ETIM International

The international classification standard for technical products

ETIM Modelling Class standardisation guidelines

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ETIM International

1. Introduction

ETIM MC is an addition to the ETIM classification standard. MC stands for modelling class. The ETIM MC standard separates the manufacturer's data from the BIM technology. This makes it possible for manufacturers to supply their BIM geometry, technical features and product data with one set of data, without having to master all BIM software and technologies. Furthermore, the ETIM MC standard describes standard objects, and therefore the costs and investments of building third party applications can be shared among multiple suppliers.

1.1. About ETIM

ETIM offers an open standard for the unambiguous grouping and specification of products in the technical sector through a uniform product classification model. This classification uses: product classes, features, values and synonyms that make it easy to find the right product. The classification system itself is no "final product" but offers a structure for an electronic product database and applications such as an online web shop, search engine or configuration software. ETIM classification is multilingual, media neutral and supplier neutral.

ETIM International is the international standardization committee for ETIM. The principal objectives and activities are to develop, maintain, publish and promote the ETIM classification model. The long-term goal of ETIM International is to achieve that the ETIM model becomes the most used technical information model in the involved industries.

1.2. About this document

This document aims to provide a full overview of formal guidelines, procedures, quality requirements and tooling for the content management of the ETIM Modelling Class standard. To secure the uniform application and further development of a common ETIM MC model, it will be necessary to specify basic rules.

This document replaces all previous versions of this document as well as all previously published documents regarding ETIM MC guidelines. Should a previously published version or any other document conflict with this document, the regulations within this document have priority.

1.3. Extension of ETIM guidelines

This document should be read as an extension to the latest version of the **ETIM Standardisation guidelines,** which is publicly available on our website. General rulings and guidelines on governance, RFC procedures, classes, features, values, or units apply as stated in that document, unless this is otherwise described in the following chapters in this document.

1.4. Publishing and maintenance of the standard.

As of 3-10-2022 ETIM MC is maintained and published in a dedicated Modelling Class Management tool on https://modelling.etim-international.com. The modelling classes are also accessible via the ETIM API. See the API documentation for further information on this.

2. General purpose of a modelling class

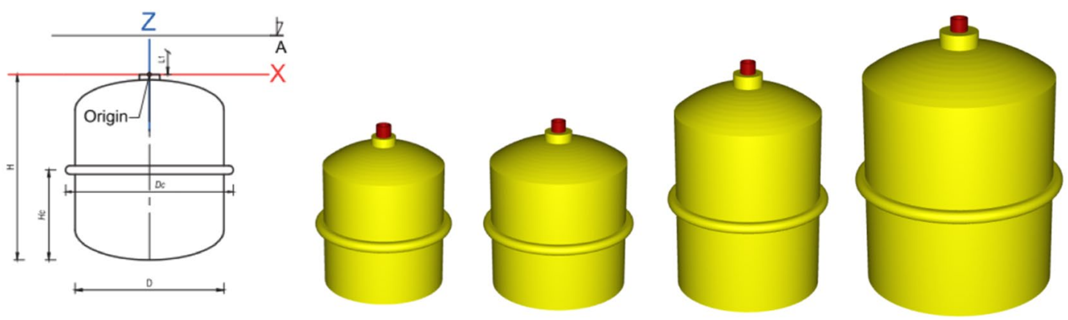
2.1. It's an extension to ETIM

The modelling class is an extension of the regular product class. A modelling class consists of a class name, a set of synonyms, a set of features and a two-dimensional drawing. The Features can describe geometric sizes or detailed properties for engineering purposes. This drawing consists of geometrical shapes of a generic product representing a (part of) a regular product class. This drawing has references to variable sizes, which correspond to the set of geometric features.

2.2. Blueprint for a neutral and generic, parametric BIM object

The purpose of a modelling class is to act as a blueprint to build parametric content in any 3D software, with data from manufacturers provided according to a standardized set of features. A modelling class is not intended to embody manufacturer-specific geometrical design details.

It is intentionally neutral and generic in shape and form. This shall benefit the BIM design process, and it also ties in with common practices and (inter)national laws on public procurement within the construction and installation industry. This means that BIM objects created based on ETIM modelling class structures can be used as manufacturer neutral components in any BIM model. In the final stages of the BIM process, BIM objects based upon ETIM modelling classes can be made manufacturer-specific by consuming product data enriched with a modelling class id and features as supplied by that manufacturer.



Artnr	Descr	Volume	Connection	Diameter - Dc	Diameter - D	Height - H	Height - Hc	Length - L1
2516941	Expansion tank 8 liters	8	G 3/4" ext	245	225	277	133,5	10
2516944	Expansion tank 12 liters	12	G 3/4" ext	286	246	309	149,5	10
2516947	Expansion tank 18 liters	18	G 3/4" ext	286	246	405	197,5	10
2516950	Expansion tank 25 liters	25	G 3/4" ext	328	308	421	205,5	10

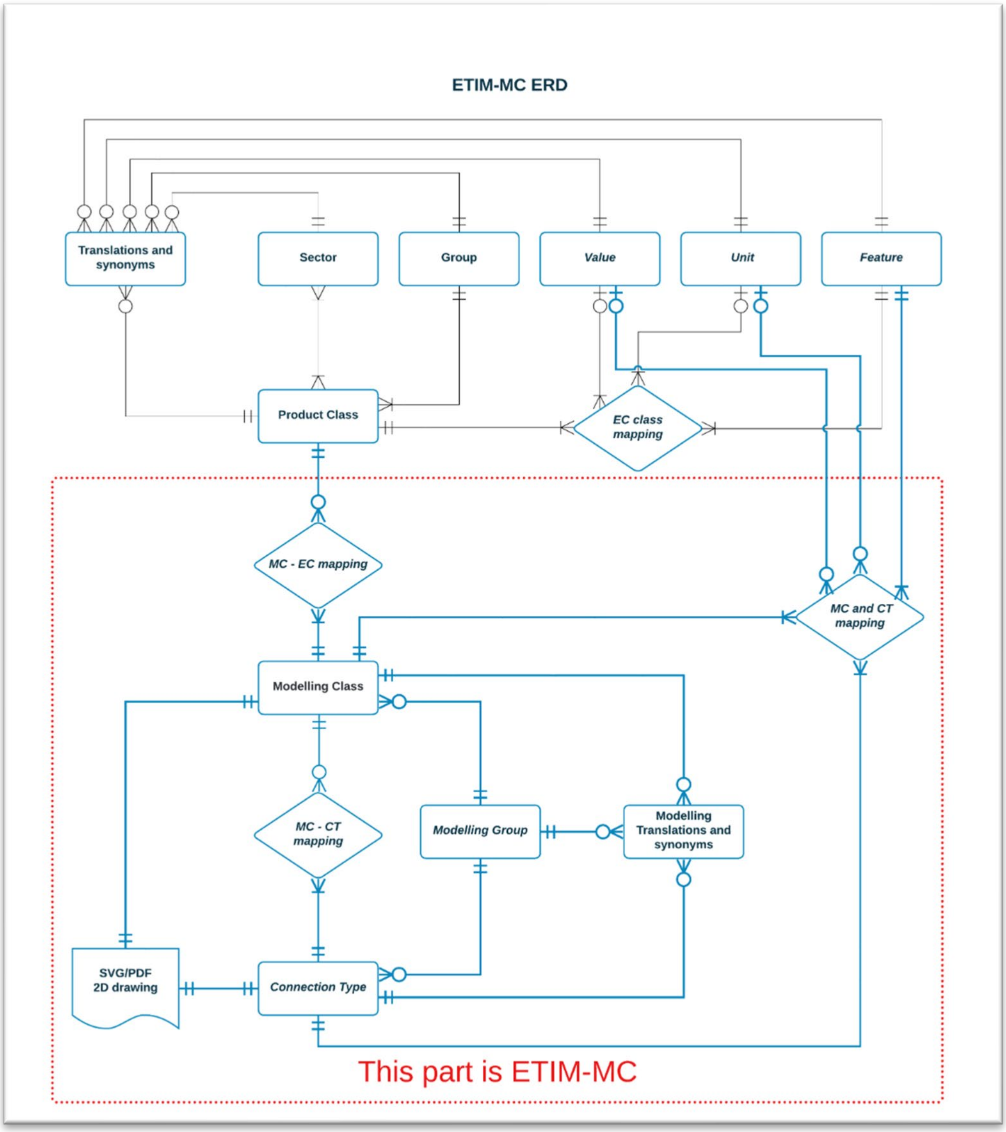
![ETIM International logo]

2.3. Engineering features

Besides geometrical content, the modelling class is also purposed for containing features for engineering data, that cannot be included in common regular product class features. However, over the last decade the regular ETIM classes have evolved in such a way that most engineering requirements have been met. In rare cases matrix data types may be included to include more complex situation-dependent data such as flow diagrams.

3. The data model

As a basis the modelling class uses the same data model and structure as regular ETIM classes. But some exceptions apply, which are described in the following paragraphs. See also the documentation on exchange formats and the ETIM API. The below ERD visualizes the relations between the entities used in specifying Modelling Classes.



3.1. Modelling classes and connection type classes

A modelling class is an information object that describes a set of parametric dimensions and engineering features accompanied by a reference drawing. The drawing is used as a visual guide of which feature should link to which dimensional parameter in a BIM object.

Connecting ends of an object can be referred to by its port numbers, features regarding connections are collected and isolated in connection type classes that can be referenced to at each port number.

3.2. The modelling group

Modelling classes may have links to general product classes from different groups. Therefore the modelling classes cannot use the existing ETIM grouping system. A new set of groups is introduced exclusively for modelling classes.

Modelling groups are coded with an 8-character id number starting with "MG" and followed by six digits which is an incremental number ("MG[0-9]{6}").

There is one special group:

3.2.1. MG000001 – Connection types

This group is for connection types only. All connection types shall be listed under this group code.

3.3. The relationship between modelling classes and regular product classes.

A product that is classified according to an ETIM class may exist in more than one generic geometrical form. Expansion vessels for instance (EC010958) can exist in shapes such as vertically or horizontally oriented, hanging or floor standing, cylindrical or disc shaped. This would require a different set of features per specific shape. Therefore, multiple modelling classes may be linked to a regular product class.

+ **EC010958 – membrane pressure expansion vessel**

  - MC000038 - Membrane pressure expansion vessel vertical with legs- bottom connection
  - MC000036 - Membrane pressure expansion vessel vertical with legs - side connection
  - MC000037 - Membrane pressure expansion vessel vertical with legs - top connection
  - MC000105 - Membrane pressure expansion vessel vertical suspended - top connection

A modelling class may be used as a geometrical shape for more than one ETIM class, provided that the entire data and drawing contents apply in the same context in all linked regular product classes. For instance, a modelling class for a floor standing vessel can be used for:

+ **MC000038 - Membrane pressure expansion vessel vertical with legs - bottom connection**

  - EC010958 - Membrane pressure expansion vessel
  - EC010571 - Coupling vessel

3.4. The relationship between modelling classes and connection types

A modelling class may have connecting ends that can be in various forms. One product may have a threaded connection, others may be connected using flanges, and some may even be welded together. Base conduit couplings have several different types of connections. On the other hand, each connection type is used on much more than base conduit couplings alone. They could be used in pumps, vessels, valves and so many more products. Therefore, these different types of connections with their specific set of features have been collected and isolated into connection type classes. By referring to possible connection type classes at each connecting port, one can easily inherit all standard features per connection type. This makes maintenance of modelling classes a lot easier, and it prevents a lot of redundancy.

Modelling classes may be linked to multiple connection type classes. And within a modelling class the same connection type class can be referred to at different connection ports. See this example:

+ MC000010 – Base conduit coupling without spanner plane

- Port 1
  - CT000001 - Inner thread (6 features)
  - CT000002 - Outer thread (6 features)
  - CT000003 - Flange (11 features)
  - CT000004 - Press sleeve (6 features)

- Port 2
  - CT000001 - Inner thread (6 features)
  - CT000002 - Outer thread (6 features)
  - CT000003 - Flange (11 features)
  - CT000004 - Press sleeve (6 features)

A connection type class can be referred to in various classes. See this example:

+ CT000004 - Flange

- MC000010 - Base conduit coupling without spanner plane (ports 1, 2)
- MC000011 - Base conduit bend (ports 1, 2)
- MC000012 - Base conduit coupling with spanner plane (ports 1, 2)
- MC000043 - Inline circulation pump with standard motor (single) – (ports 1,2)
- MC000105 - Membrane pressure expansion vessel vertical suspended, top connection (port1)

3.5. Features and values

Features and values are used from the standard ETIM model. Meaning: if a feature or value does not yet exist, it should be created in the Classification Management Tool, not the Modelling Management Tool. And should no regular product class use a newly created feature, an administrator should approve the feature first before it will be visible in the modelling management tool.

For further guidelines of features and values please refer to the ETIM International guidelines.

There are some exceptions on generic features and features used in modelling classes.

3.5.1. Two extra data types of features

Two extra data types have been added to the ETIM IXF format to make modelling class features more suitable for modelling and engineering.

C – Coordinate

The coordinate type consists of a set of three values, for the X, Y and Z coordinate. These are signed floating point decimal numbers (decimals that can be negative).

M – Matrix

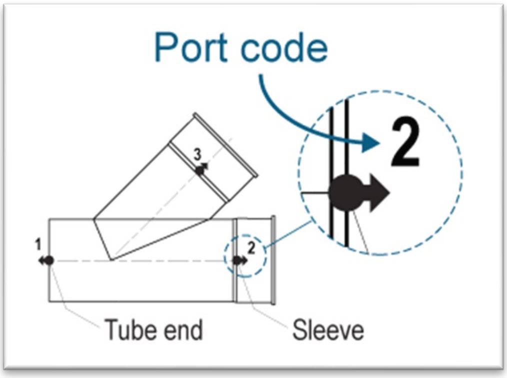
The matrix type consists of a data object stored as key-value pairs. This could for instance be a JSON (Java Script Object Notation), or a nested array. This is to facilitate for engineering with graph-like data or lookup tables.

3.5.2. Features in classes are assigned to port codes

Connections are numbered and for each connection with its port code features are required to be filled in.

