy or signals. For more information about in/outlets see ISO 16757-4:2025, 4.3.4.3.

No geometric shape data is assigned to in/outlets. The shape, for example, of air baffles is part of the product shape.

In addition to the media values during operation through (volume flow, pressure, temperature, flow velocity), output or input values are determined by the shape of the products (e.g. ceiling diffusers, jet nozzles, exhaust air grilles). These products generate different flow patterns.



Key

- 1 type 8: ports at shape geometry
- 2 type 9: in/outlet (output) at shape geometry
- 3 type 8: port at shape geometry
- 4 type 9: in/outlet (input) at shape geometry

Figure 9 — Examples of ports and in/outlets configured products

In/outlets shall be set up independently for:

- the symbolic geometry in level 1 and 2;
- the shape geometry in level 3, 4 and 5.

In/outlets are positioned geometrically in the 2D plane or in 3D space only with the opening points and media directions. No geometric shape data is assigned to them.

The graphical representation of in/outlets lies in the responsibility of the respective CAD system. Arrow symbols in certain colours, for example, can convey important, agreed information.

The flows, pressures, temperatures and speeds of the media can also be temporarily displayed using text panels. Simulation software can also be used to calculate and display the dispersion of air, gases and liquids from in/outlets.

5.7 Spaces

ISO 16757-2 defines for one geometric product model the following kinds of spaces (see [Figure 10](#)):

- Type 10: 3D overall space;
- Type 11: 3D operation space;
- Type 12: 3D access space;
- Type 13: 3D transportation space;
- Type 14: 3D installation space.

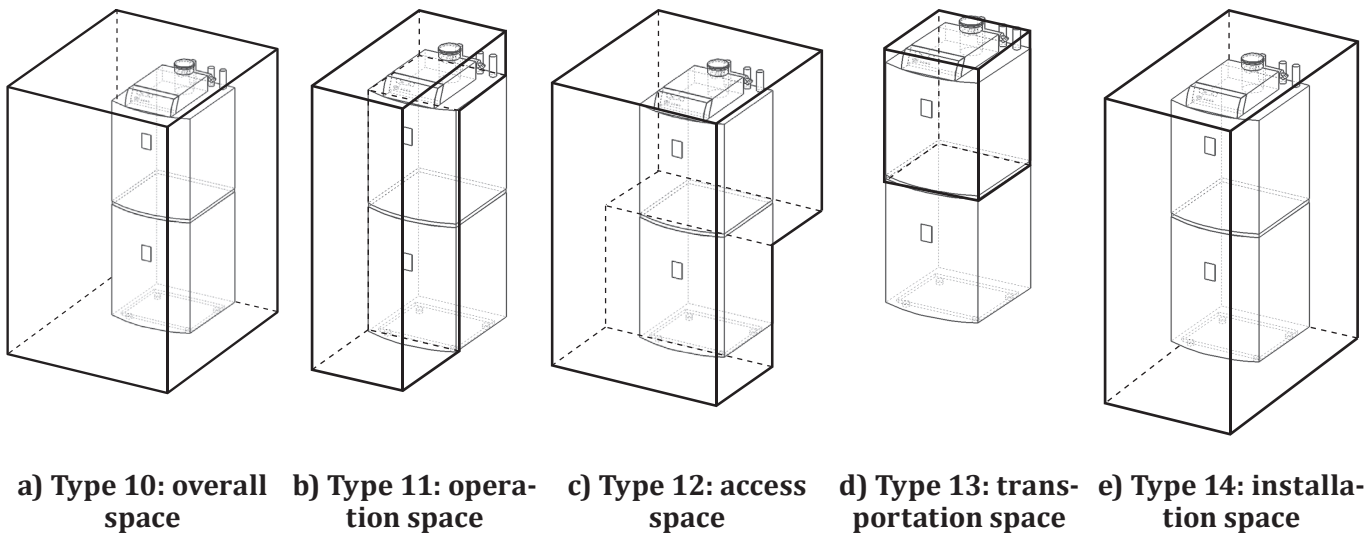


Figure 10 — Examples: types of spaces

See ISO 16757-2 for a detailed description of geometry.

5.8 Media data

The product determination from product catalogues can be supported by visual and acoustic media, images, videos and audio documents (see [Figure 11](#)). They give the user an overall impression of the product and thus an intuitive decision-making aid. The descriptive objects of the media data are referenced in the data exchange structure, but not integrated into it.

