



Facility Management Handover - Equipment Maintenance MVD: Working Draft Spreadsheet Mapping Specification

(Version 2.0)

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EXECUTIVE SUMMARY

This working draft paper identifies mapping requirements for the bSI Facility Management (FM) Handover - Equipment Maintenance Model View Definition (MVD) to its Spreadsheet Physical File Format.

The intended audience for this document includes those implementing the Facility Management (FM) Handover - Equipment Maintenance MVD in Spreadsheet Physical File Format and those who may have produced, evaluated, or consumed depreciated national or local FM Handover - Basic MVD implementations.

Included in this document are the initial draft specification for each worksheet in an FM Handover - Equipment Maintenance spreadsheet file format, the low-level data checking required for each worksheet cells, and the list of IFC objects allowed under this specification. During Phase 1B of the upcoming buildingSMART International (bSI) FM Handover - Equipment Maintenance MVD project, facility owners, designers, contractors, facility managers, and software implementers will fully consider, and update the proposal found in this document.

This document is one of a series of publications from bSI that taken together define the requirements, design, implementation, usage, and requirements for software testing for files conforming to the FM Handover - Equipment Maintenance MVD.

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VERSION CONTROL

Version	Date	Status
0.5	01-Feb-2021	Initial draft document submitted to bSI COBie Certified Professional™ technical expert panel.
0.9	12-Feb-2021	Updated to reflect comments of bSI COBie Certified Professional™ technical expert panel.
2.0	16-Feb-2021	Updated document to bSI "working draft" status

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1. INTRODUCTION

In 2009, buildingSMART international approved the first Industry Foundation Class (IFC) Model View Definition (MVD) for the delivery of Facility Management Handover data (East 2013). Two types of information were required to be captured in this schema, information about products and systems. Required product data included operations, maintenance, performance, parts, warranty, and training information. Required system data included design, construction, and fabrication drawings, test procedures, test results, operations, maintenance, and training requirements. A simplified Unified Model Language (UML) data model demonstrated how IFC schema requirements might be “flattened” to simplify the presentation of the underlying MVD for those who need to deliver the information (Figure 1).

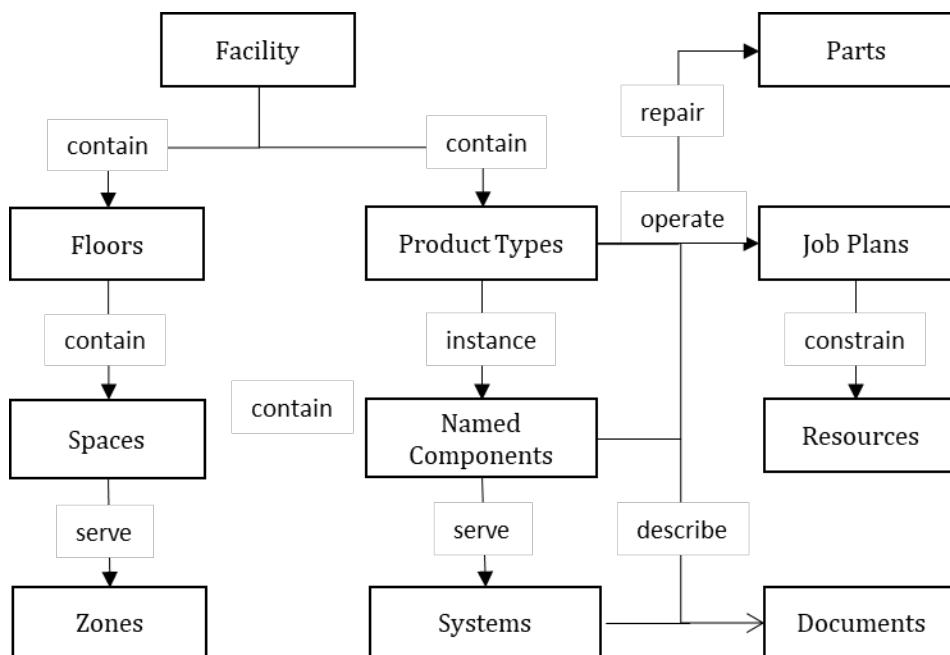


Figure 1 Handover Data Model (East 2013)

The mapping between the general data model diagram, Figure 1, and the specific IFC entities were also defined. An additional benefit of the describing the required schema in terms more familiar to practitioners than IFC data modelers, was the insight that physical file format, other than those previously used for geometrically intensive design modeling may be more accessible to those needing to capture data during the construction stage of the project. Thus, buildingSMART recognized the value mapping facility handover data in spreadsheet form as well as the STEP Physical File Format (ISO 2016).

As delivery of information related to building operations and maintenance is one of several instances of the types of information delivered at construction handover, the buildingSMART international (bSI) Building Room has begun the development of a roadmap for these efforts. To distinguish between information exchange data required at construction handover from the operational information needed during the facility management stage itself, bSI is now organizing these projects into those supporting the upstream data delivery as “Facility Management

Handover” projects and those supporting operations as “Facility Management” projects. Specific types of information will then be identified by stakeholders and implemented as individual MVD’s. For example, FM Handover - Equipment Maintenance, is the updated name for the original bSI MVD described above. Another possible project, FM - Maintenance History, would include the updated handover information as well as the history of maintenance.

2. OBJECTIVE

This document provides the updated FM Handover - Equipment Maintenance spreadsheet mapping in support of the bSI 2020 Technical Roadmap.

This document is one in a series of related bSI technical documents supporting the FM Handover - Equipment Maintenance project. Other documents include:

- A description of FM Handover - Equipment Maintenance lessons learned and resulting modeling and implementation requirements.
- A description of the FM Handover - Equipment Maintenance software testbed and certification process.
- A description of the integration of the FM Handover - Equipment Maintenance MVD with the buildingSMART Data Dictionary for the purposes of international language translation.
- A description of the needed changes to the existing individual and professional certification programs in support of FM Handover - Equipment Maintenance MVD implementation

3. EXPECTED RESULTS

This document, along with the associated formal IFC 4.3 MVD schema, software, and individual certification programs will be used as the basis for the ongoing bSI FM Handover - Equipment Maintenance project.

4. INTENDED AUDIENCE

Those with hands-on experience using previous national specifications for construction handover data sets will be able to use this document to see how lessons learned from field use of such information has been incorporated. Those seeking a full discussion of these lessons learned and critique of national specifications for construction handover will find that in the associated bSI Technical Note.

Software implementers and information technology integrators will find this document helpful in cases where Spreadsheet Physical File Formatted files containing FM Handover - Equipment Maintenance data are required to be produced, updated, or consumed. This document demonstrates the backward compatibility of these updates to prior national specifications.

bSI Chapter members will be able to use this document as a catalyst for evaluation of requirements, language translation, creation of localized testbed examples, and production of localized individual

certification requirements. Providing this specific document as the first in this series of Technical Notes is aimed at speeding international adoption across all bSI Chapters.

5. STYLE GUIDE

The specification below requires the application of specific language to identify the specific issue being addressed. The terms below shall be used as noted:

- “Shall” identifies a mandatory requirement. Failure to comply with all mandatory requirements shall result in the rejection of a FM Handover - Equipment Maintenance MVD data file.
- “May” identifies one of several permissible options. One of the permissible options identified shall be implemented, unless otherwise stated.
- “Can” identifies possible actions within the proscribed “shall” and “may” requirements of the standard.

This specification will refer to the Spreadsheet Physical File Format presentation of the FM Handover - Equipment Maintenance MVD. As a result, the following standard terminology shall be used when referring to data provided in this presentation format:

- “Workbook” the complete set of all data required to deliver a set of data that claims to be in conformance with the FM Handover - Equipment Maintenance MVD.
- “Worksheet” an individual spreadsheet or “Tab” within a workbook.

To refer to a specific column of information within a given Worksheet, the Name of the worksheet shall be provided, followed by “.” character, followed by the name of the column. Such a description shall be defined as relevant to that specific data for all data provided. For example, “Type.Name” shall refer to the any data within the Type worksheet under the “Name” column.

To refer to a specific row of information within a given Worksheet, the Name of the worksheet shall be provided, followed by the list of named fields and associated data that make the value of that data row unique within the Worksheet.

The list of all workbooks, named fields, and files that identify a unique row of data is defined later in this document.

6. BUSINESS CASE REQUIREMENTS

The development of a IFC MVD must be based on the identification of a clear statement of business case, the identification of the set of information needed to support that business case, and identification of practical constraints on the use of such information in practice. The sections below identify specific requirements considered in the development of the original (and now updated MVD), as reflected in Figure 1.

The rational for these requirements is more fully described in a separate bSI project publication.

7. HEADER INFORMATION

IFC STEP Physical Format files (ISO 10303-21) require the software producing the data to provide a file description identifying the MVD that the data is meant to supply, the software that created the data, and the IFC schema version. This information is provided in a simplified format.

File Description:	FM Handover - Equipment Maintenance (required text)
File Schema:	IFC4.3 (required text)
File Date/Time:	ISO Date/Time provided by software or user (User data)
Producing Method:	Name of software or company providing deliverable (User data)

Software and manually produced FM Handover - Equipment Maintenance MVD data files shall include a header in accordance with the specific requirements identified for STEP Physical File Format or Spreadsheet Physical File Format.

8. FLATTENING IFC ROOT HEIRARCHY

Although the IFC model provides a rich descriptive language for an IfcProject that may have one or more locations (IfcSite), and multiple buildings (IfcBuilding) on a given site, that is not typically the way that Facility Management Handover data is developed or used for most projects. As a result, the Facility Management Handover - Equipment Maintenance use case restricts a given handover data set to one building.

The impact of this change is that one compressed data row is sufficient to provide project, site, and building information. Note that infrastructure domains will have a slightly different flattening process as they will not reference IfcBuilding, but other domain-specific project objects. A separate discussion of infrastructure projects is found later in this document.

For each object included in the Building record, the entity name, description, and IFC GUID (required if data provided by software) for ifcProject, ifcSite, and IfcBuilding. Including this information allows the interoperable transfer of data between physical file formats.

Software producing FM Handover - Equipment Maintenance MVD in STEP Physical File Format shall retain the IFC IfcProject, IfcSite, and IfcBuilding hierarchy.

Software producing FM Handover - Equipment Maintenance MVD in Spreadsheet Physical File Format shall flatten these objects in accordance with the specific requirements identified for the Spreadsheet Physical File Format.

9. GEOMETRIC EXCLUSION

As described in Figure 1, the Basic FM Handover MVD does not contain information about building geometry. The location for the placement of equipment within a space is defined by the semantic relationship “contains.” As a result, the FM Handover - Equipment Maintenance MVD shall not include building geometry.

While prior national implementations of the original Basic FM Handover MVD allowed the specified information to be overloaded on geometric building data, software vendors producing data identified as meeting FM Handover - Equipment Maintenance MVD requirements shall not include geometric information.

The capability of software to export a FM Handover - Equipment Maintenance MVD data file, in STEP Physical File Format or Spreadsheet Physical File Format shall be tested and documented in Phase 2 of this project.

10. OBJECT EXCLUSION

As identified in the introduction ISO 16739, the application of the IFC standard demands that the specific subset of IFC entities supporting a given business case be explicitly defined as an MVD. Figure 1, points to the extent to which the possible set of all IFC model entities must be pruned to support equipment maintenance.

Key amongst these exclusions is the understanding that there may be many individual MVD's needed to cover all aspects of building maintenance. While these will all share the core organization of the IFC schema, they will not all require the same set of information. FM Handover - Room Finishes will not require, for example operating equipment.

The FM Handover - Equipment Maintenance MVD does focus exclusively on equipment maintenance. The business rule used to determine if an installed object in a building is to be defined as "equipment" is twofold: (1) is installed object created by an off-site manufacturer who identifies the item with a model number and product catalog data, and (2) the object requires preventative (or other) maintenance regimes for the product to maintain efficient operation.

As there are many items installed in the building, and possibly contained in a design or construction building information models, that are not considered "equipment," this specification contains the list of IFC entities that are never allowed to be included in a file claiming to meet the requirements of the FM Handover - Equipment Maintenance MVD.

Chapter 17, Allowed IFC Type Objects, identifies the set of allowed IFC object. All software providing FM Handover - Equipment Maintenance MVD data shall limit data exports to the list of allowed object types, by default.

11. PROPERTY EXCLUSIONS

Major national and international efforts to establish requirements for product data delivery have been underway for decades across multiple countries. To date no internationally required equipment property sets have been defined and a critical mass of product data transfer platforms are not in common use. As a result, software companies find many ways to capture equipment properties within their exported data sets. The variation in currently allowed expression of product properties with IFC files, can be confusing to those using SPFF data.

Needing to come to a practical resolution of this matter to support the use of product property data that is provided a standard rule set was produced and publicly distributed to software companies implementing an earlier version of the FM Handover - Equipment Maintenance MVD.

Chapter 18, Excluded Property Sets, summarizes mandatory property exclusions. All software providing FM Handover - Equipment Maintenance MVD data shall limit data exports exclude the identified properties, by default.

12. PROPERTY UNITS

Key to the use of information outside the context of the originating design and/or construction building information authoring platforms, is to have precise definitions of the information that is being exchanged and the meaning of that information. Critical to understanding the meaning of those properties that are expected to be delivered within an FM Handover - Equipment Maintenance data set are the units of measure associated with those properties.

As the design and construction teams capture building properties, it is also the case that information is often provided that is simple for humans to comprehend but may be easily misinterpreted by software companies. To be consistent with the schema used to capture properties within IFC, all FM Handover - Equipment Maintenance properties must be comprised of two parts. The first part is the “value” being described. The second part is the “unit” that defines (when needed) the measurement of that value.

To ensure there is no confusion resulting from the unsupervised changes of data when information is exchanged, all property values provided through the FM Handover - Equipment Maintenance shall be single-valued units. The only implication for such a requirement, from a practical point of view is that individual columns will have to be provided for range values that would previously have been included as two values separated by a delimiter.

For example, consider a mechanical equipment schedule that has the column “Electrical”. Consider that the contents of such a column might be “120 / 20 / 1”. The export of such data into an FM Handover - Equipment Maintenance MVD data set shall not be allowed. Instead, the provision of three fields corresponding to 120 Volts, 20 Amps, and 1 Phase may be provided.

In another example, consider a mechanical equipment schedule that has the following column “CFM-Range”. The contents of such an example schedule column might be values such as “0-125” or “501-700”. The export of such data into an FM Handover - Equipment Maintenance MVD data set shall not be allowed. Instead, the provision of two fields corresponding to “CFM-Min” and “CFM-Max” may be provided.

Of course, it is not possible for software vendors to implement changes in the definition of properties to limit their values based on what end-users wish to provide. However, all software exporting FM Handover - Equipment Maintenance MVD data shall notify users that property sets that have multiple values or delimiters may not comply with FM Handover - Equipment Maintenance MVD requirements.

All software providing FM Handover - Equipment Maintenance MVD data shall deliver properties as single valued measurements with an explicitly identified unit of measure. In cases where unit-less measures are reported as property values, software vendors shall provide the NULL value.

13. DATA TYPES

Software must consistently interpret being provided data, therefore, FM Handover - Equipment Maintenance explicitly defines the type, allowed character sets, and field length of every data element. Five (5) data types allowed are described below. To meet the international specification of data types, each language shall explicitly register the list Allowed Character Sets, Allowed Length, and Implementation Notes for all five data types.

The software producing FM Handover - Equipment Maintenance shall be responsible for all required transformations and quality control of user-entered text strings necessary to comply with these data type specifications. Producing software shall introduce a minimum set of regular expression testing when exporting data to inform users when they must reformat data prior to export.

13.1. NUMERIC DATA TYPE

A Numeric data type is a number that may contain a decimal fraction. If the number is a negative value, the first character in the number shall be as noted below. If this character is not present, the number shall be interpreted as a positive number. Every bSI chapter adopting this specification shall provide an explicit list of Allowed Character Sets, Allowed Length, and Implementation Notes as part of their local appendix to a later bSI Implementation Guide.

13.1.1. ALLOWED LENGTH

Single-precision floating-point format[2], 32 bits.

13.1.2. GENERIC IMPLEMENTATION NOTE

Generic Implementation Notes apply to the delivery of this data type regardless of language.

This specification does not mandate the precision (i.e. number of significant digits) allowed for all possible numeric measurements. However, software vendors should provide numerical data consistent with the typical accuracy of tolerances on a construction site. The practical implication of this rule is that unless otherwise specified, software vendors shall provide no more than two (2) significant digits for unspecified numerical values.

Under no circumstances shall a unit of measure value or symbol be provided within the numeric data type. All unit of measure values are explicitly specified for every numeric data type.

Under no circumstances shall a range of numeric data types be provided in a single numeric data type using a non-specified delimiter.

Under no circumstances shall a range of numeric data types be transformed to an alphanumeric data type.

13.1.1.3. ENGLISH LANGUAGE IMPLEMENTATION

Allowed Character Set

Purpose	Character Range	Encoding Range[1]
Number symbols	0 - 9	Chr(48)-Chr(57)
Decimal fraction identifier	.	Chr(46)
Negative number signifier	-	Chr(45)

Additional Implementation Notes

Imperial measurement values must be transformed from a number part and a fractional part into a decimal fraction. For example, the Imperial linear measure “six feet, two inches” (6' -2”) shall not be allowed. The transformed value of “6.5” shall be used instead. Note also that the typical practice of Imperial measurement to include the unit symbol with the number is not allowed.

13.2. ALPHANUMERIC DATA TYPE

An Alphanumeric data type is a string of letters and/or numbers. In all cases, the producing and receiving systems shall interpret the information provided as a string of letters and not numbers. Alphanumeric data types may also contain specific symbols from the approved list.

13.2.1. ALLOWED LENGTH

Alphanumeric data type fields shall have a length from 1 to 255 characters.

13.2.1.2. GENERIC IMPLEMENTATION NOTE

Generic Implementation Notes apply to the delivery of this data type regardless of language.

Additional formatting requirements of specific data fields (e.g. email addresses, and file names) shall be specified under each language.

Given the possible alternative physical implementations of FM Handover - Equipment Maintenance spreadsheet, XML, or many other forms allowed under the bSI 2020 Technical Roadmap, the list of allowed symbols shall be carefully restricted to eliminate the possibility of misinterpretation.

Under no circumstances shall non-printing ASCII characters, other than the “Space” character, Chr(32), be included in any Alphanumeric data.

Any characters outside the range of those identified below, shall be replaced with the asterisk “*” symbol, Chr(42).

Any characters beyond the length of the allowed string, as noted below, shall be replaced with the last character of the string of the asterisk “*” symbol, Chr(42).

In the special case that a field allows the listing of multiple values, the semi-colon symbol “;”, Chr(59), shall be used in all languages.

13.2.1.3. ENGLISH LANGUAGE IMPLEMENTATION

Primary Character Set

Purpose	Character Range	Encoding Range[1]
Numeric symbols	0 - 9	Chr(48)-Chr(57)
Alphabetic symbols (upper)	A-Z	Chr(65)-Chr(90)
Alphabetic symbols (lower)	a-z	Chr(97)-Chr(122)
Ampersand symbol	&	Chr(38)
Parenthesis symbols	()	Chr(40), Chr(41)
Dash symbol	-	Chr(45)
Period symbol	.	Chr(46)
Forward slash symbol	/	Chr(47)
Colon symbol	:	Chr(58)
At symbol	@	Chr(64)
Backward slash symbol	\	Chr(92)
Underscore symbol	_	Chr(95)
Space (non-printing character)	" "	Chr(32)

Figure 2 Allowed Alphanumeric Characters (English)

Reserved Character Set

The following characters shall only be used for the following purpose:

Purpose	Character Range	Encoding Range[1]
List delimiter, semi-colon	;	Chr(59)
Truncated, or replaced text	*	Chr(42)

Figure 3 Reserved Alphanumeric Characters (English)

13.2.1.4. IMPLEMENTATION NOTES

The following additional restrictions shall be put on the data fields identified below:

Email and related fields - well-formed email addresses. Characters shall be limited to the following: Numeric, Alphabetic (upper and lower), Dash, Period, and At.

File names and related fields - well-formed relative path names. Characters shall be limited to Numeric, Alphabetic (upper and lower), Dash, Period, Forward slash, and Backward slash.

13.3. ISO DATE/TIME DATA TYPE

An ISO Date/Time data type is string of letters and numbers corresponding to the ISO standard presentation of Date time. For example, 31 December 1999 at 3:25 PM were added in ISO Date/Time format, the result would be "1999-12-31T15:25:00".

13.3.1.1. GENERIC IMPLEMENTATION NOTE

Generic Implementation Notes apply to the delivery of this data type regardless of language.

When adding dates and times into spreadsheets, it is often the case that consuming program incorrectly interpret the information. For example, any string of numbers and letters that appear to be a date are automatically transformed for internal proprietary storage as the number of seconds since “1900-01-01T00:00:00”. Thus, the use of ISO Date/Time is mandatory because spreadsheet programs change anything that looks like a date into an internal reference value.