Port code is a mandatory field whenever there are one or more connections involved.

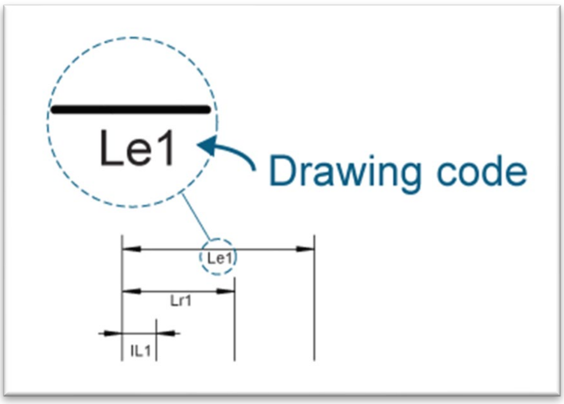
Ports are indicated by this symbol , with the arrow facing outward.



3.5.3. Features may be assigned drawing codes

Drawing codes are short abbreviations that relate to specific areas in the dimension drawing. In this example, "Le1" relates to a dimension that is referring to feature EF001438 – Length.

Only features that cannot be related to dimensions as indicated in the reference drawing, will not require a drawing code.



3.6. Relations between features used in standard classes, modelling classes and connection type classes.

Features can be linked to regular product classes (EC), modelling classes (MC) as well as connection type classes (CT). In some cases, duplicate usage can occur, and in other cases, duplicate usage is unwanted.

3.6.1. Duplicate features in EC – MC relations

Regular product classes already carry dimensional information such as Width, Height, Depth, Built-in sizes. Obviously, these sizes would be also part of the modelling class. This creates a redundancy, which can't be eliminated that easily.

The purest solution would be to move any feature regarding sizes to the modelling class, but we cannot do so yet, since the basic ETIM model needs to remain fully applicable for those that are not implementing modelling classes. The main reason for that being that not every software application has a need for modelling class data.

3.6.2. No duplicate features in MC – CT relations

Modelling class features used to indicate dimensions and shapes of connections should always reference a port number that they belong to. Features describing a connection are subject to a lot of repetition. Therefore, all connection related features are preferably isolated into connection type classes, and then used in modelling classes by referencing these connection type classes at port code level.

The use of connection type classes is highly recommended, but for backwards compatibility reasons not mandatory.

It is not allowed to use these features twice at the same class and port code, once as a standard feature, and once as part of a connection type class. Existing both as a feature of a linked connection type and as a feature in the modelling class would be considered an unnecessary redundancy.

When connection type classes are used, old references to features indication dimensions and shapes of connections should be removed from the modelling class.

When requests for changes are processed on existing classes, the migration of these features into connection type classes should be included in these requests as well.

3.6.3. Advice on arbitrary data in regular product classes

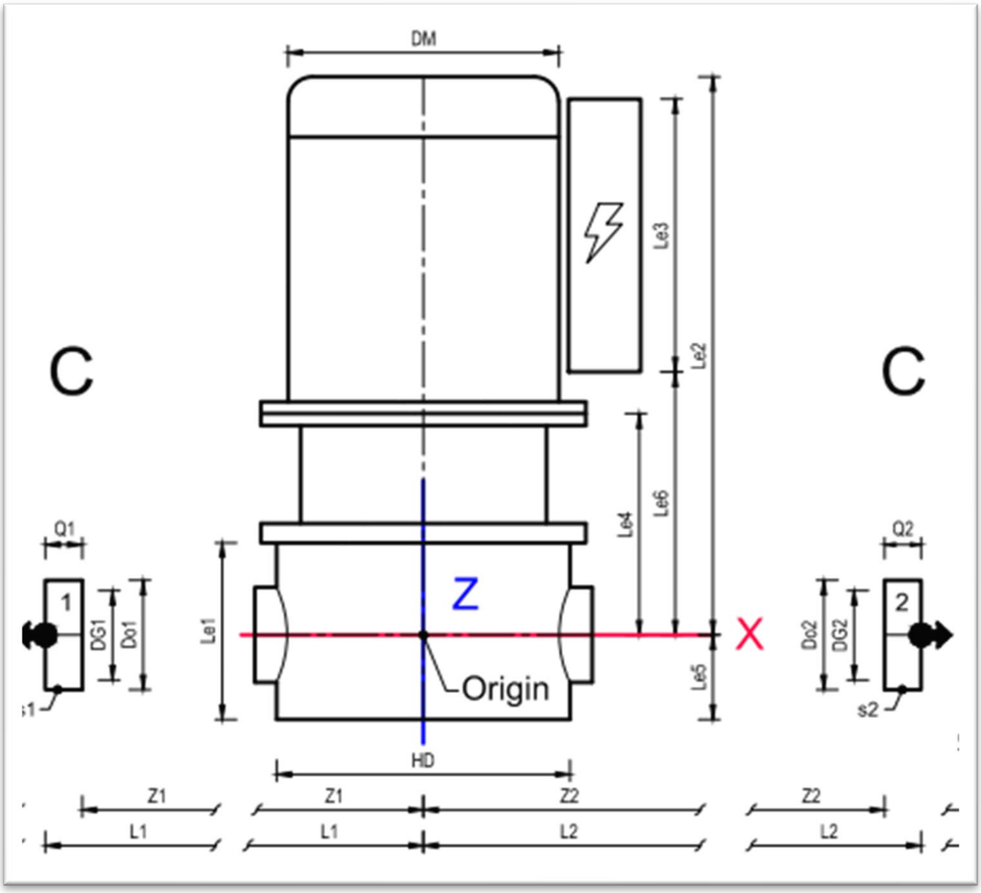
The concept and meaning of "Width" within the standard ETIM class could have been interpreted differently than what is unambiguously indicated on the dimensional drawing in the MC class. There could for instance be a discrepancy in built-in size versus the actual size, possibly leading to arbitrary data and differences between the same features in the regular product class and the modelling class. In that rare event, the BIM-modelling engineer should only use the modelling class variant of this feature. Sizes given as features of a modelling class should always take precedence over sizes given as features in a regular product class.

Inheritance of redundant regular product class features is favourable, when the above is taken into consideration. This is a feature that could be developed by MDM and PIM suppliers.

3.6.4. Features with an indirect numerical dependency to regular product class features.

Some classes, like the inline circulation pump have features that have arithmetic dependencies.

In this example the sum of the length of the connections (drawing codes Z1 and Z2) should be equal to the feature "built in length" in the linked regular product class.



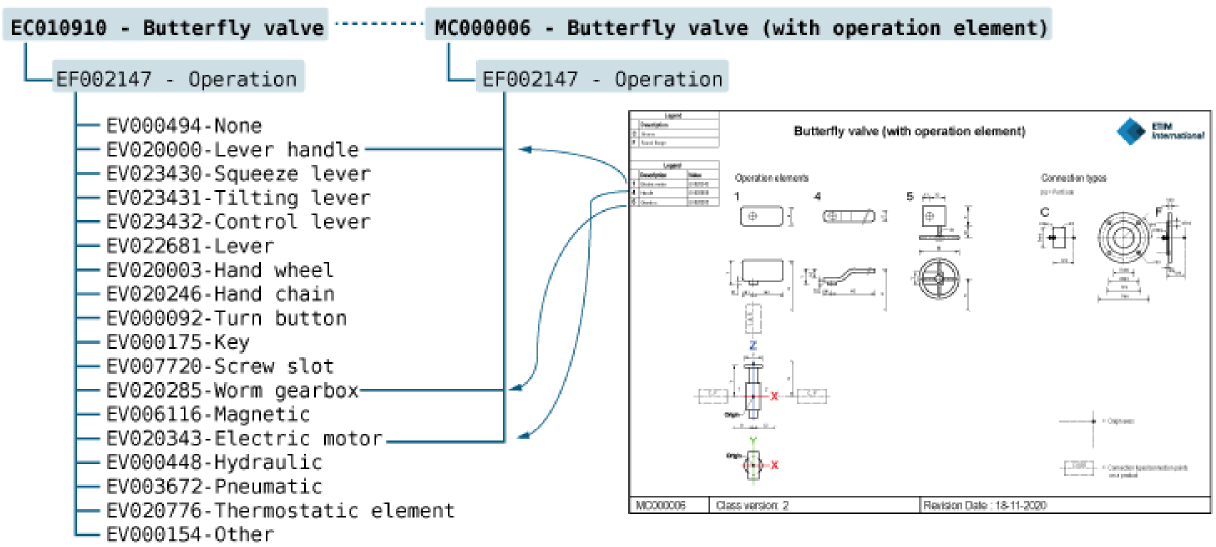
Other examples are:

- Outer diameter should be greater than inner diameter.
- Inner/outer diameter should have a specific relation to DN size according to a pipe standard.

Validation and controlling data-quality in regards with these dependencies is not a part of the ETIM standard. It is the responsibility of the manufacturer, their software vendors and data-pools.

3.6.5. Features with other dependencies

Other dependencies may apply such as when model types are described in the regular product class, and the modelling class is only intended for a subsection of the listed model types. This feature is then copied with only this subsection as possible options. See for instance the situation for butterfly valves:



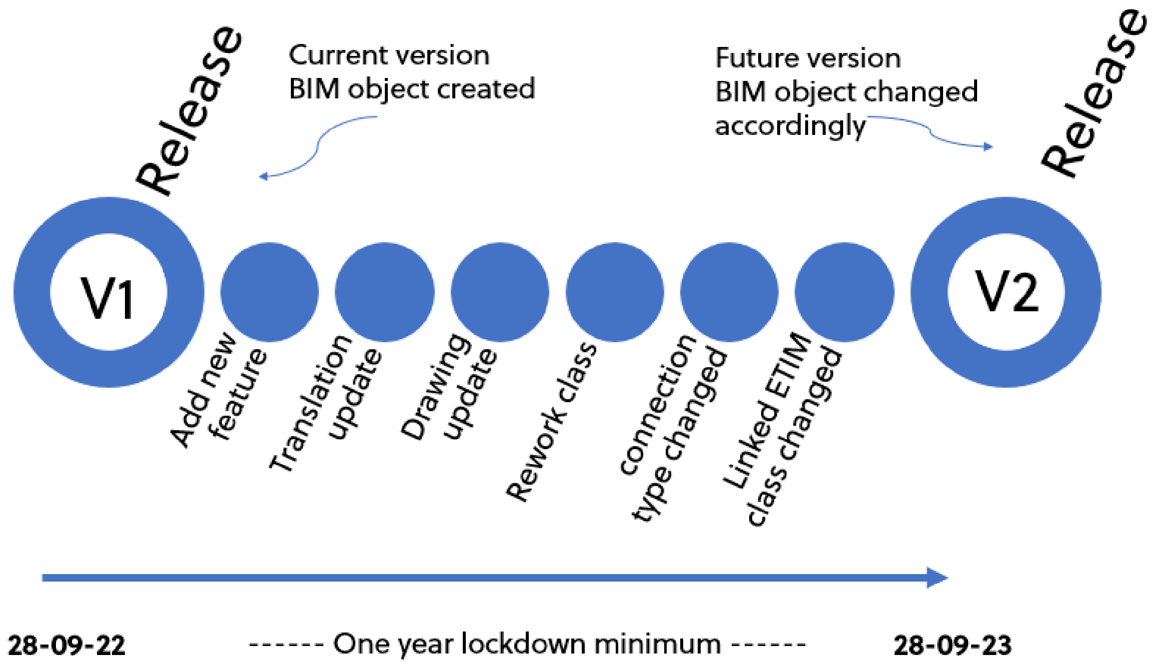
The general product class EC010910 – Butterfly valve has 17 different options for the feature **EF002147 – Operation** while the modelling class **MC000006 – Butterfly valve** only covers 3 different options for **EF002147 – Operation**. The suitability of MC00006 for products classified as EC010910 should be checked according to values entered at **EF002147 – Operation**.

Validation and controlling data-quality in regards with these dependencies is also in this case not a part of the ETIM standard. It is the responsibility of the manufacturer, their software vendors, and data-pools.

4. Versioning system

Modelling classes and connection type classes have a versioning system that is not based on a release of a collection of all class versions at a certain time. Instead, a versioning and release system on a per-class basis is used. After the release of a class, the class status becomes "published" and this version will be put in lockdown for a minimum period of 1 year. During this period, any requests for change will be processed and collected for the release of the next version of this class.

Versioning shall be indicated by an incrementing integer.



4.1. Versioning of linked classes

To ensure stability of data sets, version numbers of linked classes are stored upon linking. This makes the version number of a linked class part of a version of a modelling class.

For instance:

- MC000010 (Version = 2)
- Link: EC003034 (Version = 9)
- Link: CT000001 (Version = 1, PortCode = 1)

Should versions of these linked classes change, then this will not have any effect on the current version of a modelling class. New versions of linked classed should be introduced as a new link, in the next version of a modelling class. For linked connection type classes as well as regular product classes this process is automated in the modelling management tool (MMT).

This set up makes it possible to show for instance that MC000010 version 2 is compatible with EC003034, versions 9 and 10, but MC000010 version 1 was only compatible with Versions 6 to 8.

4.1.1. Versioning in relation to changes in connection type classes

When changes are made to connection type classes causing a version nr. to increment, then automatically a request for change is created at all linked modelling classes that link to this connection type classes. The changes in the connection type will become valid after approval and publishing of the automatically created requests for change.

Our recommendation on the use of versions

Change requests are always submitted with a good reason. We recommend to always use the latest versions. Maintaining your object library according to the latest versions should be a recurring task in your work processes.

5. Parameter reference drawings

The parameter reference drawings are an important part of the ETIM MC standard. These drawings are 2D line drawings that reference the parametric sizes of common products.

A parameter reference drawing shall be consistent in style, according to the corporate design standards of ETIM International. It should also be consistent in approach to referencing the technical breakdown of a product's shape and its dimensions into parameters.

In general, the true value of BIM object templates created from the ETIM MC standard lies in the following characteristics:

- Small in size.
- Uses as little as vectors as needed while showing a recognizable generic form of the product type.
- Connected to manufacturer's ETIM (MC) data.
- Should remain generic, not resemble a specific brand or type of product.

