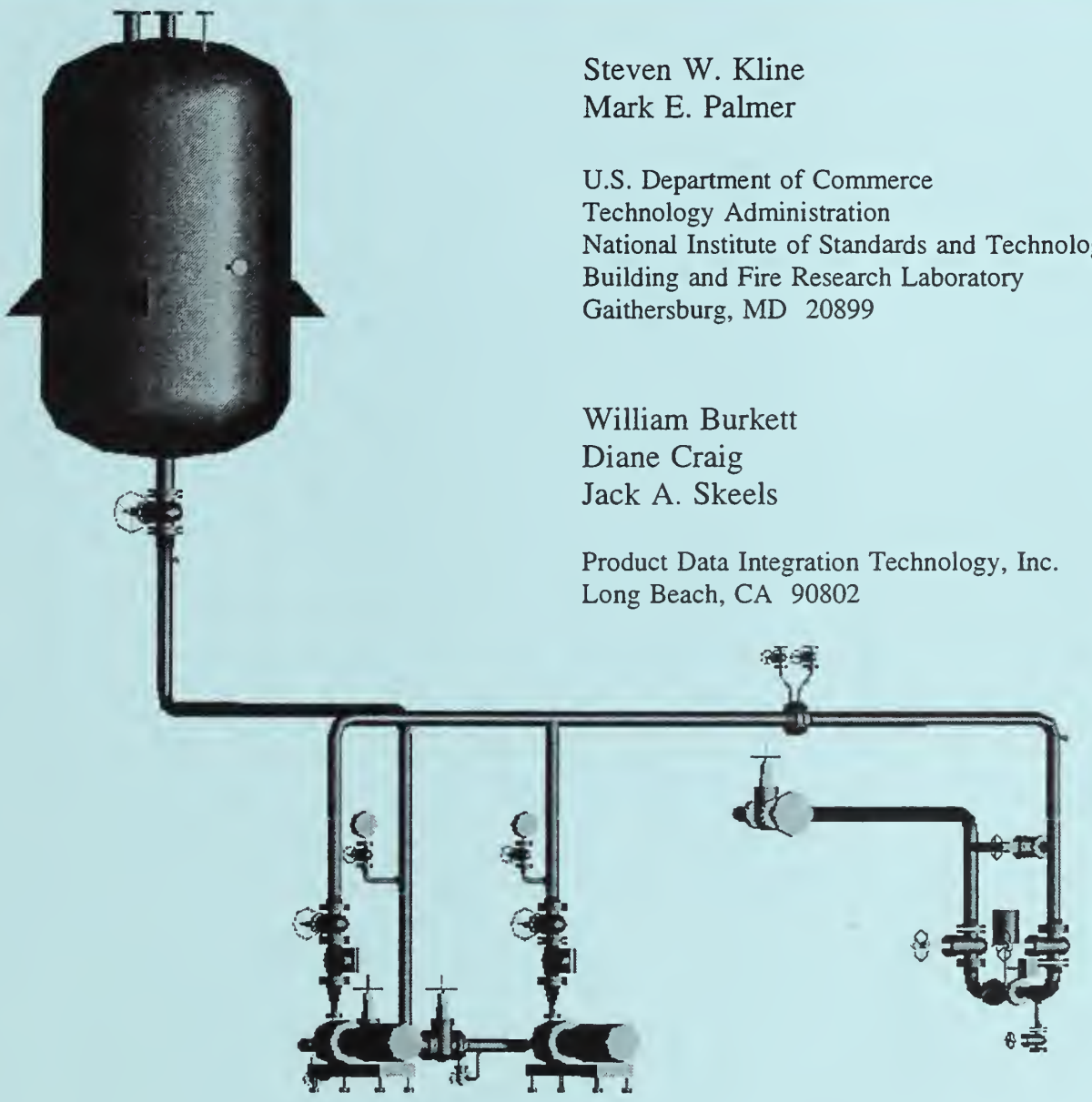
NISTIR 5812

Plant Spatial Configuration Application Protocol Version 1.0 — Volume 1



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ABSTRACT

Part 227 of ISO 10303, *Plant Spatial Configuration*, specifies an application protocol (AP) for the exchange of spatial configuration information of process plants. This includes shape characteristics, spatial arrangement characteristics, and design and fabrication information for piping system components, and functional and stream information for piping and HVAC (heating, ventilating, and air conditioning) systems. Also included are shape and spatial arrangement characteristics of other related plant systems that impact the design and layout of piping systems.

This document specifies the scope and information requirements for AP 227 and provides the Application Activity Model (AAM), Application Reference Model (ARM), and Application Interpreted Model (AIM) for the AP. The document follows the format and clause numbering scheme prescribed for this type of International Organization for Standardization (ISO) standard. The clauses and annexes contained in this document are those required by ISO for Committee Draft (CD) review and balloting.

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PREFACE

Industry and government require comprehensive and reliable information exchange mechanisms to effectively integrate computer-aided (CAx) systems and evolving information technologies. Subcommittee Four (Industrial data and global manufacturing programming languages) of the International Organization for Standardization (ISO) Technical Committee 184 (Industrial automation systems and integration), ISO TC184/SC4, is preparing ISO 10303, a set of international standards titled *Industrial automation systems and integration - Product data representation and exchange*. The set of proposed standards is informally known as STEP (STandard for the Exchange of Product model data).

ISO 10303 will provide a neutral mechanism for describing product data throughout the life cycle of a product, independent of any particular CAx system. ISO 10303 is suitable for file exchange and for implementing, sharing, and archiving product databases. The development of ISO 10303 is based upon the use of information models, a framework for product data modelling, formal data specification languages, and an architecture that separates information requirements from implementation methods.

A fundamental concept of STEP is the definition of application protocols (APs) as the mechanism for specifying information requirements and for ensuring reliable communication. An **application protocol** is a Part of ISO 10303 that defines the context, scope, and information requirements for designated application(s) and specifies the resource constructs used to satisfy these requirements. The scope of an AP is defined by the type of product, the supported stages in the life cycle of the product, the required types of product data, the uses of the product data, and the disciplines that use the product data. Additionally, an AP enumerates the conformance requirements for conformance testing of implementations of the AP.

Part 227 of ISO 10303, *Plant Spatial Configuration*, specifies an AP for the exchange of spatial configuration information of process plants. This document constitutes the Committee Draft (CD) documentation for AP 227. Volume 1 of this document contains clauses covering the AP 227 scope, normative references, definitions and abbreviations, information requirements, application interpreted model, and conformance requirements. Volume 2 of this document contains the normative and informative annexes.

The *Plant Spatial Configuration Application Protocol* has been submitted for international review and balloting as an ISO CD document.

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Foreword

The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303-227 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data.*

ISO 10303 consists of the following parts under the general title *Industrial automation systems and integration - Product data representation and exchange*:

— Part 1, Overview and fundamental principles;

— Part 11, Description methods: The EXPRESS language reference manual;

— Part 12, Description methods: The EXPRESS-I language reference manual;

— Part 21, Implementation methods: Clear text encoding of the exchange structure;

— Part 22, Implementation methods: Standard data access interface (SDAI);

— Part 23, Implementation methods: C++ language binding to SDAI;

— Part 24, Implementation methods: C language binding to SDAI;

— Part 31, Conformance testing methodology and framework: General concepts;

— Part 32, Conformance testing methodology and framework: Requirements on testing laboratories and clients;

— Part 33, Conformance testing methodology and framework: Abstract test cases;

— Part 41, Integrated generic resources: Fundamentals of product description and support;

— Part 42, Integrated generic resources: Geometric and topological representation;

— Part 43, Integrated generic resources: Representation structures;

— Part 44, Integrated generic resources: Product structure configuration;

— Part 45, Integrated generic resources: Materials;

— Part 46, Integrated generic resources: Visual presentation;

— Part 47, Integrated generic resources: Shape variation tolerances;

— Part 49, Integrated generic resources: Process structure and properties;

— Part 101, Integrated application resources: Draughting;

— Part 104, Integrated application resources: Finite element analysis;

— Part 105, Integrated application resources: Kinematics;

— Part 201, Application protocol: Explicit draughting;

— Part 202, Application protocol: Associative draughting;

— Part 203, Application protocol: Configuration controlled 3D design of mechanical parts and assemblies;

— Part 204, Application protocol: Mechanical design using boundary representation;

— Part 205, Application protocol: Mechanical design using surface representation;

— Part 207, Application protocol: Sheet metal die planning and design;

— Part 209, Application protocol: Design-analysis of composite structures;

— Part 210, Application protocol: Printed circuit assembly product design data;

— Part 212, Application protocol: Electrotechnical design and installation;

— Part 213, Application protocol: Numerical control process plans for machined parts.

— Part 214, Application protocol: Core data for automotive design processes;

— Part 224, Application protocol: Mechanical product definition for process planning using form features;

— Part 225, Application protocol: Structural building elements using explicit shape representation;

— Part 227, Application protocol: Plant spatial configuration;

— Part 501, Application interpreted construct: Edge-based wireframe;

— Part 502, Application interpreted construct: Shell-based wireframe;

— Part 503, Application interpreted construct: Geometrically bounded 2D wireframe;

— Part 504, Application interpreted construct: Draughting annotation;

— Part 505, Application interpreted construct: Drawing structure and administration;

— Part 506, Application interpreted construct: Draughting elements;

— Part 507, Application interpreted construct: Geometrically bounded surface;

— Part 508, Application interpreted construct: Non-manifold surface;

— Part 509, Application interpreted construct: Manifold surface;

— Part 510, Application interpreted construct: Geometrically bounded wireframe;

— Part 511, Application interpreted construct: Topologically bounded surface;

— Part 512, Application interpreted construct: Faceted boundary representation;

— Part 513, Application interpreted construct: Elementary boundary representation;

— Part 514, Application interpreted construct: Advanced boundary representation;

— Part 515, Application interpreted construct: Constructive solid geometry;

— Part 516, Application interpreted construct: Mechanical design context;

— Part 517, Application interpreted construct: Mechanical design geometric presentation;

— Part 518, Application interpreted construct: Mechanical design shaded presentation.

The structure of this International Standard is described in ISO 10303-1. The numbering of the parts of this International Standard reflects its structure:

— Parts 11 to 12 specify the description methods;

— Parts 21 to 24 specify the implementation methods;

— Parts 31 to 33 specify the conformance testing methodology and framework;

— Parts 41 to 49 specify the integrated generic resources;

— Parts 101 to 105 specify the integrated application resources;

— Parts 201 to 227 specify the application protocols;

— Parts 501 to 518 specify the application interpreted constructs.

Should further parts of ISO 10303 be published, they will follow the same numbering pattern.

Annexes A, B, C, D, and E form an integral part of this part of ISO 10303. Annexes F, G, H, J, K, and L are for information only.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organized as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application protocol series. Application protocols provide the basis for developing implementations of ISO 10303 and abstract test suites for the conformance testing of AP implementations.

This part of ISO 10303 specifies an application protocol (AP) for the exchange of the spatial configuration information of process plants. This information includes the shape and spatial arrangement characteristics of piping system components as well as the shape and spatial arrangement characteristics of other related plant systems (i.e., electrical, instrumentation and controls, and structural systems) that impact the design and layout of piping systems. In the design and fabrication of a piping system, the piping layout must be evaluated with respect to the spatial characteristics and arrangement of these related plant systems, and the requirements for clearances between systems. The complete specification of these other systems is not needed, but only enough spatial information to support the layout of the piping system. The design and layout of a plant piping system is exchanged between different agents over the life-cycle of a plant for many different reasons. These reasons include the exchange of requirements from a plant owner to an architectural/engineering (AE) firm, the exchange of process requirements for the plant piping system from a process engineer to a system design engineer, integration of designs created by different engineers, detection of physical interferences of plant piping system components with components of other plant systems, and exchange of construction specifications between AE and construction firms.

This AP specifies additional requirements for the exchange of information required for the design and fabrication of a piping system. This includes information on the piping material, process stream fluid, and the piping system functional characteristics. A process and system design specifies process requirements for a piping system that includes pipe size, design temperatures and pressures, and insulation class. The physical design uses these process requirements for the design of the piping system.

This AP also identifies and provides a functional specification of the components of the plant piping system. The design information for a piping system may specify a pump capable of maintaining a pressure and flow rate. The design will also specify the shape limitations or requirements and the location of the pump in the system, but not sufficient information for the fabrication of the pump.

Figure 1 contains the data planning model that provides a high level description of the requirements for this application protocol, as well as the relationships between the basic data components. The planning model illustrates that a plant consists of plant items; the plant items may be connected to one another with connectors on the plant item. The principle focus of the AP is on piping systems and the shape and

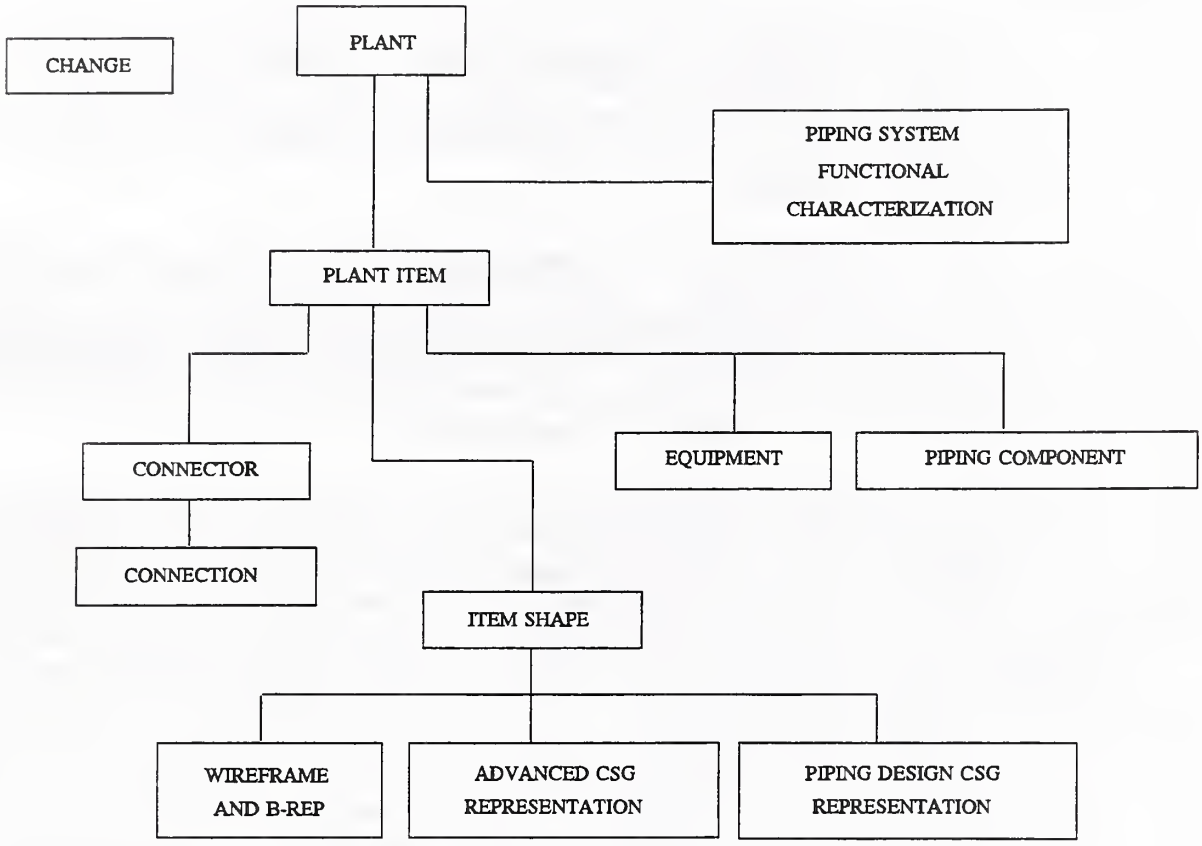

Figure 1 - Data planning model

spatial arrangement of systems including plant items required to ensure the physical integrity of piping systems. This is illustrated by the presence in the data planning model of significant concepts found on piping and instrumentation (P&I) diagrams: the functional view of the piping system (piping system functional characterization) and two kinds of plant items: piping components and equipment. The shape and spatial arrangement are represented by the item shape. The shape representation may use advanced constructive solid geometry (CSG), piping design specific CSG components, or a combination of CSG components and boundary representation (B-rep) and wireframe geometry. The shape may be represented at various levels of abstraction of the shape, from an encompassing envelope to a detailed design description. The data planning model also illustrates that the concept of change is a requirement for this application protocol. Change is applicable to each individual object, the relationships between objects, and to groupings of objects. It applies to all the concepts noted on the data planning model.

Clause 1 defines the scope of the application protocol and summarizes the functionality and data covered by the AP. An application activity model that is the basis for the definition of the scope is provided in annex F. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as

the application reference model, is given in annex G. A tiled "wallpaper" version of the application reference model is given in annex K.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in 5.2. Note that the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. The expanded listing given in annex A contains the complete EXPRESS for the AIM without annotation. A graphical representation of the AIM is given in annex H. Additional requirements for specific implementation methods are given in annex D.

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Industrial automation systems and integration — Product data representation and exchange — Part 227: Application protocol: Plant spatial configuration

1 Scope

This part of ISO 10303 specifies the use of the integrated resources necessary for the exchange of spatial configuration information of process plants. The spatial configuration information includes the shape, spatial arrangement, and other characteristics of the plant piping systems. Components of the plant piping system include pipes, fittings, pipe supports, valves, in-line equipment, and instruments. Shape and spatial arrangement information for equipment and non-piping plant systems are also included. Supported life cycle phases include design, fabrication, installation, and maintenance of plant piping systems.

NOTE 1 - The application activity model (AAM) in annex F provides a graphical representation of the processes and information flows that are the basis for the definition of the scope of this part of ISO 10303.

The following are within the scope of this part of ISO 10303:

— The shape and spatial arrangement of plant systems within the process plant;

— Explicit representation of the 3D shape of plant piping systems;

— Explicit representation of the 3D external shape of plant piping system components and equipment. The representation may include envelope, outline and detailed representations as well as a parametric representation of the external shape.

— The logical configuration of the plant piping system and the relationship of the logical configuration to the planned physical piping system design;

NOTES

2 - The logical configuration is an intersection with the requirements specified in ISO 10303-221.

3 - "Logical configuration" entails connectivity, sequencing, pipe size, pipe schedule, and flange class, and may include other information, such as equipment tag numbers, required to perform consistency checks between the logical and physical representations of the design.

— Basic engineering data as needed for spatial layout and configuration of the plant piping system;

— References to functional requirements of the plant piping system, such as stream data and operational characteristics;

— References to or designation of functional characteristics of piping components and connected equipment;

— The identification, shape, location, and orientation of reserved areas, volumes, and space-occupying elements of a plant that are not part of heating, ventilation, and air conditioning (HVAC), piping, structural, electrical, or instrumentation and controls systems;

— References to specifications, standards, guidelines, or regulations, for the plant piping systems, components, or connected equipment that may specify physical characteristics of the system or component;

NOTE 4 - Physical characteristics include items such as material and welding requirements.

— Status of spatial arrangement of piping components, piping components, and connected equipment;

NOTE 5 - Status are labels used by project management to monitor and control the execution of the project. Labels such as "preliminary", "in-work", and "released for design" are used to designate the degree of completeness or suitability for further action of the design or layout to which the label is applied.

— Connections and connection requirements for piping components and equipment;

— Definition of piping components sufficient for the acquisition of the components;

— Change request, approval, notification, verification, tracking of differences between versions of piping system design information. Tracking of changes to plant items and attributes of plant items.

EXAMPLE 1 - Changing an impeller in a pump affects the pump flow rate and results in the changing of the attribute for pump flow rate.

NOTE 6 - Only the specific change information is in scope. The change process itself is not in scope.

— Specification of the chemical composition of the streams carried by the plant piping systems in sufficient detail to evaluate the suitability of piping components for the desired process.

The following are outside the scope of this part of ISO 10303:

— 2D schematic representations;

EXAMPLE 2 - Examples of 2D schematic representations include P&I diagrams and process flow diagrams.

— The contents of specifications, standards, guidelines, or regulations;

— Information required for the assembly and erection of non-piping plant systems or the manufacture of components of these systems;

— Specification of the chemical composition of the streams carried by the plant piping system in sufficient detail for process flow design;

— Process design;

EXAMPLE 3 - Process design includes activities such as process material and heat balances, process flow diagram development, and determination of equipment sizes.

— Plant operating procedures;

— Commercial aspects of procurement procedures;

EXAMPLE 4 - Commercial aspects include pricing, terms and conditions, and payment schedules.

— Internal design of equipment.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10303. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 8824-1:1994, *Information technology — Open systems interconnection — Abstract syntax notation one (ASN.1) — Part 1: Specification of basic notation.*

ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles.*

ISO 10303-11:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual.*

ISO 10303-21:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure.*

ISO 10303-31:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 31: Conformance testing methodology and framework: General concepts.*

ISO 10303-41:1994, *Industrial automation systems and integration — Product data representation and exchange - Part 41: Integrated generic resources: Fundamentals of product description and support.*

ISO 10303-42:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resources: Geometric and topological representation.*

ISO 10303-43:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 43: Integrated generic resources: Representation structures.*

ISO 10303-44:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resources: Product structure configuration.*

ISO 10303-45:—[1)], *Industrial automation systems and integration — Product data representation and exchange — Part 45: Integrated generic resources: Material.*

ISO 10303-46:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 46: Integrated generic resources: Visual presentation.*

ISO 10303-47:—[1)], *Industrial automation systems and integration — Product data representation and exchange — Part 47: Integrated generic resources: Shape variation tolerances.*

3 Definitions and abbreviations

3.1 Terms defined in ISO 10303-1

This part of ISO 10303 makes use of the following terms defined in ISO 10303-1:

— application;

— application activity model (AAM);

— application interpreted model (AIM);

— application protocol (AP);

— application reference model (ARM);

— conformance class;

— implementation method;

— integrated resource;

— product;

[1)] To be published.

— product data;

— unit of functionality (UoF).

3.2 Terms defined in ISO 10303-31

This part of ISO 10303 makes use of the following terms defined in ISO 10303-31:

— abstract test suite (ATS);

— conformance testing;

— protocol information and conformance statement (PICS).

3.3 Other definitions

For the purposes of this part of ISO 10303, the following definitions apply:

3.3.1 actual: descriptive adjective which, when applied to a item, refers to the state of the information known about the item, upon which subsequent action can be taken. An "actual" item is a item that has existence in the real world and has physical properties that can be measured.

NOTE - See 3.3.25 and 3.3.30. The terms actual, planned, and required loosely reflect life cycle stages of a item. For example, a required item leads to a planned item that meets or satisfies the requirement.

3.3.2 basic engineering data: parameters and descriptions which specify design characteristics and boundaries for the plant item that are required to support piping system design.

EXAMPLE 5 - Piping system design parameters and descriptions include design temperature, design pressure, design codes, and weights.

3.3.3 branch: a portion of a piping system that diverges or divides from the main flow path.

NOTE - A branch may have a different identifier from that of the main flow path.

3.3.4 catalogue: a list of things or a document that contains a list of things.

NOTES

1 - A catalogue may be a list of symbols or of plant items and their properties and features.

2 - A catalogue may be either an electronic or printed document.

3.3.5 component: a plant item that may be part of another plant item.

3.3.6 connection: an association between two plant items that results from a physical joining. A connection has both physical and functional properties. The properties describe both the physical nature of a connection and the functional capability that it provides.

3.3.7 connector: a physical property of a plant item that allows it to join to another plant item, or to a compatible connector on another plant item, and enable the flow of energy, loads, materials or signals. A connector has both physical and functional properties.

NOTES

1 - A connector may be a complete assembly involving multiple physical connectors and plant items.

2 - A piping connector may enable several distinct flows of material, e.g., a manifold. An electrical connector may enable several distinct flows of electric current.

3 - The term 'port' is often used within the process plant industry in place of the term connector when referring to the functional properties of the connector.

3.3.8 equipment: a plant item that carries out an operation on the process material. An equipment has both physical and functional properties.

NOTE - An equipment may be treated as a single item for the purpose of design, acquisition, or operation.

3.3.9 functional: descriptive adjective which, when applied to a item, refer to a set of characteristics, properties, or traits of the item. "Functional" refers to the actions, activities, or capabilities, that the item provides or may provide to fulfill a purpose.

NOTE - A tag number identifies a unique occurrence of a plant item which provides functional capability in the plant.

3.3.10 functional characteristics: nomenclature, codes, and named values that describe or specify the performance or behaviour of a plant item.

EXAMPLE 6 - Examples of functional characteristics include flow rates, operating pressure, and maximum temperature.

3.3.11 functional requirements: nomenclature, codes, and named values that describe or specify the performance or behaviour to be met by a plant item.

3.3.12 instrument: a plant item that is an individually identifiable item or combination of items that is part of a system which monitors or controls a process plant.

NOTE - Instruments include items such as control valves, sensors, and gauges.

3.3.13 insulation: a volume of material that provides resistance to the flow of heat, electricity, or sound.

3.3.14 line: a logical component of a piping system that is composed of a collection of line segments.

3.3.15 line segment: an element of a line.

3.3.16 line segment termination: one of two logical end-points of a line segment.

NOTE - Lines are composed of line segments. Line segments are connected through line segment terminations.

3.3.17 line segment termination connection: a logical linkage between two line segments or between a line segment and a plant item.

3.3.18 material: the substance or substances from which a physical plant item is composed.

3.3.19 physical: descriptive adjective which, when applied to a item, refer to a set of characteristics, properties, or traits of the item. "Physical" refers to shape and material characteristics such as weight, size and location and orientation of the item.

NOTE - A serial number identifies a physical object that is, or may be, installed as a plant item.

3.3.20 pipe: a plant item that is hollow and approximately cylindrical, that may have a constant cross-section along its length, and that conveys fluid, vapour, or particulate flow.

3.3.21 pipe fitting: a plant item that is used, or intended to be used, to join or terminate pipes or other items in a piping system or equipment connectors, or to provide changes of pipe direction or branching within a piping system.

3.3.22 piping class: a functional performance envelope defined by a set or range of common physical properties, and an identification of the pipes, pipe fittings and valves which have these properties.

EXAMPLE 7 - Examples of physical properties include diameter, pressure, and temperature.

3.3.23 piping specification: a definition of the following aspects of a piping system:

— design pressures and temperatures;

— piping materials;

— pipe wall thicknesses or schedules;

— types of fittings to be used;

— types of valves and flanges;

— valve and flange pressure rating requirements;

— fabrication, examination, testing, inspection, cleaning, and installation requirements, including the requirements for seismic installations, where applicable.

The term piping specification is also used to refer to a document or electronic file that contains such a definition.

3.3.24 piping system: a plant system that is composed primarily of pipes, pipe fittings, and valves subject to the same set or sets of design conditions, and that performs a passive transport function.

3.3.25 planned: descriptive adjective which, when applied to a item, refers to the state of the information known about the item, upon which subsequent action can be taken. A "planned" item is a item that has been designed or predicted.

NOTE - See 3.3.1 and 3.3.30. The terms actual, planned, and required loosely reflect life cycle stages of a item. For example, a required item leads to a planned item that meets or satisfies the requirement.

3.3.26 plant: an assembly of one or more plant systems and plant items that is intended to perform a chemical, physical or transport process. A plant is identified as a single unit for the purposes of management and ownership. A plant has both physical and functional properties.

3.3.27 plant item: a physical object or volume of space that is, or may be, a part of a process plant. If it is a volume of space, it may or may not contain other objects. A plant item has both physical and functional properties.

3.3.28 plant system: a part of a plant that provides or performs, or is intended to provide or perform, a service or function contributing to or enabling the operation of a plant. A plant system consists of an assembly of one or more plant items. A plant system has both physical and functional properties.

3.3.29 representation: a description or depiction of something.

3.3.30 required: descriptive adjective which, when applied to a item, refers to the state of the information known about the item, upon which subsequent action can be taken. A "required" item is a item that is essential or necessary; that is, it has to be provided or met.

NOTE - See 3.3.1 and 3.3.25. The terms actual, planned, and required loosely reflect life cycle stages of a item. For example, a required item leads to a planned item that meets or satisfies the requirement.

3.3.31 site: an area of land on which one or more process plants is or may be situated.

3.3.32 spatial arrangement: the location, orientation, and relative position of the components of a plant system.

3.3.33 stream: a flow of process material past a defined point along a path.

3.4 Abbreviations

For the purposes of this part of ISO 10303, the following abbreviations apply:

AAM	application activity model
AE	architectural/engineering
AEC	architecture, engineering, and construction
AIC	application interpreted construct
AIM	application interpreted model
AP	application protocol
ARM	application reference model
ATS	abstract test suite
B-rep	boundary representation
BOP	bottom of pipe
COP	centre of pipe
CSG	constructive solid geometry
HVAC	heating, ventilation, and air conditioning
id	identifier
PICS	protocol information and conformance statement
P&I	piping and instrumentation
UoF	unit of functionality

4 Information requirements

This clause specifies the information required for the exchange of plant spatial configuration information between application systems.

The information requirements are specified as a set of units of functionality, application objects, and application assertions. These assertions pertain to individual application objects and to relationships between application objects. The information requirements are defined using terminology of the subject area of this application protocol.

NOTES

1 - A graphical representation of the information requirements is given in annex G.

2 - The information requirements correspond to those of the activities identified as being in the scope of this application protocol in annex F.

3 - The mapping table specified in 5.1 shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements that are common to application protocols.

4.1 Units of functionality

This subclause specifies the UoFs for the plant spatial configuration application protocol. This part of ISO 10303 specifies the following UoFs:

— advanced_csg_representation UoF;

— change_information UoF;

— connection UoF;

— connector UoF;

— equipment_characterization UoF;

— piping_component_characterization UoF;

— piping_design_csg_representation UoF;

— piping_system_functional_characterization UoF;

— plant_characterization UoF;

— plant_item_characterization UoF;

— shape UoF;

— site_characterization UoF;

— wireframe_and_b_rep_geometry UoF.

The units of functionality and a description of the functions that each UoF supports are given below. The application objects included in the UoFs are defined in 4.2.

4.1.1 advanced_csg_representation UoF

The advanced_csg_representation UoF specifies the representation of Plant_item shapes using CSG primitives. CSG primitives are bounded by simple geometric surfaces such as planes, cylinders, cones, toruses, and spheres. CSG primitives may be combined using boolean operations.

The following objects are used by the advanced_csg_representation UoF:

— Block;

— Cone;

— Csg_element;

— Cylinder;

— Extrusion;

— Pyramid;

— Solid_of_revolution;

— Sphere;

— Torus;

— Trimmed_cone;

— Trimmed_pyramid;

— Trimmed_sphere;

— Trimmed_torus.

4.1.2 change_information UoF

The change_information UoF describes information such as the design change requests and approvals for modifications to Plant objects, Plant_item objects, Plant_system objects, and other components associated with the Plant.

The following objects are used by the change_information UoF:

— Change;

— Change_approval;

— Change_delta;

— Change_item;

— Change_life_cycle_stage;

— Change_life_cycle_stage_sequence;

— Change_life_cycle_stage_usage;

— Changed_line_assignment;

— Changed_line_branch_connection;

— Changed_line_plant_item_branch_connection;

— Changed_line_plant_item_connection;

— Changed_line_to_line_connection;

— Changed_material_specification_selection;

— Changed_piping_system_line;

— Changed_piping_system_line_segment;

— Changed_piping_system_line_segment_termination;

— Changed_planned_physical_plant;

— Changed_plant;

— Changed_plant_item;

— Changed_plant_item_collection;

— Changed_plant_item_connection;

— Changed_plant_item_connector;

— Changed_plant_item_design_view;

— Changed_plant_item_shape;

— Changed_plant_process_capability;

— Changed_plant_system;

— Changed_reference_geometry;

— Changed_required_material_description;

— Changed_sited_plant;

— Changed_sub_plant_relationship.

4.1.3 connection UoF

The connection UoF describes the physical linkage or connectivity between Plant_item objects. Plant_item objects have connectors. Two connectors of a compatible type are attached to form a connection. The sequence of connections establishes the physical connectivity of items within Plant_system objects.

The following objects are used by the connection UoF:

— Connection_definition;

— Electricity_transference;

— Flexible_connection;

— Fluid_transference;

— Functional_connection_definition_satisfaction;

— Functional_connection_occurrence_satisfaction;

— Load_transference;

— Locked_orientation_connection;

— Plant_item_connection;

— Plant_item_connection_occurrence.

4.1.4 connector UoF

The connector UoF is the information about the part of a Plant_item that is intended to interconnect with another Plant_item. This UoF describes the physical features of Plant_item objects that are designed to connect or mate with a similar physical feature on another Plant_item object.

The following objects are used by the connector UoF:

— Buttweld;

— Connector_definition;

— Electrical_connector;

— Female_end;

— Flanged;

— Flanged_end;

— Functional_connector;

— Functional_connector_definition_satisfaction;

— Functional_connector_occurrence_satisfaction;

— Male_end;

— Physical_connector;

— Piping_connector;

— Piping_connector_service_characteristic;

— Plant_item_connector;

— Plant_item_connector_occurrence;

— Service_operating_case;

— Socket;

— Structural_load_connector;

— Threaded.

4.1.5 equipment_characterization UoF

The equipment_characterization UoF describes Plant_item objects that perform a particular function within the Plant processes.

The following objects are used by the equipment_characterization UoF:

— Compressor;

— Engine;

— Equipment;

— Equipment_trim_piping;

— Furnace;

— Gear_box;

— Heat_exchanger;

— Pressure_vessel;

— Pump;

— Silo;

— Tank;

— Turbine.

4.1.6 piping_component_characterization UoF

The piping_component_characterization UoF describes the individual elements of the Piping_system within a Plant. Piping_component objects include pipes, fittings, valves, in-line equipment, and other elements that regulate, control, or convey Piping_system fluids.

The following objects are used by the piping_component_characterization UoF:

- Blank;
- Blind_flange;
- Bushing;
- Coupling;
- Cross;
- Eccentric_reducer;
- Eccentric_swage;
- Elbow;
- Expander_flange;
- Fitting;
- Flange;
- Inline_equipment;
- Inline_instrument;
- Insert;
- Inside_and_thickness;
- Lap_joint_flange;
- Lap_joint_stub_end;
- Lateral;
- Mitre_bend_pipe;
- Olet;
- Orifice_flange;
- Orifice_plate;

— Outside_and_thickness;

— Paddle_blank;

— Paddle_spacer;

— Pipe;

— Pipe_bend;

— Pipe_cap;

— Piping_component;

— Piping_size_description;

— Pressure_class;

— Reducer;

— Reducing_flange;

— Ring_spacer;

— Schedule;

— Slip_on_flange;

— Socket_weld_flange;

— Spacer;

— Specialty_item;

— Spectacle_blind;

— Straight_pipe;

— Swage;

— Swept_bend_pipe;

— Tee;

— Threaded_flange;

— Union;

— Valve;

— Weld_neck_flange;

— Wye.