All producing software systems are required to export internal “date” fields into ISO Date/Time data types by adding the time of “one second after mid-night” to the data. Thus, an internal date of “31 December 1999” is to be transformed on export to the following ISO Date/Time: “1999-12-31T00:00:01”

13.3.1.2. ENGLISH LANGUAGE IMPLEMENTATION

Primary Character Set

Purpose	Character Range	Encoding Range[1]
Numeric symbols	0 - 9	Chr(48)-Chr(57)

Figure 4 Allowed Date/Time Characters (English)

Reserved Character Set

The following characters shall only be used for the following purpose:

Purpose	Character Range	Encoding Range[1]
Date field delimiter	-	Chr(45)
Time field delimiter	:	Chr(58)
Date-Time section delimiter	T	Chr(84)

Figure 5 Reserved Date/Time Characters (English)

Allowed Length

All date time fields shall be limited to a length of 19 characters.

Implementation Notes

No additional notes required.

13.4. REFERENCE DATA TYPE

A Reference data type is a value in one column that must exactly match the value found in the specified source data field. All referenced data types shall match the format of the specified reference field.

13.5. CLASSIFICATION DATA TYPE

A Classification data type is a value in one column that must exactly match the predefined list of values found in the Classification worksheet. In the case of data fields necessary to provide physical file format integration and interoperability, the list of values allowed in the lookup data type shall be fixed and defined in this document.

Critical to supporting the application of this standard to the widest possible set of regions, countries, and clients is the need for local customization of Classification-based lookup data types. Each bSI Chapter shall identify the default set of classifications required for the correct application of FM Handover - Equipment Maintenance in their jurisdictions. That classification shall be published in bSI Chapter Implementation Guides.

13.6. LIST DATA TYPE

In several cases within the FM Handover - Equipment Maintenance MVD, data could not be simply normalized without adding complexity. These situations relate to the need to flatten “many-to-many” database relations that would normally require the introduction of a “linking” database table.

List data field types shall be created by concatenating the specified set of Alphanumeric data in a list. The delimiter for this list shall always be the semi-colon. Note that the semi-colon character was previously noted to be a “Reserved Character”.

13.7. EMAIL DATA TYPE

Email Data type fields shall be Alphanumeric fields defined by a “local part”, the at-sign “@”, and a “domain name” [11]. For example, john.coyote@yoodyne.com.

All email data shall be provided in lower-case format. Information shall not be provided with embedded hyperlinks.

13.8. NULL DATA TYPE

The final data type specified is the NULL data type. The NULL type is a very special type of data. The NULL value is a positive assertion by those providing the data saying that no value has been provided. A cell that is blank is ambiguous. Does the blank value mean that the value is indeed a string of zero length? Does the blank value mean that the value was not provided by those producing the data file? It is a subtle, but important distinction, to separate a “blank” value from a NULL value.

Generic Implementation Note

Generic Implementation Notes shall apply to this data type regardless of language.

In all languages, the NULL data type has only one possible value for each encoding. For the Spreadsheet Physical File Format, the NULL value shall be “n/a”. For the STEP Physical File Format, the NULL value shall be “\$”.

13.9. GUID DATA TYPE

The IFC standard require that objects be identified by a Globally Unique IDentifier (GUID) customized to reduce file size with STEP Physical File Format files. During the use of the current FM Handover MVD it has been recognized that the use of the GUID has had problems resulting from the software’s implementation of weak random number generators and easily patterned seeding algorithms.

Generic Implementation Note

Generic Implementation Notes shall apply to this data type regardless of language.

In all languages, the GUID data type shall conform to the IFC definition of GUID. All vendors shall be required to document the periodicity of the random number generator on which their GUID algorithm is based. Vendors shall also provide information as to the seeding mechanism for their algorithm to limit the possibility that the random number generators across different users could become synchronized. With submitted documentation, vendors shall provide a clear estimate the number objects that would need to be created before the random number generator produces the same GUID and a statistical analysis of the likelihood that twenty designers working on a project for different firms would produce the same GUID.

14. WORKBOOK STRUCTURE

A generalized review of the IFC model demonstrates the ability of the schema to support object-oriented data structures, however, the practical implication of such structures is limited by the ability of implementing software to easily implement the resulting functionality. As a result, the development of the IFC model has been primarily driven, and can be engineered, in a relational database structure. In addition, relational database structures are fundamentally understood by all qualified software developers and programmers, regardless of the specific data model implementation used by specific products. In the production of the Spreadsheet Physical File Format for the FM Handover - Equipment Maintenance MVD, the relational structure provided shall reflect that of the underlying IFC model.

To implement the FM Handover - Equipment Maintenance MVD in a relational database structure relies on further specification of the relationships found in Figure 1. Further refinement is required to demonstrate the flattening of the IFC model hierarchy for ease of understanding for end-users. The resulting Spreadsheet Physical File Format provides data set that can be objectively proven to be internally consistent.

Regarding the Spreadsheet Physical File Format of the FM Handover - Equipment Maintenance MVD, each spreadsheet within a workbook shall be mapped to one or more IFC Entities. As objectified relationships present in STEP Physical File Format files are not present in the Spreadsheet Physical File Format, the Spreadsheet Physical File Format shall implement relationships among these objects using identified "Reference Fields". In some cases, the use of the reference fields is equivalent to the relational "foreign key" concept. In other cases, the use of multiple reference fields shall be required to create "compound/complex keys." In the specification below, the requirement to uniquely define each data row is defined.

All software vendors shall be able to objectively verify that the relationships defined in the FM Handover - Equipment Maintenance MVD have been achieved each time physical data files are produced. This may be accomplished using third-party or open-source software, or software vendors may choose to create their own verification testing report to ensure those producing the required data can self-verify to their project team the correct application of this MVD.

When submitting software for certification against this MVD, software vendors shall define and submit published literature identifying how software users shall be required to produce a data type and data structure verification report every time a file conforming to this MVD is produced.

14.1. CONVENTIONS

As the goal of the Spreadsheet Physical File Format version of the FM Handover - Equipment Maintenance MVD is to provide a set of data that may be understood by its users, the organization of this data format is based on a set of conventions defining the naming of individual columns within each worksheet.

The conventions used in this document shall be defined for English language users. In translating the requirements for the Spreadsheet Physical File Format, international users must directly follow this pattern as it is reflective of the underlying structure of the IFC model and, by extension, the FM Handover - Equipment Maintenance MVD.

14.2. COMPLETE DATA

To ensure there is no misunderstanding by the automated systems receiving data in Spreadsheet Physical File Format, every row containing data shall contain a complete set of values for all required and optional fields. Information that is not available to the software (or user) or is not applicable to the specific row of information being provided shall be identified by the NULL value.

All software exporting in Spreadsheet Physical File Format shall not export "blank" data rows.

All software exporting in Spreadsheet Physical File Format shall not export "blank" data cells, NULL values shall be used instead of empty values or values without length.

14.3. FIXED STRUCTURE

The name of each worksheet shall match the name of each worksheet referenced in this document. The first row of every worksheet shall provide the label specified in the figures referenced later in this document. No deviation to the worksheet, column structure identified in this document shall be permitted.

Files that do not exactly conform to the worksheet and column labels shall be rejected as FM Handover - Equipment Maintenance MVD deliverables.

14.4. COLUMN A LABEL

Except for the Header and Lookup worksheets, the first column of every worksheet shall be called "Name". Unless specifically noted, data in this column shall be mapped to the Name field of the associated IFC object referenced in that worksheet.

14.5. PRIMARY OBJECTS

To reflect the mandatory database structure of the FM Handover - Equipment Maintenance MVD Spreadsheet Physical File Format, as previously described, worksheets that map to foundational IFC

objects shall, within a single building's workbook, have a unique "Name" value among all other data rows within that worksheet.

These "Primary" worksheets and specific Primary Key fields are identified in the Spreadsheet Physical File Format tables found later in this document.

14.6. DIRECTED ASSOCIATIONS

Directed, Aggregational, Compositional are strong associations between Primary worksheet data and data found in other worksheets. These relations are implemented in the FM Handover - Equipment Maintenance MVD Spreadsheet Physical File Format as "Foreign" key fields.

Foreign key fields are identified in the Spreadsheet Physical File Format tables found later in this document.

14.7. GENERAL ASSOCIATION

When associations between classes of objects provided in Spreadsheet Physical File Format worksheets are meant to support other (or potentially all) Primary worksheet data rows, the relational "Compound Key" values are used.

In general, these compound keys must identify the worksheet and data row being referenced, and distinguish the information being provided within that context. Compound key fields are identified in the Spreadsheet Physical File Format tables found later in this document.

14.8. OWNER HISTORY

As the FM Handover - Equipment Maintenance MVD is a life-cycle information exchange specification, data provided through this MVD will be submitted in full, or in part, throughout the life of the project. To allow those receiving the data to implement the necessary tracking of the progress of data throughout the life of the project, the FM Handover - Equipment Maintenance MVD requires the provision of IfcOwnerHistory information on each data row in every worksheet of each workbook.

In keeping with the design practice of simplifying the production of data in the Spreadsheet Physical File Format IfcOwnerHistory can be compressed into the name of the company providing the information and the date on which the data was changed. As a result, the second and third columns in all Spreadsheet Physical File Format files shall be:

- AuthorOrganizationName
- AuthorDate

In all data rows AuthorOrganizationName shall be a value found in the first (i.e. "Name") column of the Organization worksheet.

This convention applies to all worksheets except Header and Lookup.

14.9. CATEGORY AND RELATED LOOKUP FIELDS

The fourth column of every worksheet is mapped to classification requirements of the row of data provided. Unless otherwise noted, the fourth column of every worksheet shall be called “Category”. Other required references shall also be provided as defined for each worksheet. The values of these fields may be identified in the Lookup worksheet, if provided by the software export routine.

There shall be three types of lookup reference fields. The first set are “Classification” values that will default to a regional specification but may be changed based on explicitly contracted client-specific requirements. The second set are “Category” lookup values that are defined by default in the FM Handover - Equipment Maintenance MVD, but whose content may be updated based on regional designations. The third set are “Fixed” lookup values that are required to maintain referential integrity of FM Handover - Equipment Maintenance MVD data sets.

The requirements for each worksheet’s Classification column are identified in the Spreadsheet Physical File Format tables found later in this document. For more information, see Chapter 19, Lookup worksheet Requirement.

14.10. REFERENCE FIELDS

While the FM Handover - Equipment Maintenance MVD defines a set of data that does not require geometry, it may be helpful to use geometric models as a graphical user interface to navigate to information related to building equipment. In addition, the data being delivered in each Spreadsheet Physical File Format file may have been created by multiple software products over time. To reconstruct the link between the source building information models and non-geometric data required in this specification, three model reference fields allow geometric data to be referenceable:

- Model Software - Name and version number of the authoring software.
- Model Object - The IFC Entity name available for this object.
- Model GUID - The IFC GUID associated with this object.

In cases where a complete or partial set of information is added or updated by software that has an underlying geometric model, this data shall be updated to represent the software, object, and GUID corresponding to the ChangeCompanyName and ChangeCompanyDateTime data.

In cases where a partial set of information is added by processes that do not have an underlying geometric model, such a manual update, the three model reference fields shall have the NULL value.

In cases where a complete or partial set of information updated through software or processes that do not have an underlying geometric model, software shall not modify these three reference fields.

This convention applies to all those FM Handover - Equipment Maintenance MVD objects whose IFC entities are typically expected to have geometric representations. The specific requirements for each worksheet’s Model Reference columns are identified in the Spreadsheet Physical File Format tables found later in this document.

14.11. WORKSHEET COLOR CODING

Large workbooks may be made easier through the presentation of worksheet data using color coding conventions. These color-coding conventions shall be used to identify fields that are required, not required at this deliverable phase, required if applicable, reference or lookup data, or model mapping fields. The specific color-coding scheme that shall be applied is identified in the bSI Implementation Guide publication where process based deliverable requirements are specified.

15. WORKSHEET DESCRIPTION

This section provides the specification that shall be used to map the FM Handover - Equipment Maintenance MVD to a Spreadsheet Physical File Format. As there are many other types of FM Handover information exchange requirements and data that must be created and shared during the FM stage, this specification identifies "core" mappings from IFC to the Spreadsheet Physical File Format as well as those mappings required to support the specific MVD for FM Handover - Equipment Maintenance.

This document is a complete mapping of the FM Handover - Equipment Maintenance MVD into the Spreadsheet Physical File Format. This document does not identify the time and/or responsibility to produce such data during the process of design and construction. In addition, this mapping does not identify requirements for data delivered in "batch" or "transactional" methods suitable for updating an existing set of data. The discussion of FM Handover - Equipment Maintenance MVD data deliverable production and package requirements are provided in a separate bSI publication.

An example application of the idea of FM/FMH Core MVD versus FM Handover - Equipment Maintenance MVD can be seen in a requirement for only the delivery of information related to janitorial services contracts. Such contracts only need information about the spaces within a building and their finishes. Other possible MVD's related to FM Handover, such as those for "Hardware and Keying Schedules," would necessarily include specific classes of Types and Components but exclude items that are not doors.

The primary contribution of the FM Handover - Equipment Maintenance MVD to the idea of a Core FMH/FM MVD specification is that there can be a shared compression of IFC entities to simplify and regularize the use of IFC data by those contributing non-geometric data. An additional bSI Technical Note will provide a general outline of expected FMH/FM MVD specifications defining the possible implementation of the Core FMH/FM MVD Spreadsheet Physical File Format.

15.1. WORKSHEET LIST

A workbook conforming to the FM Handover - Equipment Maintenance MVD standard shall contain the following worksheets in the order specified in Figure 2.

The first column of Figure 2 identifies the required order of each worksheet. Any change to this order, in a complete file submission, shall be identified as being non-compliant with this standard.

The second column of Figure 2 identifies name of each worksheet. This name shall not be changed. Any change to these names, in a complete file submission, shall be identified as being non-compliant with this standard.

The third column of Figure 2 identifies the worksheets that are required to support the FM Handover - Equipment Maintenance MVD and those proposed to form the “core” MVD for future FM Handover and FM MVD’s. An introductory discussion of the use of the ‘core’ FM and FM Handover designation and its application to a wide range of projects that deliver non-geometric building information is provided under a separate bSI publication.

An example of a use of the ‘core’ FM Handover requirements would be the definition of information that must be delivered to provide the facility manager information about janitorial services. In such a case, the list of building equipment might not be relevant, however, information about spatial finish properties and spatial areas must be provided.

Worksheet		MVD Requirements	
Order	Name	Equipment Maintenance	Core
1	Header	X	X
2	Organization	X	X
3	Building	X	X
4	Level	X	X
5	Space	X	X
6	Zone	X	-
7	System	X	-
8	Type	X	-
9	Component	X	-
10	Part	X	-
11	Resource	X	-
12	Job	X	-
13	Document	X	X
14	Property	X	X
15	Lookup	X	X

Figure 6 FMH - Equipment Maintenance Worksheet List

Another example of the use of this basic structure might be a future FM Handover specification for capturing Industrial Control Systems inventories. Such a specification would include the core, plus related equipment worksheets (type, component, properties), but not need maintenance tasks (part, resource, and job).

The paragraphs below provide a description of each worksheet and identifies the source of the information as defined in the bSI FM Handover - Equipment Maintenance MVD.

15.2. HEADER

The Header worksheet shall contain information necessary to reproduce the required STEP Physical File Format, ISO 10303-21”HEADER” record.

The specification of this worksheet shall conform to the information provided in Figure 7, page 33.

15.3. ORGANIZATION

The Company worksheet shall contain information about the company creating or updating every record of information in a FM Handover - Equipment Maintenance MVD file. In addition, the Company worksheet shall contain references to companies participating at every contracting tier. Such companies include, but are not limited to the following: owners, tenants, facility managers, facility maintainers, facility operators, designers, design consultants, contractors, subcontractors, manufacturers, suppliers, and warranty guarantors.

EU General Data Protection Regulation (GDPR) requires that information shall not contain Personally Identifiable Information (PII). In some cases, this information is defined to include individual person's business contact information, such as phone number and email. While such information may be permissible to exchange within the context of contractually required business transactions, when FM Handover - Equipment Maintenance MVD data is delivered as a full deliverable, such information must be removed.

Additional information on the implication of GDPR on the transactional use of FM Handover - MVD data is provided in a separate bSI publication.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 4 MVD Mapping to Company Worksheet, page 33.

The organization of this worksheet shall conform to the information provided in Figure 5 Company Worksheet Specification, page 34.

15.4. BUILDING

The Building worksheet shall contain the name of the building. Only one building shall be provided per file. Projects comprised of multiple facilities or buildings shall be delivered in separate files.

Information provided in the Building worksheet shall compress IfcProject, IfcSite, and IfcBuilding objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 6 MVD Mapping to Building Worksheet, page 35.

The organization of this worksheet shall conform to the information provided in Figure 7 Building Worksheet Specification, page 36.

15.5. LEVEL

The Level worksheet shall contain the list of vertical levels within a building containing spaces containing or providing access to maintained equipment. All data files shall contain a minimum of one level containing exterior building spaces above and around the building's perimeter. This is required to identify spaces on a building's roof and site.

Information provided in the Level worksheet shall compress IfcBuildingStorey, IfcRoof, and IfcSite objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided Figure 8 MVD Mapping to Level Worksheet, page 37.

The organization of this worksheet shall conform to the information provided in Figure 9 Level Worksheet Specification, page 37.

15.6. SPACE

The Space worksheet shall contain the list of volumes on a given Level from which maintained equipment may be accessed. A minimum of one Space row shall be provided for every level identified in Level.

Per the underlying IFC MVD, Space.Height shall be vertically defined within the building from top of floor of the floor slab on which the bottom of the space is defined to the bottom of slab (or roof) above. Should the bottom of the slab or roof be made of a complex shape at the same height, the information provided shall be the bottom of the structural elements comprising the slab or roof (including insulation, if applicable). Should the slab or roof above have an angle or complex shape, the Space.Height shall be defined as the smallest distance from the floor below to the structure above.

Space.Height may be, but are not required to be, provided for spaces identified as being on Levels above our outside the building envelope.

The vertical height ceilings shall be expressed by Space.UsableHeight.

Large or shared Space volumes with more than a single functional purpose shall be separated into individual Spaces. Differences in Space use may be identified on traditional design documentation as spaces which have different finishes.

Space volumes spanning multiple Level.Name(s) shall be identified with the corresponding Space.LevelName with the lowest elevation. In cases where the vertical position of shafts, such as elevator shafts, are below the position of a given Level, the lowest level from which maintenance access is provided shall be identified.

Information provided in the Space worksheet shall be directly mapped to IfcSpace objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 10 MVD Mapping to Space Worksheet, page 38.

The organization of this worksheet shall conform to the information provided in Figure 11 Space Worksheet Specification, page 39.

15.7. ZONE

The Zone worksheet shall contain the list of spatial aggregations necessary to describe the purpose or function of a set of spaces within a building.

One and only one space shall be referenced in each row of the Zone worksheet. Lists of spaces shall not be allowed.

Each Space.Name shall not be identified more than once for a given Zone.Category.

Every Space.Name row shall not be required to be identified in each Zone.Category.

Information provided in the Zone worksheet shall be directly mapped to IfcZone objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 12 MVD Mapping to Zone Worksheet, page 40.

The organization of this worksheet shall conform to the information provided in Figure 13 Zone Worksheet Specification, page 40.

15.8. SYSTEM

The System worksheet shall contain the top-level name of every functional System and subsystem that have maintenance requirements within the building. There are two uses of this system designation in the FM Handover - Equipment Maintenance MVD. First, are building systems comprised of named equipment that have maintenance requirements. Examples of such building systems are the HVAC, Plumbing, or Fire Protection systems.

Lesson learned have also identified the requirement that systems without named equipment may also have maintenance requirements. An example of such a system is a building enclosure system. Examples of building enclosure systems include, but are not limited to, wall systems or roofing systems. Should the delivery of maintenance requirements for such systems be needed, then the name of the system can be identified, and the associated Job, Document, and Attribute data can support the delivery of related FM Handover - (Equipment) Maintenance data.

Readers who have worked with national implementations of the Basic FM Handover MVD will recognize the allowance to include building enclosure (or similar) systems as a major improvement in the usability of the FM Handover - Equipment Maintenance MVD.

The System.ParentSystemName shall be used to identify nested sub-systems.

Information in System shall be mapped to ifcSystem objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 14 MVD Mapping to System Worksheet, page 41.

The organization of this worksheet shall conform to the information provided in Figure 15 System Worksheet Specification, page 41.

15.9. TYPE

The Type worksheet shall contain the list of off-site manufactured products and equipment with maintenance requirements whose manufacturer and model number can be explicitly identified on traditional design, construction, fabrication, or erection drawings.

Not all classes of objects within a building are manufactured products. Once the project reaches the conclusion of Phase 1B, the FM Handover - Equipment Maintenance MVD will contain a list of objects that shall not be provided in a FM Handover - Equipment Maintenance data file.

To simplify implementer's and user's understanding of the scope of the FM Handover - Equipment Maintenance MVD, Chapter 17, Allowed IFC Type Objects, starting on page 53. This list contains the complete list of IFC Type Objects that shall be included. IFC Type Objects explicitly identified as allowed shall not be included in an FM Handover - Equipment Maintenance MVD data file.

Software vendors whose software is tested for compliance against the FM Handover - Equipment Maintenance MVD shall, regardless of the ultimate physical file format for the delivery of their files, shall provide pre-set or default user options to filter excluded objects.

As will be documented in the associated FM Handover - Equipment Maintenance Implementation Guide Technical Note. Information associated with product selection, installation, testing, and warranty of Type(s) shall typically be provided by the contractor or subcontractor who installed the associated Type objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 16, MVD Mapping to Type Worksheet, page 42.