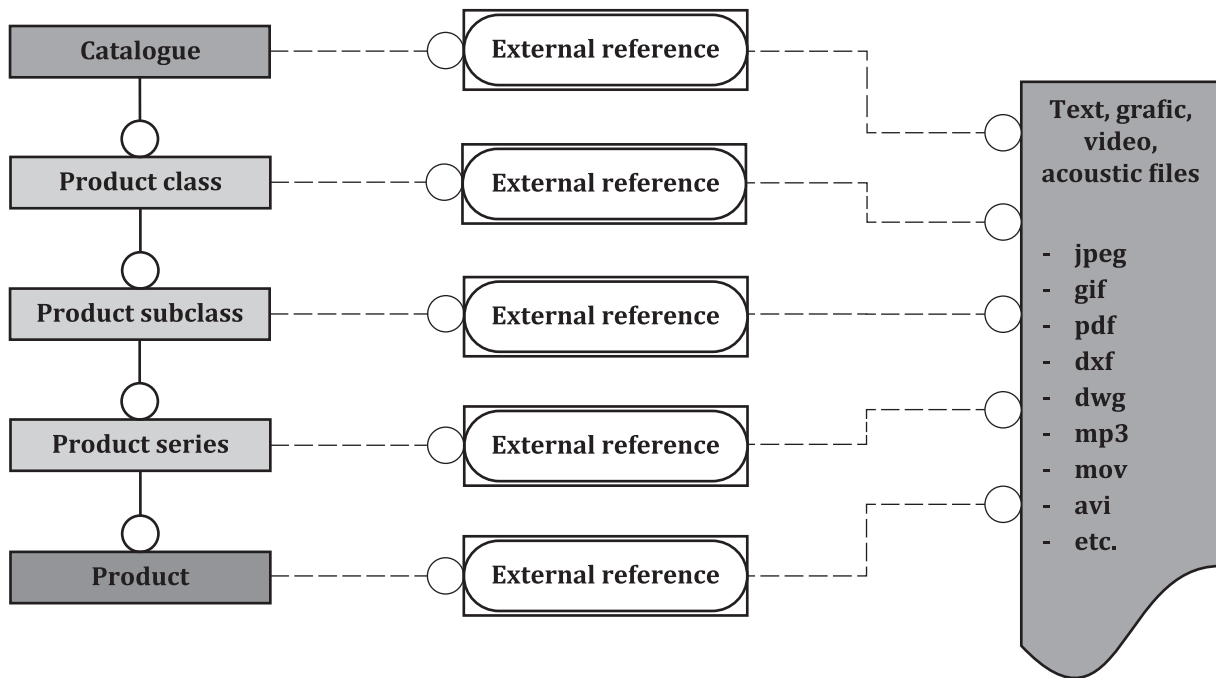


Figure 11 — Referenced external media data

6 Product catalogue as IFC structure

6.1 General

The data exchange of product catalogues for building services engineering shall be realized via the IFC data format described in ISO 16739-1.

IFC enables the complete transmission of design models. In order to enable a rule-compliant data exchange, certain specifications shall be made.

The IFC catalogue data exchange file shall contain the product-specific values of the properties defined in the related data dictionary in accordance with ISO 16757-4.

The exchange of building services product catalogues with contained model data requires an arbitrary data file for the transport of the values of model properties. All values of the properties are manufacturer related.

The creation of product catalogues always requires the cooperation of product managers with the product catalogue creators and, if necessary, corresponding service providers.

Data generation requires application programmes that combine existing data, for example, from product information management systems (PIM systems) with calculation data (dynamic features) and the geometry data of the graphical product symbols, product shapes, ports and in/outlets as well as the various required product spaces.

See EN 17549-2:2023, 4.1.

The pictures shown in [Figure 12](#) are used for visualizing IFC structures, representing IFC entities, relationships and references.

See [Annex A](#) for examples for IFC data structures.

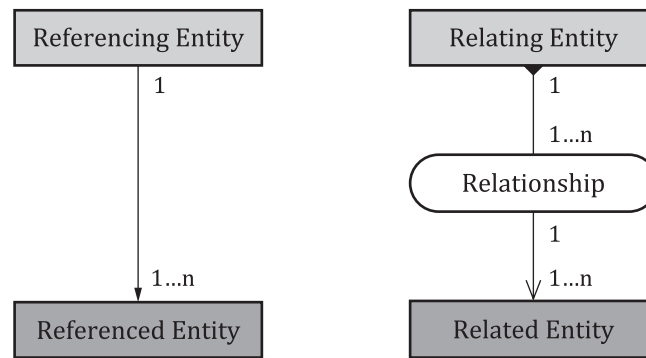


Figure 12 — Pictures used to represent IFC entities, relationships and references

Referenced entities are called directly from the referencing entity.

Relationships call both the relating entity and the related entities.

6.2 IFC catalogue metadata

The product catalogue of building services products is an IFC project. The project declares the project library, containing the product property definitions, which is external from the IFC data exchange medium.

The product catalogue metadata shall be listed in `IfcOrganization` and dependent relationships (see [Figure 13](#)). The product catalogue metadata not defined there shall be defined in a data dictionary and referenced from the data exchange medium.

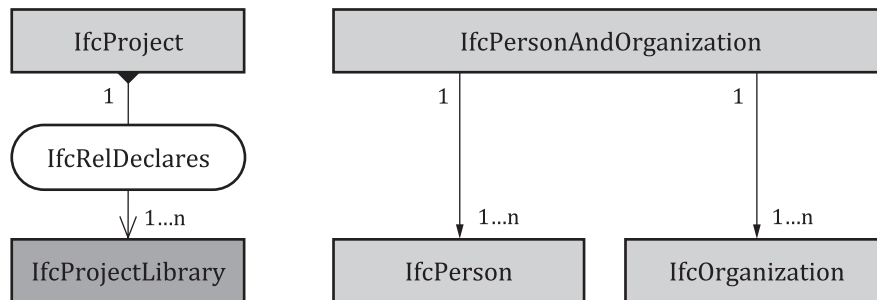


Figure 13 — Product catalogue edition property structure in IFC

In IFC files describing a building project, there is a relationship between the project and a building with its geometric representation.

Here, however, there is no direct relationship between the product catalogue project and a geometric representation, as each product in the product catalogue has its own geometry, unless some products share the same one (see [Clause 7](#)).

6.3 Product classes and their structures in IFC

The classification of products into product classes is a component of manufacturer-related product catalogues (see [Figure 14](#)). It shall be used both in printed product catalogues and in electronic product catalogues to quickly find the way to the desired products. The definitions of product classes and their structures shall be stored in a data dictionary in accordance with ISO 16757-4.