4.1.7 piping_design_csg_representation UoF

The piping_design_csg_representation UoF specifies the representation of Plant_item shapes using CSG primitives that are expressly suited to piping design. CSG primitives may be combined using boolean operations.

The following objects are used by the piping_design_csg_representation UoF:

— Circular_ellipsoid;

— Csg_element;

— Eccentric_cone;

— Eccentric_cylinder;

— Eccentric_pyramid;

— Hemisphere;

— Reducing_torus;

— Square_to_round;

— Trimmed_block;

— Trimmed_cylinder;

— Tube.

4.1.8 piping_system_functional_characterization UoF

The piping_system_functional_characterization UoF describes the functional connectivity of a Piping_-system and among Plant_item objects in that system. This UoF provides the information that describes the logical links and properties of a flow stream in a Piping_system. It includes information about the

segments in the line and the specifications for these segments, such as design criteria, service conditions, and line identifier.

The following objects are used by the piping_system_functional_characterization UoF:

— Line_branch_connection;

— Line_branch_termination;

— Line_piping_system_component_assignment;

— Line_plant_item_branch_connection;

— Line_plant_item_branch_connector;

— Line_plant_item_connection;

— Line_plant_item_connector;

— Line_plant_item_termination;

— Line_to_line_connection;

— Line_to_line_termination;

— Piping_specification;

— Piping_system_line;

— Piping_system_line_segment;

— Piping_system_line_segment_termination;

— Segment_insulation;

— Stream_design_case;

— Stream_phase.

4.1.9 plant_characterization UoF

The plant_characterization UoF describes identifiable collections of Plant_item objects that perform specific functions within a plant. The Plant_item objects are functionally dependent on one another for the performance of the system and are interrelated through physical connections. The collection of Plant_-system objects as a whole enable the Plant to operate.

The following objects are used by the plant_characterization UoF:

— Electrical_system;

— Functional_plant;

— Functional_plant_satisfaction;

— Hvac_system;

— Instrumentation_and_control_system;

— Line_less_piping_system;

— Location_in_plant;

— Manufacturing_line;

— Piping_system;

— Planned_physical_plant;

— Plant;

— Plant_process_capability;

— Plant_system;

— Plant_system_assembly;

— Structural_system;

— Sub_plant_relationship;

— Train;

— Unit.

4.1.10 plant_item_characterization UoF

The plant_item_characterization UoF describes major elements of which Plant objects and Plant_system objects are comprised. These are items within a Plant that occupy space and possess physical, measurable characteristics. This UoF specifies spatial and physical information about Piping_system_component

objects and Equipment, but only spatial characteristics of components of other Plant_system objects, such as HVAC and instrumentation.

This UoF describes the information and options associated with the specification of the substance or substances of which a Plant_item is composed. It also describes specification and catalogue information concerning piping components.

This UoF describes the spatial shape and position of volumes of space in a Plant.

NOTES

1 - Physical plant_items are things that can be touched.

2 - As used in this part, material does not refer to the products which flow within plant systems.

The following objects are used by the plant_item_characterization UoF:

— Cable_support;

— Catalogue_definition;

— Catalogue_item;

— Catalogue_item_substitute;

— Connected_assembly;

— Construction_material;

— Design_project;

— Ducting_component;

— Electrical_component;

— Equipment_breaching;

— Functional_design_view;

— Functional_plant_item_satisfaction;

— Hierarchical_assembly;

— Hvac_component;

— Installed_physical_design_view;

— Instrument;

— Instrumentation_and_control_component;

— Insulation;

— Jacketed_piping;

— Material_specification_selection;

— Material_specification_subset_reference;

— Offline_instrument;

— Physical_design_view;

— Piping_spool;

— Piping_spool_assignment;

— Piping_system_component;

— Planned_physical_plant_item;

— Plant_item;

— Plant_item_collection;

— Plant_item_definition;

— Plant_item_design_view;

— Plant_item_instance;

— Plant_item_location;

— Plant_item_weight;

— Plant_volume;

— Process_ducting;

— Project_design_assignment;

— Relative_item_location;

— Required_material_description;

— Reserved_space;

— Route;

— Specification_item_family;

— Structural_component;

— Support_component;

— Support_constraints;

— Support_usage;

— Support_usage_connection;

— System_space.

4.1.11 shape UoF

The shape UoF specifies the external shapes of components, assemblies of components, and volumes of a Plant. The component's external shape can be specified as an envelope of the space occupied by a component, as an outline of the component, or as a detailed definition of the component's shape.

The following objects are used by the shape UoF:

— Detail_shape;

— Envelope_shape;

— Interfering_shape_element;

— Outline_shape;

— Plant_item_centreline;

— Plant_item_geometric_origin;

— Plant_item_interference;

— Plant_item_interference_status;

— Plant_item_shape;

— Reference_geometry;

— Shape_interference_zone_usage;

— Shape_representation;

— Shape_representation_element;

— Shape_representation_element_usage.

4.1.12 site_characterization UoF

The site_characterization UoF describes the significant features of the Site on which the Plant is located. It includes information about the site location, infrastructure like roads and sewers, buildings and other structures located on the Site, and the shape of the terrain on which a Building or Site_feature is located.

The following objects are used by the site_characterization UoF:

— Breakline;

— Building;

— Facet;

— Faceted_terrain_model;

— Location_in_building;

— Location_in_site;

— Point_terrain_model;

— Site;

— Site_feature;

— Sited_plant;

— Survey_point;

— Terrain_model.

4.1.13 wireframe_and_b_rep_geometry UoF

The wireframe_and_b_rep_geometry UoF specifies the representations of Plant_item shapes using wireframe models and B-rep geometry.

The following objects are used by the wireframe_and_b_rep_geometry UoF:

— B_rep_element;

— Conic;

— Curve;

— Free_form_curve;

— Line;

— Point;

— Polygon;

— Surface;

— Vector;

— Wire_and_surface_element.

4.2 Application objects

This subclause specifies the application objects for the plant spatial configuration application protocol. Each application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object. The application objects and their definitions are given below.

4.2.1 B_rep_element

A B_rep_element is a type of Shape_representation_element (see 4.2.209) that is composed of geometric and topological elements.

NOTE - A B_rep_element need not represent a solid shape.

4.2.2 Blank

A Blank is a type of Fitting (see 4.2.79) that is placed between two Flange (see 4.2.80) objects to block the flow of material between the pipelines on either side of the Blank. Each Blank may be one of the following: a Paddle_blank (see 4.2.144) or a Spectacle_blind (see 4.2.222).

The data associated with Blank are the following:

— outside_diameter;

— thickness.

4.2.2.1 outside_diameter

The outside_diameter specifies the external diameter of the Blank.

4.2.2.2 thickness

The thickness specifies the measure of the face-to-face length of the Blank.

4.2.3 Blind_flange

A Blind_flange is a type of Flange (see 4.2.80) that is used to block material flow at a flanged connection.

4.2.4 Block

A Block is a type of Csg_element (see 4.2.53) that is a 3D right rectangular solid. A Block may be a Trimmed_block (see 4.2.248).

NOTE - The size and shape of a Block is described by three real values representing the dimensions of the Block.

4.2.5 Breakline

A Breakline is a contiguous set of straight line segments that designate a path across a Terrain_model (see 4.2.243).

NOTE - The path is a constraint on the mathematical interpolation of the surface of the terrain.

4.2.6 Building

A Building is a partially or totally enclosed structure located on a Site (see 4.2.212) and which contains Plant_system (see 4.2.183) objects or provides supporting infrastructure within its boundaries.

The data associated with Building are the following:

— building_id;

— location_and_orientation;

— name;

— shape.

4.2.6.1 building_id

The building_id specifies a unique number used to identify the building.

4.2.6.2 location_and_orientation

The location_and_orientation specifies the position of the Building relative to the site coordinate system and the orientation of the Building relative to a specified direction.

EXAMPLE 8 - E5704.35', N5912.87' are coordinates. They can be used to locate a known point in the Building (e.g., centrelines of column row 1A).

4.2.6.3 name

The name specifies the designation or label given to the Building.

4.2.6.4 shape

The shape specifies the outline or characteristic surface configuration or contour of the building.

4.2.7 Bushing

A Bushing is a type of Fitting (see 4.2.79) with one external and one smaller internal end.

The data associated with Bushing are the following:

— end_1_connector;

— end_2_connector;

— end_to_end_length.

4.2.7.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.7.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.7.3 end_to_end_length

The end_to_end_length specifies the external length of the Bushing from one face to the other face.

4.2.8 Buttweld

A Buttweld is a type of Piping_connector (see 4.2.152) that consists of the welding of two Piping_-component (see 4.2.151) objects where they are aligned edge to edge.

The data associated with Buttweld are the following:

— end_preparation.

The end_preparation specifies a description of the end of the connector that is necessary to prepare it for welding.

4.2.9 Cable_support

A Cable_support is a type of Support_component (see 4.2.232) that provides support to Electrical_-component (see 4.2.65) objects.

The data associated with Cable_support are the following:

— cable_support_type.

The cable_support_type specifies a description of the category of Cable_support.

4.2.10 Catalogue_definition

A Catalogue_definition is the identification of a document that lists Catalogue_item (see 4.2.11) objects.

NOTE - Catalogue_definition may reference either an electronic or printed catalogue.

The data associated with Catalogue_definition are the following:

— catalogue_id;

— catalogue_name;

— catalogue_vendor_name;

— catalogue_version.

4.2.10.1 catalogue_id

The catalogue_id specifies a unique identifier given to a catalogue.

4.2.10.2 catalogue_name

The catalogue_name specifies the descriptive catalogue identifier.

4.2.10.3 catalogue_vendor_name

The catalogue_vendor_name specifies the designation of the organization whose Plant_item (see 4.2.166) objects are described in the catalogue.

NOTE - This attribute allows for a vendor reference to be added, where applicable, to an entire collection of Catalogue_item (see 4.2.11) objects.

4.2.10.4 catalogue_version

The catalogue_version specifies a revision of the catalogue.

4.2.11 Catalogue_item

A Catalogue_item is an item whose characteristics are standardized and have been categorized in a library or catalogue.

The data associated with Catalogue_item are the following:

— item_reference;

— item_version;

— model_number.

4.2.11.1 item_reference

The item_reference specifies an alternate identifier or a further refinement of Catalogue_item attributes.

EXAMPLE 9 - Item_references may include "size designation", "figure number", or "rating".

4.2.11.2 item_version

The item_version specifies a revision of a catalogue_item.

NOTE - This attribute accommodates the possibility of revision pages to a vendor catalogue.

4.2.11.3 model_number

The model_number is the identifier assigned by the vendor to one or more Catalogue_item objects.

4.2.12 Catalogue_item_substitute

A Catalogue_item_substitute is an alternate Catalogue_item (see 4.2.11) that can be substituted for the specified Catalogue_item.

4.2.13 Change

A Change is the modification or requested modification of a Plant_item (see 4.2.166).

NOTE - A Change may be a request to make a change or an approved change.

The data associated with Change are the following:

— business_unit;

— change_id;

— change_reason;

— change_summary;

— date;

— project_number;

— revision;

— status;

— title.

4.2.13.1 business_unit

The business_unit specifies the organization, company, or functional group responsible for the Change.

4.2.13.2 change_id

The change_id specifies a unique identifier for the Change.

4.2.13.3 change_reason

The change_reason specifies the rationale for the Change.

4.2.13.4 change_summary

The change_summary specifies a general description of the Change.

4.2.13.5 date

The date specifies the calendar day-month-year on which the Change was initiated.

NOTE - A specific ordering of the day, month, and year within the date is not required.

4.2.13.6 project_number

The project_number specifies a designation assigned to identify projects within an organization.

EXAMPLE 10 - Identification of a project_number is used to allow tracking of items such as costs and job hours associated with a Change.

4.2.13.7 revision

The revision specifies the version of the Change and its description.

4.2.13.8 status

The status specifies an indication of the current state of the Change.

EXAMPLE 11 - This indication may have the value "draft", "in review", "approved", or "completed".

4.2.13.9 title

The title specifies a descriptive label for the Change.

4.2.14 Change_approval

A Change_approval is the endorsement by an authority of the change in status of a specific Change.

The data associated with Change_approval are the following:

— approval_date;

— approver.

4.2.14.1 approval_date

The approval_date specifies the specific calendar day-month-year when the approval authority signed the Change (see 4.2.13) as approved.

NOTE - A specific ordering of the day, month, and year within the date is not required.

4.2.14.2 approver

The approver specifies the name of the individual who endorsed the Change (see 4.2.13).

4.2.15 Change_delta

A Change_delta is the relationship between a previous Change_item (see 4.2.16) and the current Change_-item.

4.2.16 Change_item

A Change_item is an item that may be modified, for which there is a request to modify, or is the result of a modification to a Change_item. Each Change_item may be one of the following: a Changed_line_-assignment (see 4.2.20), a Changed_line_branch_connection (see 4.2.21), a Changed_line_plant_item_-branch_connection (see 4.2.22), a Changed_line_plant_item_connection (see 4.2.23), a Changed_line_to_-line_connection (see 4.2.24), a Changed_material_specification_selection (see 4.2.25), a Changed_piping_-system_line_segment (see 4.2.27), a Changed_piping_system_line_segment_termination (see 4.2.28), a Changed_planned_physical_plant (see 4.2.30), a Changed_plant (see 4.2.30), a Changed_plant_item (see 4.2.31), a Changed_plant_item_collection (see 4.2.32), a Changed_plant_item_connection (see 4.2.33), a Changed_plant_item_connector (see 4.2.34), a Changed_plant_item_design_view (see 4.2.34), a Changed_-plant_item_shape (see 4.2.36), a Changed_plant_process_capability (see 4.2.37), a Changed_plant_system (see 4.2.38), a Changed_reference_geometry (see 4.2.39), a Changed_required_material_description (see 4.2.40), a Changed_sited_plant (see 4.2.41), or a Changed_sub_plant_relationship (see 4.2.42).

The data associated with Change_item are the following:

— change_item_id;

— creation_date;

— description;

— item_owner;

— supersedence_status;

— title.

4.2.16.1 change_item_id

The change_item_id specifies a unique identifier for a Change_item.

4.2.16.2 creation_date

The creation_date specifies the calendar day-month-year on which the Change_item is created.

NOTE - A specific ordering of the day, month, and year within the date is not required.

4.2.16.3 description

The description specifies a textual summary of the item being changed.

4.2.16.4 item_owner

The item_owner specifies the name of the person or organization that owns the item being changed and is responsible for implementing or approving the change.

4.2.16.5 supersedence_status

The status specifies the textual description of the existence condition of a Change_item.

EXAMPLE 12 - A Change_item status may have the value of "Current", "Superseded", or "Deleted".

4.2.16.6 title

The title specifies a descriptive label for the Change_item.

4.2.17 Change_life_cycle_stage

A Change_life_cycle_stage is a state in the life cycle of the change that indicates or classifies the status or disposition of the change.

The data associated with Change_life_cycle_stage are the following:

— change_life_cycle_stage_id;

— name.

4.2.17.1 change_life_cycle_stage_id

The change_life_cycle_stage_id specifies the unique identification of the Change_life_cycle_stage.

4.2.17.2 name

The name specifies a descriptive label of the stage.

EXAMPLE 13 - Names may have the value "requested", "pending", or "implemented".

4.2.18 Change_life_cycle_stage_sequence

A Change_life_cycle_stage_sequence is the mechanism by which the sequence of life cycle stages is specified.

4.2.19 Change_life_cycle_stage_usage

A Change_life_cycle_stage_usage is the assignment of a Change (see 4.2.13) to a particular Change_life_-cycle_stage (see 4.2.17).

The data associated with Change_life_cycle_stage_usage are the following:

— current;

— date;

— description.

4.2.19.1 current

The current specifies whether or not the Change_life_cycle_stage_usage represents the active assignment of the Change to the Change_life_cycle_stage.

NOTE - A Change has only one current Change_life_cycle_stage_usage at a given point in time. Every other Change_life_cycle_stage_usage objects for the Change indicate that it is not the active assignment.

4.2.19.2 date

The date specifies the calendar day-month-year when the Change was assigned to the Change_life_cycle_-stage.

NOTE - A specific ordering of the day, month, and year within the date is not required.

4.2.19.3 description

The description specifies the description of the assignment of the Change to a particular stage.

4.2.20 Changed_line_assignment

A Changed_line_assignment is a type of Change_item (see 4.2.16) that identifies a Line_piping_system_-component_assignment (see 4.2.120) that is being changed or is the result of a Change (see 4.2.13).

4.2.21 Changed_line_branch_connection

A Changed_line_branch_connection is a type of Change_item (see 4.2.16) that identifies a Line_branch_-connection (see 4.2.117) that is being changed or is the result of a Change (see 4.2.13).

4.2.22 Changed_line_plant_item_branch_connection

A Changed_line_plant_item_branch_connection is a type of Change_item (see 4.2.16) that identifies a Line_plant_item_branch_connection (see 4.2.121) that is being changed or is the result of a Change (see 4.2.13).

4.2.23 Changed_line_plant_item_connection

A Changed_line_plant_item_connection is a type of Change_item (see 4.2.16) that identifies a Line_-plant_item_connection (see 4.2.123) that is being changed or is the result of a Change (see 4.2.13).

4.2.24 Changed_line_to_line_connection

A Changed_line_to_line_connection is a type of Change_item (see 4.2.16) that identifies a Line_to_line_-connection (see 4.2.126) that is being changed or is the result of a Change (see 4.2.13).

4.2.25 Changed_material_specification_selection

A Changed_material_specification_selection is a type of Change_item (see 4.2.16) that identifies a Material_specification_selection (see 4.2.135) that is being changed or is the result of a Change (see 4.2.13).

4.2.26 Changed_piping_system_line

A Changed_piping_system_line is a type of Change_item (see 4.2.16) that identifies a Piping_system_line (see 4.2.160) that is being changed or is the result of a Change (see 4.2.13).

4.2.27 Changed_piping_system_line_segment

A Changed_piping_system_line_segment is a type of Change_item (see 4.2.16) that identifies a Piping_-system_line_segment (see 4.2.161) that is being changed or is the result of a Change (see 4.2.13).

4.2.28 Changed_piping_system_line_segment_termination

A Changed_piping_system_line_segment_termination is a type of Change_item (see 4.2.16) that identifies a Piping_system_line_segment_termination (see 4.2.162) that is being changed or is the result of a Change (see 4.2.13).

4.2.29 Changed_planned_physical_plant

A Changed_planned_physical_plant is a type of Change_item (see 4.2.16) that identifies a Planned_-physical_plant (see 4.2.163) that is being changed or is the result of a Change (see 4.2.13).

4.2.30 Changed_plant

A Changed_plant is a type of Change_item (see 4.2.16) that identifies a Plant (see 4.2.165) that is being changed or is the result of a Change (see 4.2.13).

4.2.31 Changed_plant_item

A Changed_plant_item is a type of Change_item (see 4.2.16) that identifies a Plant_item (see 4.2.166) that is being changed or is the result of a Change (see 4.2.13).

4.2.32 Changed_plant_item_collection

A Changed_plant_item_collection is a type of Change_item (see 4.2.16) that identifies a Plant_item_-collection (see 4.2.168) that is being changed or is the result of a Change (see 4.2.13).

4.2.33 Changed_plant_item_connection

A Changed_plant_item_connection is a type of Change_item (see 4.2.16) that identifies a Plant_item_-connection (see 4.2.169) that is being changed or is the result of a Change (see 4.2.13).

4.2.34 Changed_plant_item_connector

A Changed_plant_item_connector is a type of Change_item (see 4.2.16) that identifies a Plant_item_-connector (see 4.2.171) that is being changed or is the result of a Change (see 4.2.13).

4.2.35 Changed_plant_item_design_view

A Changed_plant_item_design_view is a type of Change_item (see 4.2.16) that identifies a Plant_item_-design_view (see 4.2.174) that is being changed or is the result of a Change (see 4.2.13).

4.2.36 Changed_plant_item_shape

A Changed_plant_item_shape is a type of Change_item (see 4.2.16) that identifies a Plant_item_shape (see 4.2.180) that is being changed or is the result of a Change (see 4.2.13).

4.2.37 Changed_plant_process_capability

A Changed_plant_process_capability is a type of Change_item (see 4.2.16) that identifies a Plant_-process_capability (see 4.2.182) that is being changed or is the result of a Change (see 4.2.13).

4.2.38 Changed_plant_system

A Changed_plant_system is a type of Change_item (see 4.2.16) that identifies a Plant_system (see 4.2.183) that is being changed or is the result of a Change (see 4.2.13).

4.2.39 Changed_reference_geometry

A Changed_reference_geometry is a type of Change_item (see 4.2.16) that identifies a Reference_geometry (see 4.2.198) that is being changed or is the result of a Change (see 4.2.13).

4.2.40 Changed_required_material_description

A Changed_required_material_description is a type of Change_item (see 4.2.16) that identifies a Required_material_description (see 4.2.200) that is being changed or is the result of a Change (see 4.2.13).

4.2.41 Changed_sited_plant

A Changed_sited_plant is a type of Change_item (see 4.2.16) that identifies a Sited_plant (see 4.2.41) that is being changed or is the result of a Change (see 4.2.13).

4.2.42 Changed_sub_plant_relationship

A Changed_sub_plant_relationship is a type of Change_item (see 4.2.16) that identifies a Sub_plant_-relationship (see 4.2.231) that is being changed or is the result of a Change (see 4.2.13).

4.2.43 Circular_ellipsoid

A Circular_ellipsoid is a type of Csg_element (see 4.2.53) that has the following geometric characteristics: it is axial symmetric; cross sections taken in a plane normal to the axis result are circular; cross sections taken in plane containing the axis are elliptical; it is trimmed with a plane that is normal to an axis.

NOTE - The shape of a Circular_ellipsoid may be described as a hemisphere that has been compressed along the circular axis.

4.2.44 Compressor

A Compressor is a type of Equipment (see 4.2.71) that increases the pressure of a gas or vapour by reducing its volume.

The data associated with Compressor are the following:

— compressor_type.

The compressor_type specifies a designation that classifies a Compressor based on its operational characteristics.

EXAMPLE 14 - A compressor_type may have the value "centrifugal", "reciprocating", or "axial flow".

4.2.45 Cone

A Cone is a type of Csg_element (see 4.2.53) that is a 3D volume with parallel, coaxial, circular cross-sections of radii which varies uniformly from a circular base to an axis normal to and positioned at the centrepoint of the base. A Cone may be an Eccentric_cone (see 4.2.59). A Cone may be a Trimmed_-cone (see 4.2.249).

4.2.46 Conic

A Conic is a type of Curve (see 4.2.54) composed of points located at a uniform distance from a point, a pair of points, or a point and a line.

EXAMPLE 15 - Kinds of Conics include "circles", "ellipses", "parabolas", and "hyperbolas".

4.2.47 Connected_assembly

A Connected_assembly is a type of Plant_item_collection (see 4.2.168) whose constituent elements must be connected.

NOTE - These connections may be identified explicitly by Plant_item_connection (see 4.2.169) objects.

4.2.48 Connection_definition

A Connection_definition is a type of Plant_item_connection (see 4.2.169) that specifies a non-instantiated connection comprised of two or more connectors.

4.2.49 Connector_definition

A Connector_definition is a type of Plant_item_connector (see 4.2.171) that identifies the connector where a non-instantiated Plant_item (see 4.2.166) can connect to one or more other Plant_item_connector (see 4.2.171) objects.

4.2.50 Construction_material

A Construction_material is the substances used as constituents in the construction of a Plant_item (see 4.2.166).

The data associated with Construction_material are the following:

— material_id;

— name;

— specification.

4.2.50.1 material_id

The material_id specifies a unique identifier for the material.

4.2.50.2 name

The name specifies the designation or label given to the material.

4.2.50.3 specification

The specification specifies a document that defines the requirements and characteristics of the substances used in a Plant_item (see 4.2.166) in a complete, precise, verifiable manner.

4.2.51 Coupling

A Coupling is a type of Fitting (see 4.2.79) that is used to make a linear connection between two pipes.

The data associated with Coupling are the following:

— end_1_connector;

— end_2_connector;

— end_to_end_length.

4.2.51.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.51.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.51.3 end_to_end_length

The end_to_end_length specifies the external distance between the end one and end two faces.

4.2.52 Cross

A Cross is a type of Fitting (see 4.2.79) that is a branched outlet consisting of four perpendicular legs to provide straight through and 90 degree flow.

The data associated with Cross are the following:

— centre_to_end_1_length;

— centre_to_end_2_length;

— centre_to_end_3_length;

— centre_to_end_4_length;

— end_1_connector;

— end_2_connector;

— end_3_connector;

— end_4_connector.

4.2.52.1 centre_to_end_1_length

The centre_to_end_1_length specifies the distance from the intersection of the cross straight run centreline and branch run centreline to the end one (straight run) face.

4.2.52.2 centre_to_end_2_length

The centre_to_end_2_length specifies the distance from the intersection of the cross straight run centreline and branch run centreline to the end two (straight run) face.

4.2.52.3 centre_to_end_3_length

The centre_to_end_3_length specifies the distance from the intersection of the cross straight run centreline and branch run centreline to the end three (branch run) face.

4.2.52.4 centre_to_end_4_length

The centre_to_end_4_length specifies the distance from the intersection of the cross straight run centreline and branch run centreline to the end four (branch run) face.

4.2.52.5 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.52.6 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.52.7 end_3_connector

The end_3_connector specifies the Piping_connector (see 4.2.152) designated as end three.

4.2.52.8 end_4_connector

The end_4_connector specifies the Piping_connector (see 4.2.152) designated as end four.

4.2.53 Csg_element

A Csg_element is a type of Shape_representation_element (see 4.2.209) that is a regular, 3D geometric shape that is combined with other regular shapes through boolean operations to create a complex, 3D,

solid model. Each Csg_element may be one of the following: a Block (see 4.2.4), a Circular_ellipsoid (see 4.2.43), a Cone (see 4.2.45), a Cylinder (see 4.2.55), an Extrusion (see 4.2.75), a Pyramid (see 4.2.194), a Solid_of_revolution (see 4.2.218), a Sphere (see 4.2.223), a Square_to_round (see 4.2.224), or a Torus (see 4.2.246).

4.2.54 Curve

A Curve is a type of Wire_and_surface_element (see 4.2.261) that is a one-dimensional manifold in a space of dimension two or three. A Curve is either a Conic (see 4.2.46), a Free_form_curve (see 4.2.85), a Line (see 4.2.116), a Polygon (see 4.2.188), or a Vector (see 4.2.259).

NOTE - Informally, a Curve can be envisioned as the path of a point moving in its coordinate space.

4.2.55 Cylinder

A Cylinder is a type of Csg_element (see 4.2.53) that is a 3D cylindrical solid primitive with end surfaces that are planar and are perpendicular to the axis. The size and shape of a Cylinder is completely described by two real values, which represent the radius and length of the cylinder. A Cylinder may be an Eccentric_cylinder (see 4.2.60). A Cylinder may be a Trimmed_cylinder (see 4.2.250). A Cylinder may be a Tube (see 4.2.254).

4.2.56 Design_project

A Design_project is a task with a specifically defined purpose and scope.

The data associated with Design_project are the following:

— design_project_id;

— design_project_name;

— design_project_number;

— design_project_owner.

4.2.56.1 design_project_id

The design_project_id specifies a unique identifier for the Design_project.

4.2.56.2 design_project_name

The design_project_name specifies a textual designation or label for the Design_project.

4.2.56.3 design_project_number

The design_project_number specifies a numeric designation for the Design_project.

4.2.56.4 design_project_owner

The design_project_owner specifies the name of the organization that owns the Design_project id, name, and number.

4.2.57 Detail_shape

A Detail_shape is a type of Plant_item_shape (see 4.2.180) that is the 3D spatial volume that corresponds to the complete surface representation of a Plant_item (see 4.2.166).

4.2.58 Ducting_component

A Ducting_component is a type of Plant_item (see 4.2.166) that conveys gaseous or airborne particulate matter. Each Ducting_component may be one of the following: an Equipment_breaching (see 4.2.72), a Hvac_component (see 4.2.100), or a Process_ducting (see 4.2.191).

4.2.59 Eccentric_cone

An Eccentric_cone is a type of Cone (see 4.2.45) with an axis that is not normal to the base.

4.2.60 Eccentric_cylinder

An Eccentric_cylinder is a type of Cylinder (see 4.2.55) with an axis that is not normal to the base.

4.2.61 Eccentric_pyramid

An Eccentric_pyramid is a type of Pyramid (see 4.2.194) with an axis that is not normal to the base.

4.2.62 Eccentric_reducer

An Eccentric_reducer is a type of Reducer (see 4.2.195) where the small end is off-centre from the large end.

The data associated with Eccentric_reducer are the following:

— centreline_offset;

— flat_side_orientation.

4.2.62.1 centreline_offset

The centreline_offset specifies the perpendicular distance between the centreline of the large end of the Reducer (see 4.2.195) and the centreline of the smaller end of the Reducer.

4.2.62.2 flat_side_orientation

The flat_side_orientation specifies whether the direction of the straight side of the Eccentric_reducer is up or down.

4.2.63 Eccentric_swage

An Eccentric_swage is a type of Swage (see 4.2.238) where the small end is off-centre from the large end.

The data associated with Eccentric_swage are the following:

— centreline_offset;

— flat_side_orientation.

4.2.63.1 centreline_offset

The centreline_offset specifies the perpendicular distance between the centreline of the large end of the Swage (see 4.2.238) and the centreline of the smaller end of the Swage.

4.2.63.2 flat_side_orientation

A flat_side_orientation specifies whether the direction of the straight side of the Eccentric_swage is up or down.

4.2.64 Elbow

An Elbow is a type of Fitting (see 4.2.79) that is used to change the direction of piping.

The data associated with Elbow are the following:

— centre_to_end_1_length;

— centre_to_end_2_length;

— centreline_radius;

— end_1_connector;

— end_2_connector;

— sweep_angle;

— type.

4.2.64.1 centre_to_end_1_length

The centre_to_end_1_length specifies the distance from the centre of the Elbow (i.e., where the centrelines for the two ends intersect) to the face of end one.

4.2.64.2 centre_to_end_2_length

The centre_to_end_2_length specifies the distance from the centre of the Elbow (i.e., where the centrelines for the two ends intersect) to the face of end two.

4.2.64.3 centreline_radius

The centreline_radius specifies the distance from the centreline of the Elbow to the intersection of the perpendicular projection of the centreline taken at the point where the Elbow centreline ends or where the inlet and outlet ends of the Elbow centreline become straight lines.

4.2.64.4 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.64.5 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.64.6 sweep_angle

The sweep_angle specifies the included angle formed between two lines that are parallel to the inlet and outlet faces of the Elbow, measured at their point of intersection (the centre of radius of the Elbow).

4.2.64.7 type

The type specifies a designation that classifies the Elbow.

EXAMPLE 16 - Elbow designations may have the value "long radius", "short radius", "reducing", or "street".

4.2.65 Electrical_component

An Electrical_component is a type of Plant_item (see 4.2.166) that is an individually identifiable and functional part of an Electrical_system (see 4.2.67).

EXAMPLE 17 - Electrical_components may include "cable tray", "wireway", "conduit", "ductbank", "cables", "switches", "relays", "motor control centres", and "junction boxes".

4.2.66 Electrical_connector

An Electrical_connector is a type of Plant_item_connector (see 4.2.171) that is intended to establish an electrical connection (signal or power) between two Plant_item (see 4.2.166) objects.

The data associated with Electrical_connector are the following:

— type.

The type specifies the designation that describes the functional behaviour of the Electrical_connector.

4.2.67 Electrical_system

An Electrical_system is a type of Plant_system (see 4.2.183) that is a system of wiring, switches, relays, and other equipment associated with receiving and distributing electrical power.

The data associated with Electrical_system are the following:

— system_voltage_designation;

— type.

4.2.67.1 system_voltage_designation

The system_voltage_designation is the rated voltage of the system.

4.2.67.2 type

The type specifies a designation that classifies the Electrical_system based on the kind of service that it provides.

4.2.68 Electricity_transference

An Electricity_transference is a type of Plant_item_connection (see 4.2.169) that identifies the purpose or role of the connection as being the transfer of electrical current or signal.

4.2.69 Engine

An Engine is a type of Equipment (see 4.2.71) that converts the thermal energy generated through the consumption of fuel into mechanical energy to produce force and motion.

The data associated with Engine are the following:

— engine_type.

The engine_type specifies a designation that classifies an Engine based on its operational characteristics.

EXAMPLE 18 - Engine_type designations may have the value "gasoline", "natural gas", or "diesel".

4.2.70 Envelope_shape

An Envelope_shape is a type of Plant_item_shape (see 4.2.180) that is a 3D spatial volume that completely encloses or bounds a Plant_item (see 4.2.166).

4.2.71 Equipment

An Equipment is a type of Plant_item (see 4.2.166) that is treated as a single and self-contained unit that provides a function. Each Equipment may be one of the following: a Compressor (see 4.2.44), an Engine (see 4.2.69), a Furnace (see 4.2.95), a Gear_box (see 4.2.96), a Heat_exchanger (see 4.2.97), a Pressure_-vessel (see 4.2.190), a Pump (see 4.2.193), a Silo (see 4.2.211), a Tank (see 4.2.241), or a Turbine (see 4.2.255). Each Equipment may be an Inline_equipment (see 4.2.102).

The data associated with Equipment are the following:

— delivery_date;

— heat_tracing_type;

— insulation_specification;

— performance_characteristics;

— purchase_order_number;

— requisition_number;

— vendor_name.

4.2.71.1 delivery_date

The delivery_date specifies the calendar day-month-year when the Equipment was or is scheduled to be delivered to the Site (see 4.2.212).

NOTE - A specific ordering of the day, month, and year within the date is not required.

4.2.71.2 heat_tracing_type

The heat_tracing_type specifies the means utilized to impart a temperature increase to the Equipment by an external wrapping or coiling.

NOTE - Types include, but are not limited to, electrical or steam.

4.2.71.3 insulation_specification

The insulation_specification specifies the document that defines the insulation requirements for the Equipment.

4.2.71.4 performance_characteristics

The performance_characteristics specifies a description of the functional attributes of the Equipment.

EXAMPLE 19 - Performance characteristics of a Pump (see 4.2.193) may be that it operates at 80% efficiency while pumping 1250 gallons per minute.

4.2.71.5 purchase_order_number

The purchase_order_number specifies an identifier assigned to the Equipment purchase order.

4.2.71.6 requisition_number

The requisition_number specifies an identifier assigned to a written request for a piece of Equipment.

4.2.71.7 vendor_name

The vendor_name specifies the identifier of the company or organization that is providing the Equipment.

4.2.72 Equipment_breaching

An Equipment_breaching is a type of Ducting_component (see 4.2.58) consisting of a type of ductwork connected to a piece of Equipment (see 4.2.71) for the purpose of exhausting gases.