The organization of this worksheet shall conform to the information provided in Figure 17 Type Worksheet Specification, page 43.

15.10. COMPONENT

The Component worksheet shall contain each instance of a given Type. There shall be one or more Components for each Type.Name listed in the Type worksheet.

Although the FM Handover - Equipment Maintenance MVD allows the identification of the precise geometry of each Component through the model reference fields, the precise requirement, in the context of this MVD is the identification of the Component.SpaceName from which a component is most likely to be maintained.

For equipment found within the space volume, the Component.SpaceName shall be the name of that Space. Equipment or products within walls shall be identified by the room through which access to that Component is provided. Large equipment spanning several Spatial volumes shall be identified with the Component.SpaceName from which maintenance access is most likely to be required.

Each Component shall be identified by an associated Component.SystemName that provides the means to describe the place of the Component within the System/subsystem hierarchy for the specific project.

Not all classes of objects within a building are manufactured products. Objects on the Component Exclusion List defined in the FM Handover - Equipment Maintenance MVD shall not be delivered under this specification. Products that may be included are instances of the included object types identified later in this document.

As identified in the associated FM Handover - Equipment Maintenance Implementation Guide Technical Note. Information associated with the installation and warranty of Component(s) shall typically be provided by the contractor or subcontractor who installed the associated Type objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 18 MVD Mapping to Component Worksheet, page 44.

The organization of this worksheet shall conform to the information provided in Figure 19 Component Worksheet Mapping, page 45.

15.11. PART

The Part worksheet shall contain the list of a variety of products and materials required for building operations and maintenance. The list of items includes, but is not limited to, the following: on-site spare parts and lubricants, on-site maintenance and operations products, and replacement parts.

As identified in the associated FM Handover - Equipment Maintenance Implementation Guide Technical Note. Spare data shall typically be provided by the contractor or subcontractor who installed the associated Type objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 20 MVD Mapping to Part Worksheet, page 46.

The organization of this worksheet shall conform to the information provided in Figure 21 Part Worksheet Mapping, page 46.

15.12. RESOURCE

The Resource worksheet shall identify specific resources required to perform operations and maintenance tasks found in the Job worksheet. The list of these items includes, but is not limited to, the following: tools, material, training, and labor.

Each Resource identified shall be referenced for a minimum of one Job.

As identified in the associated FM Handover - Equipment Maintenance Implementation Guide Technical Note. Resource data shall typically be provided by the contractor or subcontractor who installed the associated Type objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 22 MVD Mapping to Resource Worksheet, page 47.

The organization of this worksheet shall conform to the information provided in Figure 23 Resource Worksheet Mapping, page 47.

15.13. JOB

The Job worksheet shall identify the list of tasks necessary for building operations and maintenance. The list of tasks within a Job shall reproduce the tasks lists found in manufacturer's literature in one of the two following ways: (1) the description of the job shall be provided in paragraph form with a task identifier of "1", or (2) the list of tasks needed to complete the job shall be provided in list form with sequential task identifiers of natural numbers beginning with "1".

Software shall map the list of tasks identified for each Job to their native data structure. In some cases, this will require consuming software to concatenate the task lists into a single long text field.

One or more Resource(s) may be identified for each Job through the application of a delimited list. This is the only example of a many-to-many data relation in the FM Handover - Equipment Maintenance Spreadsheet Physical File Format.

The FM Handover - Equipment Maintenance MVD Implementation Guide will identify a minimum set of object types for which job tasks shall be required. Job, Resource, and Spare data shall be provided by the contractor or subcontractor who installed the associated Type objects.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 24 MVD Mapping to Job Worksheet, page 48.

The organization of this worksheet shall conform to the information provided in Figure 25 Job Worksheet Mapping, page 49.

15.14. DOCUMENT

The Document worksheet shall provide the linkage between traditional documents, such as drawings, product data sheets, manufacturer's operations and maintenance manuals, and warranty certificates to the relevant FM Handover - Equipment Maintenance object.

A FM Handover - Equipment Maintenance deliverable package shall contain the completed worksheet corresponding to that stage of the project and all linked documents identified in the Document worksheet.

All linked documents shall be placed, and referenced, in continuous subdirectories under the location of the FM Handover - Equipment Maintenance Spreadsheet File. The identified location documents within Document worksheet shall be based on the relative path name from the directory containing the Spreadsheet file.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 26 MVD Mapping to Document Worksheet, page 50.

The organization of this worksheet shall conform to the information provided in Figure 27 Document Worksheet Mapping, page 51.

15.15. PROPERTY

The Properties worksheet shall provide the combined set of properties for all necessary FM Handover - Equipment Maintenance objects.

Properties shall be identified as single values. All numeric values shall be assumed to require an associated unit of measure.

The requirements for the provision of Property data, as described in the FM Handover - Equipment Maintenance Implementation Guide, differs for those with design responsibility from those with construction responsibility. Deliverables produced by those with design responsibility shall include Property values found on associated drawings and drawing schedules. Deliverables produced by those with construction responsibility shall include those Property values individually specified by the region, country, or client.

The FM Handover - Equipment Maintenance MVD does not require the precise location of Properties within named IFC Property Sets. Instead, the FM Handover - Equipment Maintenance MVD requires that properties be linked through IFC relationship objects with one reference.

All properties in STEP Physical File Format files that are more than one reference object away from the source object required by the FM Handover - Equipment Maintenance MVD shall be ignored.

Regardless of the FM Handover - Equipment Maintenance MVD file format delivered, software vendors shall not include the excluded property values, or types of property values referenced in section 11 Property Exclusions. Software vendors producing FM Handover - Equipment Maintenance MVD files shall provide users a default setting that eliminates prohibited property values.

Should manufactured product data be available in computable data formats, the data provided by manufacturers shall be transformed for use during operations and maintenance according to the instructions provided by the FM Handover - Equipment Maintenance Implementation Guide.

The worksheet mapping between the FM Handover - Equipment Maintenance MVD and this worksheet shall conform to the information provided in Figure 28 MVD Mapping to Property Worksheet, page 52.

The organization of this worksheet shall conform to the information provided in Figure 29 Property Worksheet Mapping, page 52.

15.16. LOOKUP

The Lookup worksheet shall provide the complete set of permissible values for each FM Handover - Equipment Maintenance worksheet field identified as a Reference value. There are three classes of reference fields:

Classification - project-specified, ";" delimited number and name pairs.

Type - regionally or nationally specified category names to be defined by bSI Chapters.

List - fixed lists of category names that shall not be changed.

All mappings to Lookup Classification field data shall be implemented as IFC Classification objects that requires a “number” and a “name” for each Classification value, with a semi-colon “;” delimiter.

All other classifications shall be identified by “name” only.

The Lookup worksheet shall have the name of each Reference field listed in the first row of the worksheet. The list of reference field values shall be listed under the name of the field.

See section 19 Lookup List Requirement, page 115 for the list and order of each Reference field.

16. MVD - WORKSHEET MAPPING

All users of this specification shall conform to the column order and naming provided. Any Spreadsheet Physical File Format deviating from the design provided in the figures below, shall be identified as non-compliant.

The figures provided in this section list each worksheet and specify the English-language names of each column. The definition of the contents of each column will be provided in the next update to this document.

The “Data > Type” column uses the following to specify the mandatory (or NULL) specification of the data in the identified worksheet column:

- N - Numeric
- A - Alphanumeric
- L - List of Alphanumeric values, “;” delimited.
- R - Reference (required value must match cited field)
- E - Email
- D - ISO Date/Time
- G - GUID

The “Key” column provides the following abbreviated data relation:

- P - Primary Key (this value must be unique with this worksheet)
- F - Foreign Key (allowable values found in the designated reference field)
- C - Compound Key (this combination of values must be unique with this worksheet)
 - If the character “-” is provided, this indicates that there is no defined data relation.

The “Reference” column identifies the worksheet and column name that must match the value provided.

Definitions of all worksheet columns is provided by the mapped IFC Object definition. Further specification may also be provided by the related Implementation Guide.

As noted previously, a fixed color code shall be required by this specification to reinforce the conventions identified below and those needed to identify when different sets of data are expected to be delivered. Color coding shall be specified in a later version of this document.

Column		Data Type	Database Key	Reference/Key Field Source	Notes
Order	Name				
A	IfcSchema	A	-		(1)
B	MvdName	A	-		(1)
C	MvdVersion	A	-		(1)
D	AuthorDate	D	-		(1)
E	SoftwareName	A	-		(1)

Figure 7 Header Worksheet Specification

NOTE: (1) Header data shall conform to ISO 10303-21 requirements, (2) One and only one Header worksheet data row shall be provided per workbook.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcOrganization.Label
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcActorRole.UserDefinedRole
E	Email	IfcTelecomAddress.ElectronicMailAddresses
F	Phone	IfcTelecomAddress.TelephoneNumbers
G	ModelSoftware	IfcApplication.ApplicationFullName
H	ModelID	IfcOrganization.GlobalID
I	Department	IfcPostalAddress.InternalLocation
J	Street	IfcPostalAddress.AddressLines
K	PostalBox	IfcPostalAddress.PostalBox
L	Town	IfcPostalAddress.Town
M	StateRegion	IfcPostalAddress.Region
N	PostalCode	IfcPostalAddress.PostalCode
O	Country	IfcPostalAddress.Country
P	CompanyURL	FMH_PSetCompany.URL

Figure 8 MVD Mapping to Organization Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
Order	Name				
A	Name	A	P		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.ClassificationRole	
E	Email	E	-		
F	Phone	A	-		
G	ModelSoftware	A	-		
I	ModelID	G	-		(2)
J	Department	A	-		
K	Street	A	-		
L	PostalBox	A	-		
M	Street	A	-		
N	Town	A	-		
O	StateRegion	A	-		
P	PostalCode	A	-		
Q	CountryCode	R	-	Lookup.FixedCountryCode	
R	CompanyURL	A	-		

Figure 9 Organization Worksheet Specification

NOTE: (1) Company.Name shall be unique. (2) Maps to single class of IFC objects: IfcOrganization

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcBuilding.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Identification + ":" + IfcClassificationReference.Name
E	ProjectName	IfcProject.Name
F	SiteName	IfcSite.Name
G	LinearUnits	IfcUnitAssignment.Units
H	AreaUnits	IfcUnitAssignment.Units
I	AreaMeasurement	IfcElementQuantity.MethodOfMeasurement
J	Phase	IfcProject.Phase
K	ModelSoftware	IfcApplication.ApplicationFullName
L	ModelProjectID	IfcProject.GlobalID
M	ModelSiteID	IfcSite.GlobalID
N	ModelBuildingID	IfcBuilding.GlobalID

Figure 10 MVD Mapping to Building Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
Order	Name				
A	Name	A	P		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.ClassificationBuilding	
E	ProjectName	A	-		
F	SiteName	A	-		
G	LinearUnit	R	-	Lookup.TypeLinearUnit	
H	AreaUnit	R	-	Lookup.TypeAreaUnit	
I	AreaMeasurement	A	-		
J	Phase	R	-	Lookup.TypePhase	
K	ModelSoftware	A	-		
M	ModelProjectID	G	-		(2)
O	ModelSiteID	G	-		(2)
Q	ModelBuildingID	G	-		(2)

Figure 11 Building Worksheet Specification

NOTE: (1) One and only one Building worksheet data row shall be provided per workbook. (2) All subsequent worksheets have implied Building.Name foreign key. (2) Maps to IfcProject, IfcSite, and IfcBuilding to recreate flattened IFC object model.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcBuildingStorey.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Identification + ":" + IfcClassificationReference.Name
E	ModelSoftware	IfcApplication.ApplicationFullName
F	ModelID	IfcBuildingStorey.GlobalID
G	Elevation	IfcBuildingStorey.Elevation
H	Height	IfcQuantityLength.LengthValue

Figure 12 MVD Mapping to Level Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	P		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorCreationDate	D	-		
D	Category	R	-	Lookup.FixedLevelType	(4)
E	ModelSoftware	A	-		
F	ModelID	G	-		
G	Elevation	N			(2)(3)
H	Height	N			(2)(3)

Figure 13 Level Worksheet Specification

NOTE: (1) Level.Name shall be unique. (2) Unit of measure shall be Building.LinearUnit, (3) software vendors shall provide no more than two significant digits. (4) Maps to single IFC Object: IfcBuildingStorey, IfcSite, IfcRoof based on value of Level.Category.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcSpace.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Identification + ":" + IfcClassificationReference.Name
E	LevelName	IfcBuildingStorey.Name, IfcSite.Name, IfcRoof.Name
F	Description	IfcSpace.Description
G	ModelSoftware	IfcApplication.ApplicationFullName
H	ModelID	IfcSpace.GlobalID
I	Room	FMH_PSetSpace.Room
J	UsableHeight	IfcQuantityLength.LengthValue
K	AreaGross	IfcQuantityArea.AreaValue
L	AreaNet	IfcQuantityArea.AreaValue

Figure 14 MVD Mapping to Space Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	P		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.ClassificationSpace	
E	LevelName	R	F	Level.Name	(6)
F	Description	A	-		
G	ModelSoftware	A	-		
H	ModelID	G	-		(4)
I	Room	A	-		(5)
J	UsableHeight	N	-		(2)(3)
K	AreaGross	N	-		(2)(3)
L	AreaNet	N	-		(2)(3)

Figure 15 Space Worksheet Specification

NOTE: (1) Space.Name shall be unique. (2) Unit of measure shall be Building.AreaUnit, (3) software vendors shall provide no more than two significant digits. (4) Maps to single class of IFC objects: IfcSpace. (5) Allows an aggregation of bound spaces with different functions but have a common client presentation. (6) There shall be one or more Space objects for each Level.Name.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcZone.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Identification + ":" + IfcClassificationReference.Name
E	SpaceName	IfcSpace.Name
F	ModelSoftware	IfcApplication.ApplicationFullName
G	ModelID	IfcZone.GlobalID
H	ParentZoneName	IfcZone.Name

Figure 16 MVD Mapping to Zone Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	C		(1) (2)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	C	Lookup.TypeZone	(1) (2)
E	SpaceName	R	C	Space.Name	(1) (2) (5)
F	ModelSoftware	A	-		
G	ModelID	G	-		(4)
H	ParentZoneName	R	F	Zone.Name	(3)

Figure 17 Zone Worksheet Specification

NOTE: (1) Zone.SpaceName shall be unique within a given Zone.Category. (2) Complexity of compound required as this worksheet is representing multiple relationships. (3) Zone.ParentZoneName used to identify zone hierarchy. (4) Maps to a single class of IFC object: IfcZone. (5) A Zone worksheet row shall contain one, and only one, SpaceName. Lists of space names shall not be allowed.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcSystem.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Identification + ":" + IfcClassificationReference.Name
E	ModelSoftware	IfcApplication.ApplicationFullName
F	ModelID	IfcSystem.GlobalID
G	ParentSystemName	IfcSystem.Name

Figure 18 MVD Mapping to System Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	P		(1)(4)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.ClassificationSystem	
E	ModelSoftware	A	-		
F	ModelID	G	-		(3)
G	ParentSystemName	R	F	System.Name	(2)

Figure 19 System Worksheet Specification

NOTE: (1) System.Name shall be unique. (2) Identification of sub-system hierarchy provided by SystemParentSystemName. (3) Maps to a single class of IFC object: IfcSystem. (4) the System worksheet shall only be provided for those building systems that have regularly scheduled maintenance requirements. Such systems will typically have associated equipment with maintenance requirements, in which case System provides the system/subsystem decomposition. Some building systems, such as those that provide exterior closure (e.g. curtain wall systems or roofing systems) may also be included as long as those systems shall contain Job, Document, and Property information.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcTypeObject.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Identification + ":" + IfcClassificationReference.Name
E	AssetType	FMH_PSetType.ProcurementType
F	Description	IfcTypeObject.Description
G	ManufacturerOrganizationName	IfcOrganization.Name
H	ModelNumber	FMH_PSetType.ModelLabel
I	WarrantyOrganizationName	IfcOrganization.Name
J	WarrantyDuration	FMH_PSetType.PartsWarrantyMonths
K	ModelSoftware	IfcApplication.ApplicationFullName
L	ModelProjectObject	Non-Excluded subtype of IfcTypeObject
M	ModelProjectID	IfcTypeObject.GlobalID
N	SupplierOrganizationName	IfcOrganization.Name
O	SpecificationSection	FMH_PSetType.SpecificationSectionNumber
P	SubmittalID	FMH_PSetType.SubmittalIdentifier
Q	ProductURL	FMH_PSetType.ProductURL

Figure 20 MVD Mapping to Type Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	C		(1)(2)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.ClassificationType	(1)
E	ProcurementType	R	-	Lookup.TypeProcurement	
F	Description	A	-		
G	ManufacturerOrganizationName	R	F	Company.Name	
H	ModelNumber	A	-		
I	WarrantyOrganizationName	R	F	Company.Name	
J	WarrantyDuration	N	-		(3)
K	ModelSoftware	A	-		
L	ModelObject	R	-		(2)
M	ModelID	G	-		(5)
N	SupplierOrganizationName	R	F	Company.Name	(4)
O	ProductURL	A	-		(4)
P	SpecificationSection	R	-	Lookup.TypeSpecification	(4)
Q	SubmittalID	A	-		(4)

Figure 21 Type Worksheet Specification

NOTE: (1) Type.Name shall be unique. Rules for merging files that may result in name collisions will be described in the associated Implementation Guide publication. (2) The set of IfcType Objects provided through the FM Handover - Equipment Maintenance shall not contain any IfcType object identified in the FM Handover - Equipment Maintenance Exclusion set. (3) The unit of "month(s)" shall be applied in all instances to this field. (4) Allows information exchange, including transactional information exchange, in the context of common data environments. (5) The Identifier provided is for the IFC object class identified in ModelObject.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcProduct.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	TypeName	IfcTypeObject.Name
E	SpaceName	IfcSpace.Name
F	InstallationDate	FMH_PSetComponent.InstallationDate
G	WarrantyStartDate	FMH_PSetComponent.WarrantyStartDate
H	ModelSoftware	IfcApplication.ApplicationFullName
I	ModelObject	Non-Excluded subtype of IfcProduct
J	ModelID	IfcProduct.GlobalID
K	InstalledModelNumber	FMH_PSetComponent.ModelNumber
L	SerialNumber	FMH_PSetComponent.SerialNumber
M	TagNumber	FMH_PSetComponent.TagOrCode
N	OwnerAssetID	FMH_PSetComponent.OwnerAssetIdentifier
O	SystemName	IfcSystem.Name
P	FluidHotFeedName	IfcProduct.Name
Q	FluidColdFeedName	IfcProduct.Name
R	ElectricPanelName	IfcProduct.Name
S	ElectricCircutName	FMH_PSetComponent.ElectricalCiircutLabel
T	ControlledByName	IfcProduct.Name
U	InterlockdWithName	IfcProduct.Name
V	PartOfAssemblyName	IfcProduct.Name

Figure 22 MVD Mapping to Component Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	C		(1)(2)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	TypeName	R	F	Type.Name	(1)
E	SpaceName	R	F	Space.Name	
F	InstallationDate	D	-		
G	WarrantyStartDate	D	-		
H	ModelSoftware	A	-		
I	ModelObject	R	-		(2)
J	ModelID	G	-		(7)
K	InstalledModelNumber	A	-		
L	SerialNumber	A	-		
M	TagOrCode	A	-		
N	OwnerAssetID	A	-		
O	SystemName	R	F	System.Name	(3)
P	FluidHotFeedName	R	F	Component.Name	(4)
Q	FluidColdFeedName	R	F	Component.Name	(4)
R	ElectricPanelName	R	F	Component.Name	(4)
S	ElectricCircutName	A	-		(4)
T	ControlledByName	R	F	Component.Name	(5)
U	InterlockWithName	R	F	Component.Name	(5)
V	PartOfAssemblyName	R	F	Component.Name	(6)

Figure 23 Component Worksheet Mapping

NOTE: (1) Component.Name shall be unique. Rules for merging files that may result in name collisions will be described in the associated Implementation Guide publication. (2) The set of IfcProduct Objects provided through the FM Handover - Equipment Maintenance shall not contain any IfcProduct object identified in the FM Handover - Equipment Maintenance Exclusion set. (3) Component.SystemName shall be required for all commissioning stage deliverables. (4) clarifies association requirements among Component records needed for operations and maintenance activities, (5) clarifies association requirements among Component records needed to delivery industrial control systems, (6) clarifies representation of complex product assemblies. (7) Maps to the identifier for IFC Object class in Component.ModelObject.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcConstructionProductResource.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Name
E	WorksheetName	IfcRelation reference
F	WorksheetRow	IfcRelation reference
G	ModelSoftware	IfcApplication.ApplicationFullName
H	ModelID	IfcConstructionProductResource.GlobalID
I	SupplierOrganizationName	IfcOrganization.Name
J	Description	IfcConstructionProductResource.Description
K	SpaceName	IfcSpace.Name
L	CatalogURL	FMH_PSetPart.CatalogURL

Figure 24 MVD Mapping to Part Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	C		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.TypePart	
E	WorksheetName	R	C	Lookup.FixedWorksheet	(1)
F	WorksheetRow	R	C		(1)
G	ModelSoftware	A	-		
H	ModelProjectGUID	G	-		
I	SupplierOrganizationName	R	F	Company.Name	
J	Description	A	-		
K	SpaceName	R	F	Space.Name	(3)
L	CatalogURL	A	-		(2)

Figure 25 Part Worksheet Mapping

NOTE: (1) Part.Name shall be unique within a given set of Spare.SheetName, Spare.RowName records. (2) Allows information exchange, including transactional information exchange, in the context of common data environments. (3) to be provided for all on-site spare parts provided at occupancy.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcTypeResource.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Name
G	ModelSoftware	IfcApplication.ApplicationFullName
H	ModelProjectObject	Associated Object
I	ModelProjectGUID	IfcTypeResource.GlobalID
J	SupplierCompanyName	IfcOrganization.Name
K	Description	IfcTypeResource.Description

Figure 26 MVD Mapping to Resource Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	P		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.TypeResource	
G	ModelSoftware	A	-		
H	ModelProjectObject	A	-	IfcTypeResource allowed subtypes	
I	ModelProjectGUID	G	-		
J	SupplierCompanyName	R	F	Company.Name	
K	Description	A	-		

Figure 27 Resource Worksheet Mapping

NOTE: (1) Resource.Name shall be unique.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcTask.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassificationReference.Name
E	Status	FMH_PSetJob.Status
F	WorksheetName	IfcRelation reference
G	WorksheetRow	IfcRelation reference
H	Number	IfcTask.Identification
K	Description	IfcTask.Description
L	Duration	IfcTaskTime.ScheduledDuration
M	Frequency	IfcRecurrencePattern.Occurrences
N	NextOccurance	IfcTaskTime.ScheduleStart
O	ModelSoftware	IfcApplication.ApplicationFullName
P	ModelProjectGUID	IfcTask.GlobalID
Q	ResourceNames	IfcConstructionEquipmentResource.Name

Figure 28 MVD Mapping to Job Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	C		(3)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.TypeJob	
E	Status	R	-	Lookup.TypeJobStatus	
F	WorksheetName	R	C	Lookup.FixedWorksheet	(3)
G	WorksheetRow	R	C		(3)
H	Number	N	C		(1)(2)(3)
K	Description	A	-		
L	Duration	N			(4)
M	Frequency	N			(5)
N	NextOccurance	N			(5)
O	ModelSoftware	A	-		
P	ModelProjectGUID	G	-		
Q	ResourceNames	L	-		(6)

Figure 29 Job Worksheet Mapping

NOTE: (1) Jobs shall be defined as a list of one or more tasks. (2) Job.TaskNumber shall be provided as a list of sequential Natural numbers. (3) For a given Job.WorksheetName, Job.WorksheetRow the sequential list of Job.Name rows shall be unique starting with the numeral “1”. (4) The unit “hours” shall be used, (5) The unit “months” shall be used. (6) If more than one Resource is required, a “;” delimited list shall be used.