In the IFC file, the assignment of all product classes to the data dictionary shall be represented by a relationship 'IfcRelDeclares'.

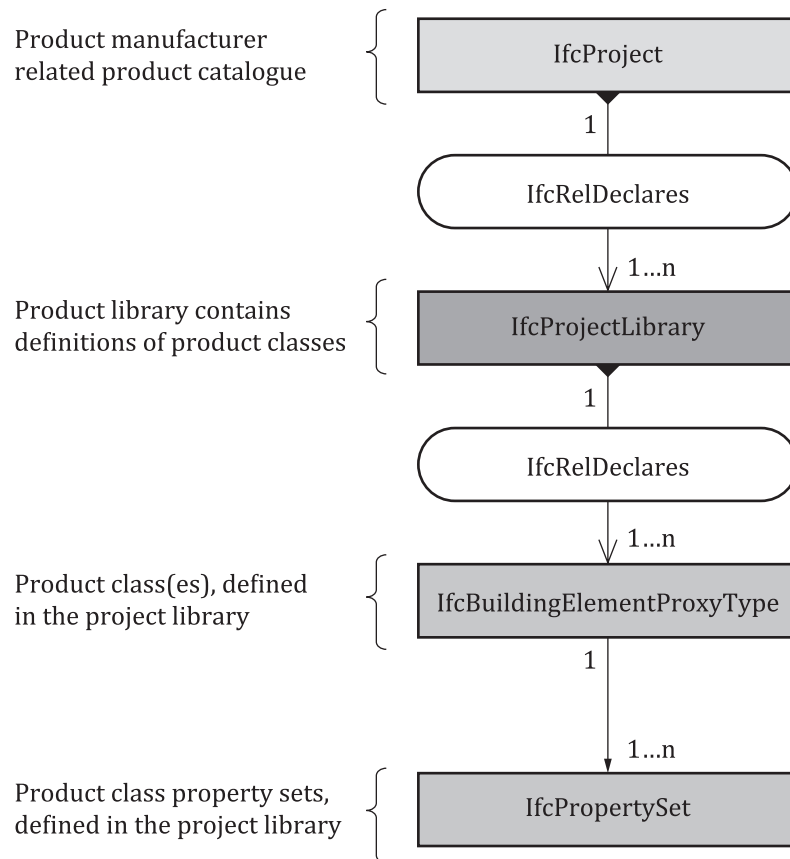


Figure 14 — Declaration of product classes and properties in an IFC catalogue

The product catalogue in the IFC-File shall contain the product models that are entered into the models of the surrounding technical systems during system design. The classes of the surrounding technical systems - in the example the heating system in a building - shall only be present as abstract classes for the dynamic properties.

The class structure is represented in IFC by relationships 'IfcRelNests' as nesting of the respective classes and subclasses (see [Figure 15](#)).

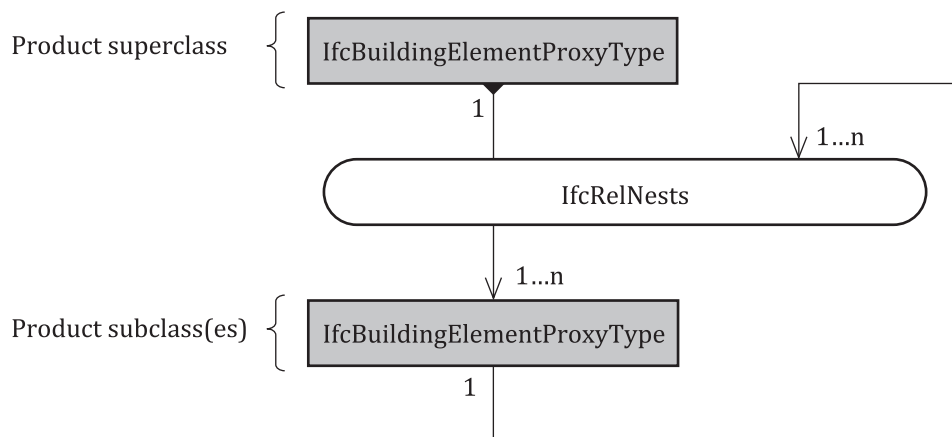


Figure 15 — Structure of product classes and subclasses in an IFC catalogue

6.4 Product series in IFC

Product series are groups of any products. These products can belong to one or more, even different, classes. Products can therefore be members of product classes and at the same time belong a product series.

Product properties are generally assigned to the defined product classes. Product series can only access properties of the classes. A generally valid assignment of product types to product series for product catalogues is therefore not possible. Therefore, the 'Name of product series' is specified for the product as one of the product properties.

6.5 Components and accessories in IFC

Components and accessories shall form a configurable product as an assembly with variable build-up conditions, sub-assemblies and sub-parts. The product configuration requires the user to follow the assembly conditions until the product is correctly assembled. Such a product assembly shall form a product group of several components and accessories, which are only assembled during product determination.

In IFC, the assembly structure shall be represented by a tree of IfcGroup entities (see [Figure 16](#)).