4.2.73 Equipment_trim_piping

An Equipment_trim_piping is piping connected to a piece of Equipment (see 4.2.71) that performs a function integral to the Equipment.

NOTE - The piping is normally designed and possibly provided or installed by the Equipment manufacturer. Piping of this nature is normally of nominal size two inches and below.

4.2.74 Expander_flange

An Expander_flange is a type of Flange (see 4.2.80) that provides a transition from a smaller to a larger diameter Pipe (see 4.2.148) at a flanged connection.

4.2.75 Extrusion

An Extrusion is a type of Csg_element (see 4.2.53) that is a closed, 2D profile swept through a linear distance in space.

4.2.76 Facet

A Facet is a planar, polygonal surface.

NOTE - In 3D computer models, curved surfaces are sometimes represented by a collection of Facets that approximate the curved surface.

4.2.77 Faceted_terrain_model

A Faceted_terrain_model is a type of Terrain_model (see 4.2.243) that consists of a collection of Facet (see 4.2.76) objects that represent the topography of a Site (see 4.2.212).

4.2.78 Female_end

A Female_end is a type of Piping_connector (see 4.2.152) end type that forms a hub of material at the connector to support the insertion of a compatible male connector.

The data associated with Female_end are the following:

— depth;

— hub_inside_diameter;

— hub_length;

— hub_outside_diameter.

4.2.78.1 depth

The depth specifies the distance from the face of the Piping_connector to the depth of relief.

4.2.78.2 hub_inside_diameter

The hub_inside_diameter specifies the diameter of the opening at the hub.

4.2.78.3 hub_length

The hub_length specifies the distance from the face of the Plant_item_connector (see 4.2.171) to the point at which the hub size transitions to the body size of the Plant_item (see 4.2.166).

4.2.78.4 hub_outside_diameter

The hub_outside_diameter specifies the external diameter of the hub.

4.2.79 Fitting

A Fitting is a type of Piping_component (see 4.2.151) used to join or terminate sections of Pipe (see 4.2.148) or provide changes of direction or branching in a Piping_system (see 4.2.158). Each Fitting may be one of the following: a Blank (see 4.2.2), a Bushing (see 4.2.7), a Coupling (see 4.2.51), a Cross (see 4.2.52), an Elbow (see 4.2.64), a Flange (see 4.2.80), an Insert (see 4.2.104), a Lap_joint_stub_end (see 4.2.114), a Lateral (see 4.2.115), an Olet (see 4.2.139), an Orifice_plate (see 4.2.141), a Pipe_cap (see 4.2.150), a Reducer (see 4.2.195), a Spacer (see 4.2.219), a Swage (see 4.2.238), a Tee (see 4.2.242), a Union (see 4.2.256), or a Wye (see 4.2.262).

4.2.80 Flange

A Flange is a type of Fitting (see 4.2.79) that is an annular collar designed to permit a bolted connection to a similar collar. A Flange contains two end connectors, one of which shall be a Piping_connector of type Flanged_end. Each Flange may be one of the following: a Blind_flange (see 4.2.3), an Expander_-flange (see 4.2.74), an Orifice_flange (see 4.2.140), or a Reducing_flange (see 4.2.196). Each Flange may be one of the following: a Lap_joint_flange (see 4.2.113), a Slip_on_flange (see 4.2.215), a Socket_weld_-flange (see 4.2.217), a Threaded_flange (see 4.2.245), or a Weld_neck_flange (see 4.2.260).

The data associated with Flange are the following:

— end_1_connector;

— end_2_connector;

— hub_through_length;

— hub_weld_point_diameter.

4.2.80.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.80.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.80.3 hub_through_length

The hub_through_length specifies the distance between the flange face and the hub face.

4.2.80.4 hub_weld_point_diameter

The hub_weld_point_diameter specifies the outside diameter of the hub at the point of connection between the flange and the pipe.

4.2.81 Flanged

A Flanged is a type of Piping_connector (see 4.2.152) end engagement type consisting of a disk of material with holes around the circumference and a facing style.

> NOTE - The holes are used to bolt together two connected flanges. The facing is the mating surface which in conjunction with a gasket forms a tight connection by the pressure of the two connected flanged connectors. A flanged connection can be disassembled.

4.2.82 Flanged_end

A Flanged_end is a type of Piping_connector (see 4.2.152) end type that is a disk of material to support the insertion of bolts to mate with a compatible Flanged_end.

The data associated with Flanged_end are the following:

— face_finish;

— flange_inside_diameter;

— flange_outside_diameter;

— flange_thickness;

— raised_face_diameter;

— raised_face_height.

4.2.82.1 face_finish

The face_finish specifies a description of the Flange (see 4.2.80) face surface roughness and groove pattern.

4.2.82.2 flange_inside_diameter

The flange_inside_diameter specifies the interior diameter of the Flange (see 4.2.80) at the working point.

4.2.82.3 flange_outside_diameter

The flange_outside_diameter specifies the external diameter of the Flange (see 4.2.80).

4.2.82.4 flange_thickness

The flange_thickness specifies the distance between the inside and outside Flange (see 4.2.80) disk surfaces measured at the disk perimeter.

4.2.82.5 raised_face_diameter

The raised_face_diameter specifies the diameter measured across the elevated portion of the mating surface of a Flange (see 4.2.80).

4.2.82.6 raised_face_height

The raised_face_height specifies the perpendicular distance measured from the elevated portion of the Flange (see 4.2.80) mating surface to the lower Flange surface.

4.2.83 Flexible_connection

A Flexible_connection is a type of Plant_item_connection (see 4.2.169) in which two Plant_item_-connector (see 4.2.171) objects are in physical contact, though there is no implication concerning the freedom of motion of the connected Plant_item (see 4.2.166) objects.

> EXAMPLE 20 - The pump driver may be connected to an electrical cable at its terminal using a Flexible_connection; the cable need not rotate when the pump is rotated, but contact must be preserved.
>
> NOTE - A pipe resting on a structure is modelled as a pipe support.

4.2.84 Fluid_transference

A Fluid_transference is a type of Plant_item_connection (see 4.2.169) that identifies the purpose or role of the connection as being the transfer of gas, vapour, liquid or solid material.

4.2.85 Free_form_curve

A Free_form_curve is type of Curve (see 4.2.54). It is a one-dimensional, contiguous set of points.

4.2.86 Functional_connection_definition_satisfaction

A Functional_connection_definition_satisfaction is the assignment of an actual Connection_definition (see 4.2.48) to a functional Connection_definition for the purpose of satisfying the functional requirements with a physical object.

4.2.87 Functional_connection_occurrence_satisfaction

A Functional_connection_occurrence_satisfaction is the assignment of an actual Plant_item_connection_-occurrence (see 4.2.170) to a functional Plant_item_connection_occurrence for the purpose of satisfying the functional requirements with a physical object.

4.2.88 Functional_connector

A Functional_connector is a type of Plant_item_connector_occurrence (see 4.2.172) that represents the functional or logical aspect of the plant_item_connector_occurrence. Each Functional_connector may be one of the following: a Line_plant_item_branch_connector (see 4.2.122) or a Line_plant_item_connector (see 4.2.124).

4.2.89 Functional_connector_definition_satisfaction

A Functional_connector_definition_satisfaction is the assignment of an actual Connector_definition (see 4.2.49) to a functional Connector_definition for the purpose of satisfying the functional requirements with a physical object.

4.2.90 Functional_connector_occurrence_satisfaction

A Functional_connector_occurrence_satisfaction is the assignment of an actual Physical_connector (see 4.2.146) to a Functional_connector (see 4.2.88) for the purpose of satisfying the functional requirements with a physical object.

4.2.91 Functional_design_view

A Functional_design_view is a type of Plant_item_design_view (see 4.2.174) that describes the logical characteristics of a Plant_item (see 4.2.166).

The data associated with Functional_design_view are the following:

— tag_number.

The tag_number specifies an optional identifier assigned to the Plant_item (see 4.2.166) for purposes of eventual physical tracking and tagging.

4.2.92 Functional_plant

A Functional_plant is a Plant (see 4.2.165) that describes the logical characteristics of a Plant.

4.2.93 Functional_plant_satisfaction

A Functional_plant_satisfaction is the assignment of an actual Planned_physical_plant (see 4.2.163) to a Functional_plant (see 4.2.92) for the purpose of satisfying the functional requirements with a physical object.

4.2.94 Functional_plant_item_satisfaction

A Functional_plant_item_satisfaction is the assignment of a Physical_design_view (see 4.2.147) to a Functional_design_view (see 4.2.91) for the purpose of satisfying the functional requirements with a physical object.

4.2.95 Furnace

A Furnace is a type of Equipment (see 4.2.71) that is an enclosed structure in which heat is generated and transferred either directly or indirectly to a solid or fluid mass for the purpose of effecting a physical or chemical change.

The data associated with Furnace are the following:

— furnace_type.

The furnace_type specifies a designation that classifies a Furnace based on its operational characteristics.

EXAMPLE 21 - Furnace type designations may have the value "blast", "electric-arc", or "submerged-arc".

4.2.96 Gear_box

A Gear_box is a type of Equipment (see 4.2.71) that is an assembly of gears to transfer force between machines or mechanisms normally resulting in changes in torque, speed, and direction of rotation between input and output shafts.

The data associated with Gear_box are the following:

— gear_box_type.

The gear_box_type specifies a designation that classifies a Gear_box based on its operational characteristics.

4.2.97 Heat_exchanger

A Heat_exchanger is a type of Equipment (see 4.2.71) that is used to transfer heat from a liquid or gas flowing on one side of a barrier to a liquid or gas flowing on the other.

The data associated with Heat_exchanger are the following:

— heat_exchanger_type.

The heat_exchanger_type specifies a designation that classifies a Heat_exchanger based on its operational characteristics.

EXAMPLE 22 - Heat_exchanger_type designations may have the value "shell and tube", "plate and frame", or "direct contact".

4.2.98 Hemisphere

A Hemisphere is a type of Trimmed_sphere (see 4.2.252) that is formed by cutting the Sphere with a plane that passes through the centrepoint of the Sphere and removing one section.

4.2.99 Hierarchical_assembly

A Hierarchical_assembly is a type of Plant_item_collection (see 4.2.168) that consists of a grouping of Plant_item (see 4.2.166) objects that are related to each other, but need not be physically connected.

4.2.100 Hvac_component

An Hvac_component is a type of Ducting_component (see 4.2.58) that is an individually identifiable item or combination of items that is part of an HVAC system.

EXAMPLE 23 - The description attribute inherited from Plant_item may describe the HVAC_component as an "air handling unit", "chiller", or "space heater".

4.2.101 Hvac_system

An Hvac_system is a type of Plant_system (see 4.2.183) that controls the temperature, humidity, cleanliness, and circulation of environmental air as required in a Building (see 4.2.6).

The data associated with Hvac_system are the following:

— type.

The type specifies a designation that classifies a Hvac_system based on the kind of service that it provides.

4.2.102 Inline_equipment

An Inline_equipment is a type of Equipment (see 4.2.71) and Piping_system_component (see 4.2.159) that is inserted into the flow of a process stream to perform some function. Each Inline_equipment may be a Jacketed_piping (see 4.2.112).

4.2.103 Inline_instrument

An Inline_instrument is a type of Instrument (see 4.2.107) and Piping_system_component (see 4.2.159) that is inserted into the flow of a process stream to measure some characteristic of the stream.

4.2.104 Insert

An Insert is a type of Fitting (see 4.2.79) with one external and one smaller internal end.

The data associated with Insert are the following:

— end_1_connector;

— end_2_connector;

— end_to_end_length.

4.2.104.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.104.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.104.3 end_to_end_length

The end_to_end_length specifies the external length of the Insert from one face to the other face.

4.2.105 Inside_and_thickness

An Inside_and_thickness is a type of Piping_size_description (see 4.2.154) which describes the size of a Piping_system_component (see 4.2.159) or a Piping_connector (see 4.2.152) using an actual (intended) inside diameter and wall thickness.

The data associated with Inside_and_thickness are the following:

— inside_diameter;

— thickness.

4.2.105.1 inside_diameter

The inside_diameter specifies the actual (intended, not nominal) inside diameter of the Piping_system_-component (see 4.2.159) or Piping_connector (see 4.2.152).

4.2.105.2 thickness

The thickness specifies the minimum wall thickness required for the Piping_system_component (see 4.2.159) or Piping_connector (see 4.2.152).

4.2.106 Installed_physical_design_view

An Installed_physical_design_view is an indication that the Plant_item (see 4.2.166) described by a Physical_design_view (see 4.2.147) that is installed within the Plant (see 4.2.165).

4.2.107 Instrument

An Instrument is a type of Instrumentation_and_control_component (see 4.2.108) that monitors one or more performance characteristics of a system. Each Instrument may be one of the following: an Inline_-instrument (see 4.2.103) or an Offline_instrument (see 4.2.138).

The data associated with Instrument are the following:

— actuation_type;

— control_loop_id;

— instrument_type;

— signal_type.

4.2.107.1 actuation_type

The actuation_type specifies a classification of an Instrument actuator based on its operational characteristics.

EXAMPLE 24 - Instrument actuator_type classifications may have the value "pneumatic", "solenoid", or "motor".

4.2.107.2 control_loop_id

The control_loop_id specifies a unique identifier for the Instrument loop.

4.2.107.3 instrument_type

The instrument_type specifies a classification of an Instrument based on its performance characteristics.

EXAMPLE 25 - Instrument_type classifications may have the value "flow control", "level control", "pressure", or "temperature".

4.2.107.4 signal_type

The signal_type specifies a classification of an Instrument signal based on its physical characteristics.

EXAMPLE 26 - Instrument signal_type classifications may have the value "electric" or "pneumatic".

4.2.108 Instrumentation_and_control_component

An Instrumentation_and_control_component is a type of Plant_item (see 4.2.166) that is an individually identifiable item or combination of items that is part of the Instrumentation_and_control_system (see 4.2.109). Each Instrumentation_and_control_component may be an Instrument (see 4.2.107).

EXAMPLE 27 - Instrumentation_and_control_component objects may have the value "wiring", "switches", "control valves", or "gauges".

4.2.109 Instrumentation_and_control_system

An Instrumentation_and_control_system is a type of Plant_system (see 4.2.183) that is a system of wiring, switches, controls, and other equipment associated with monitoring and controlling the performance characteristics of Plant_system objects.

The data associated with Instrumentation_and_control_system are the following:

— type.

The type specifies a designation that classifies the Instrumentation_and_control_system based on the kind of service that it provides.

4.2.110 Insulation

An Insulation is a type of Plant_item (see 4.2.166) that is a material or assembly of materials used to provide resistance to heat flow.

4.2.111 Interfering_shape_element

An Interfering_shape_element is the portion of the Plant_item_shape (see 4.2.180) which is interfered with by a shape element of another Plant_item (see 4.2.166).

The data associated with Interfering_shape_element are the following:

— interference_colour.

The interference_colour specifies the colour with which the element is displayed.

4.2.112 Jacketed_piping

A Jacketed_piping is a type of Inline_equipment (see 4.2.102) that is a Pipe (see 4.2.148) surrounded or enclosed by another Pipe.

4.2.113 Lap_joint_flange

A Lap_joint_flange is a type of Flange (see 4.2.80) that has a rounded contour at the intersection of the bore and the Flange face in order to mate to a Lap_joint_stub_end (see 4.2.114).

NOTE - This Flange can be swiveled around a Lap_joint_stub_end in order to align bolt holes.

4.2.114 Lap_joint_stub_end

A Lap_joint_stub_end is a type of Fitting (see 4.2.79) used with a Lap_joint_flange (see 4.2.113), consisting of a cylinder or barrel with an integral flat ring or lap around one end with a rounded contour at the external intersection of the barrel and the lap.

NOTE - The other end is beveled for buttwelding to pipe. The lap face normally has a spiral serrated finish. This surface serves as the raised face gasket surface of the Flange in Lap_joint_flange connections.

The data associated with Lap_joint_stub_end are the following:

— end_1_connector;

— end_2_connector;

— length;

— stub_diameter;

— stub_thickness.

4.2.114.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.114.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.114.3 length

The length specifies the external distance between the lap face and the other stub end face.

4.2.114.4 stub_diameter

The stub_diameter specifies the nominal diameter of the Lap_joint_stub_end.

4.2.114.5 stub_thickness

The stub_thickness specifies the length of the flared portion of the stub end.

4.2.115 Lateral

A Lateral is a type of Fitting (see 4.2.79) that is a three-way fitting having two ends opposite each other in a straight run and a branch outlet projecting from the run at an angle.

The data associated with Lateral are the following:

— branch_angle;

— centre_to_end_1_length;

— centre_to_end_2_length;

— centre_to_end_3_length;

— end_1_connector;

— end_2_connector;

— end_3_connector.

4.2.115.1 branch_angle

The branch_angle specifies the angle that the branch projects from the straight run.

4.2.115.2 centre_to_end_1_length

The centre_to_end_1_length specifies the distance between the point where the branch and straight run centrelines intersect and the end one face.

4.2.115.3 centre_to_end_2_length

The centre_to_end_2_length specifies the distance between the point where the branch and straight run centrelines intersect and the end two face.

4.2.115.4 centre_to_end_3_length

The centre_to_end_3_length specifies the distance between the point where the branch and straight run centrelines intersect and the end three face.

4.2.115.5 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.115.6 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.115.7 end_3_connector

The end_3_connector specifies the Piping_connector (see 4.2.152) designated as end three.

4.2.116 Line

A Line is a type of Curve (see 4.2.54) that is a one-dimensional, contiguous set of points that are positioned at a constant distance from a vector or that constitute the shortest distance between two points.

4.2.117 Line_branch_connection

A Line_branch_connection is a connection between the logical termination of one Piping_system_line_-segment (see 4.2.161) and a point on another Piping_system_line_segment other than a termination. The former Piping_system_line_segment branches from the latter Piping_system_line_segment.

The data associated with Line_branch_connection are the following:

— branch_sequence_id.

The branch_sequence_id specifies an alphanumeric identifier that indicates the order that lines branch off of the main line segment.

NOTE - All branch_sequence_ids are unique with respect to the branches of a given Piping_system_line_-segment.

4.2.118 Line_branch_termination

A Line_branch_termination is a type of Piping_system_line_segment_termination (see 4.2.162) that connects to a piping_system_line_segment at a point other than a termination.

4.2.119 Line_less_piping_system

A Line_less_piping_system is a type of Piping_system (see 4.2.158) that does not have a line designation as defined in Piping_system_line (see 4.2.160).

4.2.120 Line_piping_system_component_assignment

A Line_piping_system_component_assignment is the relationship between a Piping_system_line (see 4.2.160) and a Piping_system_component (see 4.2.159) that is part of or satisfies the need specified by the Piping_system_line.

4.2.121 Line_plant_item_branch_connection

A Line_plant_item_branch_connection is a connection between a Line_plant_item_branch_connector (see 4.2.122) and a point on a Piping_system_line_segment other than a termination. The Line_plant_item_-branch_connector branches from the Piping_system_line_segment.

The data associated with Line_plant_item_branch_connection are the following:

— branch_sequence_id.

The branch_sequence_id specifies an alphanumeric identifier that indicates the order that lines branch off of the main line segment.

NOTE - All branch_sequence_ids are unique with respect to the branches of a given Piping_system_line_-segment.

4.2.122 Line_plant_item_branch_connector

A Line_plant_item_branch_connector is a type of Functional_connector (see 4.2.88) that participates in a Line_plant_item_branch_connection (see 4.2.121).

4.2.123 Line_plant_item_connection

A Line_plant_item_connection is a connection between the logical termination of a Piping_system_line_-segment (see 4.2.161) and a Line_plant_item_connector (see 4.2.124).

4.2.124 Line_plant_item_connector

A Line_plant_item_connector is a type of Functional_connector (see 4.2.88) that participates in a Line_-plant_item_connection (see 4.2.123).

4.2.125 Line_plant_item_termination

A Line_plant_item_termination is a type of Piping_system_line_segment_termination (see 4.2.162) that connects to Plant_item_connector_occurrence (see 4.2.172).

4.2.126 Line_to_line_connection

A Line_to_line_connection is a connection between the logical terminations of two or more Piping_-system_line_segment (see 4.2.161) objects.

The data associated with a Line_to_line_connection are the following:

— line_to_line_connection_id.

The line_to_line_connection_id specifies a unique identifier for the Line_to_line_connection.

4.2.127 Line_to_line_termination

A Line_to_line_termination is a type of Piping_system_line_segment_termination (see 4.2.162) that connects to other Line_to_line_termination objects.

4.2.128 Load_transference

A Load_transference is a type of Plant_item_connection (see 4.2.169) that identifies the purpose or role of the connection as being the transfer of load or force.

4.2.129 Location_in_building

A Location_in_building is a type of Plant_item_location (see 4.2.179) that is the position of the Plant_item (see 4.2.166) relative to the Building (see 4.2.6).

4.2.130 Location_in_plant

A Location_in_plant is a type of Plant_item_location (see 4.2.179) that is the position of the Plant_item (see 4.2.166) relative to the Plant (see 4.2.165).

4.2.131 Location_in_site

A Location_in_site is a type of Plant_item_location (see 4.2.179) that is the position of the Plant_item (see 4.2.166) relative to the Site (see 4.2.212).

4.2.132 Locked_orientation_connection

A Locked_orientation_connection is a type of Plant_item_connection (see 4.2.169) in which two Plant_-item_connector (see 4.2.171) objects are in physical contact and there is no relative motion of the connected Plant_item (see 4.2.166) objects with respect to each other.

NOTE - A pump housing (containing the impeller and shaft) can be connected to the driver (motor) using a Locked_orientation_connection; this would mean that they move in unison.

4.2.133 Male_end

A Male_end is a type of Piping_connector (see 4.2.152) end type which forms a compatible connection with a Female_end (see 4.2.78).

4.2.134 Manufacturing_line

A Manufacturing_line is a type of Plant (see 4.2.165) that is defined by the type of product it produces.

4.2.135 Material_specification_selection

A Material_specification_selection is the candidate material specifications for piping system design. Each Material_specification_selection may be a Material_specification_subset_reference (see 4.2.136).

The data associated with Material_specification_selection are the following:

— description;

— material_specification_id;

— required_or_optional;

— selection_id;

— type.

4.2.135.1 description

The description specifies a textual summary of the selected material specification.

4.2.135.2 material_specification_id

The material_specification_id specifies a unique identifier for the material specification selected.

4.2.135.3 required_or_optional

The required_or_optional specifies whether the material specification is required or whether its use is optional.

4.2.135.4 selection_id

The selection_id specifies a unique identifier for the candidate material specification.

4.2.135.5 type

The type specifies a designation that classifies a Material_specification_selection based on selection criteria.

4.2.136 Material_specification_subset_reference

A Material_specification_subset_reference is a type of Material_specification_selection (see 4.2.135) that is the reference parameters required to identify the applicable subset of a Required_material_description (see 4.2.200).

The data associated with Material_specification_subset_reference are the following:

— subset_id.

The subset_id specifies a unique identifier for the specified subset portion of a Required_material_-description.

4.2.137 Mitre_bend_pipe

A Mitre_bend_pipe is a type of Pipe (see 4.2.148) that is a change in Pipe direction accomplished through the use of two or more straight sections of Pipe that are beveled and joined on a line bisecting the angle of junction.

The data associated with Mitre_bend_pipe are the following:

— bend_angle.

The bend_angle specifies the angle formed by the change in direction of the Pipe due to the mitre bend.

4.2.138 Offline_instrument

An Offline_instrument is a type of Instrument (see 4.2.107) that monitors the conditions of a system but is not an integral element of the system.

4.2.139 Olet

An Olet is a type of Fitting (see 4.2.79) welded onto a hole in the side of a Pipe (see 4.2.148) or other Fitting.

NOTE - The primary use of an Olet is for making small branch connections or connecting Instrument (see 4.2.107) lines to Piping_component (see 4.2.151) objects.

The data associated with Olet are the following:

— base_outside_diameter;

— branch_angle;

— end_1_connector;

— end_2_connector;

— length;

— skirt_outside_diameter.

4.2.139.1 base_outside_diameter

The base_outside_diameter specifies the external diameter of the olet at the surface that mates with the straight run pipe.

4.2.139.2 branch_angle

The branch_angle specifies the angle that the branch projects from the straight run.

4.2.139.3 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.139.4 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.139.5 length

The length specifies the distance between the end one face and the end two face at the centreline of the Olet.

4.2.139.6 skirt_outside_diameter

The skirt_outside_diameter specifies the maximum external diameter of the Olet (measured perpendicular to the Olet centreline).

NOTE - The sides of an Olet are tapered (not vertical).

4.2.140 Orifice_flange

An Orifice_flange is a type of Flange (see 4.2.80) used to assemble an Inline_instrument (see 4.2.103) to meter the flow of liquids or gases in a Pipe (see 4.2.148).

NOTE - Orifice_flange objects are used in pairs in conjunction with an Orifice_plate (see 4.2.141).

The data associated with Orifice_flange are the following:

— beta_ratio;

— jacking_screw_orientation;

— tap_diameter;

— tap_orientation.

4.2.140.1 beta_ratio

The beta_ratio specifies a value which indicates the length of pipe required on either side of the Orifice_-flange to ensure non-turbulent flow past the orifice.

4.2.140.2 jacking_screw_orientation

The jacking_screw_orientation specifies the angular position of the threaded bolt holes in an Orifice_-flange.

NOTE - Jacking screws are used to separate the Orifice_flange objects sufficiently to remove or insert the Orifice_plate (see 4.2.141).

4.2.140.3 tap_diameter

The tap_diameter specifies the diameter of a radial hole in the Orifice_flange.

4.2.140.4 tap_orientation

The tap_orientation specifies the angular position of the tap in a vertical plane perpendicular to the centreline of the Pipe (see 4.2.148).

4.2.141 Orifice_plate

An Orifice_plate is a type of Fitting (see 4.2.79) that is a disk with a calibrated hole that is placed in a Pipe (see 4.2.148) to measure flow.

The data associated with Orifice_plate are the following:

— beta_ratio;

— bore_diameter;

— outside_diameter;

— thickness.

4.2.141.1 beta_ratio

The beta_ratio specifies a value which indicates the length of pipe required on either side of the Orifice_-plate to ensure non-turbulent flow past the orifice.

4.2.141.2 bore_diameter

The bore_diameter specifies the diameter of the hole in the Orifice_plate.

4.2.141.3 outside_diameter

The outside_diameter specifies the external diameter of the Orifice_plate.

4.2.141.4 thickness

The thickness specifies the perpendicular distance between the two faces of the Orifice_plate.

4.2.142 Outline_shape

An Outline_shape is a type of Plant_item_shape (see 4.2.180) that is a 3D spatial volume that corresponds to the bounding surface features of a Plant_item (see 4.2.166).

4.2.143 Outside_and_thickness

An Outside_and_thickness is a type of Piping_size_description (see 4.2.154) that describes the size by providing the outside diameter and thickness values.

The data associated with Outside_and_thickness are the following:

— outside_diameter;

— thickness.

4.2.143.1 outside_diameter

The outside_diameter specifies the external diameter of the Piping_system_component (see 4.2.159) or Piping_connector (see 4.2.152).

4.2.143.2 thickness

The thickness specifies the piping wall thickness of the Piping_system_component (see 4.2.159) or Piping_connector (see 4.2.152).

4.2.144 Paddle_blank

A Paddle_blank is a type of Blank (see 4.2.2) that reserves space between two Flange (see 4.2.80) objects and blocks the flow of material.

NOTE - A Paddle_blank has a handle that permits removal or repositioning of the Paddle_blank. The name is derived from the fact that the Paddle_blank looks like a ping pong paddle.

The data associated with Paddle_blank are the following:

— paddle_length;

— paddle_width.

4.2.144.1 paddle_length

The paddle_length specifies the length of the handle on the Paddle_blank.

NOTE - The length is measured from the outside diameter of the Blank (see 4.2.2).

4.2.144.2 paddle_width

The paddle_width specifies the width of the handle on the Paddle_blank.

4.2.145 Paddle_spacer

A Paddle_spacer is a type of Spacer (see 4.2.219) that reserves space between two Flange (see 4.2.80) objects and permits flow through the Pipe (see 4.2.148).

NOTE - A Paddle_spacer has a handle that permits its removal or repositioning. The inner diameter of the Paddle_spacer may be less than the diameter of the Pipe, thus altering flow.

The data associated with Paddle_spacer are the following:

— inside_diameter;

— paddle_length;

— paddle_width.

4.2.145.1 inside_diameter

The inside_diameter specifies the diameter of the bore hole through the Paddle_spacer.

4.2.145.2 paddle_length

The paddle_length specifies the length of the handle of the Paddle_spacer.

NOTE - The length is measured from the outside diameter of the Blank (see 4.2.2).

4.2.145.3 paddle_width

The paddle_width specifies the width of the handle of the Paddle_spacer.

4.2.146 Physical_connector

A Physical_connector is a type of Plant_item_connector_occurrence (see 4.2.172) that represents the physical aspects of the plant_item_connector_occurrence.

4.2.147 Physical_design_view

A Physical_design_view is a type of Plant_item_design_view (see 4.2.174) that describes the physical and spatial characteristics of a Plant_item (see 4.2.166).

4.2.148 Pipe

A Pipe is a type of Piping_component (see 4.2.151) that is a hollow cylindrical conveyance, with a constant radius for the cross-sectional circle, for directing fluid, vapour, or particulate flow. Each Pipe may be one of the following: a Mitre_bend_pipe (see 4.2.137), a Straight_pipe (see 4.2.225), or a Swept_-bend_pipe (see 4.2.239).

NOTES

1 - In most cases, the Pipe will conform to the dimensional requirements for nominal pipe size as tabulated in national standards such as American National Standards Institute (ANSI) B36.10 and ANSI B36.19.

2 - This definition does not exclude tubing and flex hoses from consideration as Pipe.

4.2.149 Pipe_bend

A Pipe_bend is a section of Pipe (see 4.2.148) that changes the direction of flow along a circular arc. Pipe_bend objects are aggregated into a Swept_bend_pipe (see 4.2.239).

The data associated with Pipe_bend are the following:

— centreline_radius;

— sweep_angle.

4.2.149.1 centreline_radius

The centreline_radius specifies the radius of the Pipe_bend circular arc as measured to the centreline of the Pipe (see 4.2.148).

4.2.149.2 sweep_angle

The sweep_angle specifies the subtended angle of the Pipe_bend circular arc.

4.2.150 Pipe_cap

A Pipe_cap is a type of Fitting (see 4.2.79) used to close an end of a Piping_system (see 4.2.158).

NOTE - Blind_flange (see 4.2.3) objects also perform the function of closing a Piping_system. However, industry terminology treats them differently and they have been defined as separate objects.

The data associated with Pipe_cap are the following:

— end_1_connector;

— height;

— outside_diameter;

— shape_type.

4.2.150.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.150.2 height

The height specifies the distance between the end one face and the opposing end of the cap.

4.2.150.3 outside_diameter

The outside_diameter specifies the external diameter of the Pipe_cap.

4.2.150.4 shape_type

The shape_type specifies a designation that classifies a Pipe_cap based on its shape.

EXAMPLE 28 - The shape_type of a Pipe_cap may have the value "square" or "round".

4.2.151 Piping_component

A Piping_component is a type of Piping_system_component (see 4.2.159) whose primary function is the conveyance or control of fluid flow. Each Piping_component may be one of the following: a Fitting (see 4.2.79), a Pipe (see 4.2.148), or a Valve (see 4.2.258).

4.2.152 Piping_connector

A Piping_connector is a type of Plant_item_connector (see 4.2.171) that is intended to establish a material flow connection between two Plant_item (see 4.2.166) objects. Each Piping_connector may be one of the following: a Buttweld (see 4.2.8), a Flanged (see 4.2.81), a Socket (see 4.2.216), or a Threaded (see 4.2.244). Each Piping_connector may be one of the following: a Female_end (see 4.2.78), a Flanged_end (see 4.2.82), or a Male_end (see 4.2.133).

The data associated with Piping_connector are the following:

— connector_flow_direction;

— connector_specifications;

— name.

4.2.152.1 connector_flow_direction

The connector_flow_direction specifies an indication of the way process fluid moves past the Plant_item (see 4.2.166).

4.2.152.2 connector_specifications

The connector_specifications identifies the specifications associated with the Piping_connector.

> EXAMPLE 29 - The connector_specifications identified may have the value "insulation specification", "end preparation specification", or "thread specification".

4.2.152.3 name

The name specifies the designation or label of the Piping_connector.

4.2.153 Piping_connector_service_characteristic

A Piping_connector_service_characteristic is the conditions that the Piping_connector (see 4.2.152) is designed to withstand.

The data associated with Piping_connector_service_characteristic are the following:

— design_pressure;

— design_temperature.

4.2.153.1 design_pressure

The design_pressure specifies the maximum allowable pressure at the Piping_connector (see 4.2.152).

NOTE - This value is normally created as part of doing 3D analysis of the piping system design.

4.2.153.2 design_temperature

The design_temperature specifies the maximum allowable temperature at the Piping_connector (see 4.2.152).

NOTE - This value is normally created as part of doing 3D analysis of the piping system design.

4.2.154 Piping_size_description

A Piping_size_description is used to describe the physical size of a Piping_connector (see 4.2.152) or Piping_system_component (see 4.2.159), based on a set of dimensional characteristics, and an optional dimensional standard. Each Piping_size_description is either an Inside_and_thickness (see 4.2.105), an Outside_and_thickness (see 4.2.143), a Pressure_class (see 4.2.189), or a Schedule (see 4.2.204).

The data associated with Piping_size_description are the following:

— dimensional_standard;

— ovality_allowance;

— piping_size_description_id.

4.2.154.1 dimensional_standard

The dimensional_standard specifies a designation for the standard used to dimension the Pipe (see 4.2.148).

EXAMPLE 30 - Dimensional_standard designations may have the value "ANSI" or "DIN".

4.2.154.2 ovality_allowance

The ovality_allowance specifies the acceptable deviation or tolerance allowed in the 'out-of-roundness' of the Piping_connector (see 4.2.152) or Piping_system_component (see 4.2.159). In other words, it specifies how much the Piping_connector or Piping_system_component can deviate from a perfect circle.

4.2.154.3 piping_size_description_id

The piping_size_description_id specifies a unique identifier for the Piping_size_description.

4.2.155 Piping_specification

A Piping_specification is a specification of conditions such as pressure, material, and corrosion allowance that must be met in a Piping_system_line_segment (see 4.2.161) and may include a list of Piping_-component (see 4.2.151) objects by size range that meet these conditions.

> NOTE - The Piping_specification is used in Spec-driven design, where the user specifies the size and component type, and the Piping_specification is used to look-up the correct component characteristics. The components listed in the Piping_specification may reference component catalogues.

The data associated with a Piping_specification are the following:

— name;

— owner;

— piping_specification_id;

— service_description.

4.2.155.1 name

The name specifies the designation or label given to the Piping_specification.