The parameter reference drawing has only one function: giving a visual indication of the location of the dimensional parameters in relation to the 3D object model. It is a blueprint for building a standardized parametric BIM template object.

5.1. Basic guidelines for drawing objects

Recognizable

Objects should be recognized as to what it represents. For example, a pump should look like a pump, not like a box. A wall-hung boiler should look like one.

Generic form and shape

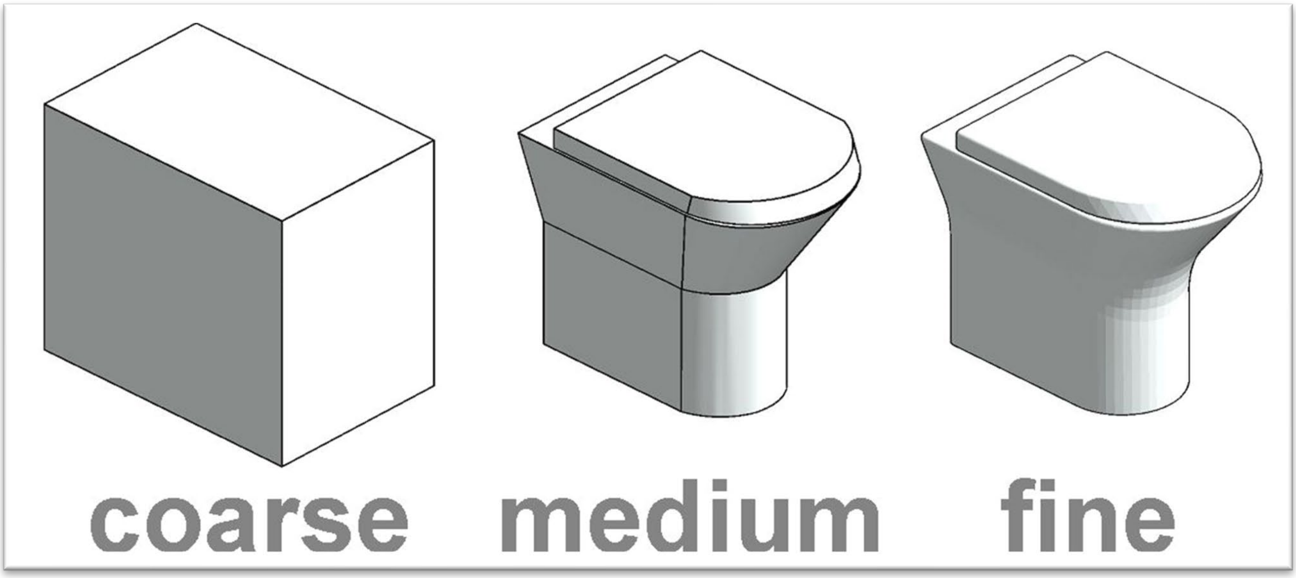
Product models should be neutral in form and shape and have no direct connection to any branded product. However, when competitors distinguish themselves by using different generic shapes for instance by changing the orientation from a vertical to a horizontal position, this is still considered a generic shape.

Simplicity over completeness

Modelling classes should not be overcomplex, overloaded with dimensional parameters. This would frustrate the manufacturer to find and share the necessary data. In BIM template objects, smaller details can easily be estimated or derived. Use multiple modelling classes if that will simplify the model and number of parameters.

5.2. Level of detail

A parameter reference drawing shall not be seen as a guideline for a specific level of detail of implementations into BIM template objects. BIM software applications may be using coarse, medium, and fine shapes for different purposes and technology is evolving constantly. The dataset of a product that is classified according to a specific ETIM modelling class should be usable in all levels of detail, independent of which software or library is used.



These 3 versions of 3D representations with different level of graphical detail can all be generated based on the same dataset as provided according to the modelling class MC000270 – Toilet closet (floor standing) drain rear bottom.

5.3. File format and naming conventions

SVG – Scalable Vector Graphics as uniform file format

Parameter reference drawings are stored as an SVG file in the classification management tool with each modelling class version. The SVG file format can serve various purposes and is openly accessible without restrictions to specific software vendors.

SVG formats should contain only vector format and no pixel-based images in any way.

The SVG file format is an XML-based markup language, supported by all browsers. It can be used as a format that can be included into web development. An SVG file is basically a text-based file that can be viewed in a text editor consisting of the SVG language. This makes it possible to make the drawing interactive within web-development using languages such as JavaScript and CSS.

More info on the SVG language can be found here: https://developer.mozilla.org/en-US/docs/Web/SVG

5.3.1. Naming convention and folder structure

To maintain order and structure in a large collection of drawings, a folder structure and naming convention is a must. Maintaining this folder structure and naming convention is not part of the maintenance – procedure, but more a responsibility of an official ETIM body that is preparing RFC's that are sent in. For further information see

"ETIM MC International Guidelines note about folder structures 2101227.pdf"

File name

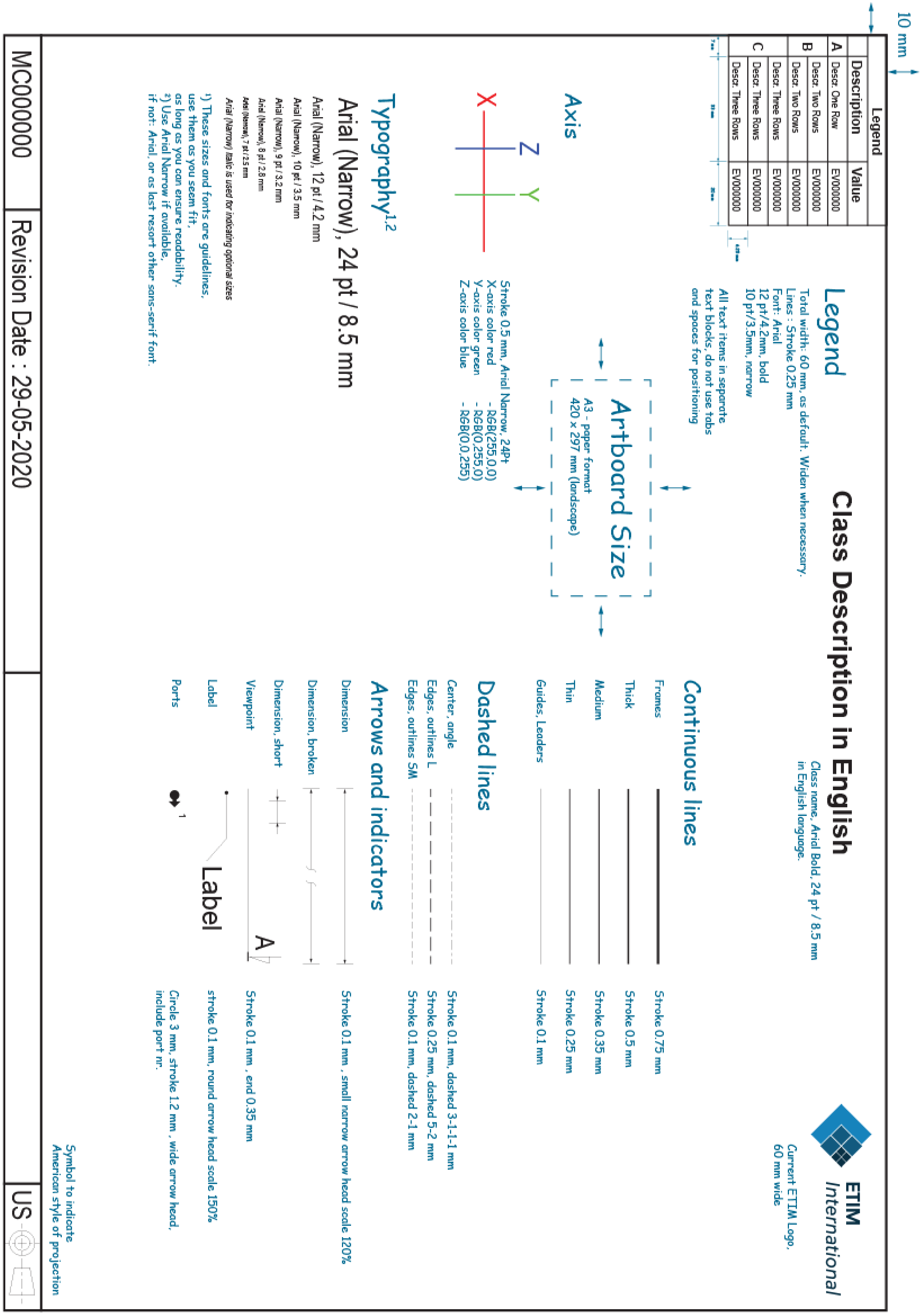
The filename may be used in automated URL referencing and should therefore have a very predictable and clear link to the modelling class and the version of the class that this drawing refers to. The filename of the parameter reference drawing shall consist of a concatenation of class id, followed by an underscore, v for version and a number as version nr, followed by the file extension.

MC######_##.svg

The filename should not have any additions such as initials, dates, or status indicators such as "final". Version indicators may not have any multi level indicators such as 1.1.1. It may only carry two digits to indicate the current version it belongs to.

5.4. Style guide

For constructing ETIM Modelling Class dimensional drawings, the drawing style guide has been created as an appendix file. See the image on the next page or the appendix for further detail.

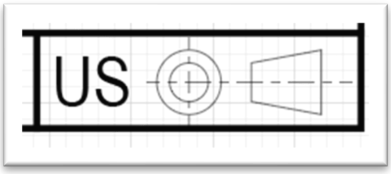

10 mm
Legend
Description
Value
A
Descr. One Row
EV000000
B
Descr. Two Rows
EV000000
Descr. Two Rows
EV000000
C
Descr. Three Rows
EV000000
Descr. Three Rows
EV000000
Descr. Three Rows
EV000000
Legend
Total width: 60 mm, as default. Widen when necessary.
Lines : Stroke 0.25 mm
Font: Arial
12 pt/4.2mm, bold
10 pt/3.5mm, narrow
All text items in separate
text blocks, do not use tabs
and spaces for positioning
Class Description in English
Class name, Arial Bold, 24 pt / 8.5 mm
in English language.
ETIM
International
Current ETIM Logo,
60 mm wide
Artboard Size
A3 - paper format
420 x 297 mm (landscape)
Axis
Z
Y
X
Stroke 0.5 mm, Arial Narrow, 24Pt
X-axis color red - RGB(255,0,0)
Y-axis color green - RGB(0,255,0)
Z-axis color blue - RGB(0,0,255)
Typography¹·²
Arial (Narrow), 24 pt / 8.5 mm
Arial (Narrow), 12 pt / 4.2 mm
Arial (Narrow), 10 pt / 3.5 mm
Arial (Narrow), 9 pt / 3.2 mm
Arial (Narrow), 8 pt / 2.8 mm
Arial (Narrow), 7 pt / 2.5 mm
Arial (Narrow) italic is used for indicating optional sizes
¹) These sizes and fonts are guidelines,
use them as you seem fit,
as long as you can ensure readability.
²) Use Arial Narrow if available,
if not: Arial, or as last resort other sans-serif font.
Continuous lines
Frames
Stroke 0.75 mm
Thick
Stroke 0.5 mm
Medium
Stroke 0.35 mm
Thin
Stroke 0.25 mm
Guides, Leaders
Stroke 0.1 mm
Dashed lines
Center, angle
Stroke 0.1 mm, dashed 3-1-1-1 mm
Edges, outlines L
Stroke 0.25 mm, dashed 5-2 mm
Edges, outlines SM
Stroke 0.1 mm, dashed 2-1 mm
Arrows and indicators
Dimension
Stroke 0.1 mm , small narrow arrow head scale 120%
Dimension, broken
Dimension, short
Viewpoint
A
Stroke 0.1 mm , end 0.35 mm
Label
Label
Stroke 0.1 mm, round arrow head scale 150%
Ports
1
Circle 3 mm, stroke 1.2 mm , wide arrow head,
include port nr.
Symbol to indicate
American style of projection
MC000000
Revision Date : 29-05-2020
US

5.5. Outer dimensions

Outer dimensions are mandatory, inner parts are unwanted ballast unless it really contributes to the BIM model's functionality.

5.6. Model views and its projection

- A model is defined based on 2D views only. No isometric views allowed.
- If needed multiple views may be used such as top, front, bottom, left, right or rear view.
- If a model can be defined by one view only, then only 2 axises (e.g. X and Z) are used on the drawing. The 3rd axis is irrelevant and should be left out of the drawing.
- US – projection is applied, indicated with the corresponding symbol in the right corner of each drawing.