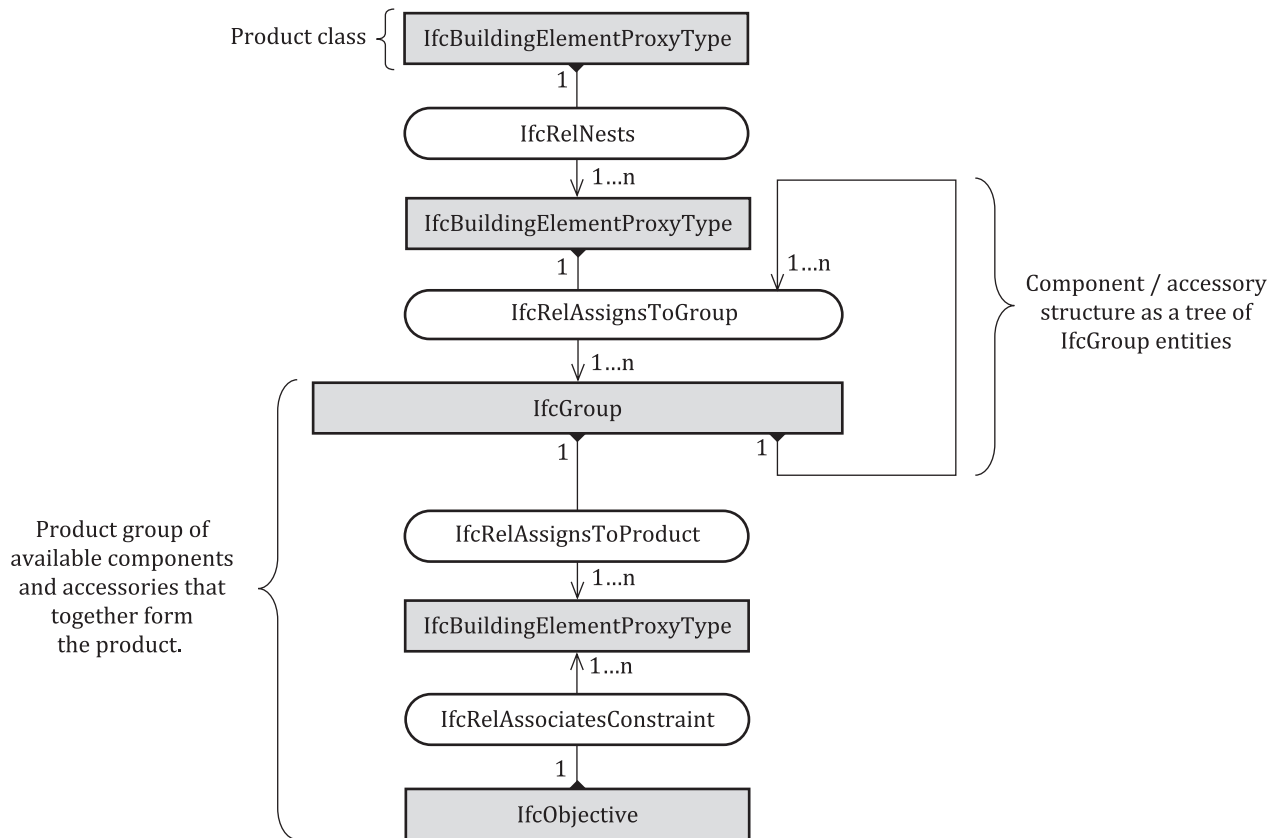


Figure 16 — Product group structure of components and accessories in an IFC catalogue

The structure of product-components resp. accessories, once defined, can be filled in with references to arbitrary products with dependencies, conditions and exclusions.

Dependencies shall be declared by the assembly tree with sub-assemblies and sub-parts.

Exclusions can be created by different branches and twigs of the assembly tree.

The tree of IfcGroup entities determines which components can be chosen in each allocation level. Constraints declare in each allocation level the number of available components.

EXAMPLE The number of available components can be:

- exactly one to choose (automatic);
- nothing or one to choose;
- to choose exactly one (or 2, 3, 4...) of many;
- to choose nothing or one (or 2, 3, 4...) of many.

NOTE The examples in EN 17549-2 use the IfcGroup entity for the combination of a radiator and a valve to form a heating system. In the product catalogue the IfcGroup stands for the product, combined from components. The data structures are the same.

6.6 Properties and constraints for property values in IFC

The IFC catalogue data exchange file shall contain the product-specific values of the properties defined in the related data dictionary according to ISO 16757-4. The IFC data structure is according to EN 17549-2 (see [Figure 17](#)).