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcDocumentInformation.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassification.Name
E	WorksheetName	IfcRelation reference
F	WorksheetRow	IfcRelation reference
G	Stage	FMH_PSetDocument.Stage
H	FilePath	IfcDocumentInformation.Location
I	FileName	IfcDocumentInformation.Identification
J	ModelSoftware	IfcApplication.ApplicationFullName
K	ModelProjectGUID	IfcTask.GlobalID
L	Description	IfcDocument.Description
M	SpecificationSection	FMH_PSetDocument.SpecificationSection
N	SubmittalID	FMH_PSetDocument.SubmittalID
O	SourceURL	FMH_PSetDocument.SourceURL

Figure 30 MVD Mapping to Document Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	C		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.TypeDocument	
E	WorksheetName	R	C	Lookup.FixedWorksheet	(1)
F	WorksheetRow	R	C		(1)
G	Stage	R	-	Lookup.TypeStage	(2) (3) (4)
H	FilePath	A	-		
I	FileName	A	-		
J	ModelSoftware	A	-		
K	ModelProjectGUID	G	-		
L	Description	A	-		
M	SpecificationSection	A	-		(3)
N	SubmittalID	A	-		(3)
O	SourceURL	A	-		(3)

Figure 31 Document Worksheet Mapping

NOTE: (1) Document.Name shall be unique within a given Document.WorksheetName, Document.WorksheetRow (2) Stage shall define if the document identified is “Requirement” or a “Submittal”. If “Requirement”, then Document.FilePath and Document.FileName shall be NULL. (3) This field shall allow information exchange, including transactional information exchange, in the context of common data environments. (4) Note that since this field is not part of the complex/compound key, there may not be one row with a “Requirement” and another row as “Approved”

Column		FM Handover - Equipment Maintenance MVD Mapping
Order	Name	
A	Name	IfcProperty.Name
B	AuthorOrganizationName	IfcOwnerHistory
C	AuthorDate	IfcOwnerHistory
D	Category	IfcClassification.Name
E	Stage	FMH_PSetAttribute.Stage
	WorksheetName	IfcRelation reference
F	WorksheetRow	IfcRelation reference
G	Value	IfcPropertySingleValue.NominalValue
H	Unit	IfcPropertySingleValue.Unit (Prefix + Name)
I	ModelSoftware	IfcApplication.ApplicationFullName
J	ModelProjectObject	PSet Name
K	ModelProjectGUID	IfcProperty.GlobalId

Figure 32 MVD Mapping to Property Worksheet

Column		Data Type	Database Key	Reference/Key Field Source	Notes
A	Name	A	C		(1)
B	AuthorOrganizationName	R	F	Organization.Name	
C	AuthorDate	D	-		
D	Category	R	-	Lookup.TypeStage	
E	WorksheetName	R	C	Lookup.FixedWorksheet	(1)
F	WorksheetRow	R	C		(1)
G	Value	A	-		
H	Unit	A	-		
I	ModelSoftware	A	-		
J	ModelProjectObject	A	-		
K	ModelProjectGUID	G	-		

Figure 33 Property Worksheet Mapping

NOTE: (1) Property.Name shall be unique within a given Property.WorksheetName, Property.WorksheetRow. Note that this does not allow for a given property listed in one row as a "Requirement" and another row as "Approved".

17. ALLOWED IFC TYPE OBJECTS

Tables provided in this section shall be used to restrict the delivery of IFC 4.3 Product Type objects that may be delivered under the FM Handover - Equipment Maintenance MVD. IFC 2x3 mapping is also provided for backward compatibility with the bSI FM Handover - Basic MVD. The complete list of IFC 4.3 (and IFC 2x3) Product Types that shall be excluded are provided in the MVD documentation.

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
DistributionControlElement	ifcFlowController	Impart control over flow control elements (<i>IfcFlowController</i>) in a distribution system such as dampers, valves, relays, etc., typically through the use of actuation (<i>IfcActuator</i> : See <i>IfcHVACDomain</i> schema)	ACTUATOR	ELECTRICACTUATOR	ELECTRICACTUATOR: A device that electrically actuates a control element.
	ifcActuatorType	An <i>IfcActuatorType</i> defines a particular type of actuating device that is typically used in a control system such as a building automation control system.		PNEUMATICACTUATOR	PNEUMATICACTUATOR: A device that pneumatically actuates a control element.
	ELECTRICACTUATOR	A device that electrically actuates a control element.		HYDRAULICACTUATOR	HYDRAULICACTUATOR: A device that electrically actuates a control element.
	PNEUMATICACTUATOR	A device that pneumatically actuates a control element.		HANDOPERATEDACTUATOR	HANDOPERATEDACTUATOR: A device that manually actuates a control element.
	HYDRAULICACTUATOR	A device that electrically actuates a control element.		THERMOSTATICACTUATOR	THERMOSTATICACTUATOR: A device that thermostatically actuates a control element.
	HANDOPERATEDACTUATOR	A device that manually actuates a control element.		USERDEFINED	
	THERMOSTATICACTUATOR	A device that thermostatically actuates a control element.		NOTDEFINED	
	USERDEFINED			NOTDEFINED	Generic
	NOTDEFINED				

Figure 34 Allowed IFC Type Object - Actuator

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal	ifcFlowTerminal	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.			
	ifcFlowTerminalType	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.			
			AIRTERMINAL	DIFFUSER	DIFFUSER: An outlet discharging supply air in various directions and planes.
				GRILLE	GRILLE: A covering for any area through which air passes.
				LOUVRE	LOUVRE: A rectilinear louvre.
				REGISTER	REGISTER: A grille typically equipped with a damper or control valve.
				NOTDEFINED	Generic

Figure 35 Allowed IFC Type Object - Air Terminal

IFC 2x3 Object Information			IFC 2x4 Object Information			
Entity	Type/Enum	Description	Entity	PredefinedType	Description	
FlowTerminal	ifcFlowTerminal	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.				
	ifcFlowTerminalType	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.				
			AIRTERMINALBOX	CONSTANTFLOW	CONSTANTFLOW: Terminal box does not include a means to reset the volume automatically to an outside signal such as thermostat.	
				VARIABLEFLOWPRESSUREDEPENDANT	VARIABLEFLOWPRESSUREDEPENDANT: terminal box includes a means to reset the volume automatically to a different control point in response to an outside signal such as thermostat: air-flow rate depends on supply pressure.	
				VARIABLEFLOWPRESSUREINDEPENDANT	VARIABLEFLOWPRESSUREINDEPENDANT: terminal box includes a means to reset the volume automatically to a different control point in response to an outside signal such as thermostat: air-flow rate is independent of supply pressure.	
				NOTDEFINED	Generic	

Figure 36 Allowed IFC Type Object - Air Terminal Box

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice	IfcEnergyConversionDevice	The distribution flow element <i>IfcEnergyConversionDevice</i> defines the occurrence of a device used to perform energy conversion or heat transfer and typically participates in a flow distribution system. Its type is defined by <i>IfcEnergyConversionDeviceType</i> or its subtypes.			
	IfcEnergyConversionDeviceType	The element type <i>IfcEnergyConversionType</i> defines a list of commonly shared property set definitions of an element and an optional set of product representations. It is used to define an element specification (i.e. the specific product information, that is common to all occurrences of that product type).			
AIRTOAIRHEATRECOVERY			AIRTOAIRHEATRECOVERY	FIXEDPLATECOUNTERFLOWEXCHANGER	FIXEDPLATECOUNTERFLOWEXCHANGER: Heat exchanger with moving parts and alternate layers of plates, separated and sealed from the exhaust and supply air stream passages with primary air enters at secondary air outlet location and exits at secondary air inlet location.
				FIXEDPLATECROSSFLOWEXCHANGER	FIXEDPLATECROSSFLOWEXCHANGER: Heat exchanger with moving parts and alternate layers of plates, separated and sealed from the exhaust and supply air stream passages with secondary air flow in the direction perpendicular to primary air flow.
				FIXEDPLATEPARALLELFLOWEXCHANGER	FIXEDPLATEPARALLELFLOWEXCHANGER: Heat exchanger with moving parts and alternate layers of plates, separated and sealed from the exhaust and supply air stream passages with primary air enters at secondary air inlet location and exits at secondary air outlet location.
				ROTARYWHEEL	ROTARYWHEEL: A heat wheel with a revolving cylinder filled with an air-permeable medium having a large internal surface area.
				RUNAROUNDCOILLOOP	RUNAROUNDCOILLOOP: A typical coil energy recovery loop places extended surface, finned tube water coils in the supply and exhaust airstreams of a building.
				HEATPIPE	HEATPIPE: A passive energy recovery device with a heat pipe divided into evaporator and condenser sections.

Figure 37 Allowed IFC Type Object - IfcAirToAirHeatRecovery

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
				TWINTOWERENTHALPYRECOVERYLOOPS	TWINTOWERENTHALPYRECOVERYLOOPS: An air-to-liquid, liquid-to-air enthalpy recovery system with a sorbent liquid circulates continuously between supply and exhaust airstreams, alternately contacting both airstreams directly in contactor towers.
				THERMOSIPHONSEALEDTUBEHEATEXCHANGERS	THERMOSIPHONSEALEDTUBEHEATEXCHANGERS: Sealed systems that consist of an evaporator, a condenser, interconnecting piping, and an intermediate working fluid that is present in both liquid and vapor phases where the evaporator and the condenser are usually at opposite ends of a bundle of straight, individual thermosiphon tubes and the exhaust and supply ducts are adjacent to each other.
				THERMOSIPHONCOILTYPEHEATEXCHANGERS	THERMOSIPHONCOILTYPEHEATEXCHANGERS: Sealed systems that consist of an evaporator, a condenser, interconnecting piping, and an intermediate working fluid that is present in both liquid and vapor phases where the evaporator and condenser coils are installed independently in the ducts and are interconnected by the working fluid piping.
				NOTDEFINED	Generic

(Figure cont.) Allowed IFC Type Object - Air To Air Heat Recovery Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
DistributionControlElement	IfcDistributionControlElement	This class defines elements of a building automation control system. These are typically used to control distribution system elements to maintain temperature, humidity, pressure, flow, power, lighting levels, etc., through the modulation, staging or sequencing of mechanical or electrical devices.	ALARM	BELL	BELL: An audible alarm.
	IfcDistributionControlElementType	A distribution control element type is used to define the common properties of a distribution control element that may be applied to many occurrences of that type.		BREAKGLASSBUTTON	BREAKGLASSBUTTON: An alarm activation mechanism in which a protective glass has to be broken to enable a button to be pressed.
	IfcAlarmType	The <i>IfcAlarmType</i> defines a device that signals the existence of a condition or situation that is outside the boundaries of normal expectation or that activates such a device.		LIGHT	LIGHT: A visual alarm.
	BELL	An audible alarm		MANUALPULLBOX	MANUALPULLBOX: An alarm activation mechanism in which activation is achieved by a pulling action.
	BREAKGLASSBUTTON	An alarm activation mechanism in which a protective glass has to be broken to enable a button to be pressed		SIREN	SIREN: An audible alarm.
	LIGHT	A visual alarm		WHISTLE	WHISTLE: An audible alarm.
	MANUALPULLBOX	An alarm activation mechanism in which activation is achieved by a pulling action.		USERDEFINED	
	SIREN	An audible alarm		NOTDEFINED	Generic
	WHISTLE	An audible alarm			
	USERDEFINED			NOTDEFINED	

Figure 38 Allowed IFC Type Object - Alarm

IFC 2x3 Object Information			IFC 2x4 Object Information			
Entity	Type/Enum	Description	Entity	PredefinedType	Description	
FlowTerminal	ifcFlowTerminal	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.	AUDIOVISUALAPPLIANCE	AMPLIFIER	AMPLIFIER: A device that receives an audio signal and amplifies it to play through speakers.	
	ifcFlowTerminalType	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.		CAMERA	CAMERA: A device that records images, either as a still photograph or as moving images known as videos or movies. Note that a camera may operate with light from the visible spectrum or from other parts of the electromagnetic spectrum such as infrared or ultraviolet.	
				DISPLAY	DISPLAY: An electronic device that represents information in visual form such as a flat-panel display or television.	
				MICROPHONE	MICROPHONE: An acoustic-to-electric transducer or sensor that converts sound into an electrical signal. Microphones types in use include electromagnetic induction (dynamic microphones), capacitance change (condenser microphones) or piezoelectric generation to produce the signal from mechanical vibration.	
				PLAYER	PLAYER: A device that plays audio and/or video content directly or to another device, having fixed or removable storage media.	
				PROJECTOR	PROJECTOR: An apparatus for projecting a picture on a screen. Whether the device is an overhead, slide projector, or a film projector, it is usually referred to as simply a projector.	
				RECEIVER	RECEIVER: A device that receives audio and/or video signals, switches sources, and amplifies signals to play through speakers.	
				SPEAKER	SPEAKER: A loudspeaker, speaker, or speaker system is an electroacoustical transducer that converts an electrical signal to sound.	
				SWITCHER	SWITCHER: A device that receives audio and/or video signals, switches sources, and transmits signals to downstream devices.	
				TELEPHONE	TELEPHONE: A telecommunications device that is used to transmit and receive sound, and optionally video.	
				TUNER	TUNER: An electronic receiver that detects, demodulates, and amplifies transmitted signals.	
				NOTDEFINED	Generic	

Figure 39 Allowed IFC Type Object - Audio Visual Appliance

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice	IfcEnergyConversionDevice	The distribution flow element <i>IfcEnergyConversionDevice</i> defines the occurrence of a device used to perform energy conversion or heat transfer and typically participates in a flow distribution system.	BOILER	WATER	WATER: Water boiler.
	IfcEnergyConversionDeviceType	A energy conversion type is used to define the common properties of a energy conversion device that may be applied to many occurrences of that type. energy conversion types (or the instantiable subtypes) may be exchanged without being already assigned to occurrences.		STEAM	STEAM: Steam boiler.
	IfcBoilerType	A boiler type is used to define the common properties of a boiler that may be applied to many occurrences of that type.		NOTDEFINED	Generic
	WATER	Water		USERDEFINED	Heating Boilers
	STEAM	Steam		UnDefined	Undefined Boiler Type
	USERDEFINED	User-Defined Boiler Type			
	UnDefined	Undefined Boiler Type			

Figure 40 Allowed IFC Type Object - Boiler

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice	IfcEnergyConversionDevice	The distribution flow element <i>IfcEnergyConversionDevice</i> defines the occurrence of a device used to perform energy conversion or heat transfer and typically participates in a flow distribution system.	BURNER	NOTDEFINED	Generic
	IfcEnergyConversionDeviceType	A energy conversion type is used to define the common properties of a energy conversion device that may be applied to many occurrences of that type. energy conversion types (or the instantiable subtypes) may be exchanged without being already assigned to occurrences.		USERDEFINED	Heating Stoves

Figure 41 Allowed IFC Type Object - Burner

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice	IfcEnergyConversionDevice	The distribution flow element <i>IfcEnergyConversionDevice</i> defines the occurrence of a device used to perform energy conversion or heat transfer and typically participates in a flow distribution system.	CHILLER	AIRCOOLED	AIRCOOLED: Air cooled chiller.
	IfcEnergyConversionDeviceType	A energy conversion type is used to define the common properties of a energy conversion device that may be applied to many occurrences of that type. energy conversion types (or the instantiable subtypes) may be exchanged without being already assigned to occurrences.		WATERCOOLED	WATERCOOLED: Water cooled chiller.
	ifcChillerType	A boiler type is used to define the common properties of a boiler that may be applied to many occurrences of that type.		HEATRECOVERY	HEATRECOVERY: Heat recovery chiller.
	AIRCOOLED	Air cooled chiller.		NOTDEFINED	Generic
	WATERCOOLED	Water cooled chiller.			
	HEATRECOVERY	Heat recovery chiller.			
	USERDEFINED	User-defined chiller type.			
	NOTDEFINED	Undefined chiller type.			

Figure 42 Allowed IFC Type Object - Chiller

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice	IfcEnergyConversionDevice	The distribution flow element <i>IfcEnergyConversionDevice</i> defines the occurrence of a device used to perform energy conversion or heat transfer and typically participates in a flow distribution system.	COIL	DXCOOLINGCOIL	DXCOOLINGCOIL: Cooling coil using a refrigerant to cool the air stream directly.
	IfcEnergyConversionDeviceType	A energy conversion type is used to define the common properties of a energy conversion device that may be applied to many occurrences of that type. energy conversion types (or the instantiable subtypes) may be exchanged without being already assigned to occurrences.		WATERCOOLINGCOIL	WATERCOOLINGCOIL: Cooling coil using chilled water to cool the air stream.
	IfcCoilType	The energy conversion device type <i>IfcCoilType</i> defines commonly shared information for occurrences of coils.		STEAMHEATINGCOIL	STEAMHEATINGCOIL: Heating coil using steam as heating source.
	DXCOOLINGCOIL	Cooling coil using a refrigerant to cool the air stream directly.		WATERHEATINGCOIL	WATERHEATINGCOIL: Heating coil using hot water as a heating source.
	WATERCOOLINGCOIL	Cooling coil using chilled water to cool the air stream.		ELECTRICHEATINGCOIL	ELECTRICHEATINGCOIL: Heating coil using electricity as a heating source.
	STEAMHEATINGCOIL	Heating coil using steam as heating source.		GASHEATINGCOIL	GASHEATINGCOIL: Heating coil using gas as a heating source.
	WATERHEATINGCOIL	Heating coil using hot water as a heating source.		USERDEFINED	User-defined coil type.
	ELECTRICHEATINGCOIL	Heating coil using electricity as a heating source.		NOTDEFINED	Undefined coil type.
	GASHEATINGCOIL	Heating coil using gas as a heating source.			
	USERDEFINED	User-defined coil type.		HYDRONICCOIL	HYDRONICCOIL: Cooling or Heating coil that uses a hydronic fluid as a cooling or heating source.