4.2.155.2 owner

The owner specifies the designation given to the person or organization that created and maintains the Piping_specification.

4.2.155.3 piping_specification_id

The piping_specification_id specifies a unique identifier for the Piping_specification.

4.2.155.4 service_description

The service_description specifies a narrative explaining the process stream conditions that are supported by the Plant_item (see 4.2.166) objects described in the Piping_specification.

4.2.156 Piping_spool

A Piping_spool is a collection of piping Plant_item (see 4.2.166) objects.

The data associated with Piping_spool are the following:

— piping_spool_number.

The piping_spool_number specifies an alphanumeric identifier assigned to the Piping_spool.

NOTE - A Piping_spool may be defined to meet transportation, fabrication, or erection requirements.

4.2.157 Piping_spool_assignment

A Piping_spool_assignment is the identification of the Piping_spool (see 4.2.156) to which a Piping_-component (see 4.2.151) belongs.

4.2.158 Piping_system

A Piping_system is a type of Plant_system (see 4.2.183) that is a system of interconnected Plant_item (see 4.2.166) objects that convey fluid, vapour, or particulate flow throughout a plant. Each Piping_system may be a Line_less_piping_system (see 4.2.119).

EXAMPLE 31 - Methods of flow conveyance through the Piping_system may have the value "mechanical", "gravitational", or "electromagnetic induction".

The data associated with Piping_system are the following:

— code;

— description;

— type.

4.2.158.1 code

The code specifies the name of the specification to which the Piping_system needs to conform.

4.2.158.2 description

The description specifies a textual summary of the Piping_system.

4.2.158.3 type

The type specifies a designation of whether a Piping_system is line-based or line-less.

4.2.159 Piping_system_component

A Piping_system_component is a type of Plant_item (see 4.2.166) that is a constituent element of a Piping_system (see 4.2.158). Each Piping_system_component may be one of the following: an Inline_-equipment (see 4.2.102), an Inline_instrument (see 4.2.103), a Piping_component (see 4.2.151), a Process_ducting (see 4.2.191), or a Specialty_item (see 4.2.220).

The data associated with Piping_system_component are the following:

— coating_reference;

— heat_tracing_type;

— lining.

4.2.159.1 coating_reference

The coating_reference specifies a reference to the specification of the substances used to coat the surfaces of a Piping_system_component.

4.2.159.2 heat_tracing_type

The heat_tracing_type specifies the means utilized to impart a temperature increase to the Piping_system_-component by an external wrapping or coiling.

NOTE - Types may include electrical or steam.

4.2.159.3 lining

The lining specifies a description of the substances used to line the internal surfaces of a Piping_system_-component.

4.2.160 Piping_system_line

A Piping_system_line is a logical component of a Piping_system and is composed of a collection of interconnected Piping_system_line_segment (see 4.2.161) objects.

The data associated with Piping_system_line are the following:

— line_number;

— P_and_I_reference;

— piping_system_line_id.

4.2.160.1 line_number

The line_number specifies an alphanumeric identifier assigned to the Piping_system_line and can be used to uniquely define the Piping_system_line.

EXAMPLE 32 - A1A-PX-100-4"-150#, is a coded number which identifies the Piping_system_line and the main design criteria - spec = A1A, process = PX, number = 100, size = 4", and rating = 150#.

4.2.160.2 P_and_I_reference

The P_and_I_reference specifies the P&I diagram that depicts the Piping_system_line.

4.2.160.3 piping_system_line_id

The piping_system_line_id specifies a unique identifier for the Piping_system_line.

NOTE - It is normally a subset of the line_number.

4.2.161 Piping_system_line_segment

A Piping_system_line_segment is an element of a Piping_system_line (see 4.2.160). A Piping_system_-line_segment terminates at a functional plant_item_connector (see 4.2.171), a tap into a Piping_system_line (see 4.2.160), a point where the stream diverges or converges, a vent, or a drain.

The data associated with Piping_system_line_segment are the following:

— coating_reference;

— design_pressure;

— design_temperature;

— elevation;

— heat_tracing_type;

— line_size;

— segment_id.

4.2.161.1 coating_reference

The coating_reference specifies a reference to the specification that details the coating requirements of the Piping_component (see 4.2.151) objects associated with the Piping_system_line (see 4.2.160).

4.2.161.2 design_pressure

The design_pressure specifies the requirement for maximum allowable pressure of the Piping_component (see 4.2.151) objects associated with the Piping_system_line (see 4.2.160).

4.2.161.3 design_temperature

The design_temperature specifies the requirement for maximum allowable temperature of the Piping_-component (see 4.2.151) objects associated with the Piping_system_line (see 4.2.160).

4.2.161.4 elevation

The elevation specifies the distance above sea level that the piping assigned to the line should exist.

4.2.161.5 heat_tracing_type

The heat_tracing_type specifies the heating method used to maintain temperature in the Piping_system_line (see 4.2.160).

EXAMPLE 33 - Heating method designations may have the value "steam tracing" or "electrical".

4.2.161.6 line_size

The line_size specifies the intended diameter of the piping to be selected to satisfy the Piping_system_line (see 4.2.160). The line_size need not be specified for a particular Piping_system_line_segment where the Piping_system_line_segment corresponds to one Piping_system_component (see 4.2.159).

NOTE - When the line_size is not specified, it is either ambiguous due to the nature of the Piping_system_-component such as a Reducer, or derivable from one or more of the connecting Piping_system_line_-segments.

4.2.161.7 segment_id

The segment_id specifies a unique identifier for the Piping_system_line_segment.

4.2.162 Piping_system_line_segment_termination

A Piping_system_line_segment_termination is one of two logical end-points of a Piping_system_line_-segment (see 4.2.161). Each Piping_system_line_segment_termination may be one of the following: a Line_branch_termination (see 4.2.118), a Line_to_line_termination (see 4.2.127), or a Line_plant_item_-termination (see 4.2.125).

NOTE - Piping_system_line objects are composed of individual Piping_system_line_segment objects. Piping_system_line_segment objects are connected through Piping_system_line_segment_termination objects.

The data associated with Piping_system_line_segment_termination are the following:

— flow_direction;

— line_end_location;

— line_start_location;

— termination_id.

4.2.162.1 flow_direction

The flow_direction specifies the direction of material flow at the Piping_system_line_segment_termination. The value of the flow_direction attribute shall be one of the following:

— both;

— in;

— not_specified;

— out.

4.2.162.1.1 both: material may flow in either direction past the Piping_system_line_segment_termination.

4.2.162.1.2 in: material flows into the line segment past the Piping_system_line_segment_termination.

4.2.162.1.3 not_specified: the direction of material flow past the Piping_system_line_segment_termination is not specified.

4.2.162.1.4 out: material flows out of the line segment past the Piping_system_line_segment_termination.

4.2.162.2 line_end_location

The line_end_location specifies the relative distance in the 'X, Y, Z' directions of the position for the downstream end of the Piping_system_line (see 4.2.160), from a specified reference point and specifies an indicator of the relationship between the point and the Piping_component that will eventually satisfy it. The line_end_location position may also be defined by where it connects to a downstream piece of Equipment (see 4.2.71) or Piping_system_line.

NOTE - If the indicator is not specified, the assumed value is centre of pipe (COP).

EXAMPLE 34 - The line_end_location is a cartesian point and an indicator such as bottom of pipe (BOP).

4.2.162.3 line_start_location

The line_start_location specifies the relative distance in the 'X, Y, Z' directions of the position of the upstream end of the Piping_system_line (see 4.2.160), from a specified reference point and specifies an indicator of the relationship between the point and the Piping_component that will eventually satisfy it. The line_start_location position may also be defined by where it connects to an upstream piece of Equipment (see 4.2.71) or Piping_system_line.

NOTE - If the indicator is not specified, the assumed value is COP.

EXAMPLE 35 - The line_start_location is a cartesian point and an indicator such as BOP.

4.2.162.4 termination_id

The termination_id specifies a unique identifier for the piping_system_line_segment_termination.

4.2.163 Planned_physical_plant

A Planned_physical_plant is the set of physical and spatial characteristics that a Plant (see 4.2.165) can have, including siting, location, and orientation.

NOTE - A Planned_physical_plant can also be the basis for locating other items such as Plant_item (see 4.2.166) objects, Plant_item_location.

4.2.164 Planned_physical_plant_item

A Planned_physical_plant_item is a type of Plant_item_instance (see 4.2.176) that has been used, or instanced in a design.

NOTE - Additionally, a Planned_physical_plant_item is always intended to be 'physical' as opposed to purely volumetric. In general, this means that anything that would pose a hard physical impediment to a

kick (e.g. a pump) is a physical item, and anything that does not (e.g.: an escape route or the water in a cooling pond) is purely volumetric.

The data associated with Planned_physical_plant_item are the following:

— type.

The type specifies a designation that classifies the Plant_item (see 4.2.166).

EXAMPLE 36 - Type designations may include all major categories of Plant_item objects.

4.2.165 Plant

A Plant is a portion of an installation (or the entire installation) required to operate to produce products. Each Plant may be one of the following: a Manufacturing_line (see 4.2.134), a Train (see 4.2.247), or a Unit (see 4.2.257).

The data associated with Plant are the following:

— name;

— operators;

— owners;

— plant_id.

4.2.165.1 name

The name specifies the designation or label given to the Plant.

4.2.165.2 operators

The operators specifies the name of the organization responsible for the operation of the Plant.

4.2.165.3 owners

The owners specifies the name of the organization that owns the Plant.

4.2.165.4 plant_id

The plant_id specifies a unique identifier for the Plant.

4.2.166 Plant_item

A Plant_item is an item or piece of Equipment (see 4.2.71) that may be used as a component of the Plant (see 4.2.165). Each Plant_item may be one of the following: a Plant_item_definition (see 4.2.173) or a Plant_item_instance (see 4.2.176). Each Plant_item may be one of the following: an Electrical_component (see 4.2.65), an Equipment (see 4.2.71), a Hvac_component (see 4.2.100), an Instrumentation_and_-control_component (see 4.2.108), an Insulation (see 4.2.110), a Piping_system_component (see 4.2.159), a Structural_component (see 4.2.228), or a Support_component (see 4.2.232).

The data associated with Plant_item are the following:

— description;

— name;

— plant_item_id.

4.2.166.1 description

The description specifies a textual summary of the Plant_item.

4.2.166.2 name

The name specifies a designation or label assigned to the Plant_item.

4.2.166.3 plant_item_id

The plant_item_id specifies a unique identifier for the Plant_item.

4.2.167 Plant_item_centreline

A Plant_item_centreline is a type of Reference_geometry (see 4.2.198) that is a line that is equidistant or at the average distance from all points on the sides or boundaries of the Plant_item (see 4.2.166).

4.2.168 Plant_item_collection

A Plant_item_collection is an aggregation of Plant_item (see 4.2.166) objects for the purposes of assembly or association. Each Plant_item_collection may be a Connected_assembly (see 4.2.47). Each Plant_item_-collection may be a Hierarchical_assembly (see 4.2.99).

> EXAMPLE 37 - A set of Plant_item objects can be collected for the purpose of defining the items that comprise an assembly. This assembly may have the value "packaged unit" or "module" in a plant.

The data associated with Plant_item_collection are the following:

— location_and_orientation.

The location_and_orientation specifies the relative position and orientation of the Plant_item (see 4.2.166) within the Plant_item_collection. The location_and_orientation need not be specified for a particular Plant_item_collection.

4.2.169 Plant_item_connection

A Plant_item_connection is a linkage between two or more Plant_item_connector (see 4.2.171) objects. The joining conditions may be specified for the connection. Each Plant_item_connection is either a Connection_definition (see 4.2.48) or a Plant_item_connection_occurrence (see 4.2.170). Each Plant_-item_connection is either a Flexible_connection (see 4.2.83) or a Locked_orientation_connection (see 4.2.132). Each Plant_item_connection may be an Electricity_transference (see 4.2.68). Each Plant_item_-connection may be a Fluid_transference (see 4.2.84). Each Plant_item_connection may be a Load_-transference (see 4.2.128). Each Plant_item_connection can have many function types, for the purpose of describing the role that the connection plays in the plant.

NOTES

1 - In most cases, such as piping components, a Plant_item_connection links only two Plant_item_connector objects.

2 - The term connection does not imply functional continuity beyond the connectors involved in the connection.

The data associated with Plant_item_connection are the following:

— connection_id;

— connection_material;

— description.

4.2.169.1 connection_id

The connection_id specifies a unique identifier for the Plant_item_connection.

4.2.169.2 connection_material

The connection_material specifies the substances or other Plant_item (see 4.2.166) objects used at the connection of two Plant_item_connector (see 4.2.171) objects. This may be one or more specifications and one or more Plant_item (see 4.2.166) objects.

EXAMPLE 38 - At a connection of two buttweld connectors, there is a welding specification that applies to the connection. At a connection of two flanged connectors there are bolts and gaskets that are part of the connection, as well as a specification for the use of these items.

4.2.169.3 description

The description specifies the textual summary of the function of the Plant_item_connection.

4.2.170 Plant_item_connection_occurrence

A Plant_item_connection_occurrence is a type of Plant_item_connection (see 4.2.169) that involves a physical linkage between two or more Plant_item_connector_occurrence (see 4.2.172) objects.

4.2.171 Plant_item_connector

A Plant_item_connector is a feature of a Plant_item (see 4.2.166) that is designed to connect to a connector on another Plant_item. Each Plant_item_connector may have specified its design type as one of the following: an Electrical_connector (see 4.2.66), a Piping_connector (see 4.2.152), or a Structural_-load_connector (see 4.2.229). Each Plant_item_connector is either a Connector_definition (see 4.2.49) (a definitional type) or a Plant_item_connector_occurrence (4.2.172) (a specified type).

NOTE - The definitional type is used as the connector definition for a Plant_item_definition (see 4.2.173). A specified type is used for a Plant_item_instance (see 4.2.176).

The data associated with Plant_item_connector are the following:

— plant_item_connector_id.

The plant_item_connector_id specifies a unique identifier for the Plant_item_connector.

4.2.172 Plant_item_connector_occurrence

A Plant_item_connector_occurrence is a type of Plant_item_connector (see 4.2.171) that is a physical feature of a Plant_item (see 4.2.166) that connects or mates with a like type of connector on another Plant_item. Each Plant_item_connector_occurrence may be one of the following: a Functional_connector (see 4.2.88) or a Physical_connector (see 4.2.146).

The data associated with Plant_item_connector_occurrence are the following:

— connect_point;

— location_and_orientation.

4.2.172.1 connect_point

The connect_point specifies a point on or in the connector where the terminal interface with another connector occurs.

4.2.172.2 location_and_orientation

The location_and_orientation specifies the relative position and orientation of the Plant_item_connector_-occurrence to a defined point on the Plant_item (see 4.2.166).

4.2.173 Plant_item_definition

A Plant_item_definition is a type of Plant_item (see 4.2.166) that has been designed to some level of completeness, but has not been used as the design for physical Plant_item (see 4.2.166) objects.

4.2.174 Plant_item_design_view

A Plant_item_design_view is the collection of information about a Plant_item (see 4.2.166) that is associated with a particular design phase. Each Plant_item_design_view may be one of the following: a Functional_design (see 4.2.91) or a Physical_design_view (see 4.2.147).

4.2.175 Plant_item_geometric_origin

A Plant_item_geometric_origin is a type of Reference_geometry (see 4.2.198) that specifies the locating point for the geometric shape of a Plant_item (see 4.2.166).

4.2.176 Plant_item_instance

A Plant_item_instance is a planned type of Plant_item (see 4.2.166), as instanced in a spatial, functional or other design. Each Plant_item_instance is either a Planned_physical_plant_item (see 4.2.164) or a Plant_volume (see 4.2.185).

> NOTE - A Plant_item_instance is created through the use or instancing of a Plant_item_definition (see 4.2.173) by placing it in a design.

4.2.177 Plant_item_interference

A Plant_item_interference is where the spatial volume occupied by a Plant_item (see 4.2.166) overlaps the space occupied by one or more Plant_item objects.

The data associated with Plant_item_interference are the following:

— interference_id;

— type.

4.2.177.1 interference_id

The interference_id specifies an identifier for the Plant_item_interference.

4.2.177.2 type

The type specifies the classification assigned to the Plant_item_interference (see 4.2.177).

EXAMPLE 39 - The type classification may have the value "hard" or "soft".

4.2.178 Plant_item_interference_status

A Plant_item_interference_status is a designation indicating the state of resolution of an identified interference.

The data associated with Plant_item_interference_status are the following:

— assessor;

— status.

4.2.178.1 assessor

The assessor specifies the individual or organization assigned the responsibility for resolving the Plant_-item_interference (see 4.2.177).

4.2.178.2 status

The status specifies a designation indicating the state of resolution of an identified Plant_item_interference (see 4.2.177).

4.2.179 Plant_item_location

A Plant_item_location is the position of the Plant_item (see 4.2.166) within a Plant (see 4.2.165). Each Plant_item_location is either a Location_in_building (see 4.2.129), a Location_in_plant (see 4.2.130), a Location_in_site (see 4.2.131), or a Relative_item_location (see 4.2.199).

The data associated with Plant_item_location are the following:

— location_and_orientation;

— location_id.

4.2.179.1 location_and_orientation

The location_and_orientation specifies the relative position and orientation of the Plant_item (see 4.2.166) within the Plant (see 4.2.165).

4.2.179.2 location_id

The location_id specifies a unique identifier for the Plant_item_location.

4.2.180 Plant_item_shape

A Plant_item_shape is the volumetric representation of a Plant_item (see 4.2.166). Each Plant_item_shape may be one of the following: a Detail_shape (see 4.2.57), an Envelope_shape (see 4.2.70), or an Outline_-shape (see 4.2.142).

The data associated with Plant_item_shape are the following:

— clash_detection_class;

— shape_id.

4.2.180.1 clash_detection_class

The clash_detection_class specifies a designation that classifies a Plant_item_shape for the purposes of interference checking. The value of the clash_detection_class attribute shall be one of the following:

— hard;

— ignore;

— soft.

4.2.180.1.1 hard: The Plant_item_shape is used for clash detection and indicates that the shape represents solid, physical matter.

4.2.180.1.2 ignore: The Plant_item_shape is not used for clash detection.

4.2.180.1.3 soft: The Plant_item_shape is used for clash detection and indicates that the shape represents a volume of space.

NOTE - See table 1. Table 1 represents a comparison between the clash_detection_class designations for two Plant_item_shapes and indicates whether the resulting interference would be designated as "hard clash", "soft clash", or "no clash". A "hard clash" refers to an interference between two Plant_item_shapes whose clash_detection_class is "hard". A "soft clash" refers to an interference between two Plant_item_shapes where at least one of the Plant_item_shapes has a clash_detection_class of "soft". A "no clash" refers to an interference between two Plant_item_shapes where at least one of the Plant_item_shapes has a clash_-detection_class of "ignore".

Table 1 - Plant_item_shape interference clash detection

	Hard	Ignore	Soft
Hard	hard clash	no clash	soft clash
Ignore	no clash	no clash	no clash
Soft	soft clash	no clash	soft clash

4.2.180.2 shape_id

The shape_id specifies a unique identifier for the Plant_item_shape.

4.2.181 Plant_item_weight

A Plant_item_weight is a measure of the mass of the Plant_item (see 4.2.166).

The data associated with Plant_item_weight are the following:

— centre_of_gravity;

— weight_state;

— weight_value.

4.2.181.1 centre_of_gravity

The centre_of_gravity specifies the point at which the entire weight of a Plant_item (see 4.2.166) may be considered as concentrated so that if supported at this point the Plant_item (see 4.2.166) would remain in equilibrium in any position.

4.2.181.2 weight_state

The weight_state specifies a designation of the condition of the Plant_item (see 4.2.166) that corresponds to the Plant_item_weight.

NOTE - The value of the weight_state may be one of a set of predefined values or may be user supplied.

The value of the weight_state attribute may be one of the following:

— empty;

— full;

— operating;

— shipping;

— test.

4.2.181.2.1 empty: the Plant_item does not contain any process materials.

4.2.181.2.2 full: the Plant_item contains maximum amount of process materials.

4.2.181.2.3 operating: the Plant_item is in normal operating conditions.

4.2.181.2.4 shipping: the Plant_item and its transportation and packing materials are included.

4.2.181.2.5 test: the Plant_item is for purposes of structural load calculations.

4.2.181.3 weight_value

The weight_value specifies a measure of the mass of the Plant_item (see 4.2.166).

4.2.182 Plant_process_capability

A Plant_process_capability is a functional behaviour that can be executed by the Plant (see 4.2.165).

The data associated with Plant_process_capability are the following:

— production_capacity;

— production_type.

4.2.182.1 production_capacity

The production_capacity specifies the rated output of the Plant (see 4.2.165) with respect to a Plant_-process_capability.

4.2.182.2 production_type

The production_type specifies a designation that classifies the Plant (see 4.2.165) based on the products it produces.

4.2.183 Plant_system

A Plant_system is a combination of Plant_item (see 4.2.166) objects which perform a function required for the Plant (see 4.2.165) to operate to produce products. Each Plant_system may be one of the following: an Electrical_system (see 4.2.67), a Hvac_system (see 4.2.101), an Instrumentation_and_-control_system (see 4.2.109), a Piping_system (see 4.2.158), or a Structural_system (see 4.2.230).

NOTE - A Plant_system is one of the types of systems indicated or can have a designation drawn from the classification tables in clause 4 of ISO 10303-221.

The data associated with Plant_system are the following:

— name;

— plant_system_id;

— service_description.

4.2.183.1 name

The name specifies a designation or label assigned to the Plant_system.

4.2.183.2 plant_system_id

The plant_system_id specifies a unique identifier for the Plant_system.

4.2.183.3 service_description

The service_description specifies a descriptive label for the system.

EXAMPLE 40 - Service_description labels may have the value "Boiler Feedwater System", "Paraxylene System", "Pipe Rack K", or "4160V Power System".

4.2.184 Plant_system_assembly

A Plant_system_assembly is a collection of Plant_system (see 4.2.183) objects into a higher-level system to perform a functional capability.

4.2.185 Plant_volume

A Plant_volume is a type of Plant_item_instance (see 4.2.176) that is a specifically defined volume located within a Plant (see 4.2.165) which may, but need not be occupied by physical Plant_item (see 4.2.166) objects. Each Plant_volume may be one of the following: a Reserved_space (see 4.2.201), a Route (see 4.2.203), or a System_space (see 4.2.240).

The data associated with Plant_volume are the following:

— type.

The type specifies a designation that classifies the Plant_volume.

> EXAMPLE 41 - Plant_volume object type classifications may have the value "reserved space, "zone-area", "area classification zone", "equipment pull space", or "egress for personnel".

4.2.186 Point

A Point is a type of Wire_and_surface_element (see 4.2.261) that is a dimensionless location in space.

4.2.187 Point_terrain_model

A Point_terrain_model is a type of Terrain_model (see 4.2.243) represented as a collection of Point (see 4.2.186) objects that define the surface grid of the topography of a Site (see 4.2.212).

4.2.188 Polygon

A Polygon is a type of Curve (see 4.2.54) that is composed of a set of points connected by line segments that form a planar, closed, non-self-intersecting figure.

4.2.189 Pressure_class

A Pressure_class is a type of Piping_size_description (see 4.2.154) based on pressure rating or classification and a nominal size value.

> NOTE - This type of piping size description is commonly associated with a dimensional specification, such as the ANSI B16.5 specification for Flanges.

The data associated with Pressure_class are the following:

— nominal_size;

— pressure_rating.

4.2.189.1 nominal_size

The nominal_size specifies a standard size designation of the Piping_system_component (see 4.2.159) or Piping_connector (see 4.2.152).

NOTE - The nominal size need not represent an actual dimension.

4.2.189.2 pressure_rating

The pressure_rating specifies a nominal pressure for the design of the Piping_system_component (see 4.2.159) or Piping_connector (see 4.2.152).

NOTE - When specified with a dimensional standard, such as ANSI B16.1, its value corresponds to a selection out of a set of available values (e.g., 150 PSI, 300 PSI).

4.2.190 Pressure_vessel

A Pressure_vessel is a type of Equipment (see 4.2.71) that is a metal container, generally cylindrical or spheroid in shape, capable of withstanding bursting pressures.

The data associated with Pressure_vessel are the following:

— pressure_vessel_type.

The pressure_vessel_type specifies a designation that classifies a Pressure_vessel based on its operational characteristics.

4.2.191 Process_ducting

A Process_ducting is a type of Ducting_component (see 4.2.58) and Piping_system_component (see 4.2.159) which consists of Piping_component (see 4.2.151) objects or ductwork that is used to convey process streams in a Plant (see 4.2.165).

The data associated with Process_ducting are the following:

— gauge.

The gauge specifies a designation which refers to the thickness of the Process_ducting.

4.2.192 Project_design_assignment

A Project_design_assignment is an assignment of a Plant_item (see 4.2.166) to a Design_project (see 4.2.56).

NOTE - The set of Project_design_assignment instances for a project defines the items and areas that are part of the project.

4.2.193 Pump

A Pump is a type of Equipment (see 4.2.71) that is used to move or alter the pressure of fluids by drawing in fluid through an entrance port and forcing the fluid out through an exhaust port.

The data associated with Pump are the following:

— pump_type.

The pump_type specifies a designation that classifies a Pump based on its operational characteristics.

EXAMPLE 42 - Pump_type designations may have the value "centrifugal" or "positive displacement".

4.2.194 Pyramid

A Pyramid is a type of Csg_element (see 4.2.53) that is a 3D volume with a rectangular base and four triangular sides that meet at an apex. The axis of a pyramid is the line segment from the centre of the base to the apex. A Pyramid may be an Eccentric_pyramid (see 4.2.61). A Pyramid may be a Trimmed_-pyramid (see 4.2.251).

4.2.195 Reducer

A Reducer is a type of Fitting (see 4.2.79) that provides a reduction from one Pipe (see 4.2.148) size to another. Each Reducer may be an Eccentric_reducer (see 4.2.62).

The data associated with Reducer are the following:

— end_1_connector;

— end_2_connector;

— end_to_end_length.

4.2.195.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.195.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.195.3 end_to_end_length

The end_to_end_length specifies the external distance between the end one face and the end two face of the Reducer.

4.2.196 Reducing_flange

A Reducing_flange is a type of Flange (see 4.2.80) used to make a flanged joint between Pipe (see 4.2.148) objects of different nominal sizes that has the dimensional characteristics of the larger Pipe and the bore of the smaller Pipe.

> EXAMPLE 43 - Reducing_flange types may have the value "weld neck flange", "slip-on flange", "socket-weld flange", or "threaded flange".

4.2.197 Reducing_torus

A Reducing_torus is a type of Torus (see 4.2.246) that is formed by sweeping a circle that uniformly decreases in size through a circular sweep angle of less that 360 degrees.

4.2.198 Reference_geometry

A Reference_geometry is the identification of one or more Shape_representation_element (see 4.2.209) objects in a model that are not part of a component shape, but provide additional geometric information relative to the shape of the Plant_item (see 4.2.166). Each Reference_geometry may be one of the following: a Plant_item_centreline (see 4.2.167) or a Plant_item_geometric_origin (see 4.2.175).

The data associated with Reference_geometry are the following:

— name;

— reference_geometry_id.

4.2.198.1 name

The name specifies a designation or label given to the Reference_geometry.

4.2.198.2 reference_geometry_id

The reference_geometry_id specifies a unique identifier assigned to the Reference_geometry.

4.2.199 Relative_item_location

A Relative_item_location is a type of Plant_item_location (see 4.2.179) that is the relative position of the Plant_item (see 4.2.166) with respect to another Plant_item.

4.2.200 Required_material_description

A Required_material_description is a specification of the substances from which a component is or is to be made.

The data associated with Required_material_description are the following:

— description;

— material_requirement_id.

4.2.200.1 description

The description specifies a textual summary of the required materials.

4.2.200.2 material_requirement_id

The material_requirement_id specifies a unique identifier for the specification that provides the required material.

NOTE - The identifier is normally a coded value that is company-specific.

4.2.201 Reserved_space

A Reserved_space is a type of Plant_volume (see 4.2.185) that is a region of space that is not to be obstructed by physical objects for reasons related to plant operation.

NOTE - Reserved spaces are normally prescriptive.

EXAMPLE 44 - Reserved_space types may have the value "maintenance volume", "operator access", or "safety zone".

4.2.202 Ring_spacer

A Ring_spacer is a type of Spacer (see 4.2.219) that fits between Flange (see 4.2.80) objects in a flanged joint to bridge a large gap or fill a slight angle between the Flange objects which cannot be accommodated by standard Flange gaskets.

The data associated with Ring_spacer are the following:

— inside_diameter.

The inside_diameter specifies the diameter of the bore hole through the Ring_spacer.

4.2.203 Route

A Route is a type of Plant_volume (see 4.2.185) that is a 3D path from one location to another.

NOTES

1 - A Route is a conceptual engineered path that reserves space for a piping system. This space need not be occupied by a Plant_item (see 4.2.166) at a future time.

2 - The shape of the reserved volume of a route is a specified Plant_item_shape (see 4.2.180).

4.2.204 Schedule

A Schedule is a type of Piping_size_description (see 4.2.154) that gives the Pipe (see 4.2.148) or Piping_component (see 4.2.151) size in terms of nominal size and a sizing schedule.

NOTE - When a Schedule entity is used, the dimensional standard attribute of Piping_size_description (see 4.2.154) must be specified.

The data associated with Schedule are the following:

— nominal_size;

— pipe_schedule.

4.2.204.1 nominal_size

The nominal_size specifies a standard size designation of the Piping_system_component (see 4.2.159) or Piping_connector (see 4.2.152).

NOTE - The nominal size need not represent an actual dimension.

4.2.204.2 pipe_schedule

The pipe_schedule specifies a designation of a standard wall thickness and external diameter for a nominal pipe size through a reference to the dimensional standard.

4.2.205 Segment_insulation

A Segment_insulation is a logical connection between a Piping_system_line_segment (see 4.2.161) and the insulation attached to the Pipe (see 4.2.148) associated with the Piping_system_line_segment.

The data associated with Segment_insulation are the following:

— boundaries;

— description;

— thickness;

— type.

4.2.205.1 boundaries

The boundaries specifies a description which defines the boundaries for insulation on the Piping_system_-line (see 4.2.160).

EXAMPLE 45 - The boundaries of a Piping_system_line insulation may have the value "personnel protection insulation shall extend to 12 feet above grade or walkway".

4.2.205.2 description

The description specifies the reasons for providing insulation.

EXAMPLE 46 - Piping_system_line insulation descriptions may have the value "provided for heat conservation" or "provided for personnel protection".

4.2.205.3 thickness

The thickness specifies the distance between the inside and outside surfaces of the insulation.

4.2.205.4 type

The type specifies the insulation material.

4.2.206 Service_operating_case

A Service_operating_case is a stream condition that may exist at a Plant_item_connector (see 4.2.171).

EXAMPLE 47 - Service_operating_case conditions may have the value "normal", "upset", or "shutdown".

The data associated with Service_operating_case are the following:

— duration;

— frequency;

— name;

— operating_case_id;

— operating_pressure;

— operating_temperature.

4.2.206.1 duration

The duration specifies the expected time span of the Service_operating_case.

4.2.206.2 frequency

The frequency specifies the expected number of times that the Service_operating_case will occur over a defined period of time.

4.2.206.3 name

The name specifies the designation or label of the condition under which the Equipment (see 4.2.71) operating characteristics are being defined.

4.2.206.4 operating_case_id

The operating_case_id specifies a unique identifier for the Service_operating_case.

4.2.206.5 operating_pressure

The operating_pressure specifies the force per unit area exerted by the process stream on the Plant_item (see 4.2.166) under a specific Service_operating_case.

4.2.206.6 operating_temperature

The operating_temperature specifies the temperature of the process stream on the Plant_item (see 4.2.166) under a specific Service_operating_case.

4.2.207 Shape_interference_zone_usage

A Shape_interference_zone_usage is the representational elements that define the shape of a zone of interference for clashing Plant_items (see 4.2.166).

4.2.208 Shape_representation

A Shape_representation is a combination of geometric elements that describe or define the general or specific surface boundaries of a Plant_item (see 4.2.166).

NOTE - Shape representation need not be the exact or specific shape of the item.

4.2.209 Shape_representation_element

A Shape_representation_element is a geometric model that is used to represent the shape or some aspect of the shape of a Plant_item (see 4.2.166). Each Shape_representation_element is either a B_rep_element (see 4.2.1), a Csg_element (see 4.2.53), or a Wire_and_surface_element (see 4.2.261).

The data associated with Shape_representation_element are the following:

— element_id;

The element_id specifies the unique identifier of the Shape_representation_element.

4.2.210 Shape_representation_element_usage

A Shape_representation_element_usage is an assignment of a Shape_representation_element to a Shape_-representation (see 4.2.208) of a Plant_item (see 4.2.166).

The data associated with Shape_representation_element_usage are the following:

— element_colour;

— layer.

4.2.210.1 element_colour

The element_colour specifies the colour with which the element is displayed.

4.2.210.2 layer

The layer specifies the collection of displayable items for the purpose of controlling visibility and presentation style.

4.2.211 Silo

A Silo is a type of Equipment (see 4.2.71) that is a large vertical, cylindrical structure made of reinforced concrete, steel, or timber, that is used for storage of various materials.

The data associated with Silo are the following:

— silo_type.

The silo_type specifies a designation that classifies a Silo based on its operational characteristics.

4.2.212 Site

A Site is real estate within which the Plant (see 4.2.165) is located.

The data associated with Site are the following:

— address;

— coordinates;

— elevation;

— environmental_references;

— locality;

— name;

— orientation;

— owners;

— site_id.

4.2.212.1 address

The address specifies the street address (including city, state, and zip code as appropriate) of the Site.

4.2.212.2 coordinates

The coordinates specifies the longitude and latitude coordinates of the Site with respect to a known point on the Site.

4.2.212.3 elevation

The elevation specifies the distance that the Site is located above sea level with respect to a known point on the Site.

NOTE - The point referenced here is the same point referenced under coordinates.

4.2.212.4 environmental_references

The environmental_references specifies a reference to a document that provides environmental information relevant to the Site.

4.2.212.5 locality

The locality specifies the municipality or region where the Site is located.

4.2.212.6 name

The name specifies the designation or label given to the Site.

4.2.212.7 orientation

The orientation specifies the relative alignment of the Site with respect to a given compass direction.

4.2.212.8 owners

The owners specify the company or organization that is financially responsible the Site.

4.2.212.9 site_id

The site_id specifies a unique identifier for the Site.

4.2.213 Site_feature

A Site_feature is the composition, proportions, form, or outward appearance of a feature on a Site (see 4.2.212).

> EXAMPLE 48 - Site_feature descriptions may have the value "road", "railway", "water tower", "river", "hill", or "forest".

The data associated with Site_feature are the following:

— location_and_orientation;

— shape;

— site_feature_id;

— type.