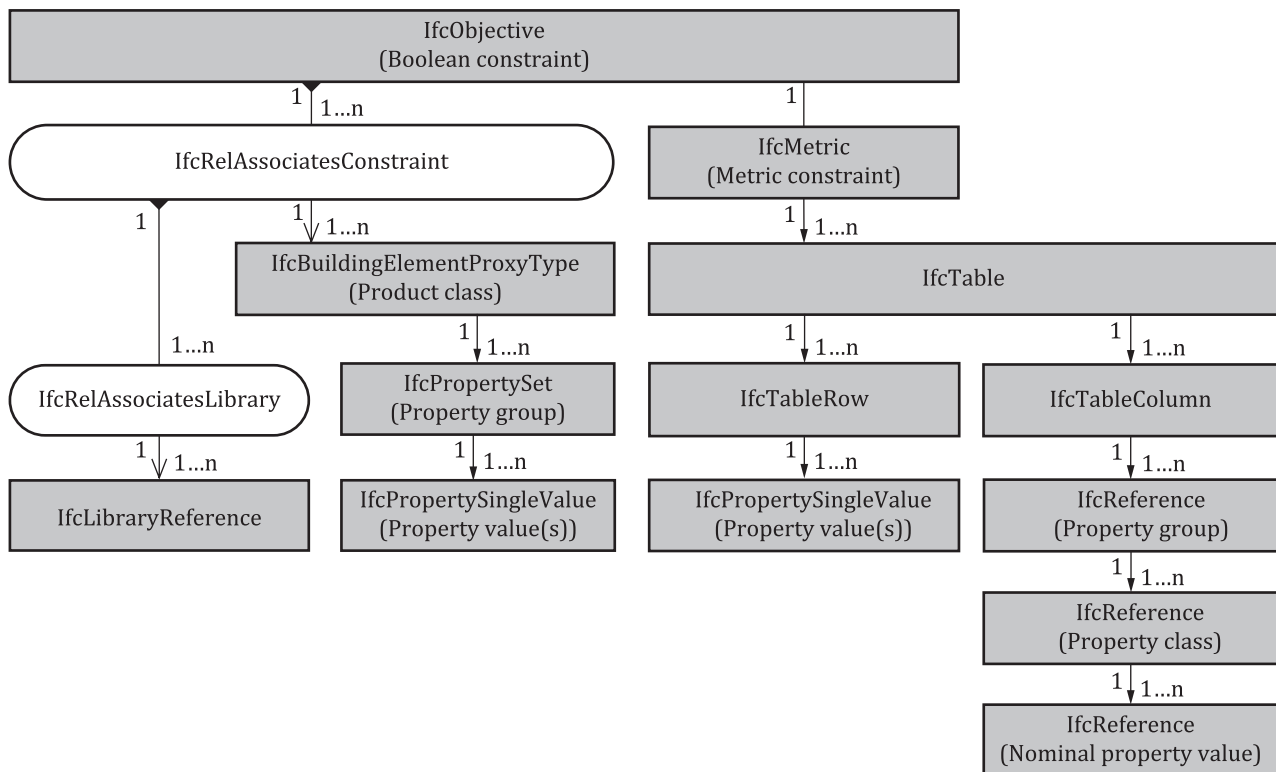


Figure 17 — Property structure with constraints in an IFC catalogue

The task at hand is to establish a relationship between the part numbers and the property values belonging to the product.

Only deliverable combinations of classes and property values shall be available for product determination.

These combinations can be stored in tables containing the properties and their values. Only valid combinations of property values are deliverable and lead to a part number.

Constraints and JavaScript functions are used for different purposes and in the following situations:

Constraints shall be used for the specification of the allowed combinations of property values. A valid combination of values of the different properties represents a variant. On the side of the receiver of a product catalogue, the constraints are to be evaluated to identify a variant or a set of variants.

When a variant has been selected as far as the parameters of the JavaScript functions are concerned and these property values are specified, then the JavaScript functions may be applied. Their parameters are then given by defined property values, so that the JavaScript function can be executed.

Selected property values can lead to dependent characteristics that are not relevant for the generation of part numbers. These can be, for example, several related performance properties that are required for calculations. These values form data blocks that form columns of different properties in tables and whose values belong together in rows (see [Figure 18](#)).

NOTE 1 The user of a product selecting software application selects the desired property values one after the other in the "Tables with individually selectable values". This creates a property value combination. After each selection, the application software checks the "Table with property value combinations valid for deliverable products" to see which other property values can supplement the resulting property value combination.

It makes sense to make only these other property values selectable in the "Tables with individually selectable values". All other characteristic values are marked accordingly or hidden by the application software.

The product is considered to be selected when all the values required to form an article number are clearly assigned. If the user ends their selection prematurely without selecting all characteristic values, the application software can determine a meaningful in the combination table itself.

The valid value row in the "Table with block data (technical)" is determined by comparing the block keys. In principle, the user can also be allowed to select a row in the "Table with block data (technical)". However, this can lead to several valid value combinations and therefore to several products, which then are to be selected further.

Configured products can be displayed completely as relationship tables in the product catalogue.

Tables with individually selectable property values:

Color	Type	Height	Length
black	open	140	500
green	closed	180	550
red		210	580
orange		250	600
yellow		300	650
violet		500	700
blue		550	750
			800

Table with property value combinations valid for deliverable products with valid part numbers:

Color	Type	Height	Length	Part number	Technical block key	Geometric block key
black	closed	180	1 200	815-471-1	1	1
red	open	200	900	815-471-2	5	1
orange	closed	250	650	815-471-3	3	2
blue	closed	550	800	815-471-4	4	3
yellow	open	600	1 100	815-471-5	3	5

Table with block data (technical):

Technical block key	Power	Efficiency	Exponent	Min. fluid flow	Radiant fraction	Kv-value	Max. pressure
1	750	0,4	1,25	17	27	17	10 000
2	900	0,583	1,2	20	26	20	11 000
3	1 350	0,5	1,24	22	25	22	11 000
4	1 500	0,59	1,2	25	25	25	11 000
5	1 900	0,53	1,2	25	25	27	11 000

Table with geometric product representation:

Geometric block key	Geometry
1	IfcGeometricRepresentationContext 1
2	IfcGeometricRepresentationContext 2
3	IfcGeometricRepresentationContext 3
4	IfcGeometricRepresentationContext 4
5	IfcGeometricRepresentationContext 5

Figure 18 — Example for tables with relationship between the part number, the geometry and the property values for product series of lower variability

Certain products, such as ventilation silencers, can be produced with any property values (length, width, height) in certain ranges, as modern, automated production processes make this possible. In purely mathematical terms, this could lead to trillions of dimensional variants (= table rows). But even here there are combinations that are not producible or absurd.