Figure 43 Allowed IFC Type Object - Coil

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal	ifcFlowTerminal	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.			
	ifcFlowTerminalType	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.			
			COMMUNICATIONSAPPLIANCE	ANTENNA	ANTENNA: A transducer designed to transmit or receive electromagnetic waves.
				COMPUTER	COMPUTER: A desktop, laptop, PDA or other type of computer that can be moved from one place to another and connected to an electrical supply via a plugged outlet.
				FAX	FAX: A machine that has the primary function of transmitting a facsimile copy of printed matter using a telephone line.
				GATEWAY	GATEWAY: A gateway connects multiple network segments with different protocols at all layers (layers 1-7) of the OSI model
				MODEM	MODEM: A modem (from modulator-demodulator) is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information
				NETWORKAPPLIANCE	NETWORKAPPLIANCE: A network appliance performs a dedicated function such as firewall protection, content filtering, load balancing, or equipment management.
				NETWORKBRIDGE	NETWORKBRIDGE: A network bridge connects multiple network segments at the data link layer (layer 2) of the OSI model, and the term layer 2 switch is very often used interchangeably with bridge
				NETWORKHUB	NETWORKHUB: A network hub connects multiple network segments at the physical layer (layer 1) of the OSI model.
				PRINTER	PRINTER: A machine that has the primary function of printing text and/or graphics onto paper or other media

Figure 44 Allowed IFC Type Object - Communications Appliance

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
			REPEATER	REPEATER	REPEATER: A repeater is an electronic device that receives a signal and retransmits it at a higher level and/or higher power, or onto the other side of an obstacle.
			ROUTER	ROUTER	ROUTER: A router is a networking device whose software and hardware are usually tailored to the tasks of routing and forwarding information. For example, on the Internet, information is directed to various paths by routers.
			SCANNER	SCANNER	SCANNER: A machine that has the primary function of scanning the content of printed matter and converting it to digital format that can be stored in a computer.
			NOTDEFINED	NOTDEFINED	Generic

(Figure cont.) Allowed IFC Type Object - Communications Appliance

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowMovingDevice	IfcFlowMovingDevice	the distribution flow element <i>IfcFlowMovingDevice</i> defines the occurrence of an apparatus used to distribute, circulate or perform conveyance of fluids, including liquids and gases, and typically participates in a flow distribution system			
	IfcFlowMovingDeviceType	A flow moving type is used to define the common properties of a flow moving device that may be applied to many occurrences of that type.			
	IfcCompressorType	the flow moving device type <i>IfcCompressorType</i> defines commonly shared information for occurrences of compressors.			
	IfcCompressorTypeEnum	Types of compressors.			
	DYNAMIC	DYNAMIC: The pressure of refrigerant vapor is increased by a continuous transfer of angular momentum from a rotating member to the vapor followed by conversion of this momentum into static pressure.			
	RECIPROCATING	RECIPROCATING: Positive-displacement compressor using a piston driven by a connecting rod from a crankshaft.			
	ROTARY	ROTARY: Positive-displacement compressor using a roller or rotor device.			
	SCROLL	SCROLL: Positive-displacement compressor using two inter-fitting, spiral-shaped scroll members.			
	TROCHOIDAL	TROCHOIDAL: Positive-displacement compressor using a rolling motion of one circle outside or inside the circumference of a basic circle and produce either epitrochoids or hypotrochoids.			
	SINGLESTAGE	SINGLESTAGE: Positive-displacement reciprocating compressor where vapor is compressed in a single stage.			
	BOOSTER	BOOSTER: Positive-displacement reciprocating compressor where pressure is increased by a booster.			

Figure 45 Allowed IFC Type Object - Compressor

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
	OPENTYPE HERMETIC SEMIHERMETIC WELDEDHELLHERMETIC ROLLINGPISTON ROTARYVANE SINGLESCREW TWINSCREW NOTDEFINED	<p>OPENTYPE: Positive-displacement reciprocating compressor where the shaft extends through a seal in the crankcase for an external drive.</p> <p>HERMETIC: Positive-displacement reciprocating compressor where the motor and compressor are contained within the same housing, with the motor shaft integral with the compressor crankshaft and the motor in contact with refrigerant.</p> <p>SEMIHERMETIC: Positive-displacement reciprocating compressor where the hermetic compressors use bolted construction amenable to field repair.</p> <p>WELDEDHELLHERMETIC: Positive-displacement reciprocating compressor where the motor compressor is mounted inside a steel shell, which, in turn is sealed by welding.</p> <p>ROLLINGPISTON: Positive-displacement rotary compressor using a roller mounted on the eccentric of a shaft with a single vane in the nonrotating cylindrical housing.</p> <p>ROTARYVANE: Positive-displacement rotary compressor using a roller mounted on the eccentric of a shaft with multiple vanes in the nonrotating cylindrical housing.</p> <p>SINGLESCREW: Positive-displacement rotary compressor using a single cylindrical main rotor that works with a pair of gate rotors.</p> <p>TWINSCREW: Positive-displacement rotary compressor using two mating helically grooved rotors, male (lobes) and female (flutes) in a stationary housing with inlet and outlet gas ports.</p> <p>NOTDEFINED: Generic</p>		DYNAMIC	<p>DYNAMIC: The pressure of refrigerant vapor is increased by a continuous transfer of angular momentum from a rotating member to the vapor followed by conversion of this momentum into static pressure.</p>

(Figure cont.) Allowed IFC Type Object - Compressor

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
COMPRESSOR	RECIPROCATING	RECIPROCATING: Positive-displacement compressor using a piston driven by a connecting rod from a crankshaft.			
	ROTARY	ROTARY: Positive-displacement compressor using a roller or rotor device.			
	SCROLL	SCROLL: Positive-displacement compressor using two inter-fitting, spiral-shaped scroll members.			
	TROCHOIDAL	TROCHOIDAL: Positive-displacement compressor using a rolling motion of one circle outside or inside the circumference of a basic circle and produce either epitrochoids or hypotrochoids.			
	SINGLESTAGE	SINGLESTAGE: Positive-displacement reciprocating compressor where vapor is compressed in a single stage.			
	BOOSTER	BOOSTER: Positive-displacement reciprocating compressor where pressure is increased by a booster.			
	OPENTYPE	OPENTYPE: Positive-displacement reciprocating compressor where the shaft extends through a seal in the crankcase for an external drive.			
	HERMETIC	HERMETIC: Positive-displacement reciprocating compressor where the motor and compressor are contained within the same housing, with the motor shaft integral with the compressor crankshaft and the motor in contact with refrigerant.			
	SEMIHERMETIC	SEMIHERMETIC: Positive-displacement reciprocating compressor where the hermetic compressors use bolted construction amenable to field repair.			
	WELDEDHELLHERMETIC	WELDEDHELLHERMETIC: Positive-displacement reciprocating compressor where the motor compressor is mounted inside a steel shell, which, in turn is sealed by welding.			
	ROLLINGPISTON	ROLLINGPISTON: Positive-displacement rotary compressor using a roller mounted on the eccentric of a shaft with a single vane in the nonrotating cylindrical housing.			
	ROTARYVANE	ROTARYVANE: Positive-displacement rotary compressor using a roller mounted on the eccentric of a shaft with multiple vanes in the nontotating cylindrical housing.			
	SINGLESCREW	SINGLESCREW: Positive-displacement rotary compressor using a single cylindrical main rotor that works with a pair of gate rotors.			

(Figure cont.) Allowed IFC Type Object - Compressor

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
			TWINSCREW		TWINSCREW: Positive-displacement rotary compressor using two mating helically grooved rotors, male (lobes) and female (flutes) in a stationary housing with inlet and outlet gas ports.
			NOTDEFINED		Generic

(Figure cont.) Allowed IFC Type Object - Compressor

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice	IfcEnergyConversionDevice	The distribution flow element <i>IfcEnergyConversionDevice</i> defines the occurrence of a device used to perform energy conversion or heat transfer and typically participates in a flow distribution system.	CONDENSER	AIRCOOLED	AIRCOOLED: A condenser in which heat is transferred to an air-stream.
	IfcEnergyConversionDeviceType	A energy conversion type is used to define the common properties of a energy conversion device that may be applied to many occurrences of that type. energy conversion types (or the instantiable subtypes) may be exchanged without being already assigned to occurrences.		EVAPORATIVECOOLED	EVAPORATIVECOOLED: A condenser that is cooled evaporatively.
	IfcCondenserType	The element type <i>IfcCondenserType</i> defines a list of condenser types.		WATERCOOLED	WATERCOOLED: Water-cooled condenser with unspecified operation.
	IfcCondenserTypeEnum	Enumeration defining the typical types of condensers.		WATERCOOLEDBRAZEDPLATE	WATERCOOLEDBRAZEDPLATE: Water-cooled condenser condenser with plates brazed together to form an assembly of separate channels.
	AIRCOOLED	AIRCOOLED: A condenser in which heat is transferred to an air-stream.		WATERCOOLEDHELLCOIL	WATERCOOLEDHELLCOIL: Water-cooled condenser with cooling water circulated through one or more continuous or assembled coils contained within the shell.
	EVAPORATIVECOOLED	EVAPORATIVECOOLED: A condenser that is cooled evaporatively.		WATERCOOLEDHELLTUBE	WATERCOOLEDHELLTUBE: Water-cooled condenser with cooling water circulated through one or more tubes contained within the shell.
	WATERCOOLED	WATERCOOLED: Water-cooled condenser with unspecified operation.		WATERCOOLEDTUBEINTUBE	WATERCOOLEDTUBEINTUBE: Water-cooled condenser consisting of one or more assemblies of two tubes, one within the other.
	WATERCOOLEDBRAZEDPLATE	WATERCOOLEDBRAZEDPLATE: Water-cooled condenser condenser with plates brazed together to form an assembly of separate channels.		NOTDEFINED	Generic
	WATERCOOLEDHELLCOIL	WATERCOOLEDHELLCOIL: Water-cooled condenser with cooling water circulated through one or more continuous or assembled coils contained within the shell.		AIRCOOLED	AIRCOOLED: A condenser in which heat is transferred to an air-stream.
	WATERCOOLEDHELLTUBE	WATERCOOLEDHELLTUBE: Water-cooled condenser with cooling water circulated through one or more tubes contained within the shell.		EVAPORATIVECOOLED	EVAPORATIVECOOLED: A condenser that is cooled evaporatively.
	WATERCOOLEDTUBEINTUBE	WATERCOOLEDTUBEINTUBE: Water-cooled condenser consisting of one or more assemblies of two tubes, one within the other.		WATERCOOLED	WATERCOOLED: Water-cooled condenser with unspecified operation.
	NOTDEFINED	Generic		WATERCOOLEDBRAZEDPLATE	WATERCOOLEDBRAZEDPLATE: Water-cooled condenser condenser with plates brazed together to form an assembly of separate channels.

Figure 46 Allowed IFC Type Object - Condenser

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
DistributionControlElement	IfcDistributionControlElement	This class defines elements of a building automation control system. These are typically used to control distribution system elements to maintain temperature, humidity, pressure, flow, power, lighting levels, etc., through the modulation, staging or sequencing of mechanical or electrical devices.			
	IfcDistributionControlElementType	A distribution control element type is used to define the common properties of a distribution control element that may be applied to many occurrences of that type.			
	IfcControllerType	An <i>IfcControllerType</i> defines a particular type of controller that interacts with other devices in a control system such as a building automation control system.			
	IfcControllerTypeEnum	The <i>IfcControllerTypeEnum</i> defines the range of different types of controller that can be specified.			
	FLOATING	Output increases or decreases at a constant or accelerating rate			
	PROPORTIONAL	Output is proportional to the control error			
	PROPORTIONALINTEGRAL	Part of the output is proportional to the control error and part is proportional to the time integral of the control error			
	PROPORTIONALINTEGRALDERIVATIVE	part of the output is proportional to the control error, part is proportional to the time integral of the control error and part is proportional to the time derivative of the control error			
	TIMEDTWOPOSITION	Output changes state for a time interval proportional to the deviation from setpoint			
	TWOPOSITION	Binary output, can be either on or off			
	USERDEFINED				
	NOTDEFINED				

Figure 47 Allowed IFC Type Object - Controller

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
			CONTROLLER	FLOATING	FLOATING: Output increases or decreases at a constant or accelerating rate.
				PROGRAMMABLE	PROGRAMMABLE: Output is programmable such as Discrete Digital Control (DDC).
				PROPORTIONAL	PROPORTIONAL: Output is proportional to the control error and optionally time integral and derivative.
				MULTIPOSITION	MULTIPOSITION: Output is discrete value, can be one of three or more values.
				TWOPOSITION	TWOPOSITION: Output can be either on or off
				NOTDEFINED	Generic

(Figure cont.) Allowed IFC Type Object - Controller

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
BuildingElementPart	IfcBuildingElement	The building element comprises all elements that are primarily part of the construction of a building, i.e., its structural and space separating system.	COOLINGTOWER	NATURALDRAFT	NATURALDRAFT: Air flow is produced naturally.
	IfcBuildingElementType	A building element type is used to define the common properties of a certain type of a building element that may be applied to many instances of that feature type to assign a specific style.		MECHANICALINDUCEDDRAFT	MECHANICALINDUCEDDRAFT: Air flow is produced by a mechanical device, typically one or more fans, located on the air outlet side of the cooling tower.
	IfcCoolingTowerType	The element type <i>IfcCoolingTowerType</i> defines a		MECHANICALFORCEDDRAFT	MECHANICALFORCEDDRAFT: Air flow is produced by a mechanical device, typically one or more fans, located on the inlet air side of the cooling tower.
	IfcCoolingTowerTypeEnum	Enumeration defining the typical types of cooling towers.		USERDEFINED	
	NATURALDRAFT	NATURALDRAFT: Air flow is produced naturally.		NOTDEFINED	Generic
	MECHANICALINDUCEDDRAFT	MECHANICALINDUCEDDRAFT: Air flow is produced by a mechanical device, typically one or more fans, located on the air outlet side of the cooling tower.		NATURALDRAFT	NATURALDRAFT: Air flow is produced naturally.
	MECHANICALFORCEDDRAFT	MECHANICALFORCEDDRAFT: Air flow is produced by a mechanical device, typically one or more fans, located on the inlet air side of the cooling tower.		MECHANICALINDUCEDDRAFT	MECHANICALINDUCEDDRAFT: Air flow is produced by a mechanical device, typically one or more fans, located on the air outlet side of the cooling tower.
	USERDEFINED			MECHANICALFORCEDDRAFT	MECHANICALFORCEDDRAFT: Air flow is produced by a mechanical device, typically one or more fans, located on the inlet air side of the cooling tower.
	NOTDEFINED	Generic		NOTDEFINED	Generic

Figure 48 Allowed IFC Type Object - Cooling Tower

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController	IfcFlowController	The distribution flow element <i>IfcFlowController</i> defines the occurrence of elements of a distribution system that regulate the flow.			
	IfcFlowControllerTypeEnum	A flow controller type is used to define the common properties of a flow controller that may be applied to any occurrence of the base flow controller.			
	BACKDRAFTDAMPER	BACKDRAFTDAMPER: Backdraft damper used to restrict the movement of air in one direction. Commonly operated by mechanical spring.			
	BALANCINGDAMPER	BALANCINGDAMPER: Damper used for purposes of manually balancing pressure differences. Commonly operated by mechanical adjustment.			
	BLASTDAMPER	BLASTDAMPER: Blast damper used to prevent protect occupants and equipment against overpressures resultant of an explosion. Commonly operated by mechanical spring.			
	CONTROLDAMPER	CONTROLDAMPER: Control damper used to modulate the flow of air by adjusting the position of the blades. Commonly operated by an actuator of a building automation system.			
	FIREDAMPER	FIREDAMPER: Fire damper used to prevent the spread of fire for a specified duration. Commonly operated by fusible link that melts above a certain temperature.			
	FIRESMOKEDAMPER	FIRESMOKEDAMPER: Combination fire and smoke damper used to prevent the spread of fire and smoke. Commonly operated by a fusible link and a smoke detector.			
	FUMEHOODEXHAUST	FUMEHOODEXHAUST: Fume hood exhaust damper. Commonly operated by actuator.			
	GRAVITYDAMPER	GRAVITYDAMPER: Gravity damper closes from the force of gravity. Commonly operated by gravitational weight.			
	GRAVITYRELIEFDAMPER	GRAVITYRELIEFDAMPER: Gravity-relief damper used to allow air to move upon a buildup of enough pressure to overcome the gravitational force exerted upon the damper blades. Commonly operated by gravitational weight.			
	RELIEFDAMPER	RELIEFDAMPER: Relief damper used to allow air to move upon a buildup of a specified pressure differential. Commonly operated by mechanical spring.			
	SMOKEDAMPER	SMOKEDAMPER: Smoke damper used to prevent the spread of smoke. Commonly operated by a smoke detector of a building automation system.			
	NOTDEFINED	Generic			
	FumeHoodExhaust	Laboratory Fume Hoods			

Figure 49 Allowed IFC Type Object - Damper

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
DAMPER	BACKDRAFTDAMPER	BACKDRAFTDAMPER: Backdraft damper used to restrict the movement of air in one direction. Commonly operated by mechanical lever.			
	BALANCINGDAMPER	BALANCINGDAMPER: Damper used for purposes of manually balancing pressure differences. Commonly operated by mechanical adjustment.			
	BLASTDAMPER	BLASTDAMPER: Blast damper use to prevent protect occupants and equipment against overpressures resultant of an explosion. Commonly operated by mechanical spring.			
	CONTROLDAMPER	CONTROLDAMPER: Control damper used to modulate the flow of air by adjusting the position of the blades. Commonly operated by an actuator or a building automation system.			
	FIREDAMPER	FIREDAMPER: Fire damper used to prevent the spread of fire for a specified duration. Commonly operated by fusible link that melts above a certain temperature.			
	FIRESMOKEDAMPER	FIRESMOKEDAMPER: Combination fire and smoke damper used to prevent the spread of fire and smoke. Commonly operated by a fusible link and a smoke detector.			
	FUMEHOODEXHAUST	FUMEHOODEXHAUST: Fume hood exhaust damper. Commonly operated by actuator.			
	GRAVITYDAMPER	GRAVITYDAMPER: Gravity damper closes from the force of gravity. Commonly operated by gravitational weight.			
	GRAVITYRELIEFDAMPER	GRAVITYRELIEFDAMPER: Gravity-relief damper used to allow air to move upon a buildup of enough pressure to overcome the gravitational force exerted upon the damper blades. Commonly operated by gravitational weight.			
	RELIEFDAMPER	RELIEFDAMPER: Relief damper used to allow air to move upon a buildup of a specified pressure differential. Commonly operated by mechanical spring.			
	SMOKEDAMPER	SMOKEDAMPER: Smoke damper used to prevent the spread of smoke. Commonly operated by a smoke detector of a building automation system.			
	NOTDEFINED	Generic			
	FumeHoodExaust	Laboratory Fume Hoods			

(Figure cont.) Allowed IFC Type Object - Damper

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
Door	IfcDoor	The door includes constructions with revolving and folding operations. A door consists of a lining and one or several panels, properties concerning the lining and panel are defined by the <i>IfcDoorLiningProperties</i> and the <i>IfcDoorPanelProperties</i> .			
	IfcDoorStyle	The door style, <i>IfcDoorStyle</i> , defines a particular style of doors, which may be included into the spatial context of the building model through an (or multiple) instances of <i>IfcDoor</i> .			
	IfcDoorStyleOperationTypeEnum	This enumeration defines the basic ways to describe how doors operate.			
	SINGLE_SWING_LEFT	Door with one panel that opens (swings) to the left. The hinges are on the left side as viewed in the direction of the positive y-axis.			
	SINGLE_SWING_RIGHT	Door with one panel that opens (swings) to the right. The hinges are on the right side as viewed in the direction of the positive y-axis.			
	DOUBLE_DOOR_SINGLE_SWING	Door with two panels, one opens (swings) to the left the other opens (swings) to the right.			
	DOUBLE_SWING_LEFT	Door with one panel that swings in both directions and to the left in the main traffic direction. Also called double acting door.			
	DOUBLE_SWING_RIGHT	Door with one panel that swings in both directions and to the right in the main traffic direction. Also called double acting door.			
	DOUBLE_DOOR_DOUBLE_SWING	Door with two panels, one swings in both directions and to the right in the main traffic direction the other swings also in both directions and to the left in the main traffic direction.			
	DOUBLE_DOOR_SINGLE_SWING_OPPOSITE_LEFT	Door with two panels that both open to the left, one panel swings in one direction and the other panel swings in the opposite direction.			
	DOUBLE_DOOR_SINGLE_SWING_OPPOSITE_RIGHT	Door with two panels that both open to the right, one panel swings in one direction and the other panel swings in the opposite direction.			
	SLIDING_TO_LEFT	Door with one panel that is sliding to the left.			
	SLIDING_TO_RIGHT	Door with one panel that is sliding to the right.			
	DOUBLE_DOOR_SLIDING	Door with two panels, one is sliding to the left the other is sliding to the right.			
	FOLDING_TO_LEFT	Door with one panel that is folding to the left.			
	FOLDING_TO_RIGHT	Door with one panel that is folding to the right.			
	DOUBLE_DOOR_FOLDING	Door with two panels, one is folding to the left the other is folding to the right.			
	REVOLVING	An entrance door consisting of four leaves set in a form of a cross and revolving around a central vertical axis (the four panels are described by a single <i>IfcDoor</i> .panel property).			
	ROLLINGUP	Door that opens by rolling up.			
	USERDEFINED	User defined operation type			

Figure 50 Allowed IFC Type Object - Door

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
IfcDoorStyleConstructionEnum	NOTDEFINED	A door with a not defined operation type is considered as a door with a lining, but no panels. It is thereby always open.	DOOR	Aluminum Doors and Frames	Aluminum Doors and Frames
	IfcDoorStyleConstructionEnum	This enumeration defines the basic types of construction of doors. The construction type relates to the main material (or material combination) used for making the door.			
	ALUMINIUM				
	HIGH_GRADE_STEEL				
	STEEL				
	WOOD				
	ALUMINIUM_WOOD				
	ALUMINIUM_PLASTIC				
	PLASTIC				
	USERDEFINED				
	NOTDEFINED				

(Figure cont.) Allowed IFC Type Object - Door

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
				DOOR	Overhead Coiling Doors
				DOOR	Overhead Coiling Fire Shutters
				DOOR	Overhead Coiling Grilles
				DOOR	Cold Storage Doors
				DOOR	Hangar Doors
				DOOR	Industrial Doors
				DOOR	Lightproof Doors
				DOOR	Darkroom Doors
				DOOR	Radio-Frequency-Interference Shielding Doors
				DOOR	Radiation Shielding Doors and Frames
				DOOR	Security Doors and Frames
				DOOR	Vault Doors and Day Gates
				DOOR	Detention Doors and Frames
				DOOR	Sound Control Door Assemblies
				DOOR	Folding Doors and Grilles
				DOOR	Sectional Doors
				DOOR	Rigid Traffic Doors
				DOOR	Watertight Doors
				DOOR	Automatic Entrances
				DOOR	Revolving Door Entrances
				DOOR	Balanced Door Entrances
				DOOR	Flush Wood Doors
				DOOR	Stile and Rail Wood Doors

(Figure cont.) Allowed IFC Type Object - Door

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
			DOOR	PANELED_WOOD_DOORS	Paneled Wood Doors
			GATE	GATE	GATE: A gate is a point of entry to a property usually within an opening in a fence. Or as a "free standing" gate.
			GATE	SECURITY_GATES	Security Gates
			GATE	PARKING_GATES	Parking Gates
			NOTDEFINED	GENERIC	Generic
			TRAPDOOR	TRAPDOOR	Trapdoor: A special door that lies horizontally in a slab opening. Often used for accessing cellar or attic.