5.7. Using texts

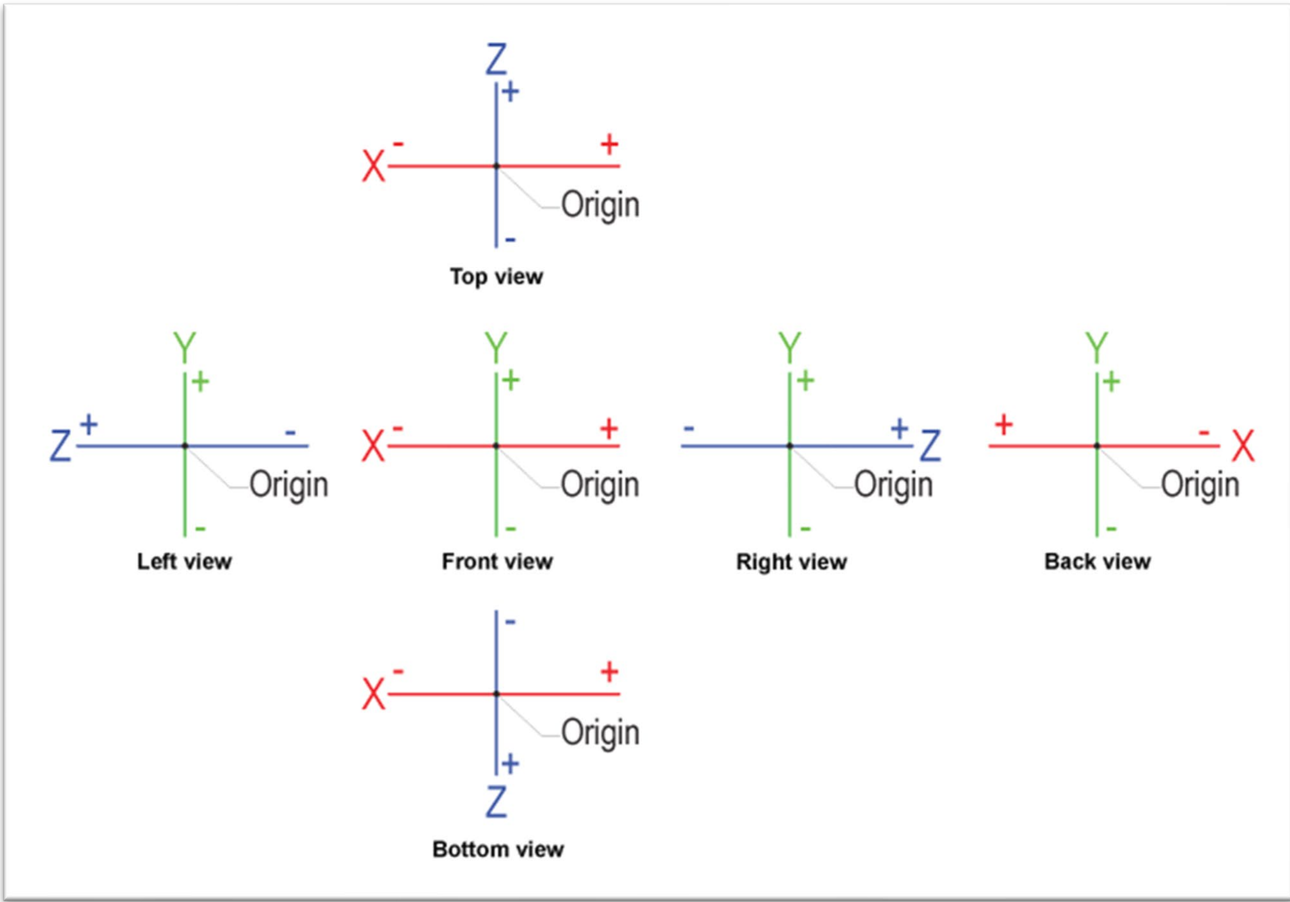
- Models should be drawn with as little language dependent indicators as possible. Use short combinations of characters as drawing codes rather than whole words.
- Texts should be editable as fonts and may not be rendered into pixels.
- Where language dependent parts are needed, such as in legends they are described in the English language.
- Class names, which are placed on the top-mid section of the page, are presented in the English language.
- On direction of manufacturers, other crucial annotations can be placed on the drawing, in English language. Like for instance "EHA" for Exhaust air as a connection's purpose.

5.8. Point of origin

A point of origin is a point within the 3D model that is used as an anchor within the 3D environment. Its coordinates are stored as the position of the object. A good and consistent choice of the point of origin is important for ease of use and for avoiding unwanted object clashes upon interchanging models within BIM-projects. Defining the right point of origin can be done according to the following cascading rules.

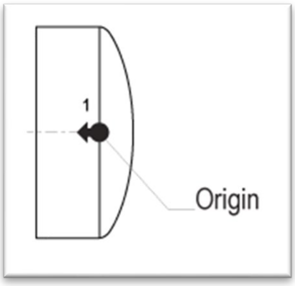
5.8.1. The X-Y-Z axis and standard viewpoints

The X-Y-Z axis shall have consistent colours, red for X-axis, Green for the Y-axis and Blue for the Z axis. The positive and negative sides may be indicated at the ends of the axis.



5.8.2. Objects with one connector

If the object has only one connector, like for example a blind plug, then the position of the connector can become the default point of origin. When the object has a more logical point of origin, due to the nature of the object, than this rule is overruled.



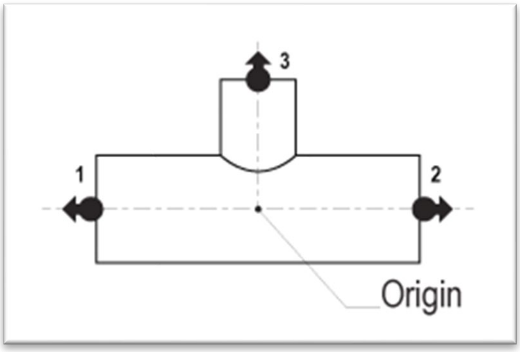
A good example is a floor standing vessel with one connection at the side that has its natural point of origin at the bottom-centre of the object.

5.8.3. Objects with two connectors

With objects that transport a medium (water, gas, air) or cable, the point of origin is situated at the connection point of port code = 1. This is usually on the left side.

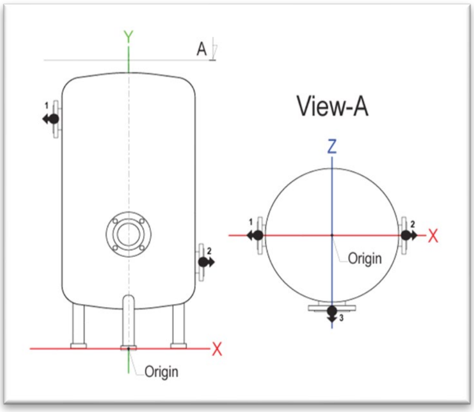
5.8.4. Objects with multiple connectors

If rules above don't apply, then the intersection of centre lines between connections is to be chosen as the point of origin.

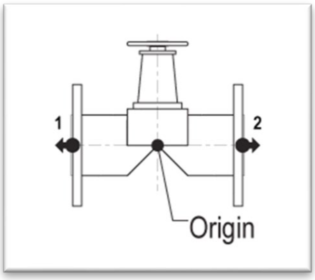


5.8.5. Point of origin for devices in hydronic, ventilation or gas systems.

For devices a point of origin should be chosen where growing of its geometry would cause the least likely number of problems with clashing. That means wall-mounted objects have point of origin positioned at the wall-side, and floor standing objects have point of origins positioned at floor-level. If that is not giving any unambiguous decision, then positioning on (intersections of) centre lines should be used for defining the point of origin as well.

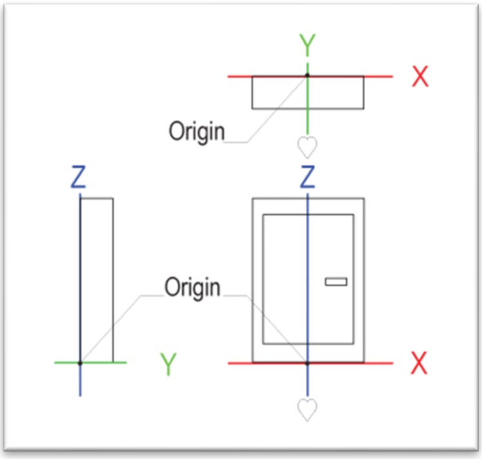


If the centrelines of the connecting ports are on the same level, then the centre position between these two ports, on that centreline should be the point of origin.



5.8.6. Box-shaped objects

Box shaped objects like panels and cabinets shall have their point of origin placed at the bottom of the object, in the centre, at the back of the object.



5.8.7. Point of origin - if none of the above applies

- The most logical point from the object nature's perspective.
- The geometrical centre of the object.

5.8.8. Points of origin – preservation over consistency

Should existing modelling classes not have points of origin according to the before mentioned guidelines, then we will choose preservation over consistency. We should avoid any unnecessary maintenance on template objects based on these classes. Only the argument of fixing unworkable situations should allow for change requests to be submitted to change the point of origin.

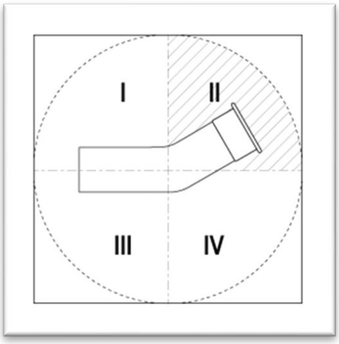
5.9. Zero-position

A zero position is the initial position the object is displayed in relation to the 3D room (e.g., what is upside, what is bottom). The zero position is determined according to its position and direction on the X, Y and Z axis. The zero position of an object is determined according to the following rules which are to be interpreted in hierarchical order:

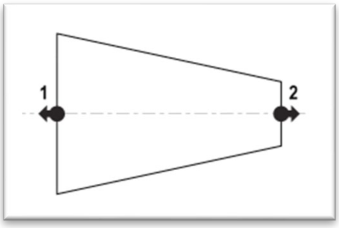
- If the product has an unambiguous defined top- and bottom side, then the top side is oriented in the direction of the positive Y- axis (Top).

- First port shall be on the negative X-axis (Left).

- A direction-changing port should point upwards toward the positive Y-axis (Top).



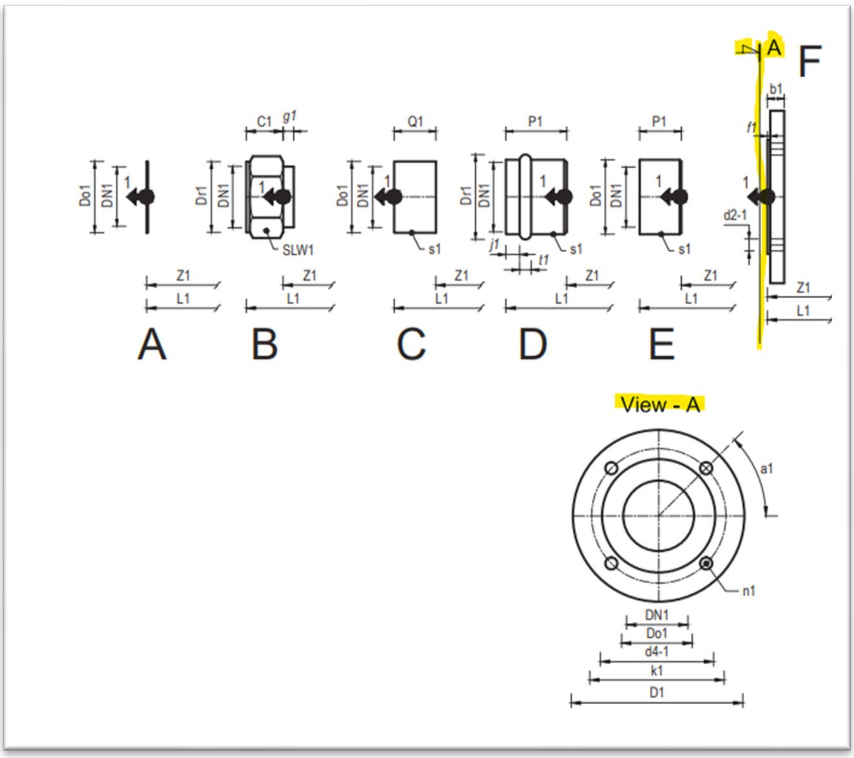
- A reducer / adapter – like object shall have the largest port oriented towards the negative X-axis (Left).



5.10. Custom viewpoints

When the standard US projection rules cannot be followed for whatever reason, a custom viewpoint can be indicated with a viewpoint symbol referring to a capital letter [A-Z].

In any other part on the drawing a different viewpoint can be indicated by referring to the before mentioned capital letter, preceded by the word "View". See example below where the frontal view of a flange connection is replaced elsewhere in the drawing due to lack of space.



5.11. Scale of the product models

- Scale indication is of no importance, as these dimensional drawings describe objects which are variable in size.
- Product models shall have the same scale throughout the entire drawing.
- Only when readability is at stake, for different viewpoints a diverting scale may be applied (to be reviewed and approved by ETIM international or its delegates).

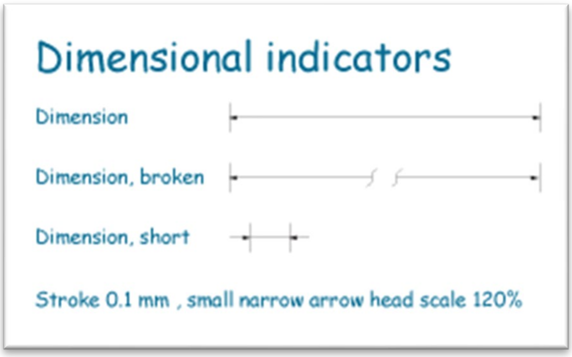
5.12. Dimensions and sizes

5.12.1. Size indicators

Use regular lines with arrow heads on both ends.

Every size indication should be appointed to a drawing code that refers to a feature in the feature list of the Modelling Class.

Further details can be found in *Appendix 1: Style Guide for dimensional drawings*.

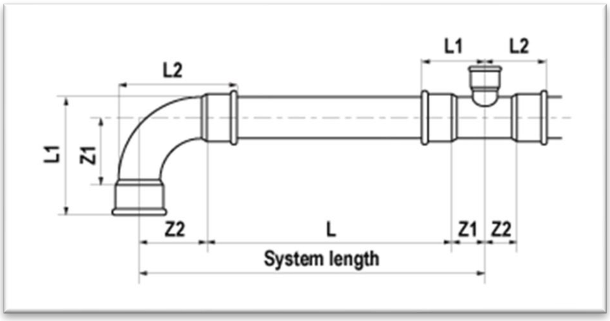


5.12.2. Shapes without size indicators

Any shape or form that has not been parametrized with a drawing code and feature, is left open for free interpretation by the 3D modeler. An optimized modelling class should have as less parameters as possible while maintaining maximum flexibility in shape.

5.13. Working lengths in plumbing

In Working lengths (indicated with drawing code "Z") should be indicated as this is necessary to determine the system length of multiple connected objects (such as fittings). In connections, a common rule of thumb is that female connections have a working length, male connections don't.



Tubes and pipes don't have a working length, its working length is the length of the tube or pipe itself. Any male connection can also be considered a tube's end.