Therefore, each dimension value can be described by its range (minimum and maximum value) and the regular width of the intermediate steps.

Each table row describes values that are valid together. Each row can be identified by a key. Thus, different value tables can be displayed in a very space-saving way (see [Figure 19](#)).

NOTE 2 For a software application the same rules apply as for [Figure 18](#).

It is assumed here that the article number is made up of a part that represents the individually selectable characteristics and one or more parts that result as a code from the selected dimensions.

The type of dimension coding is manufacturer-specific and may need to be generated using a function.

Nonsensical dimension combinations (air duct with height = 10 000 mm and width = 100 mm) can be excluded with the help of constraints. These allow the manufacturer to maintain a certain degree of control over the order.

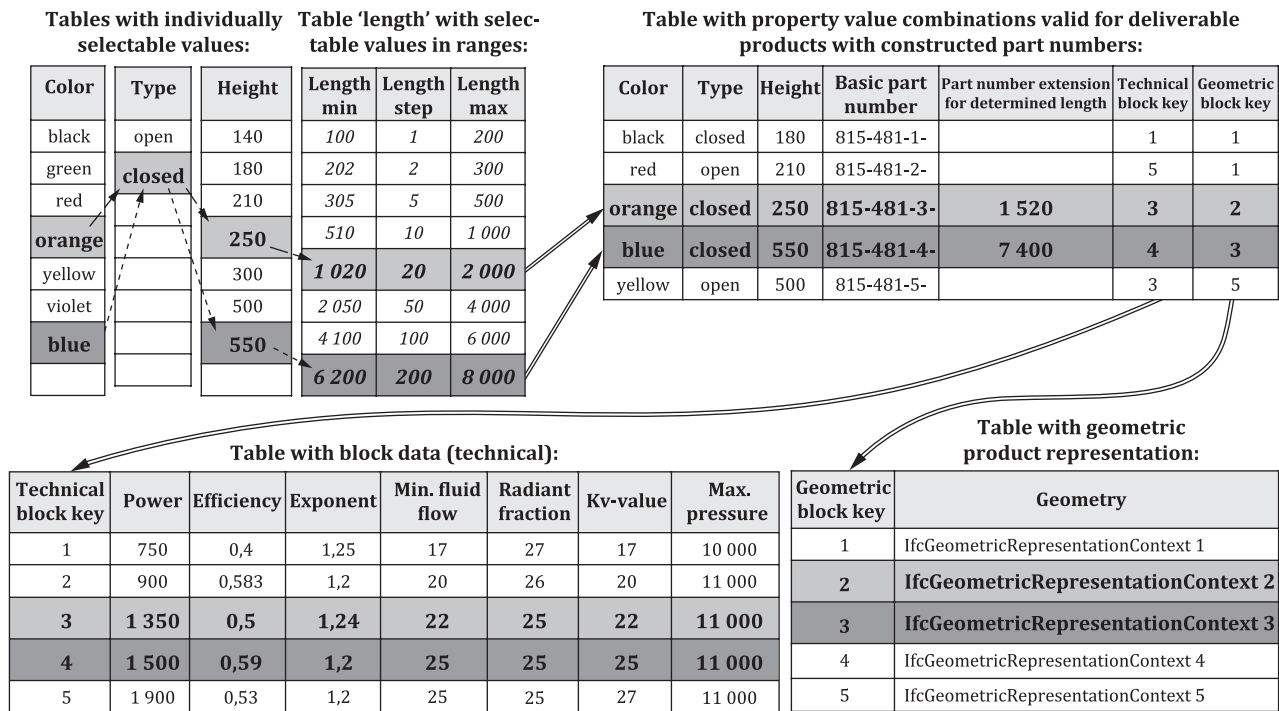


Figure 19 — Example for tables with relationship between the part number, the geometry and the property values for product series of high variability.

Parallel to the selection of a specific product variant, the values of dynamic properties can also be determined or calculated directly from the geometric and technical data.

For example, the pressure loss can be calculated using a function after entering a mass flow rate:

PL = PressureLoss(MassFlow, SelectedHeight, SelectedLength, KV_value)

The maximum power can be determined analogously:

MP = MaxPower (MassFlow, DeltaTemp, SelectedHeight, SelectedLength)

The IfcMetric constraint can describe minimum and maximum values by the IfcBenchmarkEnum operators:

(Values) GREATERTHANOREQUALTO(MinimumValue)

(Values) LESSTHANOREQUALTO(MaximumValue)

The IfcMetric constraint can describe step values by the IfcBenchmarkEnum operator:

(Values) MODULO(StepValue) EQUAL 0

See EN 17549-2:2023, 4.4, 4.5 and 4.6.

6.7 Parametric geometry in IFC

Each product shall refer to its geometric model. Each geometric model can be used independent of the others. One product can use different models. On the other hand, various products can share one geometric model, when they are similar to each other and differ, for example, only by parameterizing dimensions.

The representation of the geometry depends on the properties specified for the desired product. Analogous to the part number, the geometry models shall be defined as fixed or dynamically determined properties, representing the corresponding type of geometric representation (see 5.2).

The geometry shall be defined outside of the IFC catalogue itself. The basic idea is to generate the geometry after the selection of the variant as an IFC geometry file. For the generation of the IFC geometry, the following elements are provided and shall be used (see Figure 20):

- The IFC catalogue contains the variants.
- To a variant, one or several geometric JavaScript functions are related, representing the various types of geometric representations (see 5.2). Their parameters are related to properties in the catalogue and are filled with the respective values of these properties for the selected variant.
- The JavaScript function implementation is provided by the catalogue provider. Its primary purpose is the generation of an IFC geometry file for the selected variant.
- The JavaScript function can be based on a meta geometry, an additional file that contains support information for the generation of the IFC geometry.