(Figure cont.) Allowed IFC Type Object - Door

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
	ifcFlowTerminal	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.			
	ifcFlowTerminalType	The distribution flow element <i>IfcFlowTerminal</i> defines the occurrence of a permanently attached element that acts as a terminus or beginning of a distribution system (e.g., air outlet, drain, water closet, sink, etc.). A terminal is typically a point at which a system interfaces with an external environment. Its type is defined by <i>IfcFlowTerminalType</i> or its subtypes.			
	ifcElectricApplianceType	An <i>IfcElectricApplianceType</i> defines a particular type of common electrical appliance found in a typical AEC/FM facility. Electrical Appliances generally consist of electrical devices that are not a fixed part of the building but instead can be moved from one space to another and are powered with electricity.			
	ifcElectricApplianceTypeEnum	The <i>IfcElectricApplianceTypeEnum</i> defines the range of different types of electrical appliance that can be specified.			
	COMPUTER	A desktop, laptop, PDA or other type of computer that can be moved from one place to another and connected to an electrical supply via a plugged outlet.			

Figure 51 Allowed IFC Type Object - Electric Appliance

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal	DISHWASHER	An appliance that has the primary function of washing dishes.			
	ELECTRICCOOKER	An electrical appliance that has the primary function of cooking food (including oven, hob, grill).			
	ELECTRICHEATER	An electrical appliance that provides heat.			
	FACSIMILE	A machine that has the primary function of transmitting a facsimile copy of printed matter using a telephone line.			
	FREESTANDINGFAN	An electrical appliance that provides ventilation.			
	FREEZER	An electrical appliance that has the primary function of storing food at temperatures below the freezing point of water.			
	FRIDGE_FREEZER	An electrical appliance that combines the functions of a freezer and a refrigerator through the provision of separate compartments.			
	HANDDRYER	An electrical appliance that has the primary function of drying hands.			
	MICROWAVE	An electrical appliance that has the primary function of cooking food using microwaves			
	PHOTOCOPIER	A machine that has the primary function of reproduction of printed matter.			
	PRINTER	A machine that has the primary function of printing a stream of characters onto paper or other media. NO			
	REFRIGERATOR	An electrical appliance that has the primary function of storing food at low temperature but above the freezing point of water			
	SCANNER	A machine that has the primary function of scanning the content of printed matter and converting it to electronically interpretable			
	TELEPHONE	A device for voice communication.			
	TUMBLEDRYER	An electrical appliance that has the primary function of drying clothes.			
	TV	A device for receiving and displaying television signals.			
	VENDINGMACHINE	An appliance that stores and vends goods including food, drink and goods of various types.			
	WASHINGMACHINE	An appliance that has the primary function of washing clothes.			
	WATERCOOLER	WATERCOOLER			
	WATERHEATER	A small electrical appliance for heating water.			
	USERDEFINED				
	NOTDEFINED				

(Figure cont.) Allowed IFC Type Object - Electric Appliance

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
ELECTRICAPPLIANCE	DISHWASHER	DISHWASHER: An appliance that has the primary function of washing dishes.			
	ELECTRICCOOKER	ELECTRICCOOKER: An electrical appliance that has the primary function of cooking food (including oven, hob, grill).			
	FREESTANDINGELECTRICHEATER	FREESTANDINGELECTRICHEATER: An electrical appliance that is used occasionally to provide heat. A freestanding electric heater is a 'plugged' appliance whose load may be removed from an electric circuit.			
	FREESTANDINGFAN	FREESTANDINGFAN: An electrical appliance that is used occasionally to provide ventilation. A freestanding fan is a 'plugged' appliance whose load may be removed from an electric circuit.			
	FREESTANDINGWATERHEATER	FREESTANDINGWATERHEATER: A small, local electrical appliance for heating water. A freestanding water heater is a 'plugged' appliance whose load may be removed from an electric circuit.			
	FREESTANDINGWATERCOOLER	FREESTANDINGWATERCOOLER: A small, local electrical appliance for cooling water. A freestanding water cooler is a 'plugged' appliance whose load may be removed from an electric circuit.			
	FREEZER	FREEZER: An electrical appliance that has the primary function of storing food at temperatures below the freezing point of water.			
	FRIDGE_FREEZER	FRIDGE_FREEZER: An electrical appliance that combines the functions of a freezer and a refrigerator through the provision of separate compartments.			
	HANDDRYER	KITCHENMACHINE: A specialized appliance used in commercial kitchens such as a mixer.			
	KITCHENMACHINE	HANDDRYER: An electrical appliance that has the primary function of drying hands.			
	MICROWAVE	MICROWAVE: An electrical appliance that has the primary function of cooking food using microwaves.			
	PHOTOCOPIER	PHOTOCOPIER: A machine that has the primary function of reproduction of printed matter.			
	REFRIGERATOR	REFRIGERATOR: An electrical appliance that has the primary function of storing food at low temperature but above the freezing point of water.			
	TUMBLEDRYER	TUMBLEDRYER: An electrical appliance that has the primary function of drying clothes.			
	VENDINGMACHINE	VENDINGMACHINE: An appliance that stores and vends goods including food, drink and goods of various types.			
	WASHINGMACHINE	WASHINGMACHINE: An appliance that has the primary function of washing clothes.			

(Figure cont.) Allowed IFC Type Object - Electric Appliance

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
				NOTDEFINED	Generic
				USERDEFINED	Teller and Service Equipment
				USERDEFINED	Firearms Training Equipment
				USERDEFINED	Darkroom Processing Equipment
				USERDEFINED	Residential Kitchen Appliances
				USERDEFINED	Residential Laundry Appliances
				USERDEFINED	Foodservice Equipment
				USERDEFINED	Waste Compactors and Destructors

(Figure cont.) Allowed IFC Type Object - Electric Appliance

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowStorageDevice					
				BATTERY	BATTERY: A device for storing energy in chemical form so that it can be released as electrical energy.
				CAPACITORBANK	CAPACITORBANK: A device that stores electrical energy when an external power supply is present using the electrical property of capacitance
				HARMONICFILTER	HARMONICFILTER: A device that constantly injects currents that precisely correspond to the harmonic components drawn by the load.
				UPS	UPS: A device that provides a time limited alternative source of power supply in the event of failure of the main supply.
				NOTDEFINED	Generic

Figure 52 Allowed IFC Type Object - Electric Flow Storage Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController	IfcFlowController	The distribution flow element <i>IfcFlowController</i> defines the occurrence of elements of a distribution system that are used to regulate flow through a distribution system (e.g., damper, valve, switch, relay, etc.).	ELECTRICDISTRIBUTIONBOARD	CONSUMERUNIT	CONSUMERUNIT: A distribution point on the incoming electrical supply, typically in domestic premises, at which protective devices are located.
	IfcFlowControllerType	A flow controller type is used to define the common properties of a flow controller that may be applied to many occurrences of that type. flow controller types (or the instantiable subtypes) may be exchanged without being already assigned to occurrences.			
	IfcElectricDistributionPointFunctionEnum	This enumeration defines the various types of damper			
	ALARMPANEL	A distribution point at which alarms are annunciated.			
	CONSUMERUNIT	A distribution point on the incoming electrical supply, typically in domestic premises, at which protective devices are located.			
	CONTROLPANEL	A distribution point at which devices that control or monitor the operation of a site, building or part of a building are located.			
	DISTRIBUTIONBOARD	A distribution point at which connections are made for distribution of electrical circuits usually through protective devices.			
	GASDETECTORPANEL	A distribution point at which the detection of gas is annunciated.			
	MIMICPANEL	A distribution point at which information that is available elsewhere is repeated or 'mimicked'.			
	MOTORCONTROLCENTRE	A distribution point at which starting and control devices for major plant items are located.			
	SWITCHBOARD	A distribution point at which switching devices are located.			
	USERDEFINED				
	NOTDEFINED				

Figure 53 Allowed IFC Type Object - Electric Distribution Board

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
				CHP	CHP: Combined heat and power supply, used not only as a source of electric energy but also as a heating source for the building. It may therefore be not only part of an electrical system but also of a heating system.
				ENGINEGENERATOR	ENGINEGENERATOR: Electrical generator with a fuel-driven engine, for example a diesel-driven emergency power supply.
				STANDALONE	STANDALONE: Electrical generator which does not include its source of kinetic energy, that is, a motor, engine, or turbine is modeled by a separate object.
				NOTDEFINED	Generic

Figure 54 Allowed IFC Type Object - Electric Generator

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
				DC	DC: A motor using either generated or rectified D.C. power.
				INDUCTION	INDUCTION: An alternating current motor in which the primary winding on one member (usually the stator) is connected to the power source and a secondary winding or a squirrel-cage secondary winding on the other member (usually the rotor) carries the induced current. There is no physical electrical connection to the secondary winding; its current is induced.
				POLYPHASE	POLYPHASE: A two or three-phase induction motor in which the windings, one for each phase, are evenly divided by the same number of electrical degrees.
				RELUCTANCESYNCHRONOUS	RELUCTANCESYNCHRONOUS: A synchronous motor with a special rotor design which directly lines the rotor up with the rotating magnetic field of the stator, allowing for no slip under load.
				SYNCHRONOUS	SYNCHRONOUS: A motor that operates at a constant speed up to full load. The rotor speed is equal to the speed of the rotating magnetic field of the stator; there is no slip.
				NOTDEFINED	Generic

Figure 55 Allowed IFC Type Object - Electric Motor

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController					
				TIMECLOCK	TIMECLOCK: A control that causes action to occur at set times
				TIMEDELAY	TIMEDELAY: A control that causes action to occur following a set duration
				RELAY	RELAY: Electromagnetically operated contactor for making or breaking a control circuit
				USERDEFINED	USERDEFINED: User-defined type
				NOTDEFINED	Generic

Figure 56 Allowed IFC Type Object - Electric Time Control

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
				USERDEFINED	Furnaces
				USERDEFINED	Fuel-Fired Heaters
				USERDEFINED	Heat Exchangers for HVAC
				USERDEFINED	Refrigerant Condensers
				USERDEFINED	Packaged Water Chillers
				USERDEFINED	Cooling Towers
				USERDEFINED	Evaporative Air-Cooling Equipment

Figure 57 Allowed IFC Type Object - Energy Conversion Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
			ENGINE	EXTERNALCOMBUSTION	EXTERNALCOMBUSTION: Combustion is external.
				INTERNALCOMBUSTION	INTERNALCOMBUSTION: Combustion is internal.
				NOTDEFINED	Generic

Figure 58 Allowed IFC Type Object - Engine

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice			EVAPORATIVECOOLER	DIRECTEVAPORATIVERANDOMMEDIAAIRCOOLER	DIRECT evaporative random media air cooler: Cools the air stream by evaporating water directly into the air stream using coolers with evaporative pads, usually of aspen wood or plastic fiber/foam.
				DIRECTEVAPORATIVERIGIDMEDIAAIRCOOLER	DIRECT evaporative rigid media air cooler: Cools the air stream by evaporating water directly into the air stream using coolers with sheets of rigid, corrugated material as the wetted surface.
				DIRECTEVAPORATIVESLINGERSPACKAGEDAIRCOOLER	DIRECT evaporative slingers packaged air cooler: Cools the air stream by evaporating water directly into the air stream using coolers with a water slinger in an evaporative cooling section and a fan section.
				DIRECTEVAPORATIVEPACKAGEDROTARYAIRCOOLER	DIRECT evaporative packaged rotary air cooler: Cools the air stream by evaporating water directly into the air stream using coolers that wet and wash the evaporative pad by rotating it through a water bath.
				DIRECTEVAPORATIVEAIRWASHER	DIRECT evaporative air washer: Cools the air stream by evaporating water directly into the air stream using coolers with spray-type air washers consist of a chamber or casing containing spray nozzles, and tank for collecting spray water, and an eliminator section for removing entrained moisture.
				INDIRECTEVAPORATIVEPACKAGEAIRCOOLER	INDIRECT evaporative package air cooler: Indirect evaporative package air cooler: Cools the air stream by evaporating water indirectly and without adding moisture into the air stream. On one side of the heat exchanger, the secondary air stream is cooled by evaporation, while on the other side of heat exchanger,
				INDIRECTEVAPORATIVEWETCOIL	INDIRECT evaporative wet coil: Indirect evaporative wet coil: Cools the air stream by evaporating water indirectly and without adding moisture into the air stream. Water is sprayed directly on the tubes of the heat exchanger where latent cooling takes place and the vaporization of the water on the outside of the heat exchanger.
				INDIRECTEVAPORATIVECOOLINGTOWERORCOOLINGCOIL	INDIRECT evaporative cooling tower or coil cooler: Cools the air stream by evaporating water indirectly and without adding moisture into the air stream using a combination of a cooling tower or other evaporative water cooler with a water-to-air heat exchanger coil and fan.
				INDIRECTDIRECTCOMBINATION	INDIRECT/DIRECT COMBINATION: Indirect/Direct combination: Cools the air stream by evaporating water indirectly and without adding moisture into the air stream using a two-stage cooler with a first-stage indirect evaporative cooler and second-stage direct evaporative cooler.
				NOTDEFINED	Generic

Figure 59 Allowed IFC Type Object - Evaporative Cooler

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice				DIRECTEXPANSION	DIRECTEXPANSION: Direct-expansion evaporator.
				DIRECTEXPANSIONSHELLANDTUBE	DIRECTEXPANSIONSHELLANDTUBE: Direct-expansion evaporator where a refrigerant evaporates inside a series of baffles that channel the fluid throughout the shell side.
				DIRECTEXPANSIONTUBEINTUBE	DIRECTEXPANSIONTUBEINTUBE: Direct-expansion evaporator where a refrigerant evaporates inside one or more pairs of coaxial tubes.
				DIRECTEXPANSIONBRAZEDPLATE	DIRECTEXPANSIONBRAZEDPLATE: Direct-expansion evaporator where a refrigerant evaporates inside plates brazed or welded together to make up an assembly of separate channels.
				FLOODEDSHELLANDTUBE	FLOODEDSHELLANDTUBE: Evaporator in which refrigerant evaporates outside tubes.
				SHELLANDCOIL	SHELLANDCOIL: Evaporator in which refrigerant evaporates inside a simple coiled tube immersed in the fluid to be cooled.
				NOTDEFINED	Generic

Figure 60 Allowed IFC Type Object - Evaporator

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTreatmentDevice				AIRPARTICLEFILTER	AIRPARTICLEFILTER: A filter used to remove particulates from air.
				COMPRESSEDAIRFILTER	COMPRESSEDAIRFILTER: A filter used to remove particulates from compressed air.
				ODORFILTER	ODORFILTER: A filter used to remove odors from air.
				OILFILTER	OILFILTER: A filter used to remove particulates from oil.
				STRAINER	STRAINER: A filter used to remove particulates from a fluid.
				WATERFILTER	WATERFILTER: A filter used to remove particulates from water.
				NOTDEFINED	Generic

Figure 61 Allowed IFC Type Object - Filter

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowMovingDevice				CENTRIFUGALFORWARDCURVED	CENTRIFUGALFORWARDCURVED: Air flows through the impeller radially using blades that are forward curved.
				CENTRIFUGALRADIAL	CENTRIFUGALRADIAL: Air flows through the impeller radially using blades that are uncurved or slightly forward curved.
				CENTRIFUGALBACKWARDINCLINEDCURVED	CENTRIFUGALBACKWARDINCLINEDCURVED: Air flows through the impeller radially using blades that are backward curved.
				CENTRIFUGALARFOIL	CENTRIFUGALARFOIL: Air flows through the impeller radially using blades are airfoil shaped.
				TUBEAXIAL	TUBEAXIAL: Air flows through the impeller axially with reduced tip clearance and operating at higher tip speeds.
				VANEAXIAL	VANEAXIAL: Air flows through the impeller axially with guide vanes and reduced running blade tip clearance.
				PROPELLORAXIAL	PROPELLORAXIAL: Air flows through the impeller axially and small hub-to-tip ratio impeller mounted in an orifice plate or inlet ring.
				NOTDEFINED	Generic

Figure 62 Allowed IFC Type Object - Fan

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController					
				USERDEFINED	Facility Lightning Protection
				USERDEFINED	Circuit
				USERDEFINED	Switch

Figure 63 Allowed IFC Type Object - Flow Controller

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTreatmentDevice				BREECHINGINLET	BREECHINGINLET: Symmetrical pipe fitting that unites two or more inlets into a single pipe (BS6100 330 114 adapted). A breeching inlet may be used on either a wet or dry riser. Used by fire services personnel for fast connection of fire appliance hose reels. May also be used for foam.
				FIREHYDRANT	FIREHYDRANT: Device, fitted to a pipe, through which a temporary supply of water may be provided (BS6100 330 6107). May also be termed a stand pipe.
				HOSEREEL	HOSEREEL: A supporting framework on which a hose may be wound (BS6100 155 8201).
				SPRINKLER	SPRINKLER: Device for sprinkling water from a pipe under pressure over an area (BS6100 100 3432).
				SPRINKLERDEFLECTOR	SPRINKLERDEFLECTOR: Device attached to a sprinkler to deflect the water flow into a spread pattern to cover the required area.
				NOTDEFINED	Generic
				USERDEFINED	Fire Extinguishers
				USERDEFINED	Fire Pumps

Figure 64 Allowed IFC Type Object - Fire Suppression Terminal

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
ProxyElement					
				ENERGYMETER	ENERGYMETER: An electric meter or energy meter is a device that measures the amount of electrical energy supplied to or produced by a residence, business or machine.
				GASMETER	GASMETER: A device that measures the quantity of a gas or fuel.
				OILMETER	OILMETER: A device that measures the quantity of oil.
				WATERMETER	WATERMETER: A device that measures the quantity of water.
				NOTDEFINED	Generic

Figure 65 Allowed IFC Type Object - Flow Meter

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
ProxyElement				PRESSUREGAUGE	PRESSUREGAUGE: devices used for measuring the pressure of a gas or liquid
				THERMOMETER	THERMOMETER: devices used for measuring the temperature of a gas or liquid
				AMMETER	AMMETER: a measuring instrument used to measure the electric current in a circuit
				FREQUENCYMETER	FREQUENCYMETER: device for measuring the repetitions per unit of time
				POWERFACTORMETER	POWERFACTORMETER: measures the electrical power circulating in any electric circuit
				PHASEANGLEMETER	PHASEANGLEMETER: device verifies phase angle for appropriate application such as installation of equipment, load and power studies, synchronization of equipment
				VOLTMETER_PEAK	VOLTMETER_PEAK: a measuring instrument used to measure the peak electric potential between two points in a circuit
				VOLTMETER_RMS	VOLTMETER_RMS: a measuring instrument used to measure the average electric potential between two points in a circuit
				NOTDEFINED	Generic

Figure 66 Allowed IFC Type Object - Flow Instrument

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowFitting				CYCLONIC	CYCLONIC: Removes larger liquid drops or larger solid particles.
				GREASE	GREASE: Chamber, on the line of a drain or discharge pipe, that prevents grease passing into a drainage system (BS6100 330 6205).
				OIL	OIL: One or more chambers arranged to prevent the ingress of oil to a drain or sewer, that retain the oil for later removal (BS6100 330 67316).
				PETROL	PETROL: Two or more chambers with inlet and outlet pipes arranged to allow petrol/gasoline collected on the surface of water drained into them to evaporate through ventilating pipes.
				NOTDEFINED	Generic

Figure 67 Allowed IFC Type Object - Interceptor

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FurnishingElement			BED		BED: Furniture for sleeping.
			CHAIR		CHAIR: Furniture for seating a single person.
			DESK		DESK: Furniture with a countertop and optional drawers for a single person.
			FILECABINET		FILECABINET: Furniture with sliding drawers for storing files.
			SHELF		SHELF: Furniture for storing books or other items.
			SHELF		Library Stack Systems
			SHELF		Metal Lockers
			SHELF		Wood Lockers
			SHELF		Plastic Lockers
			SHELF		Central Mail Delivery Boxes
			SHELF		Mail Collection Boxes
			SHELF		Mail Boxes
			SHELF		Parcel Lockers
			SHELF		Metal Storage Shelving
			SHELF		Mobile Storage Shelving
			SHELF		Mail Sorting Casework
			SOFA		SOFA: Furniture for seating multiple people.
			TABLE		TABLE: Furniture with a countertop for multiple people.
			USERDEFINED		Visual Display Conference Units
			USERDEFINED		Electronic Directories
			USERDEFINED		Electronic Message Signage
			USERDEFINED		Manufactured Fireplaces
			USERDEFINED		Manufactured Fireplace Chimneys
			USERDEFINED		Unit Kitchens
			USERDEFINED		Book Depositories

Figure 68 Allowed IFC Type Object - Furniture

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
			FURNITURE	USERDEFINED	Projection Screens
				USERDEFINED	Chalkboards
				USERDEFINED	Markerboards
				USERDEFINED	Tackboards
				USERDEFINED	Display Cases
				USERDEFINED	Directories
				USERDEFINED	Plaques
				USERDEFINED	Dimensional Letter Signage
				USERDEFINED	Panel Signage
				USERDEFINED	Post and Panel or Pylon Signage
				USERDEFINED	Telephone Enclosures
				USERDEFINED	Fire Extinguisher Cabinets
				USERDEFINED	Mail Chutes
				USERDEFINED	Wardrobe and Closet Specialties
				USERDEFINED	Residential Casework
				USERDEFINED	Laboratory Casework
				USERDEFINED	Furnishing Accessories
				USERDEFINED	Entrance Floor Mats and Frames
				USERDEFINED	Entrance Floor Grilles
				USERDEFINED	Case Goods
				USERDEFINED	Seating
				USERDEFINED	Library Furniture
				USERDEFINED	Systems Furniture
				USERDEFINED	Fixed Audience Seating
				USERDEFINED	Telescoping Bleachers
				USERDEFINED	Interior Planters and Artificial Plants
				USERDEFINED	Swimming Pools

(Figure cont.) Allowed IFC Type Object - Furniture

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
				USERDEFINED	Fire Suppression
				USERDEFINED	Common Work Results for Fire Suppression
				USERDEFINED	Architectural Wood Casing

(Figure cont.) Allowed IFC Type Object - Furniture

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FurnishingElement					
			SYSTEMFURNITUREELEMENT	NOTDEFINED	Generic
				PANEL	PANEL: Vertical panel used to divide work spaces.
				WORKSURFACE	WORKSURFACE: Workstation countertop.