4.2.213.1 location_and_orientation

The location_and_orientation specifies the position of the Site_feature relative to the site coordinate system and the orientation of the Site_feature relative to a specified direction.

4.2.213.2 shape

The shape specifies a 3D spatial volume that completely encloses or bounds a feature.

NOTE - The shape of the Site_feature is necessary for the spatial layout of buildings and the piping between buildings.

4.2.213.3 site_feature_id

The site_feature_id specifies a unique identifier for the Site_feature.

4.2.213.4 type

The type specifies a designation that classifies a Site_feature based on its physical and functional characteristics.

4.2.214 Sited_plant

A Sited_plant is a Planned_physical_plant (see 4.2.163) for which a site location has been defined.

The data associated with Sited_plant are the following:

— plant_site_location;

— plant_site_orientation.

4.2.214.1 plant_site_location

The plant_site_location specifies the geographic position of the plant relative to the Site (see 4.2.212) or a feature of the Site.

4.2.214.2 plant_site_orientation

The plant_site_orientation specifies the directional orientation of the plant with respect to the Site (see 4.2.212).

4.2.215 Slip_on_flange

A Slip_on_flange is a type of Flange (see 4.2.80) that slips over the end of a Pipe (see 4.2.148) or Fitting (see 4.2.79) and is fillet welded in place.

The data associated with Slip_on_flange are the following:

— stand_off.

The stand_off specifies the measure of the distance between the face of the Slip_on_flange and the end of the pipe that is inserted into the Slip_on_flange.

4.2.216 Socket

A Socket is a type of Piping_connector (see 4.2.152) that is a physical feature of a Plant_item (see 4.2.166) that allows partial insertion of the male end of another Plant_item.

NOTE - The location of the connect point should be based on the dimension from the centreline to the bottom of the socket of a Valve (see 4.2.258) or Fitting (see 4.2.79) plus the root_gap.

The data associated with Socket are the following:

— root_gap.

The root_gap specifies the distance between the connect point of the Plant_item_connector of the fitting and the base of the Socket.

4.2.217 Socket_weld_flange

A Socket_weld_flange is a type of Flange (see 4.2.80) having a socket configuration that fits the end of a pipe for fillet welding.

4.2.218 Solid_of_revolution

A Solid_of_revolution is a type of Csg_element (see 4.2.53) that is formed by sweeping a polygonal shape about an axis.

4.2.219 Spacer

A Spacer is a type of Fitting (see 4.2.79) that is placed between two Flange (see 4.2.80) objects to enable the flow of material between the pipelines on either side of the Spacer. Each Spacer may be one of the following: a Paddle_spacer (see 4.2.145), or a Ring_spacer (see 4.2.202).

The data associated with Spacer are the following:

— outside_diameter;

— thickness.

4.2.219.1 outside_diameter

The outside_diameter specifies the external diameter of the Spacer.

4.2.219.2 thickness

The thickness specifies the measure of the face-to-face length of the Spacer.

4.2.220 Specialty_item

A Specialty_item is a type of Piping_system_component (see 4.2.159) whose specific dimensional design or configuration is not met by some standard commodity item.

The data associated with Specialty_item are the following:

— type.

The type specifies a category that the item is part of.

EXAMPLE 49 - Specialty_item object types may have the value "flange" or "valve".

4.2.221 Specification_item_family

A Specification_item_family is a Plant_item_definition (see 4.2.173) that characterizes a set of Plant_item (see 4.2.166) objects based on common physical characteristics. Physical characteristics may be specified as a range of values or as a specific value.

EXAMPLE 50 - A Piping_specification (see 4.2.155) describes a Specification_item_family, such as a class of elbows made of stainless steel that are long radius elbows between six inches and twenty four inches in diameter.

The data associated with Specification_item_family are the following:

— family_classification_description.

The family_classification_description specifies a textual explanation of the principle characteristics which vary within the family.

4.2.222 Spectacle_blind

A Spectacle_blind is a type of Blank (see 4.2.2) that consists of two "paddles" connected by an arm. One paddle blocks the flow of material (see Paddle_blank in 4.2.144) and the other is a ring that permits or alters the flow (see Paddle_spacer in 4.2.145). A spectacle either allows or disallows flow in a pipe depending on which end of the spectacle is installed inline. It is often used to isolate a section of the Piping_system (see 4.2.158) or Equipment (see 4.2.71).

NOTE - The term "spectacle" refers to shape of the item, which resembles a pair of spectacles (i.e., reading glasses).

The data associated with Spectacle_blind are the following:

— arm_width;

— centre_to_centre;

— inside_ring_diameter.

4.2.222.1 arm_width

The arm_width specifies the width of the arm connecting the paddles.

4.2.222.2 centre_to_centre

The centre_to_centre specifies the distance between the geometric centres of the paddles.

4.2.222.3 inside_ring_diameter

The inside_ring_diameter specifies the diameter of the bore hole through the ring paddle.

4.2.223 Sphere

A Sphere is a type of Csg_element (see 4.2.53) that is a solid bounded by a surface at a constant radius from a centre point. A Sphere may be a Trimmed_sphere (see 4.2.252).

4.2.224 Square_to_round

A Square_to_round is a type of Csg_element (see 4.2.53) that consists of a planar, rectangular surface, a planar circular surface parallel to the rectangular surface, and an enclosing, transitional surface that connects the boundaries of the rectangular surface and circular surface.

4.2.225 Straight_pipe

A Straight_pipe is a type of Pipe (see 4.2.148) that does not change the direction of fluid flow.

The data associated with Straight_pipe are the following:

— end_to_end_length.

The end_to_end_length specifies the external length of the Straight_pipe.

4.2.226 Stream_design_case

A Stream_design_case is the set of characteristics of a gas, liquid, vapour, or solid stream under a specific circumstance at the termination of a Piping_system_line_segment (see 4.2.161) or a plant_item_-connector_occurrence (see 4.2.172).

The data associated with Stream_design_case are the following:

— description;

— flow_rate;

— pressure;

— stream_case_type;

— stream_data_reference;

— stream_design_id.

4.2.226.1 description

The description specifies a textual summary of the Stream_design_case.

4.2.226.2 flow_rate

The flow_rate specifies the stream volume, mass, or molar units per unit time.

4.2.226.3 pressure

The pressure specifies the amount of force applied by the stream over a unit area.

4.2.226.4 stream_case_type

The stream_case_type specifies the condition under which the stream characteristics are being defined.

Example 51 - Stream_case_type conditions may have the value "normal", "upset", or "shutdown".

4.2.226.5 stream_data_reference

The stream_data_reference specifies the sources which provide the bases for the stream data.

4.2.226.6 stream_design_id

The stream_design_id specifies a unique identifier for the Stream_design_case.

4.2.227 Stream_phase

A Stream_phase is the set of characteristics of a single gas, liquid, vapour, or solid stream that may be composed into a Stream_design_case (see 4.2.226).

The data associated with Stream_phase are the following:

— constituent_mole_fraction;

— constituents;

— phase_density;

— phase_fraction;

— specific_gravity;

— surface_tension;

— temperature;

— viscosity.

4.2.227.1 constituent_mole_fraction

The constituent_mole_fraction specifies the mass ratio of any given component to the whole for the Stream_phase.

4.2.227.2 constituents

The constituents specifies the various chemicals for the Stream_phase.

4.2.227.3 phase_density

The phase_density specifies the amount of mass per unit volume for the Stream_phase.

4.2.227.4 phase_fraction

The phase_fraction specifies the percentage of the mass of this Stream_phase in the Stream_design_case (see 4.2.226).

4.2.227.5 specific_gravity

The specific_gravity specifies the ratio of the mass of a liquid to the mass of an equal volume of distilled water at 4 degrees Celsius.

4.2.227.6 surface_tension

The surface_tension specifies the force per unit area of the cohesive forces at or near the surface of a liquid Stream_phase.

4.2.227.7 temperature

The temperature specifies the measure of molecular motion of a stream.

4.2.227.8 viscosity

The viscosity specifies a measure of the resistance of a stream to deformation when subjected to a shear stress.

4.2.228 Structural_component

A Structural_component is a type of Plant_item (see 4.2.166) that is an individually identifiable item or combination of items that is part of the Plant (see 4.2.165) Structural_system (see 4.2.230).

> NOTE - Structural_component objects include structural steel members, load resisting walls, foundations, supports (excluding pipe supports) for Plant_item (see 4.2.166) objects, and have a primary function to transfer or resist live or dead loads.

The data associated with Structural_component are the following:

— exact_section;

— size_designator;

— type.

4.2.228.1 exact_section

The exact_section specifies the detailed shape of a cross section of the structural element.

4.2.228.2 size_designator

The size_designator specifies the designation given to some types of plant structural elements to define cross-sectional size and general shape based on industry-standard practice.

EXAMPLE 52 - W30 X 132 is the U.S. AISC designation for a wide flange beam of nominal 30 inches depth weighing 132 pounds per foot of length. Similar designations exist for other plant structural elements such as angles (L), channels (C), and structural tee shapes (T). Also, like designations exist for other structural elements, e.g., reinforcing bar (#8 rebar).

4.2.228.3 type

The type specifies a designation that classifies a structural element based on its function in the Structural_-system (see 4.2.230).

EXAMPLE 53 - Structural element types may have the value "beam", "column", "brace", "support", "grade beam", or "pile".

4.2.229 Structural_load_connector

A Structural_load_connector is a type of Plant_item_connector (see 4.2.171) that connects two Structural_-component (see 4.2.228) objects for the purpose of load transfer.

The data associated with Structural_load_connector are the following:

— type.

The type specifies either a shear, moment, or shear and moment type of load at the connector.

4.2.230 Structural_system

A Structural_system is a type of Plant_system (see 4.2.183) that is an assembly of one or more Structural_component (see 4.2.228) objects and Structural_load_connector (see 4.2.229) objects.

The data associated with Structural_system are the following:

— type.

The type specifies a designation that classifies the Structural_system based on the kind of service that it provides.

4.2.231 Sub_plant_relationship

A Sub_plant_relationship is the relationship between Plant (see 4.2.165) objects and sub-plants and defines their relative locations.

EXAMPLE 54 - Sub-plant_relationship types may have the value "manufacturing line", "train", or "plant unit".

The data associated with Sub_plant_relationship are the following:

— location_and_orientation.

The location_and_orientation specifies the relative position and orientation of the sub-plant within the Plant (see 4.2.165).

4.2.232 Support_component

A Support_component is a type of Plant_item (see 4.2.166) that is designed to support other Plant_item objects. This support includes carrying the weight of the Plant_item, including internal fluids and external insulation, permitting thermal expansion and contraction, and dampening any vibrational or seismic forces applied to the Plant_item. Each Support_component may be a Cable_support (see 4.2.9).

4.2.233 Support_constraints

A Support_constraints is a limitation on the movement of a Plant_item (see 4.2.166) support, normally in specified directions.

The data associated with Support_constraints are the following:

— gap;

— K;

— restrained;

— support_constraint_id.

4.2.233.1 gap

The gap specifies the allowable space between a Plant_item (see 4.2.166) and a Plant_item support.

4.2.233.2 K

The K specifies the ratio between the force applied to the support and the support deflection produced by that force.

4.2.233.3 restrained

The restrained specifies a boolean indicator that specifies whether the Plant_item (see 4.2.166) support limits movement of the Plant_item in a specified direction.

4.2.233.4 support_constraint_id

The support_constraint_id specifies a unique identifier for the Support_constraints.

4.2.234 Support_usage

A Support_usage is the relationship between a defined load bearing element and the Plant_item (see 4.2.166) to which it provides support. Each Support_usage may be a Support_usage_connection (see 4.2.235).

The data associated with Support_usage are the following:

— detail_sheet_reference;

— function.

4.2.234.1 detail_sheet_reference

The detail_sheet_reference specifies the support detail drawings which define the support.

4.2.234.2 function

The function specifies the role or purpose of using the Plant_item (see 4.2.166) as a support.

EXAMPLE 55 - Function designations may have the value "anchor", "guide", "restraint", or "support".

4.2.235 Support_usage_connection

A Support_usage_connection is a type of Support_usage (see 4.2.234) that specifies the actual Plant_-item_connection_occurrence (see 4.2.170) at which the support occurs.

4.2.236 Surface

A Surface is a type of Wire_and_surface_element (see 4.2.261) that is a set of connected points in 3D geometric space which is always locally 2D, but need not be a manifold.

NOTE - Surface has many subtypes. Besides being a self-contained object, Surface is used in the definition of other geometric objects such as Point (see 4.2.186) objects and Curve (see 4.2.54) objects. It will not be instantiated as it has no attributes.

4.2.237 Survey_point

A Survey_point is a particular location (position and elevation) on a Site (see 4.2.212) relative to a known location.

NOTE - Survey_point data are established by performing a survey. The collection of Survey_point data can be interpolated to generate a faceted or surface representation of the topography of the Site.

4.2.238 Swage

A Swage is a type of Fitting (see 4.2.79) that provides a reduction from Pipe (see 4.2.148) size to another. Each Swage may be an Eccentric_swage (see 4.2.63).

NOTE - A Swage will always have at least one male end_type and either a male or buttweld end.

The data associated with Swage are the following:

— end_1_connector;

— end_2_connector;

— end_to_end_length.

4.2.238.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.238.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.238.3 end_to_end_length

The end_to_end_length specifies the external distance between the end one face and the end two face of the swage.

4.2.239 Swept_bend_pipe

A Swept_bend_pipe is a type of Pipe (see 4.2.148) that is bent to alter the direction of flow of its contents.

NOTE - A Swept_bend_pipe is composed of one or more Pipe_bend (see 4.2.149) objects.

The data associated with Swept_bend_pipe are the following:

— wall_thinning_allowance.

The wall_thinning_allowance specifies the amount of pipe wall material that must be provided to compensate for reduction in wall thickness of the pipe caused by bending.

NOTE - As a pipe is bent, the wall thickness on the outside portion of the bend will reduce as material stretches.

4.2.240 System_space

A System_space is a type of Plant_volume (see 4.2.185) that is used to describe or allocate a volume of space for use by a Plant_system (see 4.2.183).

EXAMPLE 56 - System_space type designations may have the value "electrical chases", "HVAC chases", or "instrumentation and control chases".

4.2.241 Tank

A Tank is a type of Equipment (see 4.2.71) that is a large container for holding or storing fluids.

The data associated with Tank are the following:

— tank_type.

The tank_type specifies a designation that classifies a Tank based on its operational characteristics.

4.2.242 Tee

A Tee is a type of Fitting (see 4.2.79) that is a single branched outlet Fitting consisting of two run legs and a perpendicular branch leg used to permit straight through and 90 degree flow.

The data associated with Tee are the following:

— centre_to_end_1_length;

— centre_to_end_2_length;

— centre_to_end_3_length.

— end_1_connector;

— end_2_connector;

— end_3_connector.

4.2.242.1 centre_to_end_1_length

The centre_to_end_1_length specifies the distance from the intersection of the Tee straight run centreline and branch run centreline to the end one working point.

4.2.242.2 centre_to_end_2_length

The centre_to_end_2_length specifies the distance from the intersection of the Tee straight run centreline and branch run centreline to the end two working point.

4.2.242.3 centre_to_end_3_length

The centre_to_end_3_length specifies the distance from the intersection of the Tee straight run centreline and branch run centreline to the end three working point.

4.2.242.4 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.242.5 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.242.6 end_3_connector

The end_3_connector specifies the Piping_connector (see 4.2.152) designated as end three.

4.2.243 Terrain_model

A Terrain_model is a replica of the topography of a specific area. Each Terrain_model is either a Faceted_terrain_model (see 4.2.77) or a Point_terrain_model (see 4.2.187).

The data associated with Terrain_model are the following:

— terrain_model_id.

The terrain_model_id specifies a unique identifier for the Terrain_model.

4.2.244 Threaded

A Threaded is a type of Piping_connector (see 4.2.152) that is a physical feature of a Plant_item (see 4.2.166) that allows partial insertion of a male threaded connector.

The data associated with Threaded are the following:

— thread_engagement_depth.

The thread_engagement_depth specifies the insertion distance of the male threaded connector into a female threaded connector.

4.2.245 Threaded_flange

A Threaded_flange is a type of Flange (see 4.2.80) whose bore is threaded and that is connected to a Pipe (see 4.2.148) by screwing a threaded Pipe end into the Flange (see 4.2.80).

4.2.246 Torus

A Torus is a type of Csg_element (see 4.2.53) that is defined by sweeping the area of a circle (with minor radius) about a larger circle. A Torus may be an Reducing_torus (see 4.2.197). A Torus may be a Trimmed_torus (see 4.2.253).

4.2.247 Train

A Train is a type of Plant (see 4.2.165) that is one of two or more distinct but similar portions of a system that perform the same function.

4.2.248 Trimmed_block

A Trimmed_block is a type of Block (see 4.2.4) that is cut with a plane and one of the two sections of the block is removed.

4.2.249 Trimmed_cone

A Trimmed_cone is a type of Cone (see 4.2.45) that is cut with a plane and one of the resulting sections removed.

4.2.250 Trimmed_cylinder

A Trimmed_cylinder is a type of Cylinder (see 4.2.55) that is cut with a plane and one of the resulting sections removed.

4.2.251 Trimmed_pyramid

A Trimmed_pyramid is a type of Pyramid (see 4.2.194) that is cut with a plane and one of the resulting sections removed.

4.2.252 Trimmed_sphere

A Trimmed_sphere is a type of Sphere (see 4.2.223) that is formed by cutting a Sphere with one or more planes and removing some resulting sections. A Trimmed_sphere may be a Hemisphere (see 4.2.98).

4.2.253 Trimmed_torus

A Trimmed_torus is a type of Torus (see 4.2.246) that is defined by cutting a Torus by one or more planes.

4.2.254 Tube

A Tube is a type of Cylinder (see 4.2.55) from which a cylindrical, coaxial shape has been removed, resulting in a circular opening that passed through the cylinder along its axis.

4.2.255 Turbine

A Turbine is a type of Equipment (see 4.2.71) in which the kinetic energy of a moving fluid (air, gas, water, or steam) is converted to mechanical power by the impulse or reaction of the fluid with a series of blades, buckets, or paddles arrayed about the circumference of a wheel or cylinder.

The data associated with Turbine are the following:

— energy_source_fluid;

— turbine_type.

4.2.255.1 energy_source_fluid

The energy_source_fluid specifies the substance used to impart the kinetic energy to the Turbine.

EXAMPLE 57 - Energy_source_fluid substance designations may have the value "air", "gas", "water", or "steam".

4.2.255.2 turbine_type

The turbine_type specifies a designation that classifies a Turbine based on its operational characteristics.

4.2.256 Union

A Union is a type of Fitting (see 4.2.79) composed of multiple pieces which allows the joining or separating of piping without rotating the piping. It consists of two internally threaded ends and a centre piece that draws the two ends together when rotated.

The data associated with Union are the following:

— end_1_connector;

— end_2_connector;

— end_to_end_length;

— major_outside_diameter;

— minor_outside_diameter.

4.2.256.1 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.256.2 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.256.3 end_to_end_length

The end_to_end_length specifies the external distance between the end one face and the end two face.

4.2.256.4 major_outside_diameter

The major_outside_diameter specifies the maximum diameter of the Union along the centreline, normally at the joint between the two internal pieces of the Union.

4.2.256.5 minor_outside_diameter

The minor_outside_diameter specifies the external diameter of the Union at the end one and end two connections.

4.2.257 Unit

A Unit is a type of Plant (see 4.2.165) that is the designation (name or number) for a Plant or portion of a Plant that produces the same product by different means.

NOTE - A Unit may perform a unique function for the Plant such as oxygen production, or there may be several units that perform the same function such as multiple units in a power generation installation. The underground or offsite portion of a Plant may be a Unit.

4.2.258 Valve

A Valve is a type of Piping_component (see 4.2.151) which provides isolation or controls fluid direction or flow rate.

The data associated with Valve are the following:

— actuator_type;

— operation_mode;

— type.

4.2.258.1 actuator_type

The actuator_type specifies a descriptive designation of device or mechanism used to open, position, or close a Valve.

4.2.258.2 operation_mode

The operation_mode specifies the failure mode, as in the state of being open or closed when the actuator either has no power or is in the default position.

4.2.258.3 type

The type specifies a designation that classifies a Valve based on its purpose which defines the design of its internals and externals.

EXAMPLE 58 - Valve type designations may have the value "gate", "globe", "check", or "relief".

4.2.259 Vector

A Vector is a type of Curve (see 4.2.54). It is specifies a direction in 3D space.

4.2.260 Weld_neck_flange

A Weld_neck_flange is a type of Flange (see 4.2.80) with a tapered hub bored to match the inside diameter of matching Pipe (see 4.2.148) and with the hub beveled for butt welding to the Pipe.

4.2.261 Wire_and_surface_element

A Wire_and_surface_element is a type of Shape_representation_element (see 4.2.209) that is composed of geometric elements. Each Wire_and_surface_element may be one of the following: a Curve (see 4.2.54), a Point (see 4.2.186), or a Surface (see 4.2.236).

4.2.262 Wye

A Wye is a type of Fitting (see 4.2.79) that is a three-way fitting whose branches are at equal angles from the run forming a flow passage shaped like the letter 'Y'.

The data associated with Wye are the following:

— angle;

— centre_to_end_1_length;

— centre_to_end_2_length;

— centre_to_end_3_length;

— end_1_connector;

— end_2_connector;

— end_3_connector.

4.2.262.1 angle

The angle specifies the angle of the branch portions of the Wye with respect to the straight run.

4.2.262.2 centre_to_end_1_length

The centre_to_end_1_length specifies the distance from the intersection of the Wye straight run centreline and branch run centreline to the end one working point.

4.2.262.3 centre_to_end_2_length

The centre_to_end_2_length specifies the distance from the intersection of the Wye straight run centreline and branch run centreline to the end two working point.

4.2.262.4 centre_to_end_3_length

The centre_to_end_3_length specifies the distance from the intersection of the Wye straight run centreline and branch run centreline to the end three working point.

4.2.262.5 end_1_connector

The end_1_connector specifies the Piping_connector (see 4.2.152) designated as end one.

4.2.262.6 end_2_connector

The end_2_connector specifies the Piping_connector (see 4.2.152) designated as end two.

4.2.262.7 end_3_connector

The end_3_connector specifies the Piping_connector (see 4.2.152) designated as end three.

4.3 Application assertions

This subclause specifies the application assertions for the plant spatial configuration application protocol. Application assertions specify all relationships among application objects, the cardinality of the relationships, and the rules required for the integrity and validity of the application objects and UoFs. The application assertions and their definitions are given below.

4.3.1 Breakline to Survey_point

Each Breakline is defined by one or more Survey_point objects. Each Survey_point defines zero, one, or many Breakline objects.

4.3.2 Building to Location_in_building

Each Building is a reference frame for zero, one, or many Location_in_building objects. Each Location_-in_building has a reference frame provided by exactly one Building.

4.3.3 Catalogue_definition to Catalogue_item

Each Catalogue_definition contains zero, one, or many Catalogue_item objects. Each Catalogue_item is contained by exactly one Catalogue_definition.

4.3.4 Catalogue_item to Catalogue_item_substitute

Each Catalogue_item has zero, one, or many Catalogue_item_substitute objects. Each Catalogue_item_-substitute identifies a substitute for exactly one Catalogue_item.

Each Catalogue_item is a substitute in zero, one, or many Catalogue_item_substitute objects. Each Catalogue_item_substitutes identifies as a substitute exactly one Catalogue_item.

4.3.5 Change to Change_item

Each Change changes one or more Change_item objects. Each Change_item is changed by zero, one, or many Change objects.

4.3.6 Change to Change_life_cycle_stage_usage

Each Change is assigned by one or more Change_life_cycle_stage_usage objects. Each Change_life_-cycle_stage_usage assigns exactly one Change.

4.3.7 Change_item to Change_delta

Each Change_item is the changed from item in zero, one, or many Change_delta objects. Each Change_-delta identifies exactly one Change_item as the item that has been changed.

Each Change_item is the changed to item zero, one, or many Change_delta objects. Each Change_delta identifies exactly one Change_item as the item that is the result of a change.

4.3.8 Change_life_cycle_stage to Change_life_cycle_stage_sequence

Each Change_life_cycle_stage is the predecessor in zero, one, or many Change_life_cycle_stage_sequence objects. Each Change_life_cycle_stage_sequence has exactly one Change_life_cycle_stage as the predecessor.

Each Change_life_cycle_stage is the successor in zero, one, or many Change_life_cycle_stage_sequence objects. Each Change_life_cycle_stage_sequence has exactly one Change_life_cycle_stage as the successor.

4.3.9 Change_life_cycle_stage to Change_life_cycle_stage_usage

Each Change_life_cycle_stage has changes assigned by zero, one, or many Change_life_cycle_stage_usage objects. Each Change_life_cycle_stage_usage assigns changes for exactly one Change_life_cycle_stage.

4.3.10 Change_life_cycle_stage_usage to Change_approval

Each Change_life_cycle_stage_usage is approved by zero, one, or many Change_approval objects. Each Change_approval approves exactly one Change_life_cycle_stage_usage.

4.3.11 Connected_assembly to Plant_item_connection

Each Connected_assembly contains zero, one, or many Plant_item_connection objects. Each Plant_item_-connection participates in zero, one, or many Connected_assembly objects.

4.3.12 Connection_definition to Connector_definition

Each Connection_definition connects two or more Connector_definition objects. Each Connector_-definition may be connected by exactly one Connection_definition.

4.3.13 Connection_definition to Functional_connection_definition_satisfaction

Each Connection_definition is the functional requirements for zero, one, or many Functional_connection_-definition_satisfaction objects. Each Functional_connection_definition_satisfaction gets the functional requirements from exactly one Connection_definition.

Each Connection_definition satisfies requirements for zero, one, or many Functional_connection_-definition_satisfaction objects. Each Functional_connection_definition_satisfaction has requirements satisfied by exactly one Connection_definition.

4.3.14 Connection_definition to Plant_item_connection_occurrence

Each Connection_definition defines zero, one, or many Plant_item_connection_occurrence objects. Each Plant_item_connection_occurrence may be defined by exactly one Connection_definition.

4.3.15 Connector_definition to Functional_connector_definition_satisfaction

Each Connector_definition is the functional requirements for zero, one, or many Functional_connector_-definition_satisfaction objects. Each Functional_connector_definition_satisfaction gets the functional requirements from exactly one Connector_definition.

Each Connector_definition satisfies requirements for zero, one, or many Functional_connector_definition_-satisfaction objects. Each Functional_connector_definition_satisfaction has requirements satisfied by exactly one Connector_definition.

4.3.16 Connector_definition to Plant_item_connector_occurrence

Each Connector_definition defines zero, one, or many Plant_item_connector_occurrence objects. Each Plant_item_connector_occurrence may be defined by exactly one Connector_definition.

4.3.17 Design_project to Project_design_assignment

Each Design_project is performed in one or more Project_design_assignment objects. Each Project_-design_assignment assigns a task to exactly one Design_project.

4.3.18 Equipment to Equipment_trim_piping

Each Equipment requires zero, one, or many Equipment_trim_piping objects. Each Equipment_trim_-piping is required by exactly one Equipment.

4.3.19 Facet to Survey_point

Each Facet is defined by one or more Survey_point objects. Each Survey_point defines zero, one, or many Facet objects.

4.3.20 Faceted_terrain_model to Breakline

Each Faceted_terrain_model is constrained by zero, one, or many Breakline objects. Each Breakline may constrain exactly one Faceted_terrain_model.

4.3.21 Faceted_terrain_model to Facet

Each Faceted_terrain_model is composed of one or more Facet objects. Each Facet is a component of exactly one Faceted_terrain_model.

4.3.22 Functional_connector to Functional_connector_occurrence_satisfaction

Each Functional_connector is the functional requirements for zero, one, or many Functional_connector_-occurrence_satisfaction objects. Each Functional_connector_occurrence_satisfaction gets the functional requirements from exactly one Functional_connector.

4.3.23 Functional_plant to Functional_plant_satisfaction

Each Functional_plant is the functional requirements for zero, one, or many Functional_plant_satisfaction. Each Functional_plant_satisfaction gets the functional requirements from exactly one Functional_plant.

4.3.24 Functional_plant to Plant_system

Each Functional_plant is made up of zero, one, or many Plant_system objects. Each Plant_system is part of exactly one Functional_plant.

4.3.25 Functional_design_view to Functional_plant_item_satisfaction

Each Functional_design_view is the functional requirements for zero, one, or many Functional_plant_-item_satisfaction. Each Functional_plant_item_satisfaction gets the functional requirements from exactly one Functional_design_view.

4.3.26 Hvac_system to Stream_design_case

Each Hvac_system transports material for zero, one, or many Stream_design_case objects. Each Stream_-design_case defines potential material for zero, one, or many Hvac_system objects.

4.3.27 Line_branch_connection to Changed_line_branch_connection

Each Line_branch_connection is changed by zero, one, or many Changed_line_branch_connection objects. Each Changed_line_branch_connection changes exactly one Line_branch_connection.

4.3.28 Line_branch_termination to Line_branch_connection

Each Line_branch_termination is branched from exactly one Line_branch_connection. Each Line_branch_-connection branches exactly one Line_branch_termination.

4.3.29 Line_less_piping_system to Piping_system_component

Each Line_less_piping_system is composed of zero, one, or many Piping_system_component objects. Each Piping_system_component is a component of zero, one, or many Line_less_piping_system objects.

4.3.30 Line_less_piping_system to Stream_design_case

Each Line_less_piping_system transports material for zero, one, or many Stream_design_case objects. Each Stream_design_case defines potential material for zero, one, or many Line_less_piping_system objects.

4.3.31 Line_piping_system_component_assignment to Changed_line_assignment

Each Line_piping_system_component_assignment is changed by zero, one, or many Changed_line_assignment objects. Each Changed_line_assignment changes exactly one Line_piping_system_component_assignment.

4.3.32 Line_plant_item_branch_connection to Changed_line_plant_item_branch_connection

Each Line_plant_item_branch_connection is changed by zero, one, or many Changed_line_plant_item_branch_connection objects. Each Changed_line_plant_item_branch_connection changes exactly one Line_plant_item_branch_connection.

4.3.33 Line_plant_item_connection to Changed_line_plant_item_connection

Each Line_plant_item_connection is changed by zero, one, or many Changed_line_plant_item_connection objects. Each Changed_line_plant_item_connection changes exactly one Line_plant_item_connection.

4.3.34 Line_plant_item_branch_connector to Line_plant_item_branch_connection

Each Line_plant_item_branch_connector is connected to zero or one Line_plant_item_branch_connection. Each Line_plant_item_branch_connection connects exactly one Line_plant_item_branch_connector.

4.3.35 Line_plant_item_connector to Line_plant_item_connection

Each Line_plant_item_connector is connected to zero or one Line_plant_item_connection. Each Line_plant_item_connection connects exactly one Line_plant_item_connector.

4.3.36 Line_plant_item_termination to Line_plant_item_connection

Each Line_plant_item_termination is connected to exactly one Line_plant_item_connection. Each Line_plant_item_connection connects exactly one Line_plant_item_termination.

4.3.37 Line_to_line_connection to Changed_line_to_line_connection

Each Line_to_line_connection is changed by zero, one, or many Changed_line_to_line_connection objects. Each Changed_line_to_line_connection changes exactly one Line_to_line_connection.

4.3.38 Line_to_line_connection to Line_to_line_termination

Each Line_to_line_connection connects two or more Line_to_line_termination objects. Each Line_to_-line_termination is connected by exactly one Line_to_line_connection.

4.3.39 Material_specification_selection to Changed_material_specification_selection

Each Material_specification_selection is changed by zero, one, or many Changed_material_specification_-selection objects. Each Changed_material_specification_selection changes exactly one Material_-specification_selection.

4.3.40 Material_specification_selection to Material_specification_subset_reference

Each Material_specification_selection is used by zero, one, or many Material_specification_subset_-reference objects. Each Material_specification_subset_reference uses exactly one Material_specification_-selection.

4.3.41 Physical_connector to Functional_connector_occurrence_satisfaction

Each Physical_connector satisfies requirements for zero, one, or many Functional_connector_occurrence_-satisfaction objects. Each Functional_connector_occurrence_satisfaction has requirements satisfied by exactly one Physical_connector.

4.3.42 Physical_design_view to Functional_plant_item_satisfaction

Each Physical_design_view satisfies requirements for zero, one, or many Functional_plant_item_-satisfaction objects. Each Functional_plant_item_satisfaction has requirements satisfied by exactly one Physical_design_view.

4.3.43 Physical_design_view to Installed_physical_design_view

Each Physical_design_view is used as zero or one Installed_physical_design_view. Each Installed_-physical_design_view is exactly one Physical_design_view.

4.3.44 Piping_connector to Piping_connector_service_characteristic

Each Piping_connector provides zero or one Piping_connector_service_characteristic. Each Piping_-connector_service_characteristic is provided by exactly one Piping_connector.

4.3.45 Piping_connector to Piping_size_description

Each Piping_connector has a size described by zero, one, or many Piping_size_description objects. Each Piping_size_description describes the size of zero, one, or many Piping_connector objects.

4.3.46 Piping_connector_service_characteristic to Service_operating_case

Each Piping_connector_service_characteristic supports zero, one, or many Service_operating_case objects. Each Service_operating_case is supported by exactly one Piping_connector_service_characteristic.

4.3.47 Piping_specification to Piping_system_line_segment

Each Piping_specification specifies components for zero, one, or many piping_system_line_segment objects. Each Piping_system_line_segment has components specified by exactly one Piping_specification.

4.3.48 Piping_specification to Specification_item_family

Each Piping_specification is composed of one or more Specification_item_family objects. Each Specification_item_family is part of exactly one Piping_specification objects.

4.3.49 Piping_spool to Piping_spool_assignment

Each Piping_spool is the spool in zero, one, or many Piping_spool_assignment objects. Each Piping_-spool_assignment has exactly one Piping_spool as the spool.

4.3.50 Piping_system to Piping_system_line

Each Piping_system is made up of zero, one, or many Piping_system_line objects. Each Piping_system_-line is part of exactly one Piping_system.

4.3.51 Piping_system_component to Equipment_trim_piping

Each Piping_system_component is used as zero, one, or many Equipment_trim_piping objects. Each Equipment_trim_piping is exactly one Piping_system_component.

4.3.52 Piping_system_component to Line_piping_system_component_assignment

Each Piping_system_component satisfies zero, one, or many Line_piping_system_component_assignment objects. Each Line_piping_system_component_assignment is satisfied by exactly one Piping_system_-component.

4.3.53 Piping_system_component to Piping_size_description

Each Piping_system_component has a size described by zero, one, or many Piping_size_description objects. Each Piping_size_description describes the size of zero, one, or many Piping_system_component objects.

4.3.54 Piping_system_line to Changed_piping_system_line

Each Piping_system_line is changed by zero, one, or many Changed_piping_system_line objects. Each Changed_piping_system_line changes exactly one Piping_system_line.