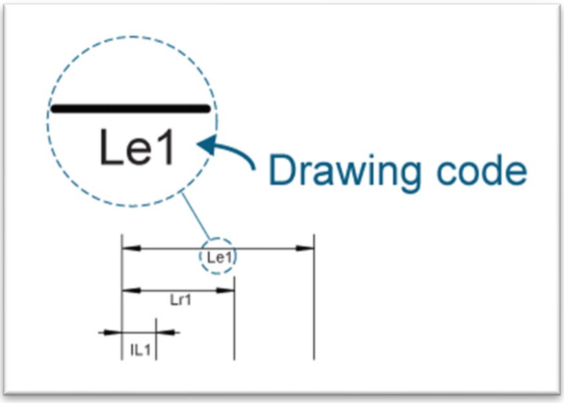
5.13.1. Small effects on dimension-lengths are disregarded.

Variable effects on dimension lengths such as differences in lengths by turning, melting, welding, bolting, pressing, and pushing of joints are disregarded. Sizing-up materials for BIM purposes is not a matter of millimetres but lies more in the range of centimetres.

5.14. Drawing codes

Drawing codes are mostly referencing sizes, but can also indicate label-type features such as:

- A nominal size like DN for nominal diameter
- The number of holes in a flange,
- The number of legs under a pump
- Coordinates and directional vectors of connectors.



Drawing codes belonging to a certain port code are suffixed with the port code nr. for instance, the DN size of port code two is indicated with DN2.

Drawing codes of optional size parameters are presented in an italic font style.

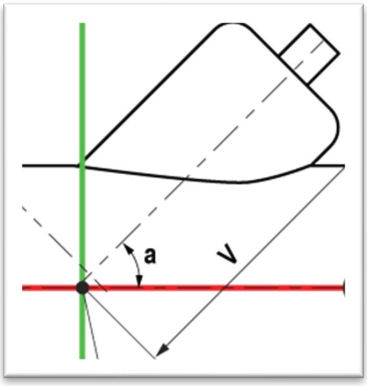
It is very important to be as consistent as possible with using drawing codes. Such as H for height, L for length. Here is an overview of the most used drawing codes:

D = Diameter
DN = Nominal diameter
Do = Outside diameter
Di = Inside diameter
Z = Working length
L = Length
H = Height
W = Width
P = Sleeve length
Q = Spigot or thread length
IL = Insert length
s = Wall thickness
a = Angle
E = Eccentricity
R = Radial
SI = Insulation thickness
CA = Position of ... (Coordinate type)
DV = Directional Vector of.. (Coordinate type)

A list of Drawing code commons is added as *Appendix 4* for assistance. This list must be followed, unless a rare exception to the rule may force you to use something else (to be reviewed and approved by ETIM international or its delegates).

5.15. Angles

Angles are numeric values that describe an angle relatively to one of the Axis. Angles are drawn with curves lines with arrow points on both sides. As drawing code "a" for angle is commonly used. When more than one angle is used in the drawing, the drawing code can be followed by a number. When sets of more than one angles are shown, then combinations of letters and numbers are allowed like [a1, a2], [b1,b2].

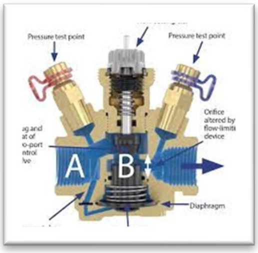


5.16. Working with coordinates and vectors

ETIM MC class features can have the datatype "C" which means coordinate. This datatype consists of a group of three signed (+/-) numeric values representing the X, Y and Z value relative from the point of origin. This data type can be used either to indicate a position in mm from the origin e.g., (+100, +50, - 35) or a directional vector e.g., (1, 0, -1).

A common use case for this is when you have connections placed on a product in many directions or places, depending on the brand-series-type of a specific product. Indicating location and direction using a coordinate and vector on the connections can drastically simplify the dimension drawing.

See this example of a control valve that has two pressure test points. Depending on the make and type of valve, these test points could be positioned in many different places, pointing in all directions.

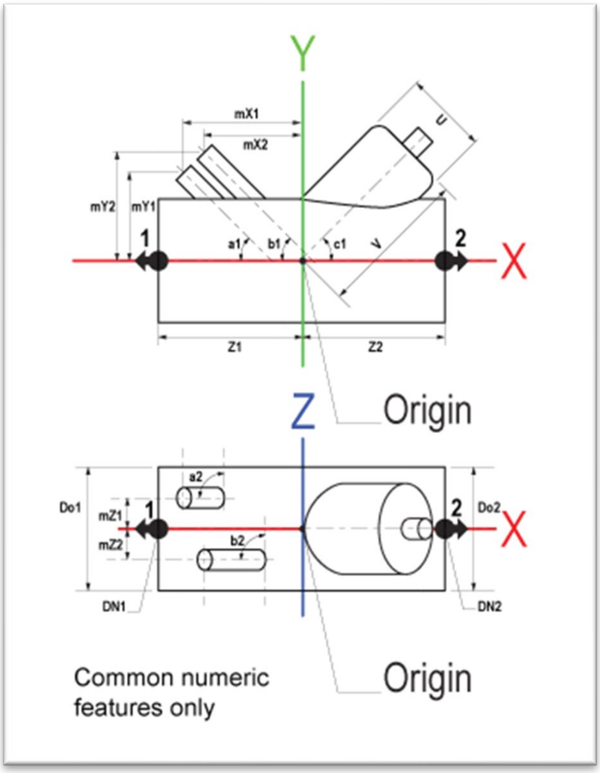


5.16.1. Using only numeric type features

Using only common numeric features, the parametric reference drawing becomes rather complex. Two views are needed and a lot of size indicators and supporting lines are needed.

To indicate the two nipples, we need to specify the following numeric sizes:

- mX1, mX2 for X position of test point connections
- mY1, mY2 for Y position of test point connections
- mZ1, mZ2 for Z position of test point connections
- a1, a2 for the direction which the first test point connection is point towards
- b1, b2 for the direction which the second test point connection is pointing towards.

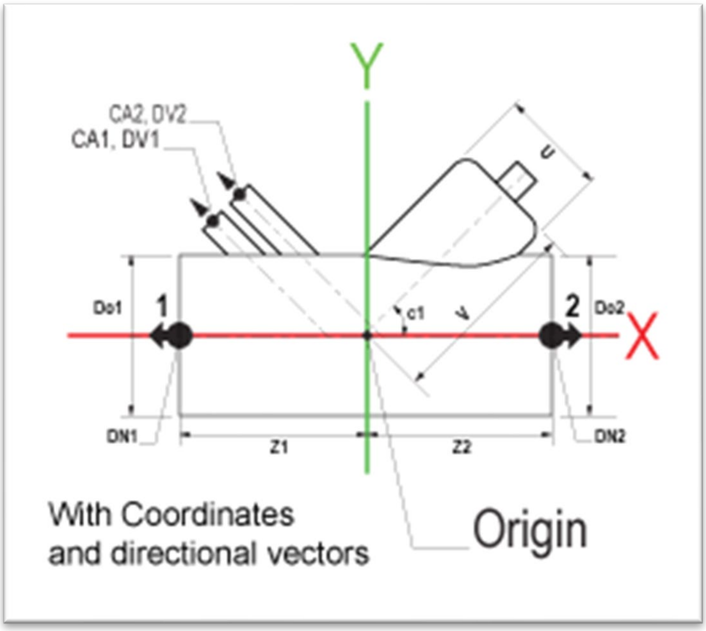


This makes it a total of 5 features per connection just to indicate where the connection can be found.

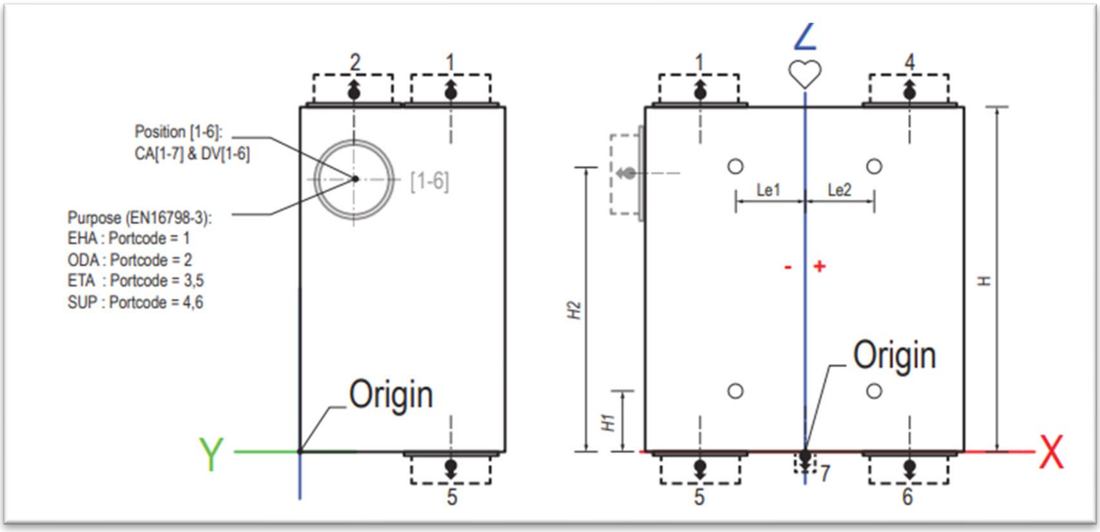
5.16.2. Simplify the model with coordinates and vectors

When we use coordinates and directional vectors, we can use only 2 features per connection to indicate the position and direction of the connection: the coordinates relatively to the point of origin and the directional vector.

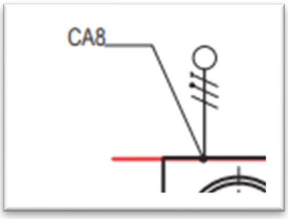
The drawing is simplified, using less indicators and lines. Only one view is needed to show where all parameters belong.



See also MC000346 – Heat recovery Unit as an example where multiple connections are given both coordinates and directional vectors.



A coordinate shall be indicated by a label-leader pointing to a drawing code. The default drawing code is DV(n) where DV stands for directional vector and n for PortCode.



Coordinates can also be used to indicate the location of parts that are not linked to any connections. Such as the location of a controller interface or a power switch.

The position in relation to the X, Y or Z-axis can be indicated by using signed (+/-) values. See also paragraph 4.8.1. (The X-Y-Z axis and standard viewpoints).

5.16.3. Using vectors to indicate variable directions

When angles and connections on products differ per brand-series and type, this should be expressed in the modelling class using directional vectors as features. In the dimensional drawing, the direction can be indicated by a cross with a point as the vector origin, and a directional arrowhead without body, accompanied by a Drawing Code. The default drawing code is DV(n), where DV stands for directional vector and n for port code. Common values for directions (relatively to zero-position):

Coordinate	Descriptive direction
[1, 0, 0]	positive X direction (towards the right).
[-1, 0, 0]	negative X direction (towards the left).
[0, 1, 0]	positive Y direction (towards the front).
[0, -1, 0]	negative Y direction (towards the back).
[0, 0, 1]	positive Z direction (towards the top).
[0, 0, -1]	negative Z direction (towards the bottom).
[0.5, 1, -1]	pointing towards the front, 30 degrees towards the left, 45 degrees towards the bottom.

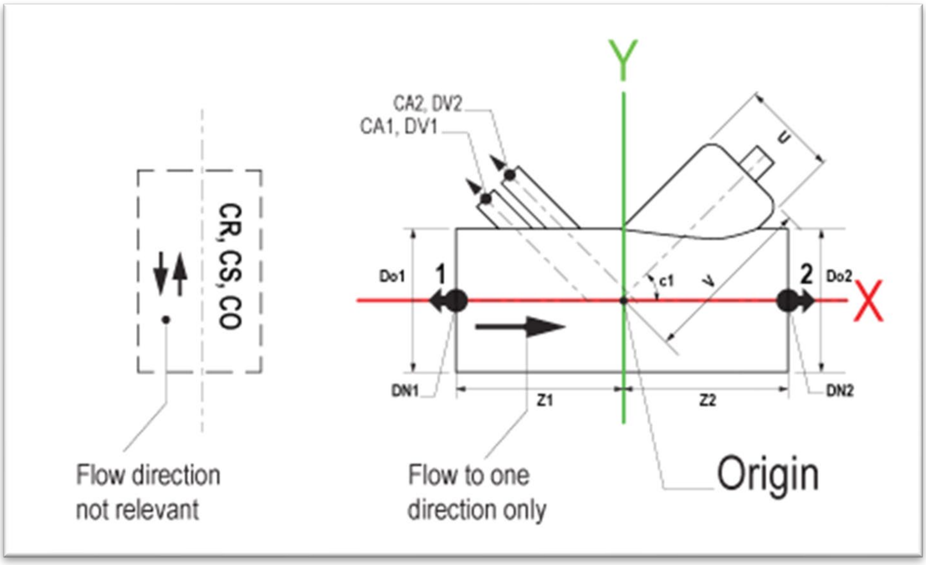
5.17. Indications, annotations, and other information

5.17.1. Flow direction

Flow directions should be indicated by a straight arrow.

The arrow should be placed near the entry point. Preferably on the object, or close to the connector just above or below the centre line.

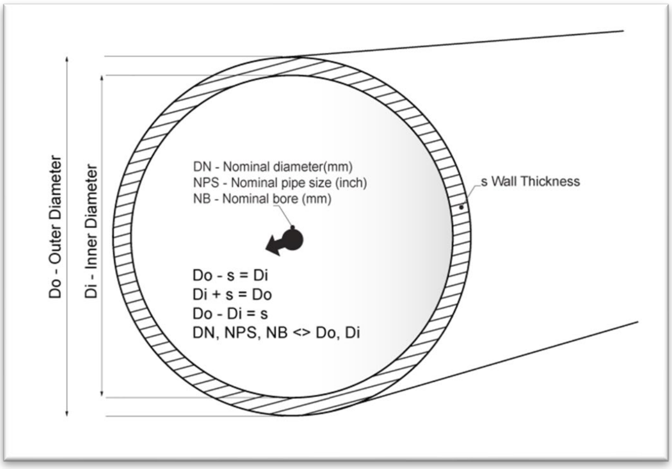
If you use generic connectors that refer to connection type legends, the arrow should be inside the dashed bounding box.