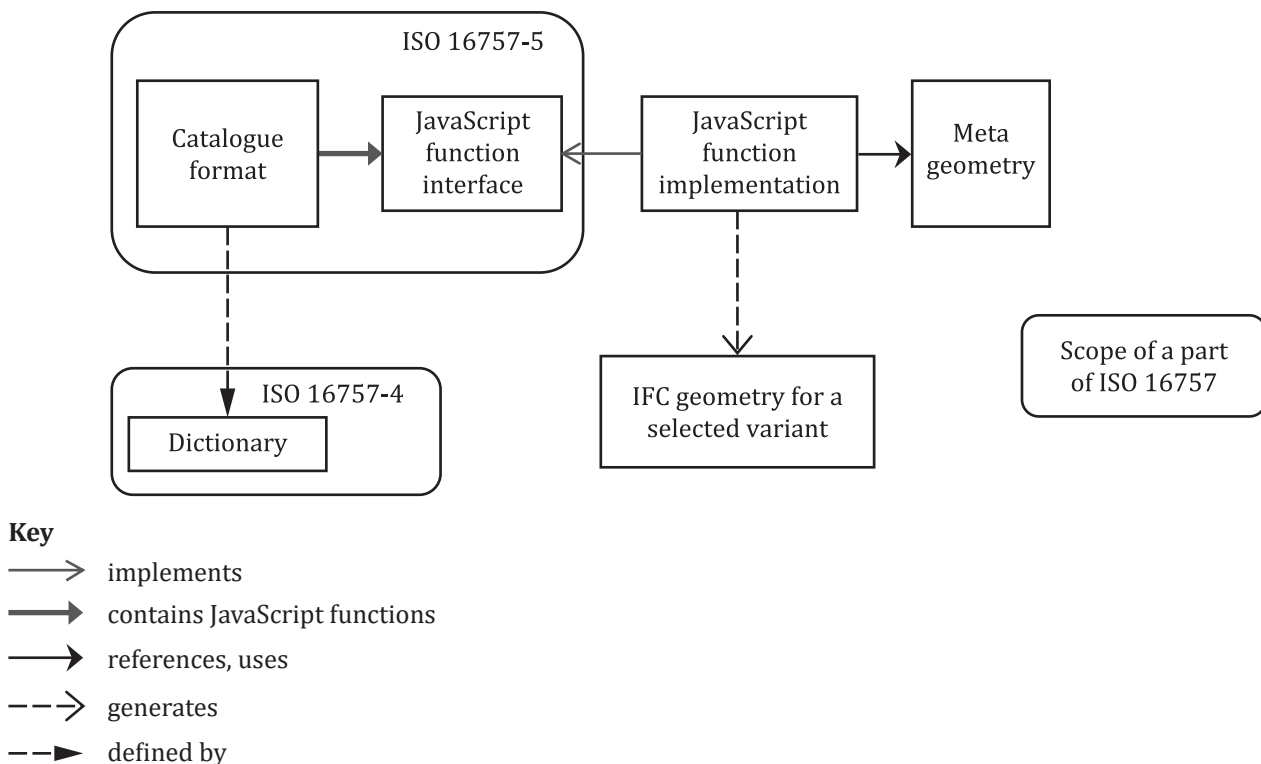


Figure 20 — Basic structures for the generation of IFC geometries for selected variants

This scheme allows various ways to generate a variant-specific IFC geometry for a selected variant. The general rule is: The JavaScript function shall generate the IFC geometry file for the selected variant. Basically, the geometry is described by a number of geometrical properties that are dependent on all or some of the basic dimensions of the selected variant provided by the property values of the catalogue. The required information is transferred into the function via the parameters of the JavaScript function. The fundamental goal of the JavaScript function in combination with the meta geometry is to compute the geometrical property values based on the dimensions given by the respective property values in the catalogue.

The geometry for the selected variant can be generated in various ways:

- The JavaScript function can generate the IFC geometry without using a meta geometry.
- The JavaScript function can generate the IFC geometry with a meta geometry that consists of an IFC geometry. The values of the dependent geometrical properties can be related to the basic dimensions of the variant by means of IFC constraints. The purpose of the JavaScript program is to overwrite the IFC values representing the dimensions of the variant with the actual values coming from the product catalogue. The advantage of this approach is that the relationship between the dimensions of the variant and the resulting geometrical properties are contained in the generated IFC file (see [Annex C](#)).
- The JavaScript function can generate the IFC geometry with a meta geometry that contains a pseudo-IFC geometry. This file looks similar to an IFC file, but property values can be replaced by variables and mathematical calculation formulas. An example is the following line:

```
#100001= IFCCARTESIANPOINT((- 0.5 * selectedXLength,- selectedYDepth,0));
```

Here the first parameters of the `IfcCartesianPoint` filled with a formular, the second with a variable, only the third one contains a static value ('0'). Given the values of the basic dimensions (here `selectedXLength`, `selectedYDepth` and `selectedZHeight` (equals 0 in #100001), all the formulas can be computed and a valid IFC geometry is produced (see [Annex D](#)).