4.3.55 Piping_system_line to Piping_system_line_segment

Each Piping_system_line is composed of one or more Piping_system_line_segment objects. Each Piping_-system_line_segment is a component of exactly one Piping_system_line.

4.3.56 Piping_system_line_segment to Changed_piping_system_line_segment

Each Piping_system_line_segment is changed by zero, one, or many Changed_piping_system_line_segment objects. Each Changed_piping_system_line_segment changes exactly one Piping_system_line_segment.

4.3.57 Piping_system_line_segment to Line_branch_connection

Each Piping_system_line_segment has branches defined by zero, one, or many Line_branch_connection objects. Each Line_branch_connection defines the branches of exactly one Piping_system_line_segment.

4.3.58 Piping_system_line_segment to Line_plant_item_branch_connection

Each Piping_system_line_segment is connected to zero, one, or many Line_plant_item_branch_connection objects. Each Line_plant_item_branch_connection defines the branches of exactly one Piping_system_-line_segment.

4.3.59 Piping_system_line_segment to Line_piping_system_component_assign-ment

Each Piping_system_line_segment defines the need for zero, one, or many Line_piping_system_-component_assignment objects. Each Line_piping_system_component_assignment satisfies the need defined by exactly one Piping_system_line_segment.

4.3.60 Piping_system_line_segment to Piping_system_line_segment_termination

Each Piping_system_line_segment is terminated by exactly two Piping_system_line_segment_termination objects. Each Piping_system_line_segment_termination terminates exactly one Piping_system_line_segment.

4.3.61 Piping_system_line_segment to Segment_insulation

Each Piping_system_line_segment requires zero, one, or many Segment_insulation objects. Each Segment_insulation is required by exactly one Piping_system_line_segment.

4.3.62 Piping_system_line_segment to Stream_design_case

Each Piping_system_line_segment defines transport needs for zero, one, or many Stream_design_case objects. Each Stream_design_case defines potential material for zero, one, or many Piping_system_line_segment objects.

4.3.63 Piping_system_line_segment_termination to Changed_piping_system_line_segment_termination

Each Piping_system_line_segment_termination is changed by zero, one, or many Changed_piping_system_line_segment_termination objects. Each Changed_piping_system_line_segment_termination changes exactly one Piping_system_line_segment_termination.

4.3.64 Planned_physical_plant to Changed_planned_physical_plant

Each Planned_physical_plant is changed by zero, one, or many Changed_planned_physical_plant objects. Each Changed_planned_physical_plant changes exactly one Planned_physical_plant.

4.3.65 Planned_physical_plant to Functional_plant_satisfaction

Each Planned_physical_plant satisfies requirements for zero, one, or many Functional_plant_satisfaction objects. Each Functional_plant_satisfaction has requirements satisfied by exactly one Planned_physical_plant.

4.3.66 Planned_physical_plant to Location_in_plant

Each Planned_physical_plant contains zero, one, or many Location_in_plant objects. Each Location_in_plant is located in zero, one, or many Planned_physical_plant objects.

4.3.67 Planned_physical_plant to Sited_plant

Each Planned_physical_plant is used as zero or one Sited_plant objects. Each Sited_plant is exactly one Planned_physical_plant.

4.3.68 Planned_physical_plant_item to Plant_item_connector_occurrence

Each Planned_physical_plant_item has zero, one, or many Plant_item_connector_occurrence objects. Each Plant_item_connector_occurrence is part of exactly one Planned_physical_plant_item.

4.3.69 Planned_physical_plant_item to Piping_spool_assignment

Each Planned_physical_plant_item is assigned a spool by zero or one Piping_spool_assignment. Each Piping_spool_assignment assigns a spool to exactly one Planned_physical_plant_item.

4.3.70 Planned_physical_plant_item to Support_usage

Each Planned_physical_plant_item is supported by zero, one, or many Support_usage objects. Each Support_usage identifies exactly one Planned_physical_plant_item which supports another.

Each Planned_physical_plant_item supports zero, one, or many Support_usage objects. Each Support_-usage identifies exactly one Planned_physical_plant_item which is supported.

4.3.71 Plant to Changed_plant

Each Plant is changed by zero, one, or many Changed_plant objects. Each Changed_plant changes exactly one Plant.

4.3.72 Plant to Functional_plant

Each Plant is used as zero or one Functional_plant objects. Each Functional_plant is exactly one Plant.

4.3.73 Plant to Planned_physical_plant

Each Plant is realized as zero, one, or many Planned_physical_plant objects. Each Planned_physical_plant is the realization of exactly one Plant.

4.3.74 Plant to Plant_process_capability

Each Plant produces zero, one, or many Plant_process_capability objects. Each Plant_process_capability is produced by exactly one Plant.

4.3.75 Plant to Sub_plant_relationship

Each Plant contains zero, one, or many Sub_plant_relationship objects. Each Sub_plant_relationship is contained in exactly one Plant.

Each Plant is used in zero, one, or many Sub_plant_relationship objects. Each Sub-plant_relationship uses exactly one Plant.

4.3.76 Plant_item to Changed_plant_item

Each Plant_item is changed by zero, one, or many Changed_plant_item objects. Each Changed_plant_item changes exactly one Plant_item.

4.3.77 Plant_item to Construction_material

Each Plant_item is constructed of zero, one, or many Construction_material objects. Each Construction_-material is used in the construction of zero, one, or many Plant_item objects.

4.3.78 Plant_item to Plant_item_design_view

Each Plant_item is defined as one or more Plant_item_design_view objects. Each Plant_item_design_view defines exactly one Plant_item.

4.3.79 Plant_item to Plant_item_collection

Each Plant_item is an element in zero, one, or many Plant_item_collection objects. Each Plant_item_-collection identifies as an element of a collection exactly one Plant_item.

Each Plant_item is a group of zero, one, or many Plant_item_collection objects. Each Plant_item_-collection identifies as a group exactly one Plant_item.

4.3.80 Plant_item to Plant_item_shape

Each Plant_item is spatially described by zero, one, or many Plant_item_shape objects. Each Plant_item_-shape spatially describes exactly one Plant_item.

4.3.81 Plant_item to Plant_item_weight

Each Plant_item is measured as having zero, one, or many Plant_item_weight objects. Each Plant_item_-weight is the measured weight of exactly one Plant_item.

4.3.82 Plant_item to Reference_geometry

Each Plant_item references zero, one, or many Reference_geometry objects. Each Reference_geometry is referenced by zero, one, or many Plant_item objects.

4.3.83 Plant_item to Required_material_description

Each Plant_item satisfies zero, one, or many Required_material_description objects. Each Required_-material_description is satisfied by zero, one, or many Plant_item objects.

4.3.84 Plant_item_collection to Changed_plant_item_collection

Each Plant_item_collection is changed by zero, one, or many Changed_plant_item_collection objects. Each Changed_plant_item_collection changes exactly one Plant_item_collection.

4.3.85 Plant_item_connection to Changed_plant_item_connection

Each Plant_item_connection is changed by zero, one, or many Changed_plant_item_connection objects. Each Changed_plant_item_connection changes exactly one Plant_item_connection.

4.3.86 Plant_item_connection_occurrence to Functional_connection_occurrence_satisfaction

Each Plant_item_connection_occurrence is the functional requirements for zero, one, or many Functional_-connection_occurrence_satisfaction objects. Each Functional_connection_occurrence_satisfaction gets the functional requirements from exactly one Plant_item_connection_occurrence.

Each Plant_item_connection_occurrence satisfies requirements for zero, one, or many Functional_-connection_occurrence_satisfaction objects. Each Functional_connection_occurrence_satisfaction has requirements satisfied by exactly one Plant_item_connection_occurrence.

4.3.87 Plant_item_connection_occurrence to Plant_item_connector_occurrence

Each Plant_item_connection_occurrence connects two or more Plant_item_connector_occurrence objects. Each Plant_item_connector_occurrence may be connected by exactly one Plant_item_connection_-occurrence.

4.3.88 Plant_item_connector to Required_material_description

Each Plant_item_connector has material requirements defined by zero, one, or many Required_material_-description objects. Each Required_material_description defines material requirements for zero, one, or many Plant_item_connector objects.

4.3.89 Plant_item_connector to Shape_representation

Each Plant_item_connector has shape and orientation defined by zero, one, or many Shape_representation objects. Each Shape_representation defines the shape and orientation of zero, one, or many Plant_item_-connector objects.

4.3.90 Plant_item_connector_occurrence to Changed_plant_item_connector

Each Plant_item_connector_occurrence is changed by zero, one, or many Changed_plant_item_connector objects. Each Changed_plant_item_connector changes exactly one Plant_item_connector_occurrence.

4.3.91 Plant_item_definition to Catalogue_definition

Each Plant_item_definition is part of zero, one, or many Catalogue_definition objects. Each Catalogue_-definition contains zero, one, or many Plant_item_definition objects.

4.3.92 Plant_item_definition to Catalogue_item

Each Plant_item_definition is defined as zero, one, or many Catalogue_item objects. Each Catalogue_item object is used as zero, one, or many Plant_item_definition objects.

4.3.93 Plant_item_definition to Connector_definition

Each Plant_item_definition has zero, one, or many Connector_definition objects. Each Connector_-definition is part of exactly one Plant_item_definition.

4.3.94 Plant_item_definition to Planned_physical_plant_item

Each Plant_item_definition defines zero, one, or many Planned_physical_plant_item objects. Each Planned_physical_plant_item may be defined by exactly one Plant_item_definition.

4.3.95 Plant_item_definition to Specification_item_family

Each Plant_item_definition defines zero, one, or many Specification_item_family objects. Each Specification_item_family is defined by exactly one Plant_item_definition objects.

4.3.96 Plant_item_design_view to Changed_plant_item_design_view

Each Plant_item_design_view is changed by zero, one, or many Changed_plant_item_design_view objects. Each Changed_plant_item_design_view changes exactly one Plant_item_design_view.

4.3.97 Plant_item_instance to Plant_item_interference

Each Plant_item_instance is the first item in zero, one, or many Plant_item_interference objects. Each Plant_item_interference has as its first item exactly one Plant_item_instance.

Each Plant_item_instance is the second item in zero, one, or many Plant_item_interference objects. Each Plant_item_interference has as its second item exactly one Plant_item_instance.

4.3.98 Plant_item_instance to Plant_item_location

Each Plant_item_instance is located by zero, one, or many Plant_item_location objects. Each Plant_item_-location locates exactly one Plant_item_instance. A Plant_item_instance shall be located only once in either a plant, site, or building or multiple times with respect to other Plant_item objects. A Plant_item_-instance shall not be located more than once in a plant, site, or building.

4.3.99 Plant_item_instance to Project_design_assignment

Each Plant_item_instance is assigned a project by zero, one, or many Project_design_assignment objects. Each Project_design_assignment assigns a project to exactly one Plant_item_instance.

4.3.100 Plant_item_instance to Relative_item_location

Each Plant_item_instance is the referenced item for zero, one, or many Relative_item_location objects. Each Relative_item_location references exactly one Plant_item_instance.

4.3.101 Plant_item_interference to Interfering_shape_element

Each Plant_item_interference has intersecting geometry of zero, one, or many Interfering_shape_element objects. Each Interfering_shape_element is the intersecting geometry for exactly one Plant_item_-interference.

4.3.102 Plant_item_interference to Plant_item_interference_status

Each Plant_item_interference has a status of one or more Plant_item_interference_status objects. Each Plant_item_interference_status provides the status for exactly one Plant_item_interference.

4.3.103 Plant_item_interference to Shape_interference_zone_usage

Each Plant_item_interference has a zone of interference defined by zero, one, or many Shape_-interference_zone_usage objects. Each Shape_interference_zone_usage defines the zone of interference for exactly one Plant_item_interference objects.

4.3.104 Plant_item_shape to Changed_plant_item_shape

Each Plant_item_shape is changed by zero, one, or many Changed_plant_item_shape objects. Each Changed_plant_item_shape changes exactly one Plant_item_shape.

4.3.105 Plant_item_shape to Shape_representation

Each Plant_item_shape is defined using zero, one, or many Shape_representation objects. Each Shape_-representation defines exactly one Plant_item_shape.

4.3.106 Plant_process_capability to Changed_plant_process_capability

Each Plant_process_capability is changed by zero, one, or many Changed_plant_process_capability objects. Each Changed_plant_process_capability changes exactly one Plant_process_capability.

4.3.107 Plant_system to Changed_plant_system

Each Plant_system is changed by zero, one, or many Changed_plant_system objects. Each Changed_-plant_system changes exactly one Plant_system.

4.3.108 Plant_system to Plant_item

Each Plant_system is composed of zero, one, or many Plant_item objects. Each Plant_item is part of zero, one, or many Plant_system objects.

4.3.109 Plant_system to Plant_system_assembly

Each Plant_system is the sub-system in zero, one, or many Plant_system_assembly objects. Each Plant_-system_assembly has exactly one Plant_system as the sub-system.

Each Plant_system is the super-system in zero, one, or many Plant_system_assembly objects. Each Plant_-system_assembly has exactly one Plant_system as the super-system.

4.3.110 Point_terrain_model to Breakline

Each Point_terrain_model is constrained by zero, one, or many Breakline objects. Each Breakline may constrain exactly one Point_terrain_model.

4.3.111 Point_terrain_model to Survey_point

Each Point_terrain_model is defined by one or more Survey_point objects. Each Survey_point defines zero, one, or many Point_terrain_model objects.

4.3.112 Reference_geometry to Changed_reference_geometry

Each Reference_geometry is changed by zero, one, or many Changed_reference_geometry objects. Each Changed_reference_geometry changes exactly one Reference_geometry.

4.3.113 Reference_geometry to Shape_representation_element

Each Reference_geometry is described by zero, one, or many Shape_representation_element objects. Each Shape_representation_element provides description for zero, one, or many Reference_geometry objects.

4.3.114 Required_material_description to Changed_required_material_description

Each Required_material_description is changed by zero, one, or many Changed_required_material_description objects. Each Changed_required_material_description changes exactly one Required_material_description.

4.3.115 Required_material_description to Material_specification_selection

Each Required_material_description is satisfied by zero, one, or many Material_specification_selection objects. Each Material_specification_selection satisfies zero, one, or many Required_material_description objects.

4.3.116 Route to Piping_system_line_segment

Each Route is composed of zero, one, or many Piping_system_line_segment objects. Each Piping_system_line_segment may be a component of exactly one Route.

4.3.117 Shape_representation to Shape_representation_element_usage

Each Shape_representation is defined by one or more Shape_representation_element_usage objects. Each Shape_representation_element_usage defines exactly one Shape_representation.

4.3.118 Shape_representation_element to Shape_interference_zone_usage

Each Shape_representation_element defines a volume for zero or one Shape_interference_zone_usage objects. Each Shape_interference_zone_usage has a volume defined by exactly one Shape_representation_element.

4.3.119 Shape_representation_element to Shape_representation_element_usage

Each Shape_representation_element provides a definition for zero or one Shape_representation_element_usage. Each Shape_representation_element_usage uses as a definition exactly one Shape_representation_element.

4.3.120 Shape_representation_element_usage to Interfering_shape_element

Each Shape_representation_element_usage is the intersecting geometry of zero, one, or many Interfering_-shape_element objects. Each Interfering_shape_element uses as intersecting geometry exactly one Shape_-representation_element_usage.

4.3.121 Site to Building

Each Site has located on it zero, one, or many Building objects. Each Building is located on exactly one Site.

4.3.122 Site to Location_in_site

Each Site is a reference frame for zero, one, or many Location_in_site objects. Each Location_in_site has a reference frame provided by exactly one Site.

4.3.123 Site to Sited_plant

Each Site has located on it one or more Sited_plant objects. Each Sited_plant is located on exactly one Site.

4.3.124 Site to Site_feature

Each Site contains zero, one, or many Site_feature objects. Each Site_feature object is contained in exactly one Site.

4.3.125 Site to Terrain_model

Each Site has shape defined by zero, one, or many Terrain_model objects. Each Terrain_model defines the shape of exactly one Site.

4.3.126 Sited_plant to Changed_sited_plant

Each Sited_plant is changed by zero, one, or many Changed_sited_plant objects. Each Changed_sited_-plant changes exactly one Sited_plant.

4.3.127 Specification_item_family to Line_piping_system_component_assign-ment

Each Specification_item_family specifies the limits for zero, one, or many Line_piping_system_-component_assignment objects. Each Line_piping_system_component_assignment may have limits specified by exactly one Specification_item_family.

4.3.128 Stream_design_case to Service_operating_case

Each Stream_design_case defines zero, one, or many Service_operating_case objects. Each Service_-operating_case is defined by exactly one Stream_design_case.

4.3.129 Stream_design_case to Stream_phase

Each Stream_design_case is composed of one or more Stream_phase objects. Each Stream_phase is defined by exactly one Stream_design_case.

4.3.130 Sub_plant_relationship to Changed_sub_plant_relationship

Each Sub_plant_relationship is changed by zero, one, or many Changed_sub_plant_relationship objects. Each Changed_sub_plant_relationship changes exactly one Sub_plant_relationship.

4.3.131 Support_constraints to Support_usage

Each Support_constraints constrains the motion in the negative x-direction of zero, one, or many Support_-usage objects. Each Support_usage may have motion in the negative x-direction constrained by exactly one Support_constraints object.

Each Support_constraints constrains the motion in the positive x-direction of zero, one, or many Support_-usage objects. Each Support_usage may have motion in the positive x-direction constrained by exactly one Support_constraints object.

Each Support_constraints constrains the motion in the negative y-direction of zero, one, or many Support_-usage objects. Each Support_usage may have motion in the negative y-direction constrained by exactly one Support_constraints object.

Each Support_constraints constrains the motion in the positive y-direction of zero, one, or many Support_-usage objects. Each Support_usage may have motion in the positive y-direction constrained by exactly one Support_constraints object.

Each Support_constraints constrains the motion in the negative z-direction of zero, one, or many Support_-usage objects. Each Support_usage may have motion in the negative z-direction constrained by exactly one Support_constraints object.

Each Support_constraints constrains the motion in the positive z-direction of zero, one, or many Support_-usage objects. Each Support_usage may have motion in the positive z-direction constrained by exactly one Support_constraints object.

Each Support_constraints constrains the negative rotation about the x-axis of zero, one, or many Support_-usage objects. Each Support_usage may have the negative rotation about the x-axis constrained by exactly one Support_constraints object.

Each Support_constraints constrains the positive rotation about the x-axis of zero, one, or many Support_-usage objects. Each Support_usage may have the positive rotation about the x-axis constrained by exactly one Support_constraints object.

Each Support_constraints constrains the negative rotation about the y-axis of zero, one, or many Support_-usage objects. Each Support_usage may have the negative rotation about the y-axis constrained by exactly one Support_constraints object.

Each Support_constraints constrains the positive rotation about the y-axis of zero, one, or many Support_-usage objects. Each Support_usage may have the positive rotation about the y-axis constrained by exactly one Support_constraints object.

Each Support_constraints constrains the negative rotation about the z-axis of zero, one, or many Support_-usage objects. Each Support_usage may have the negative rotation about the z-axis constrained by exactly one Support_constraints object.

Each Support_constraints constrains the positive rotation about the z-axis of zero, one, or many Support_-usage objects. Each Support_usage may have the positive rotation about the z-axis constrained by exactly one Support_constraints object.

4.3.132 Support_usage_connection to Plant_item_connection_occurrence

Each Support_usage_connection is detailed by zero, one, or many Plant_item_connection_occurrence objects. Each Plant_item_connection_occurrence may give the details for exactly one Support_usage_-connection.

4.3.133 Swept_bend_pipe to Pipe_bend

Each Swept_bend_pipe contains zero, one, or many Pipe_bend objects. Each Pipe_bend is contained in exactly one Swept_bend_pipe.

5 Application interpreted model

5.1 Mapping table

This clause contains the mapping table that shows how each UoF and application object of this part of ISO 10303 (see clause 4) maps to one or more AIM constructs (see annex A).

The mapping table is organized in five columns. The contents of these five columns are:

Column 1) Application element: Name of an application element as it appears in the application object definition in 4.2. Application object names are written in uppercase. Attribute names and assertions are listed after the application object to which they belong and are written in lower case.

Column 2) AIM element: Name of an AIM element as it appears in the AIM (see annex A), the term 'IDENTICAL MAPPING', or the term 'PATH'. AIM entities are written in lower case. Attribute names of AIM entities are referred to as <entity name>.<attribute name>. The mapping of an application element may result in several related AIM elements. Each of these AIM elements requires a line of its own in the table. The term 'IDENTICAL MAPPING' indicates that both application objects of an application assertion map to the same AIM element. The term 'PATH' indicates that the application assertion maps to the entire reference path.

Column 3) Source: For those AIM elements that are interpreted from the integrated resources or the application interpreted constructs (AICs), this is the number of the corresponding part of ISO 10303. For those AIM elements that are created for the purpose of this part of ISO 10303, this is the number of this part.

Column 4) Rules: One or more numbers may be given that refer to rules that apply to the current AIM element or reference path. For rules that are derived from relationships between application objects, the same rule is referred to by the mapping entries of all the involved AIM elements. The expanded names of the rules are listed after the table.

Column 5) Reference path: To describe fully the mapping of an application object, it may be necessary to specify a reference path through several related AIM elements. The reference path column documents the role of an AIM element relative to the AIM element in the row succeeding it. Two or more such related AIM elements define the interpretation of the integrated resources that satisfies the requirement specified by the application object. For each AIM element that has been created for use within this part of ISO 10303, a reference path up to its supertype from an integrated resource is specified.

For the expression of reference paths and the relationships between AIM elements the following notational conventions apply:

a) [] : multiple AIM elements or sections of the reference path are required to satisfy an information requirement;

b) () : multiple AIM elements or sections of the reference path are identified as alternatives within the mapping to satisfy an information requirement;

c) { } : enclosed section constrains the reference path to satisfy an information requirement;

d) -> : attribute references the entity or select type given in the following row;

e) <- : entity or select type is referenced by the attribute in the following row;

f) [i] : attribute is an aggregation of which a single member is given in the following row;

g) [n] : attribute is an aggregation of which member n is given in the following row;

h) => : entity is a supertype of the entity given in the following row;

i) <= : entity is a subtype of the entity given in the following row;

j) = : the string, select, or enumeration type is constrained to a choice or value.

Table 2 - Mapping table for advanced_csg_representation UoF

Application element	AIM element	Source	Rules	Reference path
BLOCK	block	42		
CONE	right_circular_cone	42		
CSG_ELEMENT	(csg_primitive) (boolean_result)	42 42		
CYLINDER	right_circular_cylinder	42		
EXTRUSION	extruded_area_solid	42		{extruded_area_solid <= swept_area_solid swept_area_solid.swept_area ->curve_bounded_surface [curve_bounded_surface.basis_surface ->surface => elementary_surface => plane] [curve_bounded_surface.boundaries[i] ->boundary_curve <= composite_curve_on_surface <= composite_curve composite_curve.segments[i] ->composite_curve_segment composite_curve_segment.parent_curve ->curve => bounded_curve => trimmed_curve trimmed_curve.basis_curve ->curve => (line) (conic)]}
PYRAMID	boolean_result	42		

Table 2 - Mapping table for advanced_csg_representation UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SOLID_OF_REVOLUTION	revolved_area_solid	42		{revolved_area_solid <= swept_area_solid swept_area_solid.swept_area ->> curve_bounded_surface curve_bounded_surface.boundaries[i] ->> boundary_curve <= composite_curve_on_surface <= composite_curve composite_curve.segments[i] ->> composite_curve_segment composite_curve_segment.parent_curve ->> curve => bounded_curve => trimmed_curve trimmed_curve.basis_curve ->> curve => (line) (conic)}
SPHERE	sphere	42		
TORUS	torus	42		
TRIMMED_CONE	boolean_result	42		{boolean_result boolean_result.first_operand ->> boolean_operand boolean_operand = csg_primitive csg_primitive csg_primitive = right_circular_cone}
TRIMMED_PYRAMID	truncated_pyramid	227		truncated_pyramid <= boolean_result
TRIMMED_SPHERE	boolean_result	42		{boolean_result boolean_result.first_operand ->> boolean_operand boolean_operand = csg_primitive csg_primitive csg_primitive = sphere}

Table 2 - Mapping table for advanced_csg_representation UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
TRIMMED_TORUS	boolean_result	42		{boolean_result boolean_result.first_operand -> boolean_operand boolean_operand = csg_primitive csg_primitive csg_primitive = torus}

Table 3 - Mapping table for change_information UoF

Application element	AIM element	Source	Rules	Reference path
CHANGE	change_action	227		change_action <= directed_action <= executed_action <= action
business_unit	organization.name	41		change_action plant_spatial_configuration_organization_item = change_action plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment organization_assignment.assigned_organization ->> organization organization.name
change_id	action.name	41		change_action <= directed_action <= executed_action <= action action.name
change_reason	action_method.purpose	41		change_action <= directed_action <= executed_action <= action action.chosen_method ->> action_method action_method.purpose
change_summary	action_method.description	41		change_action <= directed_action <= executed_action <= action action.chosen_method ->> action_method action_method.description

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
date	date	41	4	change_action plant_spatial_configuration_dated_item = change_action plant_spatial_configuration_dated_item <- plant_spatial_configuration_date_assignment.items[i] plant_spatial_configuration_date_assignment <= date_assignment date_assignment.assigned_date -> date
project_number	organizational_project.name	41		change_action plant_spatial_configuration_organization_item = change_action plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment organization_assignment.assigned_organization -> organization <- organizational_project.responsible_organizations[i] organizational_project organizational_project.name
revision	action_relationship	41		change_action <= directed_action <= executed_action <= action <- (action_relationship.relating_action) (action_relationship.related_action) {action_relationship action_relationship.name = 'change_revision'} action_relationship
status	action_status.status	41		change_action <= directed_action <= executed_action <- action_status.assigned_action action_status action_status.status

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
title	action_method.name	41		change_action <= directed_action <= executed_action <= action action.chosen_method ->> action_method action_method.name
change to change_item	PATH			change_action <= directed_action <= executed_action <= action <- action_assignment.assigned_action action_assignment => plant_spatial_configuration_change_assignment plant_spatial_configuration_change_assignment.items[i] ->> change_item
change to change_life_cycle_stage_usage	PATH		9	change_action <= directed_action directed_action.directive ->> action_directive action_directive.requests[i] ->> versioned_action_request
CHANGE_APPROVAL	plant_spatial_configuration_approval_-assignment	227		plant_spatial_configuration_approval_assignment <= approval_assignment
approval_date	calendar_date	41	1	plant_spatial_configuration_approval_assignment <= approval_assignment approval_assignment.assigned_approval ->> approval <- approval_date_time.dated_approval approval_date_time approval_date_time.date_time ->> date_time_select date_time_select = date date => calendar_date

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
approver	person	41	2	plant_spatial_configuration_approval_assignment <= approval_assignment approval_assignment.assigned_approval -> approval <- approval_person_organization.authorized_approval approval_person_organization approval_person_organization.person_organization -> person_organization_select (person_organization_select = person) (person_organization_select = person_and_organization person_and_organization person_and_organization.the_person ->) person
CHANGE_DELTA	(product_definition_relationship) (product_definition_formation_-relationship) (property_definition_relationship) (shape_aspect_relationship) ([change_from_assignment] [change_to_assignment])	41 41 45 41 227 227		{product_definition_relationship product_definition_relationship.name = 'change_delta'} {product_definition_formation_relationship product_definition_formation_relationship.name = 'change_delta'} {property_definition_relationship property_definition_relationship.name = 'change_delta'} {shape_aspect_relationship shape_aspect_relationship.name = 'change_delta'} ([change_from_assignment <= action_assignment] [change_to_assignment <= action_assignment])

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
CHANGE_ITEM	change_item	227		change_item (change_item = change_delta_item change_delta_item (change_delta_item = assembly_component_usage) (change_delta_item = line_branch_connection) (change_delta_item = line_plant_item_branch_connection) (change_delta_item = line_plant_item_connection) (change_delta_item = line_termination_connection) (change_delta_item = plant) (change_delta_item = product_definition_relationship)) (change_item = reference_geometry) (change_item = electrical_system) (change_item = externally_defined_plant_item_definition) (change_item = hvac_system) (change_item = instrumentation_and_control_system) (change_item = material_property) (change_item = piping_system) (change_item = plant_item_connection) (change_item = plant_item_connector) (change_item = plant_item_definition) (change_item = plant_line_definition) (change_item = plant_line_segment_definition) (change_item = plant_line_segment_termination) (change_item = process_capability) (change_item = product_definition) (change_item = product_definition_shape) (change_item = property_definition) (change_item = structural_system)
change_item_id	change_item_id_assignment	227	6	change_item <- change_item_id_assignment.items[i] change_item_id_assignment <= name_assignment

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
creation_date	date	41	5	change_item plant_spatial_configuration_dated_item = change_item plant_spatial_configuration_dated_item <- plant_spatial_configuration_date_assignment.items[i] plant_spatial_configuration_date_assignment <= date_assignment {date_assignment.role ->> date_role date_role.name = 'creation_date'} date_assignment.assigned_date ->> date
description	action.description	41		change_item <- plant_spatial_configuration_change_assignment.items[i] plant_spatial_configuration_change_assignment <= action_assignment action_assignment.assigned_action ->> action action.description
item_owner	person_and_organization	41		change_item plant_spatial_configuration_person_and_organization_item = change_item plant_spatial_configuration_person_and_organization_item <- plant_spatial_configuration_person_and_organization_assignment.items[i] plant_spatial_configuration_person_and_organization_assignment <= person_and_organization_assignment {person_and_organization_assignment.role ->> person_and_organization_role person_and_organization_role.name = 'owner'} person_and_organization_assignment.assigned_person_and_organization ->> person_and_organization

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
supersedence_status	action_status.status	41		change_item <- plant_spatial_configuration_change_assignment <= action_assignment action_assignment.assigned_action ->> action => executed_action <- action_status.assigned_action action_status action_status.status
title	NO MAPPING			
change_item to change_delta (changed from)	PATH			change_item ((change_item = electrical_system electrical_system <=) (change_item = externally_defined_plant_item_definition externally_defined_plant_item_definition <= plant_item_definition <=) (change_item = hvac_system hvac_system <=) (change_item = instrumentation_and_control_system instrumentation_and_control_system <=) (change_item = piping_system piping_system <=) (change_item = plant_item_definition plant_item_definition <=) (change_item = plant_line_definition plant_line_definition <= product_definition_with_associated_documents <=) (change_item = plant_line_segment_definition plant_line_segment_definition <=) (change_item = product_definition) (change_item = structural_system structural_system <=) product_definition <- product_definition_relationship.relating_product_definition {product_definition_relationship product_definition_relationship.name = 'change_delta'} product_definition_relationship)

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
change_item to change_delta (changed from) (continued)				change_item ((change_item = electrical_system electrical_system <=) (change_item = externally_defined_plant_item_definition externally_defined_plant_item_definition <= plant_item_definition <=) (change_item = hvac_system hvac_system <=) (change_item = instrumentation_and_control_system instrumentation_and_control_system <=) (change_item = piping_system piping_system <=) (change_item = plant_item_definition plant_item_definition <=) (change_item = plant_line_definition plant_line_definition <= product_definition_with_associated_documents <=) (change_item = plant_line_segment_definition plant_line_segment_definition <=) (change_item = product_definition) (change_item = structural_system structural_system <=) product_definition product_definition.formation -> product_definition_formation <- product_definition_formation_relationship.relating_product_definition_formation {product_definition_formation_relationship product_definition_formation_relationship.name = 'change_delta'} product_definition_relationship)

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
change_item to change_delta (changed from) (continued)				change_item ((change_item = material_property material_property <=) (change_item = process_capability process_capability <=) (change_item = product_definition_shape product_definition_shape <=) (change_item = property_definition) property_definition <- property_definition_relationship.relating_property_definition {property_definition_relationship property_definition_relationship.name = 'change_delta'} property_definition_relationship) ((change_item = reference_geometry reference_geometry <= derived_shape_aspect <=) (change_item = plant_item_connection plant_item_connection <=) (change_item = plant_item_connector plant_item_connector <=) (change_item = plant_line_segment_termination plant_line_segment_termination <=) shape_aspect <- shape_aspect_relationship.relating_shape_aspect {shape_aspect_relationship shape_aspect_relationship.name = 'change_delta'} shape_aspect_relationship) (change_item = change_delta_item change_delta_item <- change_from_assignment.items[i] change_from_assignment)

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
change_item to change_delta (changed to)	PATH			change_item ((change_item = electrical_system electrical_system <=) (change_item = externally_defined_plant_item_definition externally_defined_plant_item_definition <= plant_item_definition <=) (change_item = hvac_system hvac_system <=) (change_item = instrumentation_and_control_system instrumentation_and_control_system <=) (change_item = piping_system piping_system <=) (change_item = plant_item_definition plant_item_definition <=) (change_item = plant_line_definition plant_line_definition <= product_definition_with_associated_documents <=) (change_item = plant_line_segment_definition plant_line_segment_definition <=) (change_item = product_definition) (change_item = structural_system structural_system <=) product_definition <- product_definition_relationship.related_product_definition {product_definition_relationship product_definition_relationship.name = 'change_delta'} product_definition_relationship)

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
change_item to change_delta (changed to) (continued)				change_item ((change_item = electrical_system electrical_system <=) (change_item = externally_defined_plant_item_definition externally_defined_plant_item_definition <= plant_item_definition <=) (change_item = hvac_system hvac_system <=) (change_item = instrumentation_and_control_system instrumentation_and_control_system <=) (change_item = piping_system piping_system <=) (change_item = plant_item_definition plant_item_definition <=) (change_item = plant_line_definition plant_line_definition <= product_definition_with_associated_documents <=) (change_item = plant_line_segment_definition plant_line_segment_definition <=) (change_item = product_definition) (change_item = structural_system structural_system <=) product_definition product_definition.formation -> product_definition_formation <- product_definition_formation_relationship.related_product_definition_formation {product_definition_formation_relationship product_definition_formation_relationship.name = 'change_delta'} product_definition_formation_relationship)

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
change_item to change_delta (changed to) (continued)				change_item ((change_item = material_property material_property <=) (change_item = process_capability process_capability <=) (change_item = product_definition_shape product_definition_shape <=) (change_item = property_definition) property_definition <- property_definition_relationship.related_property_definition {property_definition_relationship property_definition_relationship.name = 'change_delta'} property_definition_relationship) ((change_item = reference_geometry reference_geometry <= derived_shape_aspect <=) (change_item = plant_item_connection plant_item_connection <=) (change_item = plant_item_connector plant_item_connector <=) (change_item = plant_line_segment_termination plant_line_segment_termination <=) shape_aspect <- shape_aspect_relationship.related_shape_aspect {shape_aspect_relationship shape_aspect_relationship.name = 'change_delta'} shape_aspect_relationship) (change_item = change_delta_item change_delta_item <- change_to_assignment.items[i] change_to_assignment)
CHANGE_LIFE_-CYCLE_STAGE	action_request_status	41		
change_life_cycle_stage_id	NO MAPPING			
name	action_request_status.status	41		