If both directions are possible, a flow direction indicator is not needed and should be removed. With the exception to the rule being that you would add it as an indication of bidirectionality whenever a single direction is normally expected or has yet to be determined per port.

5.17.2. Nominal sizes vs. actual sizes

Nominal sizes that are part of a connection should be indicated as a label, not as a size. These nominal sizes are used for matching connectors, and for calculations. Dimensions of tubes, sleeves and spigots should be defined by inner/outer diameters and wall thickness. These sizes can differ per object while being part of the same nominal size of the piping system.

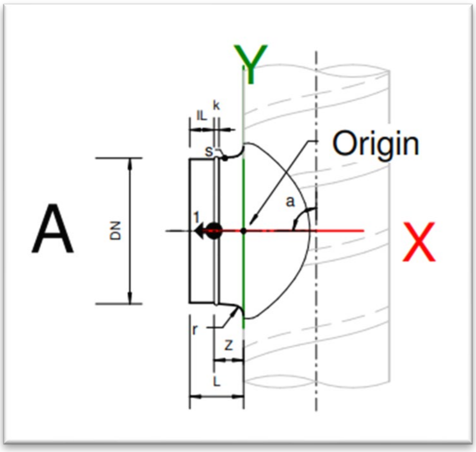


https://www.allaboutpiping.com/pipe-size-notation-nps-vs-nb-vs-dn/

For dimensioning in 3D, threaded connections will be treated as pipe-ends.
For dimensioning in 3D, Nominal Diameter, Nominal Bore and Nominal Pipe Size should never be used as real dimensions, only as labelled info on the connection. Actual sizes such as wall thickness and inner and outer diameter should be parametrized.

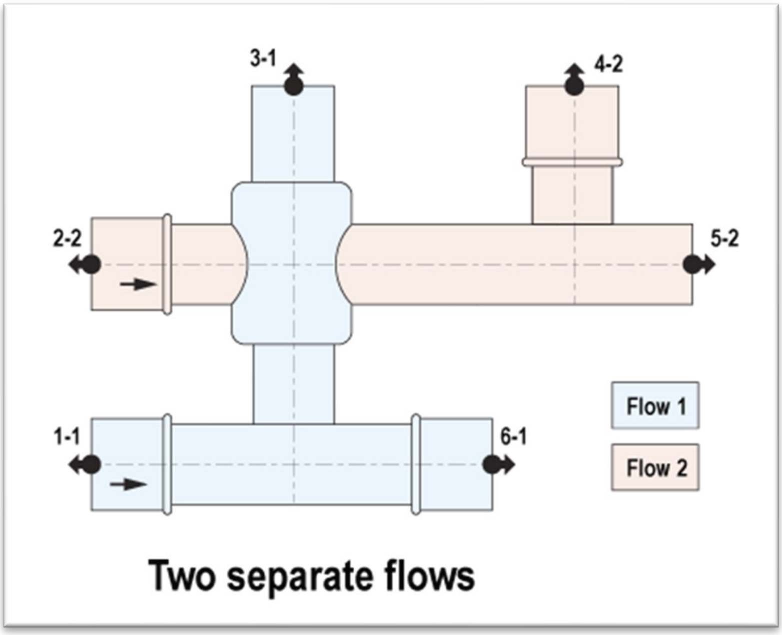
5.17.3. Indications and clarifications part of surrounding and attached objects

Parts of the drawing that do not belong to the model itself, but which are used to clarify the model, should be drawn with lines that have an opacity of 50%. Such as for example with a piece of air duct, while defining the model for a saddle.



5.17.4. Separated and crossing flows

When objects comprise two separated flows, the feature EF010809: Port connection code can be used to indicate which ports belong to the same flow (e.g. flow or return).



In the drawing, each flow is assigned a number and the port code is completed with the flow-number separated by a dash.

Like this example of a separated hot- and cold flow in a fitting with 6 connections (colours are added for illustration only):

Ports 1,3 and 6 belong to flow nr. 1 (cold) and ports 2,4 and 5 belong to flow nr. 2 (hot).

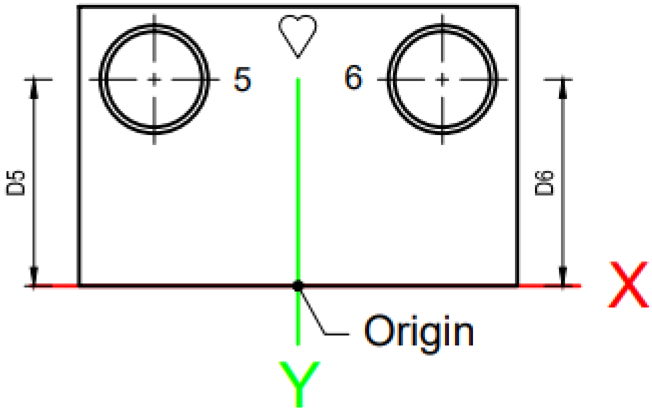
Another example can be found in the air channelling industry where two separate air flows cross each other (no Modelling Class available at the moment):

5.17.5. Axis placed on center lines

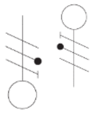
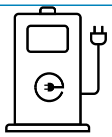
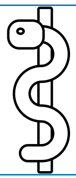
Axis placed in the centre of an object, should be indicated as such by placing a heart symbol in line with the axis.

If the Point of Origin has no connected dimensional indicators, from which the position can be derived. Then by placing the heart, it is to be assumed that the object is centred to the axis.

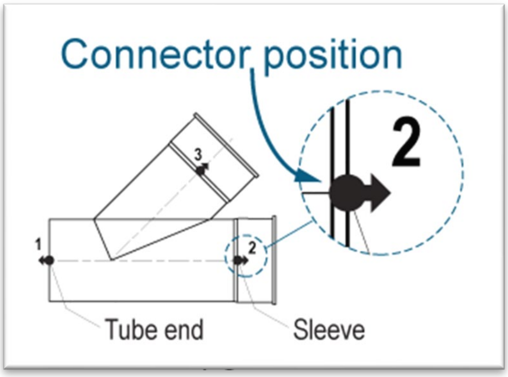
This also counts for round or oval shapes.



5.17.6. Other symbols

Electrical connection point	
Power connection 230V	
Manhole	
e-mobility charging station	
Aesculaep	

5.18. Connection indicators



Connection points are indicated by this symbol , with the arrow facing outward. This arrow does not indicate any flow direction. A connector is placed at the center line of the border of the object's position where a connection is being made to another object.

Each connection point is identified by a port code. Each connector is numbered. The number represents the port code in the data model. This port code is used to refer to features, sizes and drawing codes belonging to this port.

If the modelling class uses connection type classes, the connector symbol is placed in the connection type class. In the modelling class a placeholder for a connection type is placed instead.

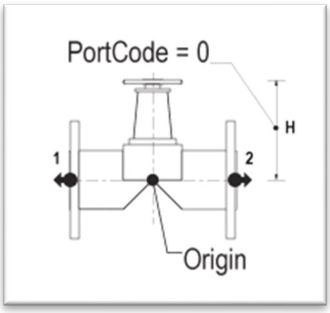
6. Assigning Port Codes and connection types

Appendages that are connected on to all sorts of main system lines such as pipework, ventilation shafts or cable trays etc. should be equipped with a connector indicator. These connectors are used for routing and connecting parts together as one system.

6.1. Numbering connection ports

Numbering of connection ports has been part of debates since the 1950s, and some rules have been written down (Nordemo et al., 2021)[2)] which we try to respect where it makes sense. These rules have a dependency towards the number of total connections.

6.1.1. PortCode = 0

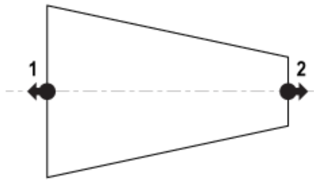


Features not belonging to a connection port, automatically get PortCode = 0. If at any point in the data flow port code is left empty (*NULL*), it should be interpreted as having the number 0 (Zero). See in this example on the right. Size H has no relation to any connector and therefore this feature will be assigned PortCode = 0. By specifying PortCode as a mandatory field, the presence of PortCode = *NULL* can be avoided.

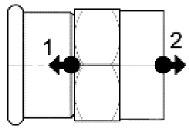
6.1.2. PortCode = 1

<table>
<tr><th>Nr of connections</th><th>Rules</th></tr>
<tr><td>2</td><td>

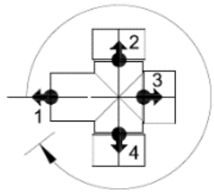
- PortCode 1 is the inbound flow stream, when a set flow direction is in place.
- PortCode 1 is the largest dimension of the two. For example, with reducer/adapter objects, the larger connection has PortCode 1



- With adapter couplings with same nominal sizes, the PortCode 1 is for the connection to the main system, other connections for branches to subsystems.



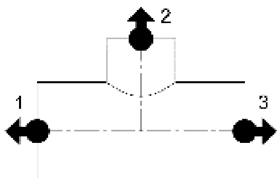
- If the above does not apply, and both connections have the same size, numbering of ports shall be in clockwise order. Starting point is the Port closest to the Left-Bottom position from the main viewpoint of the Dimension drawing.



</td></tr>
<tr><td>3 or more</td><td>

With T-joints the branch port is port nr 2

1) With T-joints the branch port is port nr 2



</td></tr>
</table>

Exceptions to the above rules are possible, when approved by ETIM International or its delegates, accompanied by sensible argumentation.

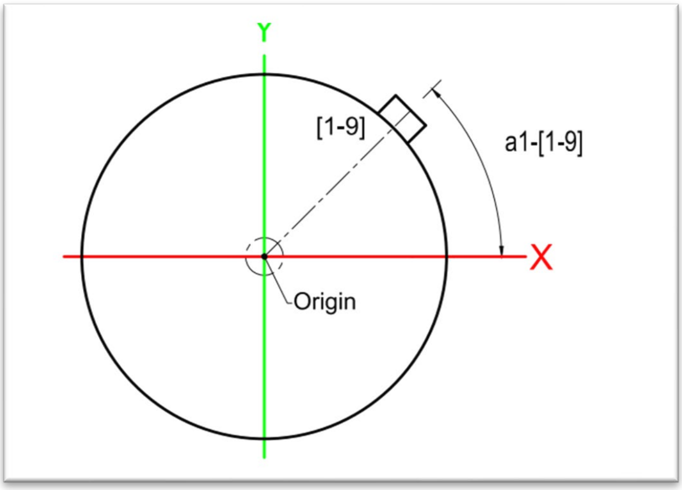
6.1.3. Multiple repeating connections [1-n]

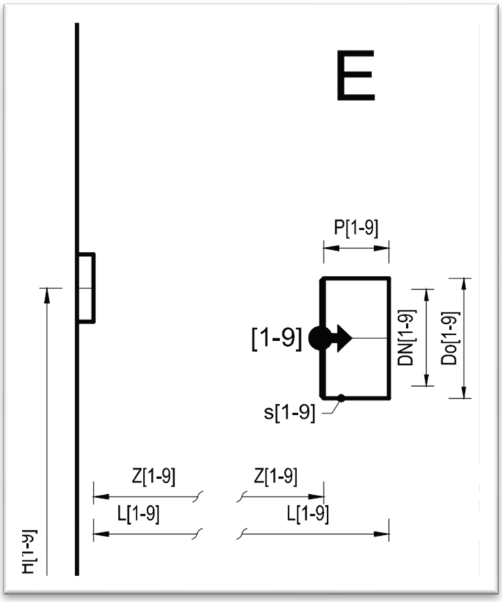
If an object has multiple repeating connections, with an unknown number of connections, a single connection can be added to the drawing with drawing codes that indicate the assignment of ports according to the following notation:

- [1 – n] => applies to port 1 to n, where n can be a maximum allowed number of ports.
- [1, n] => applies to port 1 AND n only.
- [1 / n] => same as above but this is a deprecated form of notation which should be corrected at any next RFC.

Example classes:

- MC000044 - Solar heater tank (return flow) round
- MC000368 – Heat Recovery Unit (domestic)



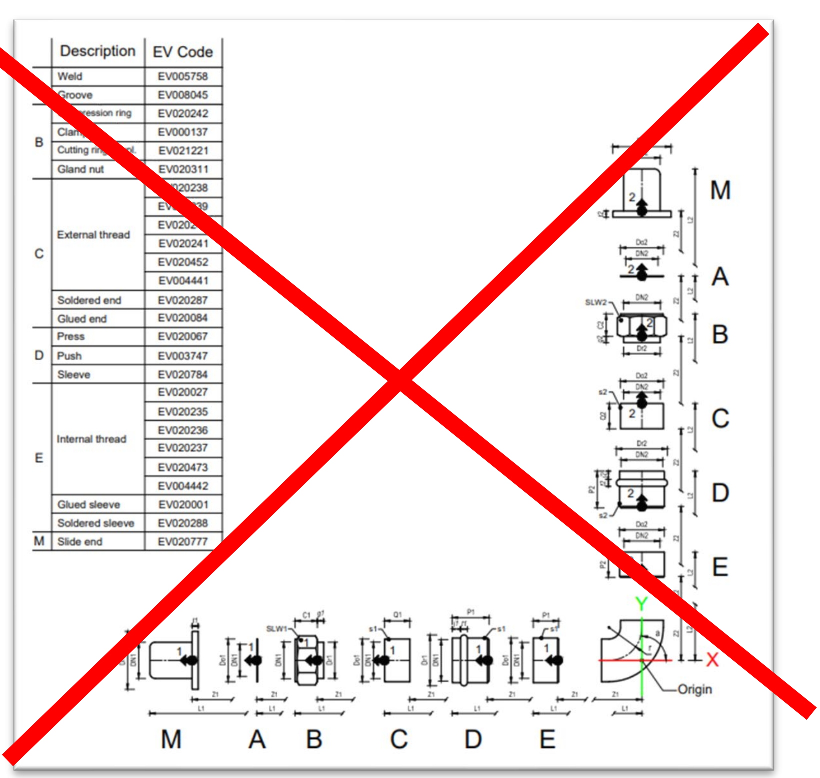


6.2. Multiple connections, using connection type placeholder and connection type legend

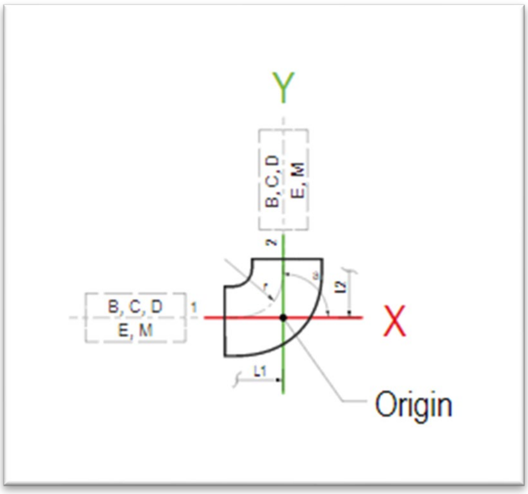
In the current collection of classes and their reference drawings there are two methods used to indicate multiple collections. The old approach is considered unwanted. The example images will show.