- The JavaScript function can generate the IFC geometry with a meta geometry that contains a spreadsheet table with the calculation formulas for all geometrical properties. The advantage of this approach is the externalization of the required computation for the generation of the geometry into a spreadsheet, so that modifications of the geometry can be done by people without programming experiences. The JavaScript function can be the same for all geometries (see [Annex E](#)).

6.8 Product ports in IFC

Product ports require a data extension compared to the definitions in IFC. This shall be done in the same way as the definition of the product properties by defining the port properties in a data dictionary in accordance with ISO 23386.

For entry into a data dictionary, port properties shall be defined for the following data types for gas and liquid ports and for electrical energy and communication:

- identification data;
- geometrical data;
- connection data;
- media data;
- functional data;
- electrical power data;
- electrical supply connections;
- connection data cores;
- physical signal connections;
- available data points signal range;
- communication interfaces;
- available data points communication interfaces;
- available LOW layer protocols;

- character frame (data bits, parity, stop bits).

An arbitrarily deep staggered structure of port groups is considered, which ultimately leads to individual ports, each of which contains its own functionality. Position, direction, and rotation shall each be relative to the absolute position of the respective parent port group (see [Figure 21](#)).

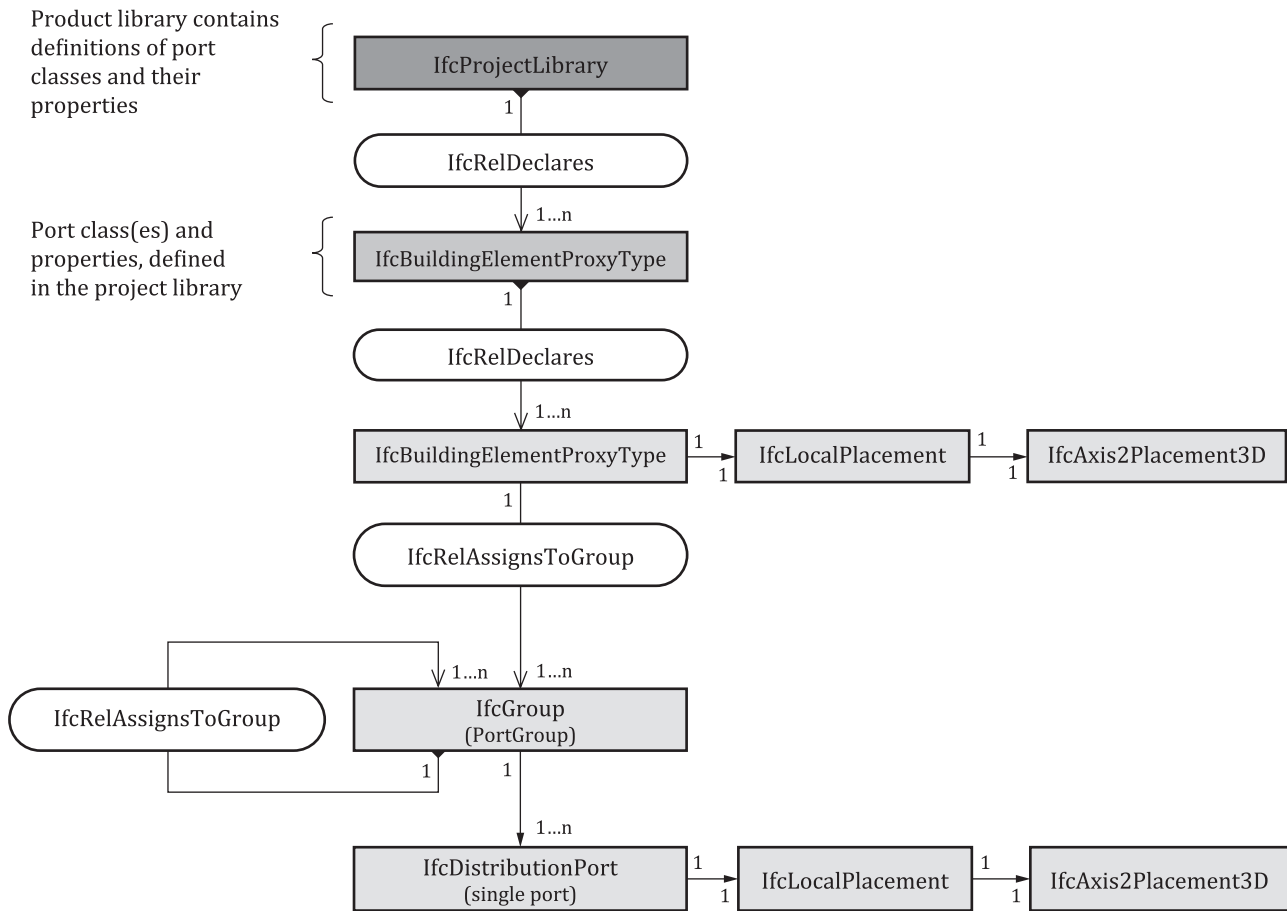


Figure 21 — Ports as arbitrarily deep staggered structure of port groups

Port data of a (3D) shape model can have different positions and orientations as port data of (2D or 3D) graphical symbols. The port data is referenced to the respective geometric representation.

6.9 Product in/outlets in IFC

Product in/outlets require a data extension compared to the definitions in IFC. This shall be done in the same way as the definition of the product properties by defining them in a data dictionary in accordance with ISO 23386.

For entry in a data dictionary, in/outlets properties shall be defined for the following data types:

- identification data;
- geometrical data;
- media data;
- functional data;
- available data points signal range.