Figure 69 Allowed IFC Type Object - System Furniture Element

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
			HEATEXCHANGER	PLATE	PLATE: Plate heat exchanger.
				SHELLANDTUBE	SHELLANDTUBE: Shell and Tube heat exchanger.
				NOTDEFINED	Generic

Figure 70 Allowed IFC Type Object - Heat Exchanger

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTreatmentDevice					
				STEAMINJECTION	STEAMINJECTION: Water vapor is added into the airstream through direction steam injection.
				ADIABATICAIRWASHER	ADIABATICAIRWASHER: Water vapor is added into the airstream through adiabatic evaporation using an air washing element.
				ADIABATICPAN	ADIABATICPAN: Water vapor is added into the airstream through adiabatic evaporation using a pan.
				ADIABATICWETTEDELEMENT	ADIABATICWETTEDELEMENT: Water vapor is added into the airstream through adiabatic evaporation using a wetted element.
				ADIABATICATOMIZING	ADIABATICATOMIZING: Water vapor is added into the airstream through adiabatic evaporation using an atomizing element.
				ADIABATICULTRASONIC	ADIABATICULTRASONIC: Water vapor is added into the airstream through adiabatic evaporation using an ultrasonic element.
				ADIABATICRIGIDMEDIA	ADIABATICRIGIDMEDIA: Water vapor is added into the airstream through adiabatic evaporation using a rigid media.
				ADIABATICCOMPRESSEDAIRNOZZLE	ADIABATICCOMPRESSEDAIRNOZZLE: Water vapor is added into the airstream through adiabatic evaporation using a compressed air nozzle.
				ASSISTEDELECTRIC	ASSISTEDELECTRIC: Water vapor is added into the airstream through water heated evaporation using an electric heater.
				ASSISTEDNATURALGAS	ASSISTEDNATURALGAS: Water vapor is added into the airstream through water heated evaporation using a natural gas heater.
				ASSISTEDPROPANE	ASSISTEDPROPANE: Water vapor is added into the airstream through water heated evaporation using a propane heater.
				ASSISTEDBUTANE	ASSISTEDBUTANE: Water vapor is added into the airstream through water heated evaporation using a butane heater.
				ASSISTEDSTEAM	ASSISTEDSTEAM: Water vapor is added into the airstream through water heated evaporation using a steam heater.
				NOTDEFINED	Generic
				USERDEFINED	Humidity Control Equipment

Figure 71 Allowed IFC Type Object - Humidifier

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowFitting					
			JUNCTIONBOX	POWER	POWER: Contains cables, outlets, and/or switches for electrical power.
				DATA	DATA: Contains cables, outlets, and/or switches for communications use.
				NOTDEFINED	Generic

Figure 72 Allowed IFC Type Object - Junction Box

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal					
			LAMP	COMPACTFLUORESCENT	COMPACTFLUORESCENT: A fluorescent lamp having a compact form factor produced by shaping the tube.
				FLUORESCENT	FLUORESCENT: A typically tubular discharge lamp in which most of the light is emitted by one or several layers of phosphors excited by ultraviolet radiation from the discharge.
				HALOGEN	HALOGEN: an incandescent lamp in which a tungsten filament is sealed into a compact transport envelope filled with an inert gas and a small amount of halogen such as iodine or bromine.
				HIGHPRESSUREMERCURY	HIGHPRESSUREMERCURY: A discharge lamp in which most of the light is emitted by exciting mercury at high pressure.
				HIGHPRESSURESODIUM	HIGHPRESSURESODIUM: A discharge lamp in which most of the light is emitted by exciting sodium at high pressure.
				LED	LED: a solid state lamp that uses light-emitting diodes as the source of light.
				METALHALIDE	METALHALIDE: A discharge lamp in which most of the light is emitted by exciting a metal halide.
				OLED	OLED: a solid state lamp that uses light-emitting diodes as the source of light whose emissive electroluminescent layer is composed of a film of organic compounds.
				TUNGSTENFILAMENT	TUNGSTENFILAMENT: A lamp that emits light by passing an electrical current through a tungsten wire filament in a near vacuum.
				NOTDEFINED	Generic

Figure 73 Allowed IFC Type Object - Lamp

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal					
			POINTSOURCE	POINTSOURCE	POINTSOURCE: A light fixture that is considered to have negligible area and that emit light with approximately equal intensity in all directions. A light fixture containing a tungsten, halogen or similar bulb is an example of a point source.
			DIRECTIONSOURCE	DIRECTIONSOURCE	DIRECTIONSOURCE: A light fixture that is considered to have a length or surface area from which it emits light in a direction. A light fixture containing one or more fluorescent lamps is an example of a direction source.
			SECURITYLIGHTING	SECURITYLIGHTING	SECURITYLIGHTING: A light fixture having specific purpose of directing occupants in an emergency, such as an illuminated exit sign or emergency flood light.
			NOTDEFINED	NOTDEFINED	Generic
			USERDEFINED	USERDEFINED	Loading Dock Lights

Figure 74 Allowed IFC Type Object - Light Fixture

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal					
			AIRSTATION	AIRSTATION	AIRSTATION: Device that provides purified medical air, composed of an air compressor and air treatment line.
			FEEDAIRUNIT	FEEDAIRUNIT	FEEDAIRUNIT: Device that feeds air to an oxygen generator, composed of an air compressor, air treatment line, and an air receiver.
			OXYGENGENERATOR	OXYGENGENERATOR	OXYGENGENERATOR: Device that generates oxygen from air.
			OXYGENPLANT	OXYGENPLANT	OXYGENPLANT: Device that combines a feed air unit, oxygen generator, and backup oxygen cylinders.
			VACUUMSTATION	VACUUMSTATION	VACUUMSTATION: Device that provides suction, composed of a vacuum pump and bacterial filtration line.
			NOTDEFINED	NOTDEFINED	Generic

Figure 75 Allowed IFC Type Object - Medical Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
			MOTORCONNECTION	BELTDRIVE	BELTDRIVE: An indirect connection made through the medium of a shaped, flexible continuous loop.
				COUPLING	COUPLING: An indirect connection made through the medium of the viscosity of a fluid.
				DIRECTDRIVE	DIRECTDRIVE: A direct, physical connection made between the motor and the driven device.
				NOTDEFINED	Generic

Figure 76 Allowed IFC Type Object - Motor Connection

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal					
			OUTLET	AUDIOVISUALOUTLET	AUDIOVISUALOUTLET: An outlet used for an audio or visual device.
				COMMUNICATIONSOUTLET	COMMUNICATIONSOUTLET: An outlet used for connecting communications equipment.
				POWEROUTLET	POWEROUTLET: An outlet used for connecting electrical devices requiring power.
				DATAOUTLET	DATAOUTLET: An outlet used for connecting data communications equipment.
				TELEPHONEOUTLET	TELEPHONEOUTLET: An outlet used for connecting telephone communications equipment.
				NOTDEFINED	Generic

Figure 77 Allowed IFC Type Object - Outlet

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController					
			CIRCUITBREAKER	CIRCUITBREAKER	CIRCUITBREAKER: A mechanical switching device capable of making, carrying, and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking, current under specified abnormal circuit conditions such as those of short circuit.
			EARTHEAKAGECIRCUITBREAKER	EARTHEAKAGECIRCUITBREAKER	EARTHEAKAGECIRCUITBREAKER: A device that opens, closes, or isolates a circuit and has short circuit protection but no overload protection. It attempts to break the circuit when there is a leakage of current from phase to earth, by measuring voltage on the earth conductor.
			EARTHINGSWITCH	EARTHINGSWITCH	EARTHINGSWITCH: A safety device used to open or close a circuit when there is no current. Used to isolate a part of a circuit, a machine, a part of an overhead line or an underground line so that maintenance can be safely conducted.
			FUSEDISCONNECTOR	FUSEDISCONNECTOR	FUSEDISCONNECTOR: A device that will electrically open the circuit after a period of prolonged, abnormal current flow.
			RESIDUALCURRENTCIRCUITBREAKER	RESIDUALCURRENTCIRCUITBREAKER	RESIDUALCURRENTCIRCUITBREAKER: A device that opens, closes, or isolates a circuit and has short circuit and overload protection. It attempts to break the circuit when there is a difference in current between any two phases. May also be referred to as 'Ground Fault Interrupter (GFI)' or 'Ground Fault Circuit Interruptor (GFCI)'
			RESIDUALCURRENTSWITCH	RESIDUALCURRENTSWITCH	RESIDUALCURRENTSWITCH: A device that opens, closes or isolates a circuit and has no short circuit or overload protection. May also be identified as a 'ground fault switch'.
			VARISTOR	VARISTOR	VARISTOR: A high voltage surge protection device.
			NOTDEFINED	NOTDEFINED	Generic
			USERDEFINED	USERDEFINED	Distribution Panel

Figure 78 Allowed IFC Type Object - Protective Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController					
			PROTECTIVEDEVICETRIPPINGUNIT	ELECTRONIC	ELECTRONIC: A tripping unit activated by electronic action.
				ELECTROMAGNETIC	ELECTROMAGNETIC: A tripping unit activated by electromagnetic action.
				RESIDUALCURRENT	RESIDUALCURRENT: A tripping unit activated by residual current detection.
				THERMAL	THERMAL: A tripping unit activated by thermal action.
				NOTDEFINED	Generic

Figure 79 Allowed IFC Type Object - Protective Device Tripping Unit

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowMovingDevice					
			PUMP	CIRCULATOR	CIRCULATOR: A Circulator pump is a generic low-pressure, low-capacity pump. It may have a wet rotor and may be driven by a flexible-coupled motor.
				ENDSUCTION	ENDSUCTION: An End Suction pump, when mounted horizontally, has a single horizontal inlet on the impeller suction side and a vertical discharge. It may have a direct or close-coupled motor.
				SPLITCASE	SPLITCASE: A Split Case pump, when mounted horizontally, has an inlet and outlet on each side of the impeller. The impeller can be easily accessed by removing the front of the impeller casing. It may have a direct or close-coupled motor.
				SUBMERSIBLEPUMP	SUBMERSIBLEPUMP: A pump designed to be immersed in a fluid, typically a collection tank.
				SUMPPUMP	SUMPPUMP: A pump designed to sit above a collection tank with a suction inlet extending into the tank.
				VERTICALINLINE	VERTICALINLINE: A Vertical Inline pump has the pump and motor close-coupled on the pump casing. The pump depends on the connected, horizontal piping for support, with the suction and discharge along the piping axis.
				VERTICALTURBINE	VERTICALTURBINE: A Vertical Turbine pump has a motor mounted vertically on the pump casing for either wet-pit sump mounting or dry-well mounting.
				NOTDEFINED	Generic

Figure 80 Allowed IFC Type Object - Pump

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
Roof					
				BARREL_ROOF	BARREL_ROOF: A roof or ceiling having a semicylindrical form.
				BUTTERFLY_ROOF	BUTTERFLY_ROOF: A roof having two slopes, each descending inward from the eaves.
				DOME_ROOF	DOME_ROOF: A hemispherical hip roof.
				FLAT_ROOF	FLAT_ROOF: A roof having no slope, or one with only a slight pitch so as to drain rainwater.
				FREEFORM	FREEFORM: Free form roof
				GABLE_ROOF	A roof sloping downward in two parts from a central ridge, so as to form a gable at each end.
				GAMBREL_ROOF	GAMBREL_ROOF: A ridged roof divided on each side into a shallower slope above a steeper one.
				HIP_ROOF	HIP_ROOF: A roof having sloping ends and sides meeting at an inclined projecting angle.
				HIPPED_GABLE_ROOF	HIPPED_GABLE_ROOF: A roof having a hipped end truncating a gable.
				MANSARD_ROOF	MANSARD_ROOF: A roof having on each side a steeper lower part and a shallower upper part.
				NOTDEFINED	Generic
				PAVILION_ROOF	PAVILION_ROOF: A pyramidal hip roof.
				RAINBOW_ROOF	RAINBOW_ROOF: A gable roof in the form of a broad Gothic arch, with gently sloping convex surfaces.
				SHED_ROOF	SHED_ROOF: A roof having a single slope.
				USERDEFINED	Metal Roof Panels

Figure 81 Allowed IFC Type Object - Roof

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal					
			SANITARYTERMINAL	BATH	BATH: Sanitary appliance for immersion of the human body or parts of it.
				BIDET	BIDET: Waste water appliance for washing the excretory organs while sitting astride the bowl.
				CISTERN	CISTERN: A water storage unit attached to a sanitary terminal that is fitted with a device, operated automatically or by the user, that discharges water to cleanse a water closet (toilet) pan, urinal or slop hopper.
				SHOWER	SHOWER: Installation or waste water appliance that emits a spray of water to wash the human body.
				SINK	SINK: Waste water appliance for receiving, retaining or disposing of domestic, culinary, laboratory or industrial process liquids.
				SANITARYFOUNTAIN	SANITARYFOUNTAIN: A sanitary terminal that provides a low pressure jet of water for a specific purpose.
				TOILETPAN	TOILETPAN: Soil appliance for the disposal of excrement.
				URINAL	URINAL: Soil appliance that receives urine and directs it to a waste outlet (BS6100).
				WASHHANDBASIN	WASHHANDBASIN: Waste water appliance for washing the upper parts of the body.
				WCSEAT	WCSEAT: [Deprecated] Hinged seat that fits on the top of a water closet (WC) pan.
				NOTDEFINED	Generic

Figure 82 Allowed IFC Type Object - Sanitary Terminal

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
DistributionControlElement					
				CONDUCTANCESENSOR	CONDUCTANCESENSOR: A device that senses or detects electrical conductance.
				CONTACTSENSOR	CONTACTSENSOR: A device that senses or detects contact, such as for detecting if a door is closed.
				FIRESENSOR	FIRESENSOR: A device that senses or detects fire.
				FLOWSENSOR	FLOWSENSOR: A device that senses or detects flow in a fluid.
				GASSENSOR	GASSENSOR: A device that senses or detects gas concentration.
				HEATSENSOR	HEATSENSOR: A device that senses or detects heat.
				HUMIDITYSENSOR	HUMIDITYSENSOR: A device that senses or detects humidity.
				IONCONCENTRATIONSENSOR	IONCONCENTRATIONSENSOR: A device that senses or detects ion concentration, such as for water hardness.
				LEVELSENSOR	LEVELSENSOR: A device that senses or detects fill level, such as for a tank.
				LIGHTSENSOR	LIGHTSENSOR: A device that senses or detects light.
				MOISTURESENSOR	MOISTURESENSOR: A device that senses or detects moisture.
				MOVEMENTSENSOR	MOVEMENTSENSOR: A device that senses or detects movement.
				PHSENSOR	PHSENSOR: A device that senses or detects acidity.
				PRESSURESENSOR	PRESSURESENSOR: A device that senses or detects pressure.
				RADIATIONSENSOR	RADIATIONSENSOR: A device that senses or detects electromagnetic radiation.
				RADIOACTIVITYSENSOR	RADIOACTIVITYSENSOR: A device that senses or detects atomic decay.
				SMOKESENSOR	SMOKESENSOR: A device that senses or detects smoke.
				SOUNDSENSOR	SOUNDSENSOR: A device that senses or detects sound.
				TEMPERATURESENSOR	TEMPERATURESENSOR: A device that senses or detects temperature.
				WINDSENSOR	WINDSENSOR: A device that senses or detects airflow speed and direction.
				NOTDEFINED	Generic

Figure 83 Allowed IFC Type Object - Sensor

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
BuildingElementPart					
			SHADINGDEVICE	AWNING	
				JALOUSIE	no definition provided 2x4
				NOTDEFINED	Generic
				SHUTTER	no definition provided 2x6
				USERDEFINED	Decorative Metal
				USERDEFINED	Security Window Screens
				USERDEFINED	Fixed Louvers
				USERDEFINED	Louvered Equipment Enclosures
				USERDEFINED	Awnings
				USERDEFINED	Bird Control Devices

Figure 84 Allowed IFC Type Object - Shading Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
			SOLARDEVICE	SOLARCOLLECTOR	SOLARCOLLECTOR: A device that converts solar radiation into thermal energy (heating water, etc.).
				SOLARPANEL	SOLARPANEL: A device that converts solar radiation into electric current.
				NOTDEFINED	Generic

Figure 85 Allowed IFC Type Object - Solar Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
			SPACEHEATER	CONVECTOR	CONVECTOR: A heat-distributing unit that operates with gravity-circulated air.
				RADIATOR	RADIATOR: A heat-distributing unit that operates with thermal radiation.
				NOTDEFINED	Generic

Figure 86 Allowed IFC Type Object - Space Heater

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal					
			STACKTERMINAL	BIRDCAGE	BIRDCAGE: Guard cage, typically wire mesh, at the top of the stack preventing access by birds.
				COWL	COWL: A cowling placed at the top of a stack to eliminate downdraft.
				RAINWATERHOPPER	RAINWATERHOPPER: A box placed at the top of a rainwater downpipe to catch rainwater from guttering.
				NOTDEFINED	Generic

Figure 87 Allowed IFC Type Object - Stack Terminal

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController					
			SWITCHINGDEVICE	CONTACTOR	CONTACTOR: An electrical device used to control the flow of power in a circuit on or off.
				DIMMERSWITCH	DIMMERSWITCH: A dimmer switch has variable positions, and may adjust electrical power or other setting (according to the switched port type).
				EMERGENCYSTOP	EMERGENCYSTOP: An emergency stop device acts to remove as quickly as possible any danger that may have arisen unexpectedly.
				KEYPAD	KEYPAD: A set of buttons or switches, each potentially applicable to a different device.
				MOMENTARYSWITCH	MOMENTARYSWITCH: A momentary switch has no position, and may trigger some action to occur.
				SELECTORSWITCH	SELECTORSWITCH: A selector switch has multiple positions, and may change the source or level of power or other setting (according to the switched port type).
				STARTER	STARTER: A starter is a switch which in the closed position controls the application of power to an electrical device.
				SWITCHDISCONNECTOR	SWITCHDISCONNECTOR: A switch disconnector is a switch which in the open position satisfies the isolating requirements specified for a disconnector.
				TOGLESWITCH	TOGLESWITCH: A toggle switch has two positions, and may enable or isolate electrical power or other setting (according to the switched port type).
				NOTDEFINED	Generic
				USERDEFINED	Outlet

Figure 88 Allowed IFC Type Object - Switching Device

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
ProxyElement			CHEMICAL	CHEMICAL	CHEMICAL: Arbitrary chemical further qualified by property set, such as for medical or industrial use.
			CHILLEDWATER	CHILLEDWATER	CHILLEDWATER: Nonpotable chilled water, such as circulated through an evaporator.
			COMPRESSEDAIR	COMPRESSEDAIR	COMPRESSEDAIR: Compressed air system.
			CONDENSERWATER	CONDENSERWATER	CONDENSERWATER: Nonpotable water, such as circulated through a condenser.
			DOMESTICCOLDWATER	DOMESTICCOLDWATER	DOMESTICCOLDWATER: Unheated potable water distribution system.
			DOMESTICHOTWATER	DOMESTICHOTWATER	DOMESTICHOTWATER: Heated potable water distribution system.
			DRAINAGE	DRAINAGE	DRAINAGE: Drainage collection system.
			FIREPROTECTION	FIREPROTECTION	FIREPROTECTION: Fire protection sprinkler system.
			GAS	GAS	GAS: Methane distribution system.
			HAZARDOUS	HAZARDOUS	HAZARDOUS: Hazardous material or fluid collection system.
			HEATING	HEATING	HEATING: Heated water distribution system.
			OIL	OIL	OIL: Oil distribution system.
			RAINWATER	RAINWATER	RAINWATER: Rainwater resulting from precipitation which directly falls on a parcel.
			REFRIGERATION	REFRIGERATION	REFRIGERATION: Refrigerant distribution system for purposes of fulfilling all or parts of a refrigeration cycle.
			SEWAGE	SEWAGE	SEWAGE: Sewage collection system.
			STORMWATER	STORMWATER	STORMWATER: Stormwater resulting from precipitation which runs off or travels over the ground surface.
			VACUUM	VACUUM	VACUUM: Vacuum distribution system.
			VENT	VENT	VENT: Vent system for wastewater piping systems.
			WASTE	WASTE	WASTE: Waste collection system.
			AIRCONDITIONING	AIRCONDITIONING	AIRCONDITIONING: Conditioned air distribution system for purposes of maintaining a temperature range within one or more spaces.
			EXHAUST	EXHAUST	EXHAUST: Exhaust air collection system for removing stale or noxious air from one or more spaces.
			VENTILATION	VENTILATION	VENTILATION: Ventilation air distribution system involved in either the exchange of air to the outside as well as circulation of air within a building.
			AUDIOVISUAL	AUDIOVISUAL	AUDIOVISUAL: A transport of a single media source, having audio and/or video streams.