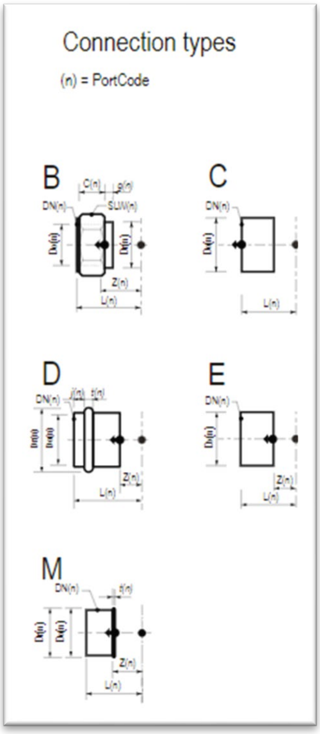
OLD wrong method: Multiple connection types can be part of a single model. In that case the connection types are indicated by a single capitalized character (A, B, C ..). These capitals letters should refer to a list, explaining the meaning of the label character, referring to ETIM values that are listed in ETIM features in the generic ETIM product class as well as or in the ETIM modelling class.

This is not manageable in the long term. Value lists are getting longer, and objects are hard to recognize. Should a connection descriptor change, it is very difficult to maintain in all drawings that use this type of connections, with inconsistencies and irregularities lurking.



NEW: Multiple connection can be referred to using a place holder. part of a single model. In that case the connection types are indicated by a single capitalized character (A, B, C ..). These capitals letters should refer to a legend, explaining the meaning of the number, referring to an ETIM connection code.





6.3. Using connection type classes

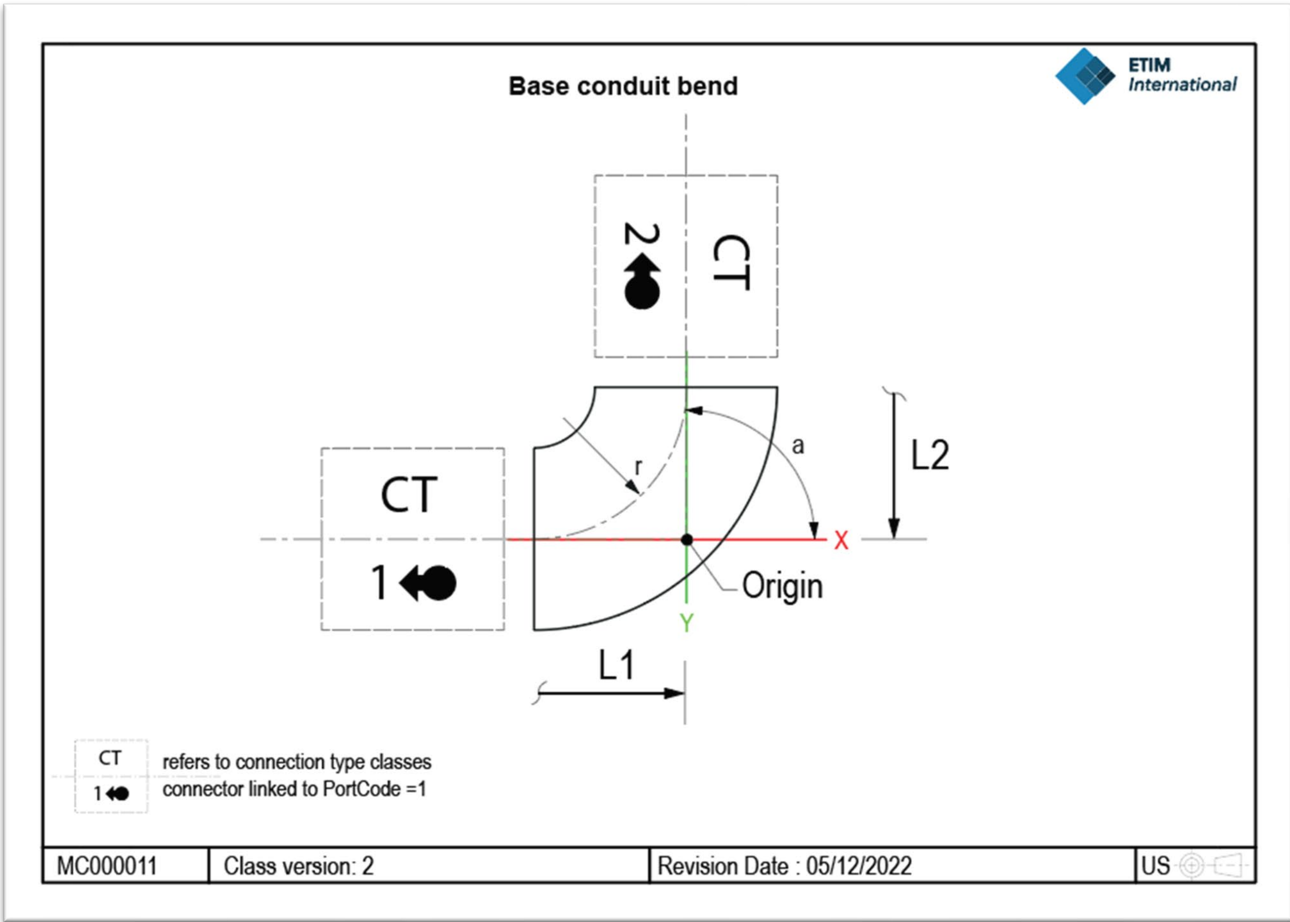
The newest and preferred method is to use connection type classes.

If a modelling class has multiple connectors, with multiple options for type of connections, the use of referring to connection type classes is mandatory.

Connection type classes are special modelling classes, describing a specific connection. There connections may reoccur in multiple modelling classes at multiple connection ports. By inheriting these connection type classes into modelling classes, a lot of redundancy problems are fixed.

6.3.1. Indicating connection type classes in the reference drawing.

At each connection point a placeholder is placed. Connection type classes are indicated in a modelling class reference drawing by showing a dashed rectangle located at the connection port. The dashed rectangle shall be centred with a centreline from the connection port. In the rectangle, above the centre line, the capitals "CT" are placed. Below the centreline, the PortCode, followed by the connector symbol are placed.



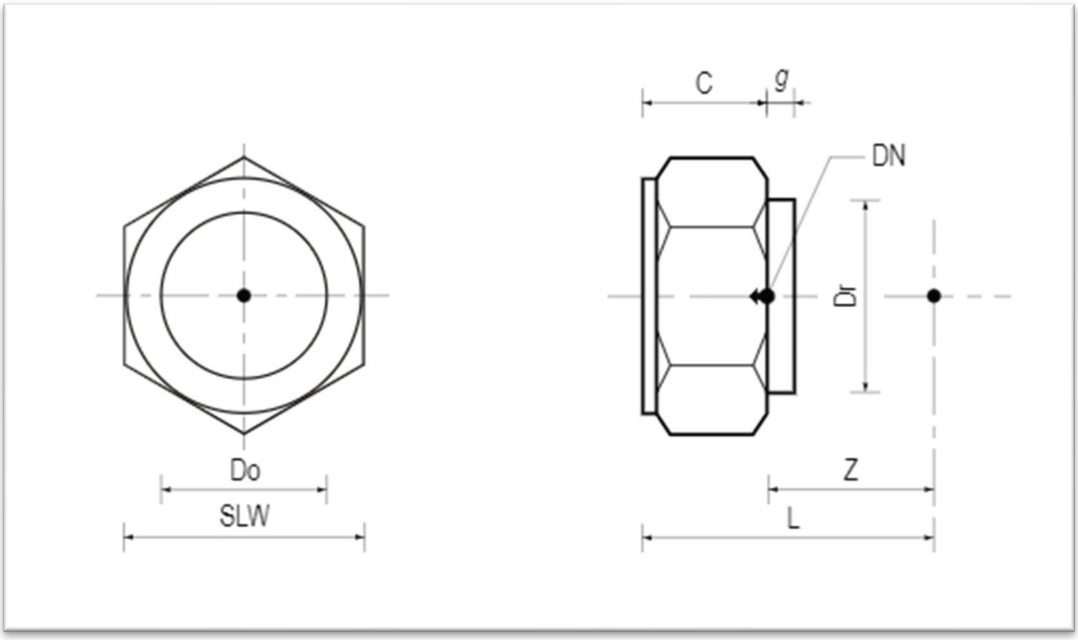
All references to possible connection types should be removed from the modelling class reference drawing to ensure independency from any connection type changes. The possible connection types shall be listed in the data structure of the modelling class.

Connection type classes shall follow the same procedures and versioning system as modelling classes.

6.3.2. Reference drawings for connection types

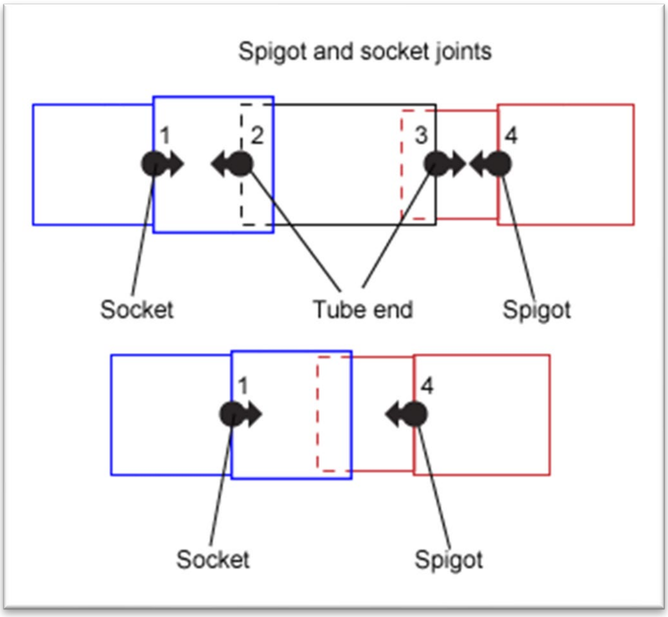
Connection type classes will have the same style guide for reference drawings with only one exception: the use of axes.

Because the connection types will be inherited into modelling classes in numerous positions, there is no relevance in defining the zero position of the connection type. A set consisting of an origin with two dashed lines, square in relation to each other, is functioning as axis reference. These dashed lines are in fact placeholders for the X-Y or Z axis. Should dimensional references that are made from or to an axis, the size lines shall run from and to these dashed lines.



6.3.3. Sleeves, sockets, spigots and threaded connection lengths

Sleeves or sockets, spigots, and threaded connections have limited lengths. These should be sized when these are relevant. Such relevance may occur when rims limit the interlocking of objects. A tube's end for instance can be used as either a sleeve or spigot but has no sized length. In this regard outer thread could be considered as being a spigot, and inner thread could be considered as being a socket or sleeve.

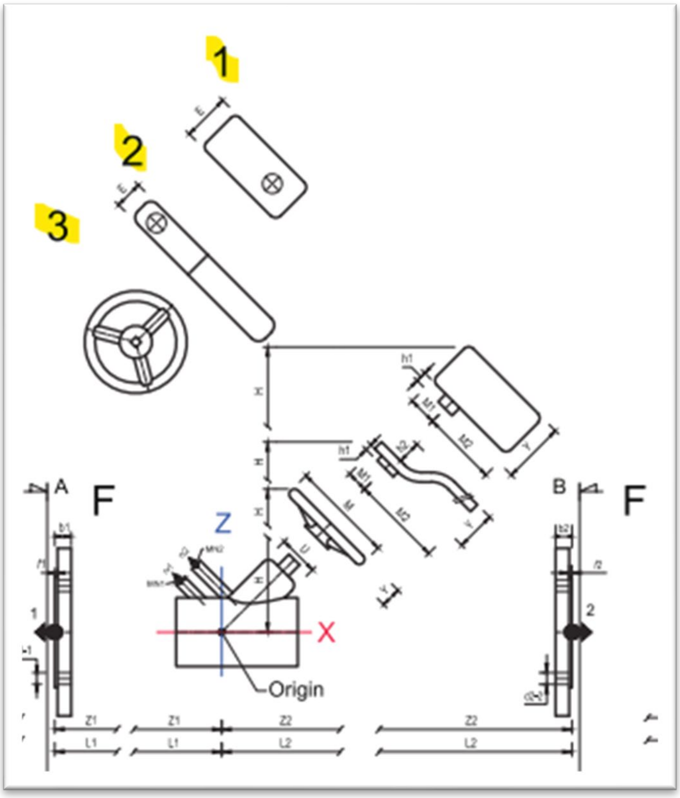


6.4. Controls

6.4.1. Multiple controls

Multiple controls (handle, motor etc.) can be part of one model. In that case the controls are numbered. The numbering should refer to a legend, explaining the meaning of the number, referring to an ETIM value code.