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
change_life_cycle_stage to change_life_cycle_ stage_sequence (as predecessor)	PATH			action_request_status action_request_status.assigned_request ->versioned_action_request <- action_request_solution.request action_request_solution action_request_solution.method ->action_method <- action_method_relationship.relating_method action_method_relationship {action_method_relationship action_method_relationship.name = 'change_life_cycle_stage_sequence'}
change_life_cycle_stage to change_life_cycle_ stage_sequence (as successor)	PATH			action_request_status action_request_status.assigned_request ->versioned_action_request <- action_request_solution.request action_request_solution action_request_solution.method ->action_method <- action_method_relationship.related_method action_method_relationship {action_method_relationship action_method_relationship.name = 'change_life_cycle_stage_sequence'}
change_life_cycle_stage to change_life_cycle_ stage_usage	PATH		8	action_request_status action_request_status.assigned_request ->versioned_action_request
CHANGE_LIFE_-CYCLE_STAGE_-SEQUENCE	action_method_relationship	41		{action_method_relationship action_method_relationship.name = 'change_life_cycle_stage_sequence'}
CHANGE_LIFE_-CYCLE_STAGE_USAGE	versioned_action_request	41		
current	NO MAPPING			

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
date	date	41		versioned_action_request <- action_directive.requests[i] action_directive plant_spatial_configuration_dated_item = action_directive plant_spatial_configuration_dated_item <- plant_spatial_configuration_date_assignment.items[i] plant_spatial_configuration_date_assignment <= date_assignment date_assignment.assigned_date -> date
description	versioned_action_request.description	41		
change_life_cycle_stage_ usage to change_approval	PATH		7	versioned_action_request <- action_directive.requests[i] action_directive <- directed_action.directive directed_action => change_action approval_item = change_action approval_item <- plant_spatial_configuration_approval_assignment.items[i] plant_spatial_configuration_approval_assignment
CHANGED_LINE_ASSIG NMENT	product_definition_relationship	41		{product_definition_relationship change_delta_item = product_definition_relationship change_delta_item change_item = change_delta_item}
CHANGED_LINE_BRAN CH_CONNECTION	line_branch_connection	227		line_branch_connection <= shape_aspect_relationship {line_branch_connection change_delta_item = line_branch_connection change_delta_item change_item = change_delta_item}

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
CHANGED_LINE_PLANT_ITEM_BRANCH_CONNECTION	line_plant_item_branch_connection	227		line_plant_item_branch_connection <= shape_aspect_relationship {line_plant_item_branch_connection change_delta_item = line_plant_item_branch_connection change_delta_item change_item = change_delta_item}
CHANGED_LINE_PLANT_ITEM_CONNECTION	line_plant_item_connection	227		line_plant_item_connection <= shape_aspect_relationship {line_plant_item_connection change_delta_item = line_plant_item_connection change_delta_item change_item = change_delta_item}
CHANGED_LINE_TO_-LINE_CONNECTION	line_termination_connection	227		line_termination_connection <= shape_aspect_relationship {line_termination_connection change_delta_item = line_termination_connection change_delta_item change_item = change_delta_item}
CHANGED_-MATERIAL_-SPECIFICATION_SELECTION	material_property	45		{material_property change_item = material_property}
CHANGED_PIPING_SYSTEM_LINE	plant_line_definition	227		plant_line_definition <= product_definition_with_associated_documents {plant_line_definition change_item = plant_line_definition}
CHANGED_PIPING_SYSTEM_LINE_SEGMENT	plant_line_segment_definition	227		plant_line_segment_definition <= product_definition {plant_line_segment_definition change_item = plant_line_segment_definition}
CHANGED_PIPING_SYSTEM_LINE_SEGMENT_-TERMINATION	plant_line_segment_termination	227		plant_line_segment_termination <= shape_aspect {plant_line_segment_termination change_item = plant_line_segment_termination}

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
CHANGED_PLANNED_- PHYSICAL_PLANT	product_definition	41		{product_definition [product_definition.formation ->] product_definition_formation product_definition_formation.of_product ->] product => plant] [product_definition.frame_of_reference ->] product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence'] [change_item = product_definition]}
CHANGED_PLANT	plant	227		plant <= product {plant change_delta_item = plant change_delta_item change_item = change_delta_item}
CHANGED_PLANT_ITE M	(plant_item_definition) (externally_defined_plant_item_- definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {(plant_item_definition change_item = plant_item_definition) (externally_defined_plant_item_definition change_item = externally_defined_plant_item_definition)}
CHANGED_PLANT_ITE M_COLLECTION	assembly_component_usage	44		{assembly_component_usage change_delta_item = assembly_component_usage change_delta_item change_item = change_delta_item}
CHANGED_PLANT_ITE M_CONNECTION	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {plant_item_connection change_item = plant_itcm_connection}

Table 3 - Mapping table for change_information UoF (continued)

Application element	AIM element	Source	Rules	Reference path
CHANGED_PLANT_ITEM_CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector change_item = plant_item_connector}
CHANGED_PLANT_ITEM_DESIGN_VIEW	(plant_item_definition) (externally_defined_plant_item_-definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {(plant_item_definition change_item = plant_item_definition) (externally_defined_plant_item_definition change_item = externally_defined_plant_item_definition)}
CHANGED_PLANT_ITEM_SHAPE	product_definition_shape	41		{product_definition_shape change_item = product_definition_shape}
CHANGED_PLANT_PROCESS_CAPABILITY	process_capability	227		process_capability <= property_definition {process_capability change_item = process_capability}
CHANGED_PLANT_SYSTEM	(electrical_system) (hvac_system) (instrumentation_and_control_system) (piping_system) (structural_system)	227 227 227 227 227		(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition {(electrical_system change_item = electrical_system) (hvac_system change_item = hvac_system) (instrumentation_and_control_system change_item = instrumentation_and_control_system) (piping_system change_item = piping_system) (structural_system change_item = structural_system)}

Table 3 - Mapping table for change_information UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
CHANGED_REFERENCE_GEOMETRY	reference_geometry	227		reference_geometry <= derived_shape_aspect {reference_geometry change_item = reference_geometry}
CHANGED_REQUIRED_-MATERIAL_DESCRIPTION	product_definition	41		{product_definition [characterized_product_definition = product_definition characterized_product_definition <- material_designation.of_product material_designation] [change_item = product_definition]}
CHANGED_SITED_PLANT	property_definition.definition	41		{property_definition.definition property_definition change_item = property_definition}
CHANGED_SUB_PLANT_RELATIONSHIP	product_definition_relationship	41		{product_definition_relationship change_delta_item = product_definition_relationship change_delta_item change_item = change_delta_item}

Table 4 - Mapping table for connection UoF

Application element	AIM element	Source	Rules	Reference path
CONNECTION_DEFINITION	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {shape_aspect_relationship shape_aspect_relationship.name = 'connection_definition'} {shape_aspect shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element (application_context_element.name = 'functional_definition') (application_context_element.name = 'physical_definition')}
connection_definition to connector_definition	PATH			plant_item_connection <= shape_aspect_relationship [shape_aspect_relationship.relating_shape_aspect ->] [shape_aspect_relationship.related_shape_aspect ->] shape_aspect => plant_item_connector

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connection_definition to functional_connection_definition_satisfaction (as functional requirements)	PATH			plant_item_connection <= {shape_aspect shape_aspect.of_shape ->product_definition_shape <= property_definition property_definition.definition ->characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element application_context_element.name = 'functional_definition'} shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship {shape_aspect_relationship shape_aspect_relationship.name = 'connection_definition_satisfaction'}

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connection_definition to functional_connection_definition_satisfaction (as requirements satisfaction)	PATH			plant_item_connection <= {shape_aspect shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_definition'} shape_aspect <- shape_aspect_relationship.related_shape_aspect shape_aspect_relationship {shape_aspect_relationship shape_aspect_relationship.name = 'connection_definition_satisfaction'}
connection_definition to plant_item_connection_occurrence	PATH			plant_item_connection <= {plant_item_connection <= shape_aspect_relationship shape_aspect_relationship.name = 'connection_definition'} shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship {shape_aspect_relationship shape_aspect_relationship.name = 'usage'} shape_aspect_relationship.related_shape_aspect -> shape_aspect => plant_item_connection {plant_item_connection <= shape_aspect_relationship shape_aspect_relationship.name = 'connection_occurrence'}

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
ELECTRICITY_TRANSFERENCE	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {plant_item_connection classification_item = plant_item_connection classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => connection_functional_classification] [group group.name = 'electricity_transference']}
FLEXIBLE_CONNECTION	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {plant_item_connection classification_item = plant_item_connection classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => connection_motion_classification] [group group.name = 'flexible']}

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
FLUID_TRANSFERENCE	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {plant_item_connection classification_item = plant_item_connection classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => connection_functional_classification] [group group.name = 'fluid_transference'}}
FUNCTIONAL_CONNECTION_DEFINITION_SATISFACTION	shape_aspect_relationship	41		{shape_aspect_relationship shape_aspect_relationship.name = 'connection_definition_satisfaction'} {shape_aspect_relationship [shape_aspect_relationship.relating_shape_aspect ->] [shape_aspect_relationship.related_shape_aspect ->] shape_aspect => plant_item_connection <= shape_aspect_relationship shape_aspect_relationship.name = 'connection_definition'}
FUNCTIONAL_CONNECTION_OCCURRENCE_-SATISFACTION	shape_aspect_relationship	41		{shape_aspect_relationship shape_aspect_relationship.name = 'connection_occurrence_satisfaction'} {shape_aspect_relationship [shape_aspect_relationship.relating_shape_aspect ->] [shape_aspect_relationship.related_shape_aspect ->] shape_aspect => plant_item_connection <= shape_aspect_relationship shape_aspect_relationship.name = 'connection_occurrence'}

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LOAD_TRANSFERENCE	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {plant_item_connection classification_item = plant_item_connection classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => connection_functional_classification] [group group.name = 'load_transference'}]
LOCKED_ ORIENTATION_ CONNECTION	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {plant_item_connection classification_item = plant_item_connection classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => connection_motion_classification] [group group.name = 'locked_orientation'}]

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_CONNECTION	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {plant_item_connection classification_item = plant_item_connection classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => connection_motion_classification] [group (group.name = 'flexible') (group.name = 'locked_orientation')]} {shape_aspect_relationship (shape_aspect_relationship.name = 'connection_definition') (shape_aspect_relationship.name = 'connection_occurrence')} {shape_aspect shape_aspect.of_shape ->product_definition_shape <= property_definition property_definition.definition ->characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element (application_context_element.name = 'functional_definition') (application_context_element.name = 'physical_definition') (application_context_element.name = 'functional_occurrence') (application_context_element.name = 'physical_occurrence')}

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connection_id	shape_aspect.name	41		plant_item_connection <= shape_aspect_relationship shape_aspect_relationship.name
connection_material #1: The connection_-material has known properties, and the properties are required by the connection #2: The properties of the material are not known. It is an identification of what material product is used.	plant_item_definition	227		#1: (plant_item_connection <= shape_aspect_relationship shape_definition = shape_aspect_relationship shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition {property_definition => material_property} {property_definition property_definition.name = 'connection_material_property'} property_definition <- property_definition_relationship.relating_property_definition property_definition_relationship property_definition_relationship.related_property_definition -> property_definition => material_property characterized_material_property = material_property characterized_material_property <- material_designation_relationship.property material_designation_relationship material_designation_relationship.designation -> material_designation material_designation.of_product -> characterized_product_definition characterized_product_definition = product_definition product_definition => plant_item_definition)

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connection_material (continued)				#2: (plant_item_connection <= shape_aspect shape_aspect.of_shape product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship {product_definition_relationship product_definition_relationship.name = 'connection_material'} product_definition_relationship.related_product_definition -> product_definition => plant_item_definition)
description	shape_aspect_relationship.description	41		plant_item_connection <= shape_aspect_relationship shape_aspect_relationship.description
plant_item_connection to changed_plant_item_ connection	IDENTICAL MAPPING			

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_CONNECTION_OCCURRENCE	plant_item_connection	227		plant_item_connection <= [shape_aspect_relationship] [shape_aspect] {shape_aspect_relationship.name = 'connection_occurrence'} {shape_aspect shape_aspect.of_shape ->product_definition_shape <= property_definition property_definition.definition ->characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element (application_context_element.name = 'functional_occurrence') (application_context_element.name = 'physical_occurrence')}

Table 4 - Mapping table for connection UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item_connection_ occurrence to functional_ connection_satisfaction (as functional requirements)	PATH			plant_item_connection <= {shape_aspect shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element (application_context_element.name = 'functional_occurrence')} shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship {shape_aspect_relationship shape_aspect_relationship.name = 'connection_occurrence_satisfaction'}

Table 4 - Mapping table for connection UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
plant_item_connection_ occurrence to functional_ connection_satisfaction (as requirements satisfaction)	PATH			plant_item_connection <= {shape_aspect shape_aspect.of_shape ->product_definition_shape <= property_definition property_definition.definition ->characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element (application_context_element.name = 'physical_occurrence')} shape_aspect <-shape_aspect_relationship.related_shape_aspect shape_aspect_relationship {shape_aspect_relationship shape_aspect_relationship.name = 'connection_occurrence_satisfaction'}
plant_item_connection_ occurrence to plant_item_ connector_occurrence	PATH			plant_item_connection <= shape_aspect_relationship [shape_aspect_relationship.relating_shape_aspect ->] [shape_aspect_relationship.related_shape_aspect ->] shape_aspect => plant_item_connector

Table 5 - Mapping table for connector UoF

Application element	AIM element	Source	Rules	Reference path
BUTTWELD	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => piping_connector_classification] [group group.name = 'buttweld']}
end_preparation	shape_aspect.description	41		plant_item_connector <= shape_aspect shape_aspect.description
CONNECTOR_DEFINITION	plant_item_connector	227		plant_item_connector <= shape_aspect {shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element (application_context_element.name = 'functional_definition') (application_context_element.name = 'physical_definition')}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connector_definition to functional_connector_definition_satisfaction (as functional requirements for)	PATH			plant_item_connector <= shape_aspect {shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_definition'} shape_aspect <- shape_aspect_relationship.relating_shape_aspect {shape_aspect_relationship shape_aspect_relationship.name = 'connector_definition_satisfaction'}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connector_definition to functional_connector_ definition_satisfaction (as satisfies requirements for)	PATH			plant_item_connector <= {shape_aspect shape_aspect.of_shape ->>br>product_definition_shape <= property_definition property_definition.definition ->>br>characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference ->>br>product_definition_context <= application_context_element application_context_element.name = 'physical_definition'} shape_aspect <- shape_aspect_relationship.relating_shape_aspect {shape_aspect_relationship shape_aspect_relationship.name = 'connector_definition_satisfaction'}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connector_definition to plant_item_connector_ occurrence	PATH			plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship {shape_aspect_relationship shape_aspect_relationship.name = 'usage'} shape_aspect_relationship.related_shape_aspect ->{shape_aspect shape_aspect.of_shape ->product_definition_shape <= property_definition property_definition.definition ->characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element (application_context_element.name) (application_context_element.name = 'functional_occurrence') (application_context_element.name = 'physical_occurrence')} shape_aspect => plant_item_connector
ELECTRICAL_CONNEC TOR	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->group => electrical_connector_classification}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
type	group.name	41		plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> group {group => electrical_connector_classification} group.name
FEMALE_END	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> [group => connector_end_type_classification] [group group.name = 'female_end']}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
depth	measure_representation_item	45		plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'depth'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
hub_inside_diameter	measure_representation_item	45		plant_item_connector <= shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'hub_inside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
hub_length	measure_representation_item	45		plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'hub_length'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
hub_outside_diameter	measure_representation_item	45		plant_item_connector <= shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation ->> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] ->> {representation_item representation_item.name = 'hub_outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}
FLANGED	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => piping_connector_classification] [group group.name = 'flanged']}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
FLANGED_END	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => connector_end_type_classification] [group group.name = 'flanged_end']}
face_finish	descriptive_representation_item	45		plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'face_finish'} representation_item => descriptive_representation_item

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
flange_inside_diameter	measure_representation_item	45		plant_item_connector <= shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation ->> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] ->> {representation_item representation_item.name = 'flange_inside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
flange_outside_diameter	measure_representation_item	45		plant_item_connector <= shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation ->> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] ->> {representation_item representation_item.name = 'flange_outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
flange_thickness	measure_representation_item	45		plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'flange_thickness'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
raised_face_diameter	measure_representation_item	45		plant_item_connector <= shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation ->> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] ->> {representation_item representation_item.name = 'raised_face_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
raised_face_height	measure_representation_item	45		plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'raised_face_height'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
FUNCTIONAL_CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {shape_aspect shape_aspect.of_shape ->product_definition_shape <= property_definition property_definition.definition ->characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element application_context_element.name = 'functional_occurrence'}
functional_connector to functional_connector_occurrence_satisfaction	PATH			plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect {shape_aspect_relationship shape_aspect_relationship.name = 'connector_occurrence_satisfaction'}
FUNCTIONAL_CONNECTOR_DEFINITION_SATISFACTION	shape_aspect_relationship	41		{shape_aspect_relationship shape_aspect_relationship.name = 'connector_definition_satisfaction'}
FUNCTIONAL_CONNECTOR_OCCURRENCE_-SATISFACTION	shape_aspect_relationship	41		{shape_aspect_relationship shape_aspect_relationship.name = 'connector_occurrence_satisfaction'}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
MALE_END	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => connector_end_type_classification] [group group.name = 'male_end']}
PHYSICAL_CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {shape_aspect shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence'}
physical_connector to functional_connector_ occurrence_satisfaction	PATH			plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect {shape_aspect_relationship shape_aspect_relationship.name = 'connector_occurrence_satisfaction'}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPING_CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => (piping_connector_classification) (connector_end_type_classification) ([piping_connector_classification] [connector_end_type_classification])}
connector_flow_direction	descriptive_representation_item	45		plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> representation_item => {representation_item representation_item.name = 'flow_direction'} descriptive_representation_item

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connector_specifications	document_usage_constraint. subject_element_value	41		plant_item_connector plant_spatial_configuration_document_item = plant_item_connector plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->{document document.kind ->{document_type document_type.product_data_type = 'connector_specification'} document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value
name	shape_aspect.name	41		plant_item_connector <= shape_aspect shape_aspect.name
piping_connector to piping_connector_ service_characteristic	PATH			plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition {property_definition.name = 'service_characteristic'}
piping_connector to piping_size_description	PATH			plant_item_connector <= shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation ->shape_dimension_representation

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPING_CONNECTOR_- SERVICE_- CHARACTERISTIC	property_definition	41		{property_definition property_definition.name = 'service_characteristic'}
design_pressure	representation	43		property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->>br>representation {representation representation.name = 'design_service_characteristic'} {representation representation.items[i] ->> [representation_item representation_item.name = 'pressure'] [representation_item => measure_representation_item]}
design_temperature	representation	43		property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->>br>representation {representation representation.name = 'design_service_characteristic'} {representation representation.items[i] ->> [representation_item representation_item.name = 'temperature'] [representation_item => measure_representation_item <= measure_with_unit => thermodynamic_temperature_measure_with_unit]}
piping_connector_ service_characteristic to service_operating_ case	PATH			property_definition <- property_definition_relationship.related_property_definition property_definition_relationship

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {shape_aspect.product_definitional = TRUE}
plant_item_connector_id	shape_aspect.name	41		plant_item_connector <= shape_aspect shape_aspect.name
plant_item_connector to required_material_ description	PATH			plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition => material_property characterized_material_property = material_property characterized_material_property <- material_designation_relationship.property material_designation_relationship material_designation_relationship.designation -> material_designation material_designation.of_product -> characterized_product_definition characterized_product_definition = product_definition product_definition => plant_item_definition

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item_connector to shape_representation	PATH			plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation => shape_representation => (advanced_csg_shape_representation) (piping_design_csg_shape_representation) (hybrid_shape_representation)
PLANT_ITEM_CONNECTOR_OCCURRENCE	plant_item_connector	227		plant_item_connector <= shape_aspect {shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element (application_context_element.name) (application_context_element.name = 'functional_occurrence') (application_context_element.name = 'physical_occurrence')}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connect_point	cartesian_point	42		plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'connect_point'} representation_item => geometric_representation_item => point => cartesian_point

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
location_and_orientation	(axis2_placement_2d) (axis2_placement_3d)	42 42		plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'location_and_orientation'} representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)
plant_item_connector_ occurrence to changed_ plant_item_connector	IDENTICAL MAPPING			
SERVICE_OPERATING_- CASE	property_definition_relationship	45		{property_definition_relationship [property_definition_relationship.relating_property_definition -> property_definition => stream_design_case] [property_definition_relationship.related_property_definition -> property_definition property_definition.name = 'service_characteristic']}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
duration	representation	43		property_definition_relationship property_definition_relationship.relating_property_definition -> property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'service_operating_characteristic'} {representation.items[i] -> [representation_item representation_item.name = 'duration'] [representation_item => measure_representation_item <= measure_with_unit => time_measure_with_unit]}
frequency	representation	43		property_definition_relationship property_definition_relationship.relating_property_definition -> property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'service_operating_characteristic'} {representation.items[i] -> [representation_item representation_item.name = 'frequency'] [representation_item => measure_representation_item]}
name	property_definition_relationship. description	45		
operating_case_id	property_definition_relationship.name	45		

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
operating_pressure	representation	43		property_definition_relationship property_definition_relationship.relating_property_definition -> property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'service_operating_characteristic'} {representation.items[i] -> [representation_item representation_item.name = 'pressure'] [representation_item => measure_representation_item]}
operating_temperature	representation	43		property_definition_relationship property_definition_relationship.relating_property_definition -> property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'service_operating_characteristic'} {representation.items[i] -> [representation_item representation_item.name = 'temperature'] [representation_item => measure_representation_item <= measure_with_unit => thermodynamic_temperature_measure_with_unit]}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SOCKET	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => piping_connector_classification] [group group.name = 'socket']}
root_gap	measure_representation_item	45		plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'root_gap'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 5 - Mapping table for connector UoF (continued)

Application element	AIM element	Source	Rules	Reference path
STRUCTURAL_LOAD_-CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> group => structural_load_connector_classification}
type	group.name	41		plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> group {group => structural_load_connector_classification} group.name
THREADED	plant_item_connector	227		plant_item_connector <= shape_aspect {plant_item_connector classification_item = plant_item_connector classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> [group => piping_connector_classification] [group group.name = 'threaded']}

Table 5 - Mapping table for connector UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
thread_engagement_depth	measure_representation_item	45		plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'piping_connector_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'thread_engagement_depth'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 6 - Mapping table for equipment_characterization UoF

Application element	AIM element	Source	Rules	Reference path
COMPRESSOR	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'compressor'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'equipment']}
compressor_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'compressor'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
ENGINE	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'engine'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'equipment']}

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
engine_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'engine'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
EQUIPMENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= (product_category) (product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category) product_category.name = 'equipment'}
delivery_date	(date_assignment.role) (date_and_time_assignment.role)	41 41		product (plant_spatial_configuration_dated_item = product plant_spatial_configuration_dated_item <- plant_spatial_configuration_date_assignment.items[i] plant_spatial_configuration_date_assignment <= date_assignment date_assignment.role) (plant_spatial_configuration_date_and_time_item = product plant_spatial_configuration_date_and_time_item <- plant_spatial_configuration_date_and_time_assignment.items[i] plant_spatial_configuration_date_and_time_assignment <= date_and_time_assignment date_and_time_assignment.role)

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
heat_tracing_type	(heat_tracing_representation) ([heat_tracing_representation] [document_usage_constraint.subject_- element_value])	227 227 41		product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation => (heat_tracing_representation) ([heat_tracing_representation] [heat_tracing_representation plant_spatial_configuration_document_item = heat_tracing_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value])

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
insulation_specification	document_usage_constraint. subject_element_value	41		product plant_spatial_configuration_document_item = product plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->> document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
performance_ characteristics	(document_usage_constraint. subject_element_value) (property_definition_representation)	41 41		(product plant_spatial_configuration_document_item = product plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->) (document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value) (product <- product_definition_formation.of_product {product_definition_formation => product_definition_formation_with_specified_- source product_definition_formation_with_specified_source.make_or_buy = 'BUY'} product_definition_formation <- product_definition.formation product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition {property_definition property_definition.name = 'performance_characteristics'} property_definition <- property_definition_representation.definition property_definition_representation)

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
purchase_order_number	action.name	41		product purchase_item = product purchase_item <- purchase_assignment.items[i] purchase_assignment <= action_assignment action_assignment.assigned_action ->{action => executed_action => directed_action} action.name
requisition_number	(versioned_action_request.id) (action_directive.requests)	41 41		product (plant_spatial_configuration_action_request_item = product plant_spatial_configuration_action_request_item <- plant_spatial_configuration_action_request_assignment.items[i] plant_spatial_configuration_action_request_assignment <= action_request_assignment action_request_assignment.assigned_action_request ->versioned_action_request versioned_action_request.id) (purchase_item = product purchase_item <- purchase_assignment.items[i] purchase_assignment <= action_assignment action_assignment.assigned_action ->action => executed_action => directed_action directed_action.directive ->action_directive action_directive.requests)

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
vendor_name	organization.name	41		product plant_spatial_configuration_organization_item = product plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment {organization_assignment.role -> organization_role organization_role.name = 'vendor'} organization_assignment.assigned_organization -> organization organization.name
equipment to equipment_trim_piping	PATH			product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition <- product_definition_relationship.relating_product_definition {product_definition_relationship product_definition_relationship.name = 'trim_piping'} product_definition_relationship

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
EQUIPMENT_TRIM_ PIPING	product_definition_relationship	41		{product_definition_relationship [product_definition_relationship.relating_product_definition -> product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product <- product_related_product_category.products[i] product_related_product_category <= (product_category) (product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category -> product_category) product_category.name = 'equipment'] [product_definition_relationship.related_product_definition -> product_definition => piping_component_definition] [product_definition_relationship.name = 'trim_piping']}
FURNACE	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'furnace'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category -> product_category product_category.name = 'equipment']}

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
furnace_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'furnace'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
GEAR_BOX	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'gear_box'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'equipment']}
gear_box_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'gear_box'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
HEAT_EXCHANGER	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'heat_exchanger'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'equipment']}
heat_exchanger_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'heat_exchanger'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
PRESSURE_VESSEL	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'pressure_vessel'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'equipment']}

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
pressure_vessel_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'pressure_vessel'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
PUMP	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'pump'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'equipment']}
pump_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'pump'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SILO	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'silo'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->] product_category product_category.name = 'equipment']}
silo_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'silo'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->] product_category product_category.name
TANK	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'tank'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->] product_category product_category.name = 'equipment']}

Table 6 - Mapping table for equipment_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
tank_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'tank'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
TURBINE	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'turbine'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'equipment']}
energy_source_fluid	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'turbine'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name

Table 6 - Mapping table for equipment_characterization UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
turbine_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'turbine'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category -> product_category product_category.name

Table 7 - Mapping table for piping_component_characterization UoF

Application element	AIM element	Source	Rules	Reference path
BLANK	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> group => blank_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspcct.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'blank_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
thickness	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'blank_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'thickness'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
BLIND_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_classification] [group group.name = 'blind_flange']}
BUSHING	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => bushing_fitting_classification}
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_to_end_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'bushing_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'end_to_end_length'} representation_item => measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
COUPLING	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> group => coupling_fitting_classification}
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_to_end_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'coupling_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'end_to_end_length'} representation_item => measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
CROSS	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => cross_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_1_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'cross_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_1_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_2_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'cross_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_2_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_3_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_3'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'cross_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_3_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_4_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_4'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'cross_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_4_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_3_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_3'} shape_aspect => plant_item_connector
end_4_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_4'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
ECCENTRIC_REDUCER	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => reducer_fitting_classification] [group group.name = 'eccentric_reducer']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centreline_offset	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'reducer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'centreline_offset'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
flat_side_orientation	shape_aspect.description	41		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect {shape_aspect.name = 'flat_side'} shape_aspect.description
ECCENTRIC_SWAGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => swage_fitting_classification] [group group.name = 'eccentric_swage']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centreline_offset	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'swage_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'centreline_offset'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
flat_side_orientation	shape_aspect.description	41		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect {shape_aspect.name = 'flat_side'} shape_aspect.description
ELBOW	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => elbow_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_1_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'elbow_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_1_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_2_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'clbow_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_2_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centreline_radius	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'elbow_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'centreline_radius'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
sweep_angle	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => {dimensional_location => angular_location} dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'elbow_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'sweep_angle'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => plane_angle_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
type	group.name	41		piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->group {group => elbow_fitting_classification} group.name
EXPANDER_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => flange_fitting_classification] [group group.name = 'expander_flange']}
FITTING	piping_component_definition	227		piping_component_definition <= product_definition

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => flange_fitting_classification}
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
hub_through_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'flange_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'hub_through_length'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
hub_weld_point_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'flange_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'hub_weld_point_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
INLINE_EQUIPMENT	inline_equipment	227		inline_equipment <= piping_component_definition <= product_definition {product_definition product_definition.formation.of_product -> product <- product_related_product_category.products[i] product_related_product_category <= product_category product_category.name product_category.name = 'equipment'}
INLINE_INSTRUMENT	piping_component_definition	227		piping_component_definition <= product_definition {product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product <- product_related_product_category.products[i] product_related_product_category <= product_category product_category.name product_category.name = 'instrument'}
INSERT	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => insert_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_to_end_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'insert_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'end_to_end_length'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit =>

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
INSIDE_AND_THICKNESS	shape_dimension_representation	47		{shape_dimension_representation <= shape_representation <= representation representation.name = 'pipe_or_connector_size'} {shape_dimension_representation plant_spatial_configuration_document_item = shape_dimension_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document document.kind -> document_type document_type.product_data_type = 'dimensional_standard'}
inside_diameter	measure_representation_item	45		shape_dimension_representation <= shape_representation <= representation representation.items[i] -> {representation_item representation_item.name = 'inside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}
thickness	measure_representation_item	45		shape_dimension_representation <= shape_representation <= representation representation.items[i] -> {representation_item representation_item.name = 'thickness'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LAP_JOINT_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_neck_type_classification] [group group.name = 'lap_joint_flange']}
LAP_JOINT_STUB_END	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => lap_joint_stub_end_fitting_classification}
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'lap_joint_stub_end_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'length'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
stub_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'lap_joint_stub_end_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'stub_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
stub_thickness	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'lap_joint_stub_end_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'stub_thickness'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LATERAL	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => lateral_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
branch_angle	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => {dimensional_location => angular_location} dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'lateral_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'branch_angle'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => plane_angle_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_1_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'lateral_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_1_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_2_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'lateral_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_2_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_3_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_3'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'lateral_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_3_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_3_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_3'} shape_aspect => plant_item_connector
MITRE_BEND_PIPE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => pipe_classification] [group group.name = 'mitre_bend_pipe']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
bend_angle	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => {dimensional_location => angular_location} dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'pipe_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'bend_angle'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => plane_angle_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
OLET	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => olet_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
base_outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {reprcsentation.name = 'olet_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'base_outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
branch_angle	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => {dimensional_location => angular_location} dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'olet_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'branch_angle'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => plane_angle_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'olet_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'length'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
skirt_outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'olet_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'skirt_outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
ORIFICE_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_classification] [group group.name = 'orifice_flange']}
beta_ratio	measure_representation_item	41		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'beta_ratio'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => ratio_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
jacking_screw_ orientation	shape_aspect.description	41		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect {shape_aspect.name = 'jacking_screw'} shape_aspect.description

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
tap_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'flange_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'tap_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
tap_orientation	shape_aspect.description	41		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect {shape_aspect.name = 'tap'} shape_aspect.description
ORIFICE_PLATE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => orifice_plate_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
beta_ratio	measure_representation_item	41		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->representation representation.items[i] ->{representation_item representation_item.name = 'beta_ratio'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => ratio_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
bore_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'orifice_plate_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'bore_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation ->> shape_dimension_representation <= shape_representation <= representation {representation.name = 'orifice_plate_fitting_dimensional_shape'} representation.items[i] ->> {representation_item representation_item.name = 'outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
thickness	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'orifice_plate_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'thickness'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
OUTSIDE_AND_THICKNESS	shape_dimension_representation			{shape_dimension_representation <= shape_representation <= [representation representation.name = 'pipe_or_connector_size'] [representation <- property_definition_representation.used_representation property_definition_representation {=> shape_definition_representation} property_definition_representation.definition ->> (property_definition {=> product_definition_shape} property_definition.definition ->> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => piping_component_definition) (property_definition property_definition.definition ->> characterized_definition characterized_definition = shape_definition shape_definition shape_definition = shape_aspect shape_aspect => plant_item_connector)]}
outside_diameter	measure_representation_item	45		shape_dimension_representation <= shape_representation <= representation representation.items[i] ->> {representation_item representation_item.name = 'outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
thickness	measure_representation_item	45		shape_dimension_representation <= shape_representation <= representation representation.items[i] ->> {representation_item representation_item.name = 'thickness'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}
PADDLE_BLANK	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => blank_fitting_classification] [group group.name = 'paddle_blank']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
paddle_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'blank_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'paddle_length'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
paddle_width	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'blank_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'paddle_width'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PADDLE_SPACER	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => spacer_fitting_classification] [group group.name = 'paddle_spacer']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
inside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'spacer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'inside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
paddle_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'spacer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'paddle_length'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
paddle_width	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'spacer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'paddle_width'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => pipe_classification}
PIPE_BEND	shape_aspect	41		{shape_aspect [shape_aspect.name = 'pipe_bend'] [shape_aspect.product_definitional = TRUE] [shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => piping_component_definition]}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centreline_radius	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'pipe_bend_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'centreline_radius'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
sweep_angle	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => {dimensional_location => angular_location} dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'pipe_bend_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'sweep_angle'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => plane_angle_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPE_CAP	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => pipe_cap_fitting_classification}
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
height	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'pipe_cap_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'height'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'pipe_cap_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
shape_type	group.name	41		piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => pipe_cap_fitting_classification] [group (group.name = 'square_cap') (group.name = 'round_cap')]
PIPING_COMPONENT	piping_component_definition	227		piping_component_definition <= product_definition
PIPING_SIZE_DESCRIPTION	shape_dimension_representation	41		{shape_dimension_representation <= shape_representation representation (representation.name = 'nominal_size') (representation.name = 'pipe_or_connector_size')} {shape_dimension_representation plant_spatial_configuration_document_item = shape_dimension_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document document.kind -> document_type document_type.product_data_type = 'dimensional_standard'}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
dimensional_standard	document	41		shape_dimension_representation plant_spatial_configuration_document_item = shape_dimension_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->>br>document {document.kind ->>br>document_type document_type.product_data_type = 'dimensional_standard'}
ovality_allowance	measure_representation_item	41		shape_dimension_representation <= shape_representation <= representation representation.items[i] ->>br>{representation_item (representation_item.name = 'ovality_upper_limit') (representation_item.name = 'ovality_lower_limit')} representation_item =>>br>measure_representation_item {measure_representation_item <= measure_with_unit <= length_measure_with_unit}
piping_size_description_id	document.id	41		shape_dimension_representation plant_spatial_configuration_document_item = shape_dimension_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->>br>document document.id
PRESSURE_CLASS	document_usage_constraint	41		{document_usage_constraint document_usage_constraint.subject_element = 'pressure_class'}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
nominal_size	shape_dimension_representation	47		document_usage_constraint document_usage_constraint.source ->> doeument <- document_reference.assigned_document document_reference => plant_spatial_configuration_document_reference plant_spatial_configuration_document_reference.items[i] ->> plant_spatial_configuration_document_item (plant_spatial_configuration_document_item = plant_item_connector plant_item_connector <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition) (plant_spatial_configuration_document_item = piping_component_definition piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition) characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> {representation representation.name = 'nominal_size'} representation => shape_representation => shape_dimension_representation
pressure_rating	document_usage_constraint. subject_element_value	41		