Figure 89 Allowed IFC Type Object - System

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
SYSTEM	CONTROL	CONTROL: A transport or network dedicated to control system usage.			
	DATA	DATA: A network having general-purpose usage.			
	ELECTRICAL	ELECTRICAL: A circuit for delivering electrical power.			
	ELECTROACOUSTIC	ELECTROACOUSTIC: An amplified audio signal such as for loudspeakers.			
	LIGHTING	LIGHTING: A circuit dedicated for lighting, such as a fixture having sockets for lamps.			
	LIGHTNINGPROTECTION	LIGHTNINGPROTECTION: A path for conducting lightning current to the ground.			
	POWERGENERATION	POWERGENERATION: A path for power generation.			
	SECURITY	SECURITY: A transport or network dedicated to security system usage.			
	SIGNAL	SIGNAL: A raw analog signal, such as modulated data or measurements from sensors.			
	TELEPHONE	TELEPHONE: A transport or network dedicated to telephone system usage.			
	TV	TV: A transport of multiple media sources (e.g. analog cable, satellite, over-the-air).			
	NOTDEFINED	Generic			
	USERDEFINED	Fire Detection and Alarm			
	USERDEFINED	Plumbing			
	USERDEFINED	Facility Water Distribution			
	USERDEFINED	Domestic Water Pumps			
	USERDEFINED	Plumbing Equipment			
	USERDEFINED	Plumbing Fixtures			
	USERDEFINED	Compressed-Air Systems for Laboratory and Healthcare Facilities			
	USERDEFINED	Gas Systems for Laboratory and Healthcare Facilities			
	USERDEFINED	Heating Ventilating and Air-Conditioning (HVAC)			
	USERDEFINED	Instrumentation and Control for HVAC			
	USERDEFINED	Facility Fuel-Oil Piping			
	USERDEFINED	Facility Natural-Gas Piping			
	USERDEFINED	HVAC Piping and Pumps			
	USERDEFINED	Steam and Condensate Heating Piping			

(Figure cont.) Allowed IFC Type Object - System

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
				USERDEFINED	Refrigerant Piping
				USERDEFINED	HVAC Air Distribution
				USERDEFINED	HVAC Ducts and Casings
				USERDEFINED	Decentralized Unitary HVAC Equipment
				USERDEFINED	Convection Heating and Cooling Units
				USERDEFINED	Integrated Automation
				USERDEFINED	Electrical
				USERDEFINED	Lighting Control Devices
				USERDEFINED	Medium-Voltage Electrical Distribution
				USERDEFINED	Low-Voltage Electrical Transmission
				USERDEFINED	Packaged Generator Assemblies
				USERDEFINED	Battery Equipment
				USERDEFINED	Static Power Converters
				USERDEFINED	Interior Lighting
				USERDEFINED	Exterior Lighting
				USERDEFINED	Communications
				USERDEFINED	Voice Communications
				USERDEFINED	Audio-Video Systems
				USERDEFINED	Public Address and Mass Notification Systems
				USERDEFINED	Sound Masking Systems
				USERDEFINED	Electronic Safety and Security
				USERDEFINED	Intrusion Detection
				USERDEFINED	Irrigation

(Figure cont.) Allowed IFC Type Object - System

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
				USERDEFINED	Water Utilities
				USERDEFINED	Wells
				USERDEFINED	Sanitary Sewerage Utilities
				USERDEFINED	Storm Drainage Utilities
				USERDEFINED	Natural-Gas Distribution
				USERDEFINED	Fuel-Storage Tanks
				USERDEFINED	Electrical Underground Ducts and Manholes
				USERDEFINED	Communications Underground Ducts Manholes and Handholes
				USERDEFINED	Cranes and Hoists

(Figure cont.) Allowed IFC Type Object - System

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
			TRANSFORMER	CURRENT	CURRENT: A transformer that changes the current between circuits.
				FREQUENCY	FREQUENCY: A transformer that changes the frequency between circuits.
				INVERTER	INVERTER: A transformer that converts from direct current (DC) to alternating current (AC).
				RECTIFIER	RECTIFIER: A transformer that converts from alternating current (AC) to direct current (DC).
				VOLTAGE	VOLTAGE: A transformer that changes the voltage between circuits.
				NOTDEFINED	Generic

Figure 90 Allowed IFC Type Object - Transformer

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
DistributionFlowElement					
			BASIN	BASIN	BASIN: An arbitrary open tank type.
			BREAKPRESSURE	BREAKPRESSURE	BREAKPRESSURE: An open container that breaks the hydraulic pressure in a distribution system, typically located between the fluid reservoir and the fluid supply points. A typical break pressure tank allows the flow to discharge into the atmosphere, thereby reducing its hydrostatic pressure to zero.
			EXPANSION	EXPANSION	EXPANSION: A closed container used in a closed fluid distribution system to mitigate the effects of thermal expansion or water hammer. The tank is typically constructed with a diaphragm dividing the tank into two sections, with fluid on one side of the diaphragm and air on the other. One example application is when connected to the primary circuit of a hot water system to accommodate the increase in volume of the water when heated.
			FEEDANDEXPANSION	FEEDANDEXPANSION	FEEDANDEXPANSION: An open tank that is used for both storage and thermal expansion. A typical example is a tank used to store make-up water at ambient pressure for supply to a hot water system, simultaneously accommodating increases in volume of the water when heated.
			PRESSUREVESSEL	PRESSUREVESSEL	PRESSUREVESSEL: A closed container used for storing fluids or gases at a pressure different from the ambient pressure. A pressure vessel is typically rated by an authority having jurisdiction for the operational pressure.
			STORAGE	STORAGE	STORAGE: An open or closed container used for storing a fluid at ambient pressure and from which it can be supplied to the fluid distribution system. There are many examples of storage tanks, such as potable water storage tanks, fuel storage tanks, etc.
			VESSEL	VESSEL	VESSEL: An arbitrary closed tank type.
			NOTDEFINED	NOTDEFINED	Generic

Figure 91 Allowed IFC Type Object - Tank

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
ProxyElement					
TRANSPORTELEMENT			ELEVATOR	Dumbwaiters	
			ELEVATOR	Electric Traction Elevators	
			ELEVATOR	Hydraulic Elevators	
			ELEVATOR	Limited-Use and Limited-Application Elevators	
			ESCALATOR	Escalators	
			MOVINGWALKWAY	Moving Walks	
			USERDEFINED	Wheelchair Lifts	
			USERDEFINED	Platform Lifts	
			USERDEFINED	Laundry and Linen Chutes	
			USERDEFINED	Trash Chutes	
			USERDEFINED	Stationary Loading Dock Equipment	
			USERDEFINED	Portable Dock Equipment	
			ESCALATOR	ESCALATOR: Escalator being a transport device to move people. It consists of individual linked steps that move up and down on tracks while keeping the threads horizontal.	
			MOVINGWALKWAY	MOVINGWALKWAY: Moving walkway being a transport device to move people horizontally or on an incline. It is a slow conveyor belt that transports people.	
			ELEVATOR	ELEVATOR: Elevator or lift being a transport device to move people of good vertically.	
			NOTDEFINED	Generic	
			CRANEWAY	CRANEWAY: A crane way system, normally including the crane rails, fasteners and the crane. It is primarily used to move heavy goods in a factory or other industry buildings.	
			LIFTINGGEAR	LIFTINGGEAR: A device used for lifting or lowering heavy goods. It may be manually operated or electrically or pneumatically driven.	

Figure 92 Allowed IFC Type Object - Transport Element

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
DistributionFlowElement					
			TUBEBUNDLE	FINNED NOTDEFINED	FINNED: Finned tube bundle type. Generic

Figure 93 Allowed IFC Type Object - Tube Bundle

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController					
			UNITARYCONTROLELEMENT	ALARMPANEL CONTROLPANEL GASDETECTIONPANEL INDICATORPANEL MIMICPANEL HUMIDISTAT THERMOSTAT WEATHERSTATION NOTDEFINED	ALARMPANEL: A control element at which alarms are annunciated. CONTROLPANEL: A control element at which devices that control or monitor the operation of a site, building or part of a building are located. GASDETECTIONPANEL: A control element at which the detection of gas is annunciated. INDICATORPANEL: A control element at which equipment operational status, condition, safety state or other required parameters are indicated. MIMICPANEL: A control element at which information that is available elsewhere is repeated or 'mimicked'. HUMIDISTAT: A control element that senses and regulates the humidity of a system or space so that the humidity is maintained near a desired setpoint. THERMOSTAT: A control element that senses and regulates the temperature of an element, system or space so that the temperature is maintained near a desired setpoint. WEATHERSTATION: A control element that senses multiple climate properties such as temperature, humidity, pressure, wind, and rain. Generic

Figure 94 Allowed IFC Type Object - Unitary Control Element

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
EnergyConversionDevice					
			AIRHANDLER		AIRHANDLER: A unitary air handling unit typically containing a fan, economizer, and coils.
			AIRCONDITIONINGUNIT		AIRCONDITIONINGUNIT: A unitary packaged air-conditioning unit typically used in residential or light commercial applications.
			DEHUMIDIFIER		DEHUMIDIFIER: A unitary packaged dehumidification unit. Note: units supporting multiple modes (dehumidification, cooling, and/or heating) should use AIRCONDITIONINGUNIT.
			SPLITSYSTEM		SPLITSYSTEM: A system which separates the compressor from the evaporator, but acts as a unitary component typically within residential or light commercial applications.
			ROOFTOPUNIT		ROOFTOPUNIT: A packaged assembly that is either field-erected or manufactured atop the roof of a large residential or commercial building and acts as a unitary component.
			NOTDEFINED		Generic

Figure 95 Allowed IFC Type Object - Unitary Equipment

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowController			AIRRELEASE		AIRRELEASE: Valve used to release air from a pipe or fitting.
			ANTIVACUUM		ANTIVACUUM: Valve that opens to admit air if the pressure falls below atmospheric pressure (BS6100 330 4104)
			CHANGEOVER		CHANGEOVER: Valve that enables flow to be switched between pipelines (3 or 4 port).
			CHECK		CHECK: Valve that permits water to flow in one direction only and is enclosed when there is no flow (2 port).
			COMMISSIONING		COMMISSIONING: Valve used to facilitate commissioning of a system (2 port).
			DIVERTING		DIVERTING: Valve that enables flow to be diverted from one branch of a pipeline to another (3 port).
			DRAWOFFCOCK		DRAWOFFCOCK: A valve used to remove fluid from a piping system.
			DOUBLECHECK		DOUBLECHECK: An assembly that incorporates two valves used to prevent backflow (BS6100 330 4106).
			DOUBLEREGULATING		DOUBLEREGULATING: Valve used to facilitate regulation of fluid flow in a system.
			FAUCET		FAUCET: Faucet valve typically used as a flow discharge.
			FLUSHING		FLUSHING: Valve that flushes a predetermined quantity of water to cleanse a toilet, urinal, etc.
			GASCOCK		GASCOCK: Valve that is used for controlling the flow of gas.
			GASTAP		GASTAP: Gas tap typically used for venting or discharging gas from a system.
			ISOLATING		ISOLATING: Valve that closes off flow in a pipeline.
			MIXING		MIXING: Valve that enables flow from two branches of a pipeline to be mixed together (3 port).
			PRESSUREREDUCING		PRESSUREREDUCING: Valve that reduces the pressure of a fluid immediately downstream of its position in a pipeline to a preselected value or by a predetermined ratio.
			PRESSURERELIEF		PRESSURERELIEF: Spring or weight loaded valve that automatically discharges to a safe place fluid that has built up to excessive pressure in pipes or fittings.
			REGULATING		REGULATING: Valve used to facilitate regulation of fluid flow in a system.
			SAFETYCUTOFF		SAFETYCUTOFF: Valve that closes under the action of a safety mechanism such as a drop weight, solenoid etc.
			STEAMTRAP		STEAMTRAP: Valve that restricts flow of steam while allowing condensate to pass through.
			STOPCOCK		STOPCOCK: An isolating valve used on a domestic water service.
			NOTDEFINED		Generic

Figure 96 Allowed IFC Type Object - Valve

IFC 2x3 Object Information			IFC 2x4 Object Information		
Entity	Type/Enum	Description	Entity	PredefinedType	Description
FlowTerminal					
				FLOORTRAP	FLOORTRAP: Pipe fitting, set into the floor, that retains liquid to prevent the passage of foul air
				FLOORWASTE	FLOORWASTE: Pipe fitting, set into the floor, that collects waste water and discharges it to a separate trap.
				GULLYSUMP	GULLYSUMP: Pipe fitting or assembly of fittings to receive surface water or waste water, fitted with a grating or sealed cover.
				GULLYTRAP	GULLYTRAP: Pipe fitting or assembly of fittings to receive surface water or waste water, fitted with a grating or sealed cover and discharging through a trap (BS6100 330 3504 modified).
				ROOFDRAIN	ROOFDRAIN: Pipe fitting, set into the roof, that collects rainwater for discharge into the rainwater system.
				WASTEDISPOSALUNIT	WASTEDISPOSALUNIT: Electrically operated device that reduces kitchen or other waste into fragments small enough to be flushed into a drainage system.
				WASTETRAP	WASTETRAP: Pipe fitting, set adjacent to a sanitary terminal, that retains liquid to prevent the passage of foul air.
				NOTDEFINED	Generic

Figure 97 Allowed IFC Type Object - Waste Terminal

18. EXCLUDED PROPERTY SETS

The source of property set information for those with design, construction, and commissioning responsibility is defined another bSI Implementer's Guide publication. The information provided here is a general guide applicable to the capture of all property sets for data identified as meeting the FM Handover - Equipment Maintenance MVD.

Lessons learned from the use of the bSI Basic FM Handover MVD indicated there is a critical need to enforce restrictions on the delivery of non-relevant property sets that may be found files produced from design authoring tools. Software vendors shall implement the instructions provided in this section.

The foundational requirement for properties to be excluded from listing in the Properties worksheet, is that information found in the primary worksheets, such as Type or Component, shall never be repeated in the property worksheet. A primary example of the type of issue that arises here, is if there is an equipment schedule that also lists the room in which the equipment is located. In this example, information is specified in the Component.SpaceName worksheet shall take precedence over any information provided in the Property worksheet and the software vendor (or user manually creating the data file) shall not duplicate the Property.

Software vendors shall provide a default filter for all FM Handover - Equipment Maintenance properties to also eliminate all internally required data fields, such as those needed to correctly display or print a given object.

Software vendors shall substitute "place holder" characters found in product properties, that may appear on design schedules, such as the character "-", with the NULL value.

Software vendors shall also filter any property whose value is the same name as the property, or that has a value of "default."

19. LOOKUP WORKSHEET REQUIREMENT

The tables provided in this section identify the contents that shall be provided for each Lookup worksheet column.

19.1. CLASSIFICATION LOOKUP COLUMNS

Figure 94 shall be used to define the first set of columns in the Lookup worksheet. All classification columns shall be provided as a ";" delimited list of two items: an identifier, and a name. Default values for these fields are to be set by local bSI Chapter. Owners may only substitute local classification by identifying the alternative classification scheme in contract documents or associated regulations.

Column		Where Referenced?	Notes
Order	Name		
A	ClassificationRole	Organization.Category	(1)
B	ClassificationBuilding	Building.Category	(2)
C	ClassificationSpace	Space.Category	(3)
D	ClassificationSystem	System.Category	(4)
E	ClassificationType	Type.Category	(5)

Figure 98 Lookup - Classification Columns

NOTES:

- (1) OmniClass: 34, UniClass PM, or regional/client specification
- (2) OmniClass: 11, UniClass En, or regional/client specification
- (3) OmniClass: 13, UniClass SL, or regional/client specification
- (4) OmniClass: 21, UniClass Ss, or regional/client specification
- (5) OmniClass: 23, UniClass Pr, or regional/client specification

19.2. CATEGORY LOOKUP COLUMNS

Figure 95 provides a list of general project categories that may be regionally or nationally specified category by bSI Chapters. In general, the values here represent widely adopted industry language in the bSI Chapter region. It is recommended that each implementing bSI Chapter update these Category values.

Column		Where Referenced?	Notes
Order	Name		
F	TypeLinearUnit	Building.LinearUnit	(1)
G	TypeAreaUnit	Building.AreaUnit	(2)
H	TypePhase	Building.Phase	(3)
I	TypeZone	Zone.Category	(4)
J	TypeProcurement	Type. ProcurementType	(5)
K	TypeSpecification	Type.SpecificationSection	(6)
L	TypePart	Part.Category	(7)
M	TypeResource	Part.Resource	(8)
N	TypeJob	Job.Category	(9)
O	TypeJobStatus	Job.Status	(10)
P	TypeDocument	Document.Category	(11)
Q	TypeStage	Document.Stage, Attribute.Stage	(12)

Figure 99 Lookup - Category Columns

NOTES:

- (1) Default values shall be: "millimeters, meters, inches, feet"
- (2) Default values shall be: "square meters, square feet"
- (3) Default values shall be: "planning, design, construction, commissioning, handover"
- (4) Default values shall be: "Circulation, Fire Alarm, Historical Preservation, Lighting, Occupancy, Ventilation"

(5) Default values shall be: "CFCI, OFCI, OFOI" for Contractor-Furnished-Contractor-Installed, Owner-Furnished-Contractor-Installed, and Owner-Furnished-Owner-Installed. The FM Handover - Equipment Maintenance MVD Implementation Guide shall identify business rules governing the quality checking of each class of objects. This allows the inclusion of items such as owner installed furniture in a handover data set without a checking tool throwing an error.

(6) Default values: per contracting method.

(7) Default values shall be: "replacement, spare" where replacement part is something that must be ordered, and Spare part is a part which is located on-site. If Spare, then Part.SpaceName must be provided to identify location of on-site product.

(8) Default values shall be: "equipment, labor, material, training"

(9) Default values shall be: "Adjustment, Calibration, Emergency, Inspection, Operation, Maintenance, Safety, ShutDown, StartUp, Testing, Troubleshooting"

(10) Default values shall be: "Not Started, Started"

(11) Default values shall be: "Certificate. Drawing - Design, Drawing - Construction, Drawing - Fabrication, Drawing - Manufacturer, Contractual, Manufacturer Field Report, Manufacturer Instruction, Operation and Maintenance, Submittal, Photograph, Product Data, Report - Design, Report - Product Test, Report - System Test, Specification"

(12) Default values shall be: "As Built, Approved, Requirement, Requirement - Exact, Requirement - Maximum, Requirement - Minimum, Submitted"

19.3. FIXED LOOKUP COLUMNS

Figure 96 provides the set of fixed lookup codes. These codes must be fixed to ensure internal consistency of the information and correct mapping of data in Spreadsheet Physical File Format to the underling building model objects.

R	FixedCountryCode	Building.CountryCode	(1)
S	FixedLevelType	Level.Category	(2)
T	FixedWorksheet	Part.Category, Job.Category, Document.Category, Attribute.Category	(3)

Figure 100 Lookup - Fixed Columns

NOTES:

(1) Fixed list of allowed values found in ISO 3166-2 Alpha-2

(2) Fixed list of allowed values for IFC SPFF structure: "Level, Roof, Site"

(3) Fixed list of allowed values: "Building, Level, Space, Zone, System, Type, Component, Job". Note that if a resource is applicable to more than one reference record, then the Part record must be duplicated. Software shall implement higher object tier reference to eliminate duplication at the Level, Space, Component object tier.

20. REFERENCES

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