	Operation	EV Code
1	Electric motor	EV020343
2	Handle	EV020000
3	Handwheel	EV020003



6.5. Controls as connection type class

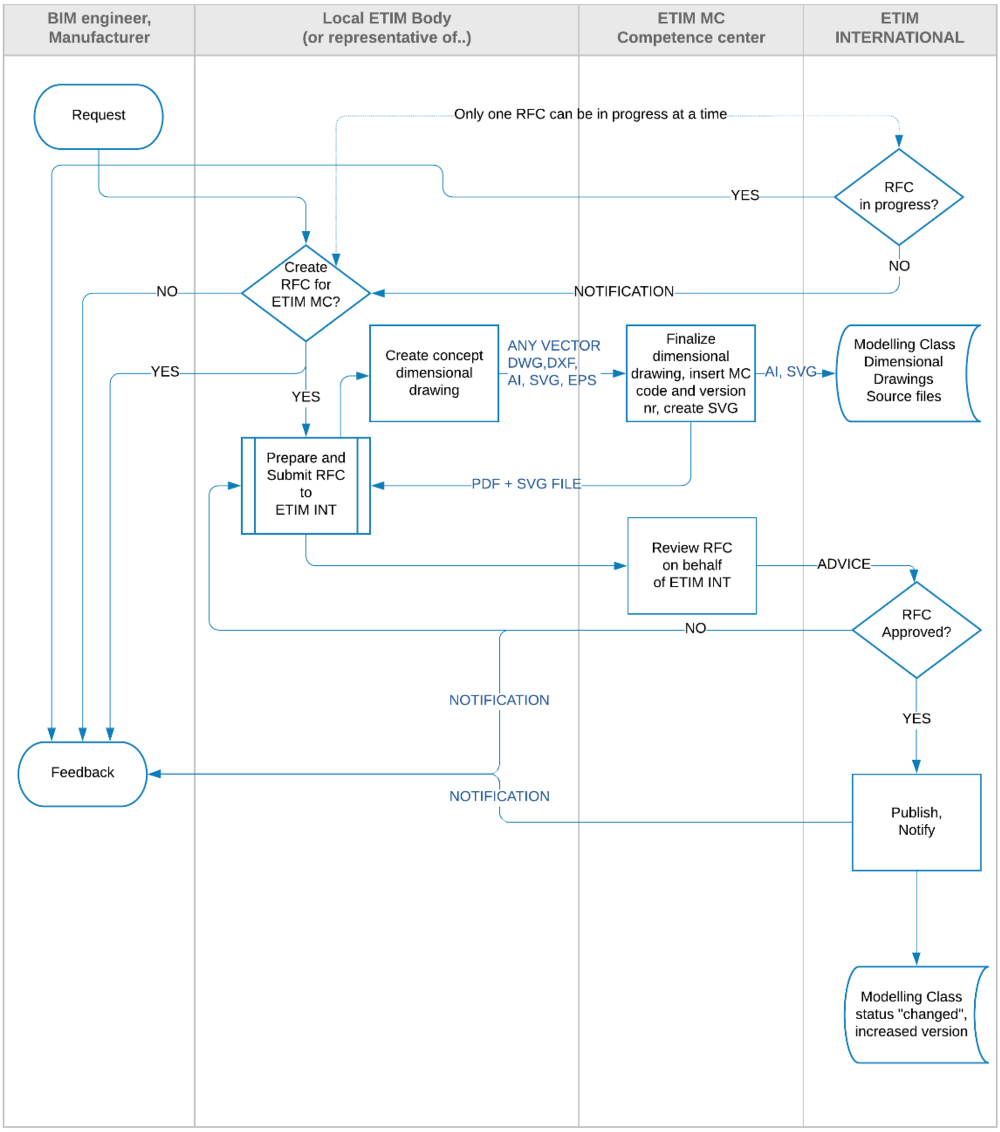
Controls can also be described in a connection type class. In this situation the same rules apply as described for regular connection types.

7. Procedures

The RFC procedures for modelling classes shall follow the same procedures as RFC's for regular product classes. However, there is one exception to this rule: to ensure the correctness of the reference drawings, an modelling class competence center or modelling class user group may look at the requests, handle the final iterations of draft drawings and should advise the local bodies in the startup of their modelling class ambitions.

This addition to the procedures serves the following purposes:

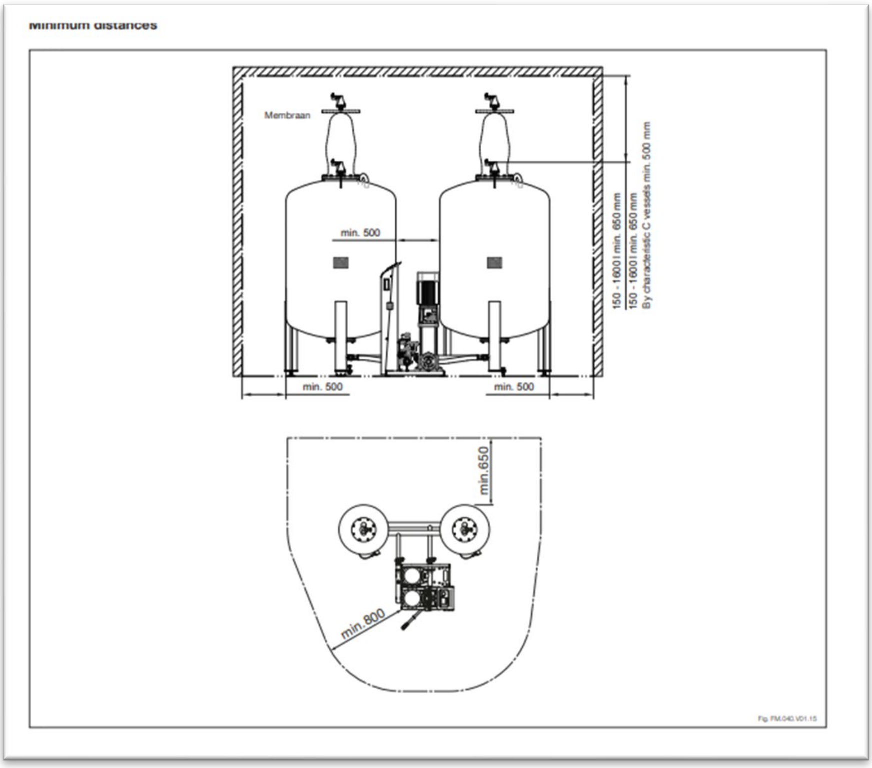
- A quick transfer of knowledge to the local bodies
- Guarding the interests of modelling class implementations
- Early notification of needed amendments to the standard
- Centralized interaction with CAD software houses

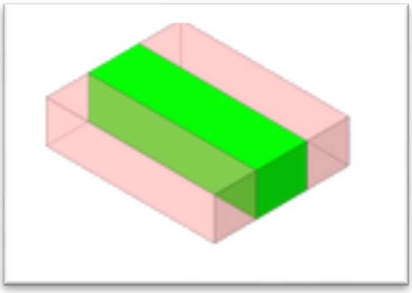


8. Known limitations of modelling classes

As modelling classes is a relatively new standard, it has some possible use cases that are not fully developed into modelling classes yet. We will discuss them below.

8.1. Spaces around the object





Spaces to indicate the minimum space requirements for installation, maintenance or operation have no place in the modelling class for now. This topic is still under investigation and up till now, no suited solution has been identified and agreed upon. Issues that have to be dealt with in this topic are:

- Until now, only a square space
- Minimum space-requirements are hard to capture in parameters in a useable way.
- Minimum space requirements can be situation dependent, and differ per application (installation vs. operation), making a drawing very complex.
- Minimum space requirements can be flexible of shape and form.
- Most manufacturers don't have any official data available in regards with minimum spaces.

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8.2. Connecting objects with flexible hoses and cables

Up to now we have not found a solution for modelling flexible shapes such as cables and hoses. For now, the connection point for a hose or cable is included in the model, the hose or cable itself is not, and should be modelled-in as data or as a separate object by the BIM-engineer.

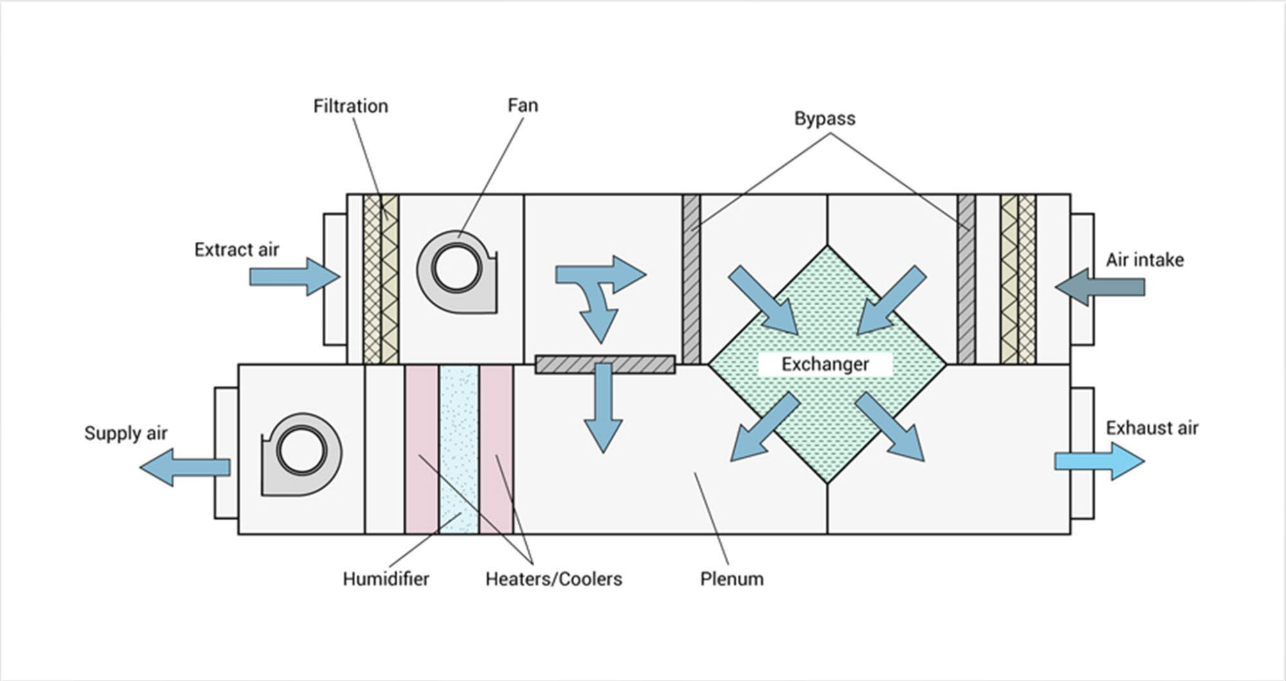
8.3. One-off custom objects

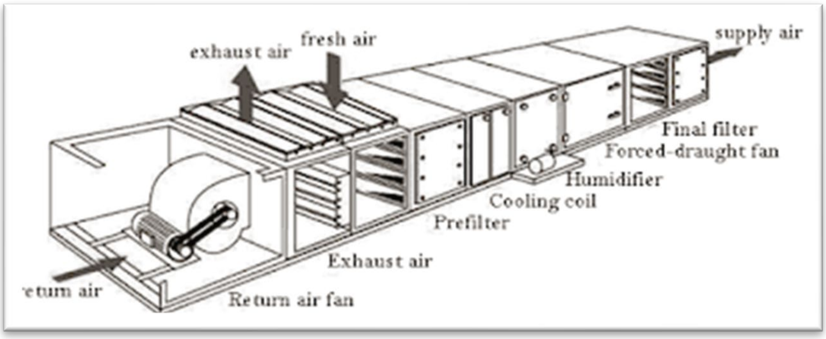
This standard is regulating the parametrization of repeatable products that come in many shapes and sizes. Parametrization of custom one-off objects has no relevance. These models should be constructed in the BIM-software of choice. By sticking close to the same native format for both the custom object and the template object build to consume modelling class data, one can use both objects in the same BIM model's system design.

8.4. High complex modular assemblies

Complex assemblies that are highly modular (like air handling units for commercial buildings) are sometimes difficult to parametrize into a morphable shape for space claim purposes. Let alone making it appear supplier generic. If possible, such assemblies should be simplified into a small number of object-variants. Separate modelling classes can be created for each variant, focussing on the space claim, rather than getting all the details in.

Future development of these assemblies could focus around breaking some parts of the model into smaller objects, that could be modelled using existing modelling classes.




exhaust air
fresh air
supply air
Final filter
Forced-draught fan
Humidifier
Cooling coil
Prefilter
Exhaust air
Return air fan
return air


FLEXIBLE CONNECTION
BLOWER
COOLING COIL
BAG FILTER
CASING
LOUVER
BASEFRAME
UV LIGHT
FINS
PRE-FILTER
LOUVER FRAME
PARTS OF AIR HANDLING UNIT

9. Appendices

The following appendices are part of the guidelines:

- Appendix 1: Style guide for Drawings.
- Appendix 2: [removed]
- Appendix 3: List of connection types, their description and their relation to ETIM Features and ETIM Values. [WORK IN PROGRESS]
- Appendix 4: EXCEL Sheet with drawing codes, their description and their relation to ETIM Features. [WORK IN PROGRESS]
- Add: notes about file formats
- Add: notes about folder structures

10. Citations

1) Technical Drawings - Wikimedia Commons (accessed 21 Oct. 2022.). Https://commons.wikimedia.org/wiki/Technical_drawings

2) Christer Nordemo, Markus Stenvall (2021) System MC – Numbering of connections in ETIM

11. Changelog

Version	Remarks
1.1-2023	• Remove version nr from the drawing template.
1.0-2022 (en)	• Complete overhaul, new illustrations, texts rewritten. • New corporate design format • Added new chapter on connection type classes • Highlighted remarks removed. • Added remark 1.3 about extending the ETIM guidelines • Updated paragraph 2.2 • Updated first paragraphs in chapter 4 • Moved "4.1 versioning management" to new chapter nr. 5 and updated. • Removed "Advice to PIM software developers" in 4.5.1 as this is no longer valid because of new versioning system.
0.6-2020 (en)	First English version. Major update on almost every page, based on first read-through of Marc Habets, and remarks of Heiko Dehne. Changes marked in red and yellow. Discussion topics highlighted with remarks.
1.0- 2016 (nl)	First Dutch version