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
REDUCER	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => reducer_fitting_classification}
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_to_end_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'reducer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'end_to_end_length'} representation_item => measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
REDUCING_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_classification] [group group.name = 'reducing_flange']}
RING_SPACER	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => spacer_fitting_classification] [group group.name = 'ring_spacer']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
inside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'spacer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'inside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SCHEDULE	shape_dimension_representation	47		{shape_dimension_representation plant_spatial_configuration_document_item = shape_dimension_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element = 'pipe_schedule') document_usage_constraint.subject_element = 'connector_schedule')}
nominal_size	measure_representation_item	45		shape_dimension_representation <= shape_representation <= representation {representation.name = 'nominal_size'} representation.items[i] ->> representation_item => measure_representation_item
pipe_schedule	document_usage_constraint. subject_element_value	41		shape_dimension_representation plant_spatial_configuration_document_item = shape_dimension_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SLIP_ON_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_neck_type_classification] [group group.name = 'slip_on_flange']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
stand_off	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect shape_aspect.name = 'flange_face'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect shape_aspect.name = 'pipe_end'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'slip_on_flange_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'stand_off'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SOCKET_WELD_ FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_neck_type_classification] [group group.name = 'socket_weld_flange']}
SPACER	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => spacer_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'spacer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
thickness	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'spacer_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'thickness'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}
SPECIALTY_ITEM	piping_component_definition	227		piping_component_definition <= product_definition

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
type	group.name	41		piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group {group => specialty_item_classification} group.name
SPECTACLE_BLIND	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => blank_fitting_classification] [group group.name = 'spectacle_blind']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
arm_width	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'blank_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'arm_width'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_centre	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'blank_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_centre'} measure_representation_item {<= measure_with_unit =>

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
inside_ring_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'blank_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'inside_ring_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
STRAIGHT_PIPE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->[group => pipe_classification] [group group.name = 'straight_pipe']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_to_end_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'pipe_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'end_to_end_length'} representation_item => measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SWAGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group ->> group => swage_fitting_classification}
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_to_end_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'swage_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'end_to_end_length'} representation_item => measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SWEPT_BEND_PIPE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => pipe_classification] [group group.name = 'swept_bend_pipe']}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
wall_thinning_allowance	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'swept_bend_pipe_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'wall_thinning_allowance'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
swept_bend_pipe to pipe_bend	PATH			piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect {shape_aspect shape_aspect.name = 'pipe_bend'}
TEE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => tee_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_1_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'tee_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_1_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_2_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'tee_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_2_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_3_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_3'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'tee_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_3_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_3_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_3'} shape_aspect => plant_item_connector
THREADED_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_neck_type_classification] [group group.name = 'threaded_flange']}
UNION	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => union_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_to_end_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'union_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'end_to_end_length'} representation_item => measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
major_outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'union_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'major_outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
minor_outside_diameter	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- dimensional_size.applies_to dimensional_size dimensional_characteristic = dimensional_size dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation ->> shape_dimension_representation <= shape_representation <= representation {representation.name = 'union_fitting_dimensional_shape'} representation.items[i] ->> {representation_item representation_item.name = 'minor_outside_diameter'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
VALVE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => valve_classification}
actuator_type	descriptive_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'actuator_type'} representation_item => descriptive_representation_item

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
operation_mode	descriptive_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'operation_mode'} representation_item => descriptive_representation_item
type	group.name	41		piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group {group => pipe_classification} group.name

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
WELD_NECK_FLANGE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> [group => flange_fitting_neck_type_classification] [group group.name = 'weld_neck_flange']}
WYE	piping_component_definition	227		piping_component_definition <= product_definition {piping_component_definition classification_item = piping_component_definition classification_item <- classification_assignment.items[i] classification_assignment <= group_assignment group_assignment.assigned_group -> group => wye_fitting_classification}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
angle	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => {dimensional_location => angular_location} dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'wye_fitting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'angle'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => plane_angle_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_1_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_1'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'wye_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_1_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_2_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_2'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'wye_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_2_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
centre_to_end_3_length	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- {shape_aspect => derived_shape_aspect => centre_of_symmetry} {shape_aspect.name = 'centre'} shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- {shape_aspect => plant_item_connector} {shape_aspect.name = 'end_3'} shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'wye_fitting_dimensional_shape'} representation.items[i] -> representation_item => {representation_item.name = 'centre_to_end_3_length'} measure_representation_item {<= measure_with_unit => length_measure_with_unit}

Table 7 - Mapping table for piping_component_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
end_1_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_1'} shape_aspect => plant_item_connector
end_2_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_2'} shape_aspect => plant_item_connector

Table 7 - Mapping table for piping_component_characterization UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
end_3_connector	plant_item_connector	227		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape {shape_aspect.name = 'end_3'} shape_aspect => plant_item_connector

Table 8 - Mapping table for piping_design_csg_representation UoF

Application element	AIM element	Source	Rules	Reference path
CIRCULAR_ELLIPSOID	boolean_result	42		
CSG_ELEMENT	(csg_primitive) (boolean_result)	42 42		
ECCENTRIC_CONE	boolean_result	42		
ECCENTRIC_CYLINDER	boolean_result	42		
ECCENTRIC_PYRAMID	boolean_result	42		
HEMISPHERE	boolean_result	42		{boolean_result boolean_result.first_operand -> boolean_operand boolean_operand = csg_primitive csg_primitive csg_primitive = sphere}
REDUCING_TORUS	boolean_result	42		
SQUARE_TO_ROUND	boolean_result	42		
TRIMMED_BLOCK	boolean_result	42		{boolean_result boolean_result.first_operand -> boolean_operand boolean_operand = csg_primitive csg_primitive csg_primitive = block}
TRIMMED_CYLINDER	boolean_result	42		{boolean_result boolean_result.first_operand -> boolean_operand boolean_operand = csg_primitive csg_primitive csg_primitive = right_circular_cylinder}

Table 8 - Mapping table for piping_design_csg_representation UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
TUBE	boolean_result	42		{boolean_result [[boolean_result.first_operand ->] [boolean_result.second_operand ->] boolean_operator boolean_operator = csg_primitive csg_primitive csg_primitive = right_circular_cylinder right_circular_cylinder] [boolean_result.operator = DIFFERENCE]}

Table 9 - Mapping table for piping_system_functional_characterization UoF

Application element	AIM element	Source	Rules	Reference path
LINE_BRANCH_ CONNECTION	line_branch_connection	227		line_branch_connection <= shape_aspect_relationship {[shape_aspect_relationship.description = 'branch_location'] [shape_aspect_relationship.relating_shape_aspect -> shape_aspect shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => plant_line_segment_definition] [shape_aspect_relationship.related_shape_aspect -> shape_aspect => plant_line_segment_termination]}
branch_sequence_id	shape_aspect_relationship.name	41		line_branch_connection <= shape_aspect_relationship shape_aspect_relationship.name
line_branch_connection to changed_line_branch_ connection	IDENTICAL MAPPING			
LINE_BRANCH_TERMIN ATION	plant_line_segment_termination	227		plant_line_segment_termination <= shape_aspect
line_branch_termination to line_branch_ connection	PATH			plant_line_segment_termination <= shape_aspect <- shape_aspect_relationship.related_shape_aspect shape_aspect_relationship

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LINE_PIPING_SYSTEM_-COMPONENT_ASSIGNMENT	product_definition_relationship	41		{product_definition_relationship [product_definition_relationship.name = 'realization'] [product_definition_relationship.relating_product_definition -> product_definition {=> plant_line_segment_definition} product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_definition'] [product_definition_relationship.related_product_definition -> product_definition {=> piping_component_definition} product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence']}
line_piping_system_component_assignment to changed_line_assignment	IDENTICAL MAPPING			
LINE_PLANT_ITEM_-BRANCH_CONNECTION	line_plant_item_branch_connection	227		line_plant_item_branch_connection <= shape_aspect_relationship
branch_sequence_id	shape_aspect_relationship.name	41		line_plant_item_branch_connection <= shape_aspect_relationship shape_aspect_relationship.name
line_plant_item_branch_connection to changed_line_plant_item_branch_connection	IDENTICAL MAPPING			

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LINE_PLANT_ITEM_- BRANCH_CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {shape_aspect [shape_aspect.description = 'line_plant_item_connector'] [shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_occurrence'}
line_plant_item_branch_ connector to line_plant_ item_branch_connection	PATH			plant_item_connector <= shape_aspect <- shape_aspect_relationship.related_shape_aspect shape_aspect_relationship => line_plant_item_connection

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LINE_PLANT_ITEM_- CONNECTION	line_plant_item_connection	227		line_plant_item_connection <= shape_aspect_relationship {[shape_aspect_relationship.relating_shape_aspect ->] shape_aspect => plant_line_segment_termination] [shape_aspect_relationship.related_shape_aspect ->] shape_aspect {shape_aspect <= plant_item_connector} shape_aspect.of_shape ->] product_definition_shape <= property_definition property_definition.definition ->] characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)]}
line_plant_item_ connection to changed_ line_plant_item_ connection	IDENTICAL MAPPING			

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LINE_PLANT_ITEM_-CONNECTOR	plant_item_connector	227		plant_item_connector <= shape_aspect {shape_aspect [shape_aspect.description = 'line_plant_item_connector'] [shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_occurrence'}
line_plant_item_connector to line_plant_item_connection	PATH			plant_item_connector <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => line_plant_item_connection
LINE_PLANT_ITEM_-TERMINATION	plant_line_segment_termination	227		plant_line_segment_termination <= shape_aspect
line_plant_item_termination to line_plant_item_connection	PATH			plant_line_segment_termination <= shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => line_plant_item_connection
LINE_TO_LINE_CONNECTION	line_termination_connection	227		line_termination_connection <= shape_aspect_relationship
line_to_line_connection_id	shape_aspect_relationship.name	41		line_termination_connection <= shape_aspect_relationship shape_aspect_relationship.name

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
line_to_line_connection to line_to_line_ termination	PATH			line_termination_connection <= shape_aspect_relationship [shape_aspect_relationship.relating_shape_aspect -> shape_aspect => (connection_node) (plant_line_segment_termination)] [shape_aspect_relationship.related_shape_aspect -> shape_aspect => plant_line_segment_termination]
line_to_line_connection to changed_line_to_line_ connection	IDENTICAL MAPPING			
LINE_TO_LINE_TERMIN ATION	plant_line_segment_termination	227		plant_line_segment_termination <= shape_aspect
PIPING_SPECIFICATION	document	41		{document document.kind -> document_type document_type.product_data_type = 'piping_specification'}
name	document.name	41		

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
owner	(organization.name) ([person.first_name] person.last_name])	41 41 41		document (plant_spatial_configuration_organization_item = document plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment {organization_assignment organization_assignment.role ->>br>organization_role organization_role.name = 'owner'} organization_assignment.assigned_organization ->>br>organization organization.name) (plant_spatial_configuration_person_item = document plant_spatial_configuration_person_item <- plant_spatial_configuration_person_assignment.items[i] plant_spatial_configuration_person_assignment <= person_assignment {person_assignment person_assignment.role ->>br>person_role person_role.name = 'owner'} person_assignment.assigned_person ->>br>person [person.first_name] [person.last_name])
piping_specification_id	document.id	41		
service_description	document_usage_constraint	41		document <- document_usage_constraint.source document_usage_constraint {document_usage_constraint document_usage_constraint.subject_element = 'service_description'}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
piping_specification to piping_system_line_ segment	PATH			document <- document_reference.assigned_document document_reference => plant_spatial_configuration_document_reference plant_spatial_configuration_document_reference.items[i] -> plant_spatial_configuration_document_item plant_spatial_configuration_document_item = plant_line_segment_definition plant_line_segment_definition
piping_specification to specification_item_family	PATH			document <- product_definition_with_associated_documents.documentation_ids[i] product_definition_with_associated_documents => plant_item_definition_class
PIPING_SYSTEM_LINE	plant_line_definition	227		plant_line_definition <= product_definition_with_associated_documents {product_definition_with_- associated_documents <= product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_definition'}
line_number	product_definition.description	41		plant_line_definition <= product_definition_with_associated_documents <= product_definition product_definition.description
P_and_I_reference	document	41		plant_line_definition <= product_definition_with_associated_documents product_definition_with_associated_documents.documentation_ids[i] -> document
piping_system_line_id	product_definition.id	41		plant_line_definition <= product_definition_with_associated_documents <= product_definition product_definition.id
piping_system_line to changed_piping_system_ line	IDENTICAL MAPPING			

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
piping_system_line to piping_system_line_ segment	PATH			plant_line_definition <= product_definition_with_associated_documents <= product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition -> product_definition => plant_line_segment_definition
PIPING_SYSTEM_LINE_-SEGMENT	plant_line_segment_definition	227		plant_line_segment_definition <= product_definition {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_definition'}
coating_reference	document_usage_constraint	41		plant_line_segment_definition plant_spatial_configuration_document_item = plant_line_segment_definition plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document <- document_usage_constraint {document_usage_constraint.subject_element = 'coating_reference'}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
design_pressure	representation	43		plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation [representation.name = 'design_pressure'] [representation.items[i] -> representation_item => measure_representation_item]}
design_temperature	representation	43		plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation [representation.name = 'design_temperature'] [representation.items[i] -> representation_item => measure_representation_item <= measure_with_unit => thermodynamic_temperature_measure_with_unit]}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
elevation	representation	43		plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation [representation.name = 'elevation'] [representation.items[i] -> representation_item => measure_representation_item]}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
heat_tracing_type	(heat_tracing_representation) ([heat_tracing_representation] [document_usage_constraint. subject_element_value])	227 227 41		plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> {representation representation.items[1] -> representation_item => descriptive_representation_item} representation => (heat_tracing_representation) ([heat_tracing_representation] [heat_tracing_representation plant_spatial_configuration_document_item = heat_tracing_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document <- document_usage_constraint document_usage_constraint.subject_element_value])

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
line_size	shape_dimension_representation	47		plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition {=> product_definition_shape} <- property_definition_representation.definition property_definition_representation {=> shape_definition_representation} property_definition_representation.used_representation -> {representation representation.items[i] -> representation_item representation_item.name = 'line_size'} representation => shape_representation => shape_dimension_representation
segment_id	product_definition.id	41		plant_line_segment_definition <= product_definition product_definition.id
piping_system_line_ segment to changed_ piping_system_line_ segment	IDENTICAL MAPPING			

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
piping_system_line_ segment to line_branch_ connection	PATH			plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => line_branch_connection
piping_system_line_ segment to line_plant_ item_branch_connection	PATH			plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship => line_plant_item_branch_connection
piping_system_line_ segment to line_piping_ system_component_ assignment	PATH			plant_line_segment_definition <= product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
piping_system_line_ segment to piping_ system_line_segment_ termination	PATH			plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect => plant_line_segment_termination
piping_system_line_ segment to segment_insulation	PATH			plant_line_segment_definition <= product_definition <- product_definition_relationship.relating_product_definition {product_definition_relationship product_definition_relationship.name = 'segment_insulation'} product_definition_relationship
piping_system_line_ segment to stream_design_case	PATH			plant_line_segment_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => stream_design_case

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPING_SYSTEM_LINE_-SEGMENT_TERMINATION	plant_line_segment_termination	227		plant_line_segment_termination <= shape_aspect {[shape_aspect <- (shape_aspect_relationship.relating_shape_aspect) (shape_aspect_relationship.related_shape_aspect) shape_aspect_relationship => (line_branch_connection) (line_plant_item_connection) (line_termination_connection)] [shape_aspect shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition {product_definition => plant_line_segment_definition} product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_definition']}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
flow_direction	descriptive_representation_item	45		plant_line_segment_termination <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'flow_direction'} representation_item => {descriptive_representation_item (descriptive_representation_item.description = 'both') (descriptive_representation_item.description = 'in') (descriptive_representation_item.description = 'not_specified') (descriptive_representation_item.description = 'out')} descriptive_representation_item

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
line_end_location	(point) (shape_aspect)	42 41		plant_line_segment_termination <= (shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'line_end_point'} representation_item => geometric_representation_item => point) (shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship shape_aspect_relationship.related_shape_aspect -> {shape_aspect shape_aspect.name = 'line_end_location'} shape_aspect)

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
line_start_location	(point) (shape_aspect)	42 41		plant_line_segment_termination <= (shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'line_start_point'} representation_item => geometric_representation_item => point) (shape_aspect <- shape_aspect_relationship.relating_shape_aspect shape_aspect_relationship shape_aspect_relationship.related_shape_aspect -> {shape_aspect shape_aspect.name = 'line_end_location'} shape_aspect)
termination_id	shape_aspect.name	41		plant_line_segment_termination <= shape_aspect shape_aspect.name
piping_system_line_ segment_termination to changed_piping_system_ line_segment_termination	IDENTICAL MAPPING			
SEGMENT_INSULATION	product_definition_relationship	41		{product_definition_relationship [product_definition_relationship.name = 'segment_insulation'] [product_definition_relationship.relating_product_definition -> product_definition => plant_line_segment_definition]}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
boundaries	representation	43		product_definition_relationship characterized_product_definition = product_definition_relationship characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition {=> product_definition_shape} <- property_definition_representation.definition property_definition_representation {=> shape_definition_representation} property_definition_representation.used_representation -> representation {representation representation.name = 'segment_insulation_boundary'}
description	product_definition_relationship. description	41		
thickness	representation	43		product_definition_relationship characterized_product_definition = product_definition_relationship characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition {=> product_definition_shape} <- property_definition_representation.definition property_definition_representation {=> shape_definition_representation} property_definition_representation.used_representation -> representation {representation representation.items[i] -> [representation_item representation_item.name = 'thickness'] [representation_item => measure_representation_item]}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
type	product.name	41		product_definition_relationship product_definition_relationship.related_product_definition ->product_definition product_definition.formation ->product_definition_formation product_definition_formation.of_product ->product product.name
STREAM_DESIGN_CASE	stream_design_case	227		stream_design_case <= [characterized_object] [property_definition]
description	characterized_object.description	41		stream_design_case <= characterized_object characterized_object.description
flow_rate	representation	43		stream_design_case <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->representation {[representation.name = 'flow_rate'] [representation.items[i] ->representation_item => measure_representation_item]}
pressure	representation	43		stream_design_case <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->representation {[representation.name = 'pressure'] [representation.items[i] ->representation_item => measure_representation_item]}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
stream_case_type	property_definition.name	41		stream_design_case <= property_definition property_definition.name
stream_data_reference	representation	43		stream_design_case <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'stream_data_reference'] [representation.items[i] ->> representation_item => measure_representation_item]}
stream_design_id	characterized_object.name	41		stream_design_case <= characterized_object characterized_object.name
stream_design_case to service_operating_case	PATH			stream_design_case <= property_definition <- property_definition_relationship.relating_property_definition property_definition_relationship
stream_design_case to stream_phase	PATH			stream_design_case <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition => stream_phase
STREAM_PHASE	stream_phase	227		stream_phase <= property_definition

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
constituent_mole_fraction	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'constituent_mole_fraction'] [representation.items[i] ->> representation_item => measure_representation_item]}
constituents	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'constituents'] [representation.items[i] ->> representation_item => measure_representation_item]}
phase_density	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'phase_density'] [representation.items[i] ->> representation_item => measure_representation_item]}

Table 9 - Mapping table for piping_system_functional_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
phase_fraction	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'phase_fraction'] [representation.items[i] ->> representation_item => measure_representation_item]}
specific_gravity	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'specific_gravity'] [representation.items[i] ->> representation_item => measure_representation_item]}
surface_tension	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'surface_tension'] [representation.items[i] ->> representation_item => measure_representation_item]}

Table 9 - Mapping table for piping_system_functional_characterization UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
temperature	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'temperature'] [representation.items[i] ->> representation_item => measure_representation_item <= measure_with_unit => thermodynamic_temperature_measure_with_unit]}
viscosity	representation	43		stream_phase <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> representation {[representation.name = 'viscosity'] [representation.items[i] ->> representation_item => measure_representation_item]}

Table 10 - Mapping table for plant_characterization UoF

Application element	AIM element	Source	Rules	Reference path
ELECTRICAL_SYSTEM	electrical_system	227		electrical_system <= product_definition
system_voltage_ designation	representation	43		electrical_system <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> {representation representation.name = 'system_voltage_designation'} representation
type	product.name	41		electrical_system <= product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product product.name
FUNCTIONAL_PLANT	product_definition	41		{product_definition [product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product => plant] [product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_occurrence']}

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
functional_plant to functional_plant_ satisfaction	PATH			product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship {product_definition_relationship product_definition_relationship.name = 'plant_satisfaction'}
functional_plant to plant_system	PATH			product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition -> product_definition => (electrical_system) (hvac_system) (instrumentation_and_control_system) (piping_system) (structural_system)
FUNCTIONAL_PLANT_- SATISFACTION	product_definition_relationship	41		{product_definition_relationship product_definition_relationship.name = 'plant_satisfaction'}
HVAC_SYSTEM	hvac_system	227		hvac_system <= product_definition
type	product.name	41		hvac_system <= product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product product.name
hvac_system to stream_design_case	PATH			hvac_system <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => stream_design_case

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
INSTRUMENTATION_ AND_CONTROL_ SYSTEM	instrumentation_and_control_system	227		instrumentation_and_control_system <= product_definition
type	product.name	41		instrumentation_and_control_system <= product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product product.name
LINE_LESS_PIPING_ SYSTEM	line_less_piping_system	227		line_less_piping_system <= product_definition
line_less_piping_system to piping_system_ component	PATH			line_less_piping_system <= product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship {product_definition_relationship => product_definition_usage => assembly_component_usage} product_definition_relationship.related_product_definition -> product_definition => piping_component_definition
line_less_piping_system to stream_design_case	PATH			line_less_piping_system <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => stream_design_case

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LOCATION_IN_PLANT	mapped_item	43		{mapped_item mapped_item.mapping_target -> [representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)] [representation_item <- representation.items[i] representation <- property_definition_representation.used_representation property_definition_representation {=> shape_definition_representation} property_definition_representation.definition -> property_definition {=> product_definition_shape} property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence'} product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product => plant]}
MANUFACTURING_ LINE	plant	227		plant <= product {product product.frame_of_reference[i] -> product_context <= application_context_element application_context_element.name = 'manufacturing_line'}

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPING_SYSTEM	piping_system	227		piping_system <= product_definition
code	document_usage_constraint. subject_element_value	41		piping_system plant_spatial_configuration_document_item = piping_system plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value {document_usage_constraint.subject_element_value = 'piping_system_code'}
description	product_definition_formation.description	41		piping_system <= product_definition product_definition.formation ->product_definition_formation product_definition_formation.description
type	product.name	41		piping_system <= product_definition product_definition.formation ->product_definition_formation product_definition_formation.of_product ->product product.name
piping_system to piping_system_line	PATH			piping_system <= product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition ->product_definition => product_definition_with_associated_documents => plant_line_definition

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANNED_PHYSICAL_ PLANT	product_definition	41		{product_definition [product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product => plant] [product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence']}
planned_physical_plant to changed_planned_ physical_plant	IDENTICAL MAPPING			
planned_physical_plant to functional_plant_ satisfaction	PATH			product_definition <- product_definition_relationship.related_product_definition product_definition_relationship {product_definition_relationship product_definition_relationship.name = 'plant_satisfaction'}

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
planned_physical_plant to location_in_plant	PATH			product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition {property_definition => product_definition_shape} property_definition <- property_definition_representation.definition {property_definition_representation => shape_definition_representation} property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)} representation_item <- mapped_item.mapping_target -> mapped_item
planned_physical_plant to sited_plant	PATH			product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition
PLANT	plant	227		plant <= product
name	product.name	41		plant <= product product.name

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
operators	(organization) (person_and_organization)	41 41		plant (plant_spatial_configuration_organization_item = plant plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment {organization_assignment.role ->> organization_role organization_role.name = 'plant_operator'} organization_assignment.assigned_organization ->> organization) (plant_spatial_configuration_person_and_organization_item = plant plant_spatial_configuration_person_and_organization_item <- plant_spatial_configuration_person_and_organization_assignment.items[i] plant_spatial_configuration_person_and_organization_assignment <= person_and_organization_assignment {person_and_organization_assignment.role ->> person_and_organization_role person_and_organization_role.name = 'plant_operator'} person_and_organization_assignment.assigned_person_and_organization ->> person_and_organization)

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
owners	(person) (organization) (person_and_organization)	41 41 41		plant (plant_spatial_configuration_person_item = plant plant_spatial_configuration_person_item <- plant_spatial_configuration_person_assignment.items[i] plant_spatial_configuration_person_assignment <= person_assignment {person_assignment.role ->>br>person_role person_role.name = 'plant_owner'} person_assignment.assigned_person ->>br>person) (plant_spatial_configuration_organization_item = plant plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment {organization_assignment.role ->>br>organization_role organization_role.name = 'plant_owner'} organization_assignment.assigned_organization ->>br>organization) (plant_spatial_configuration_person_and_organization_item = plant plant_spatial_configuration_person_and_organization_item <- plant_spatial_configuration_person_and_organization_assignment.items[i] plant_spatial_configuration_person_and_organization_assignment <= person_and_organization_assignment {person_and_organization_assignment.role ->>br>person_and_organization_role person_and_organization_role.name = 'plant_owner'} person_and_organization_assignment.assigned_person_and_organization ->>br>person_and_organization)
plant_id	product.id	41		plant <= product product.id
plant to changed_plant	IDENTICAL MAPPING			

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant to functional_plant	PATH			plant <= product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'functional_occurrence']}
plant to planned_physical_plant	PATH			plant <= product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence']}
plant to plant_process_capability	PATH			plant <= product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => process_capability

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant to sub_plant_ relationship (contains)	PATH			plant <= product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship {product_definition_relationship product_definition_relationship.name = 'sub_plant'}
plant to sub_plant_ relationship (used in)	PATH			plant <= product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition <- product_definition_relationship.related_product_definition product_definition_relationship {product_definition_relationship product_definition_relationship.name = 'sub_plant'}
PLANT_PROCESS_CAPABILITY	process_capability	227		process_capability <= property_definition
production_capacity	representation	43		process_capability <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation representation.name = 'production_capacity'}

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
production_type	descriptive_representation_item	45		process_capability <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->{representation representation.name = 'production_capacity'} representation representation.items[i] ->{representation_item representation_item.name = 'production_type'} representation_item => descriptive_representation_item
plant_process_capability to changed_plant_ process_capability	IDENTICAL MAPPING			
PLANT_SYSTEM	(electrical_system) (hvac_system) (instrumentation_and_control_system) (piping_system) (structural_system)	227 227 227 227 227		(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition
name	product_definition.name	41		(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition product_definition.name

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_system_id	product.id	41		(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition product_definition.formation ->product_definition_formation product_definition_formation.of_product ->product product.name
service_designation	product.description			(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition product_definition.formation ->product_definition_formation product_definition_formation.of_product ->product product.description
plant_system to changed_plant_system	IDENTICAL MAPPING			
plant_system to plant_item	PATH			(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition <-product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition ->product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_system to plant_system_assembly (sub-system)	PATH			(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition <- product_definition_relationship.related_product_definition product_definition_relationship product_definition_relationship.relating_product_definition -> product_definition (electrical_system) (hvac_system) (instrumentation_and_control_system) (piping_system) (structural_system)
plant_system to plant_system_assembly (super-system)	PATH			(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition -> product_definition (electrical_system) (hvac_system) (instrumentation_and_control_system) (piping_system) (structural_system)
PLANT_SYSTEM_ASSEMBLY	(electrical_system) (hvac_system) (instrumentation_and_control_system) (piping_system) (structural_system)	227 227 227 227 227		(electrical_system <=) (hvac_system <=) (instrumentation_and_control_system <=) (piping_system <=) (structural_system <=) product_definition

Table 10 - Mapping table for plant_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
STRUCTURAL_SYSTEM	structural_system	227		structural_system <= product_definition
type	product.name	41		structural_system <= product_definition product_definition.formation ->> product_definition_formation product_definition_formation.of_product ->> product product.name
SUB_PLANT_RELATION SHIP	product_definition_relationship	41		{product_definition_relationship product_definition_relationship.name = 'sub_plant'}
location_and_orientation	(axis2_placement_2d) (axis2_placement_3d)	42 42		product_definition_relationship characterized_product_definition = product_definition_relationship characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition {property_definition => product_definition_shape} property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->> {representation => shape_representation} representation representation.items[i] ->> representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)
sub_plant_relationship to changed_sub_plant_ relationship	IDENTICAL MAPPING			

Table 10 - Mapping table for plant_characterization UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
TRAIN	plant	227		plant <= product {product product.frame_of_reference[i] ->> product_context <= application_context_element application_context_element.name = 'train'}
UNIT	plant	227		plant <= product {product product.frame_of_reference[i] ->> product_context <= application_context_element application_context_element.name = 'unit'}

Table 11 - Mapping table for plant_item_characterization UoF

Application element	AIM element	Source	Rules	Reference path
CABLE_SUPPORT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'cable_support'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'support_component']}
cable_support_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'cable_support'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
CATALOGUE_DEFINITION	document_usage_constraint	41		{document_usage_constraint document_usage_constraint.subject_element = 'item_definition'}
catalogue_id	document.id	41		document_usage_constraint document_usage_constraint.source ->document document.id
catalogue_name	document.name	41		document_usage_constraint document_usage_constraint.source ->document document.name

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
catalogue_vendor_name	(organization.name) ([person.first_name] [person.last_name])	41 41 41	3	document_usage_constraint document_usage_constraint.source ->document (plant_spatial_configuration_organization_item = document plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= {organization_assignment organization_assignment.role ->organization_role organization_role.name = 'vendor'} organization_assignment organization_assignment.assigned_organization ->organization organization.name) (plant_spatial_configuration_person_item = document plant_spatial_configuration_person_item <- plant_spatial_configuration_person_assignment.items[i] plant_spatial_configuration_person_assignment <= {person_assignment person_assignment.role ->person_role person_role.name = 'vendor'} person_assignment person_assignment.assigned_person ->person [person.first_name] [person.last_name])
catalogue_version	document.description	41		document_usage_constraint document_usage_constraint.source ->document document.description

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
catalogue_definition to catalogue_item	PATH			document_usage_constraint document_usage_constraint.source -> document <- document_reference.assigned_document document_reference => plant_spatial_configuration_document_reference plant_spatial_configuration_document_reference.items[i] -> plant_spatial_configuration_document_item plant_spatial_configuration_document_item = external_source external_source <- externally_defined_item.source externally_defined_item => externally_defined_plant_item_definition => catalogue_item
CATALOGUE_ITEM	catalogue_item	227		catalogue_item <= externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item] {externally_defined_item externally_defined_item.source -> external_source plant_spatial_configuration_document_item = external_source plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document document.kind -> document_type document_type.product_data_type = 'catalogue'}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
item_reference	product_definition_relationship	41		catalogue_item <= externally_defined_plant_item_definition <= plant_item_definition <= product_definition <- product_definition_relationship.relating_product_definition {product_definition_relationship product_definition_relationship.related_product_definition ->} product_definition => plant_item_definition => externally_defined_plant_item_definition product_definition_relationship
item_version	product_definition_formation.id	41		catalogue_item <= externally_defined_plant_item_definition <= plant_item_definition <= product_definition product_definition.formation ->> product_definition_formation product_definition_formation.id
model_number	product.id	41		catalogue_item <= externally_defined_plant_item_definition <= plant_item_definition <= product_definition product_definition.formation ->> product_definition_formation product_definition_formation.of_product ->> product product.id

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
catalogue_item to catalogue_item_substitute (has as substitute)	PATH			catalogue_item <= externally_defined_plant_item_definition <= plant_item_definition <= product_definition <- product_definition_relationship.related_product_definition {product_definition_relationship product_definition_relationship.related_product_definition -> product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)} product_definition_relationship <- product_definition_substitute.context_relationship product_definition_substitute
catalogue_item to catalogue_item_substitute (is substitute)	PATH			catalogue_item <= externally_defined_plant_item_definition <= plant_item_definition <= product_definition <- product_definition_substitute.substitute_definition product_definition_substitute
CATALOGUE_ITEM_-SUBSTITUTE	product_definition_substitute	41		
CONNECTED_ASSEMBLY	assembly_component_usage	44		{assembly_component_usage <= product_definition_usage <= product_definition_relationship (product_definition_relationship.name = 'connected_assembly') (product_definition_relationship.name = 'connected_hierarchical_assembly')}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
connected_assembly to plant_item_connection	PATH			assembly_component_usage <= product_definition_usage <= product_definition_relationship product_definition_relationship.relating_product_definition -> product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect => plant_item_connection
CONSTRUCTION_MATERIAL	product_definition	41		{product_definition characterized_product_definition = product_definition characterized_product_definition <- material_designation.of_product}
material_id	product_definition.id	41		
name	material_designation.name	45		product_definition characterized_product_definition = product_definition characterized_product_definition <- material_designation.of_product material_designation material_designation.name

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
specification	document_usage_constraint. subject_element_value	41		product_definition plant_spatial_configuration_document_item = product_definition plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->> document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value
DESIGN_PROJECT	design_project	227		design_project <= organization
design_project_id	organization.id	41		design_project <= organization organization.id
design_project_name	organization.name	41		design_project <= organization organization.name
design_project_number	organization.description	41		design_project <= organization organization.description
design_project_owner	organization.name	41		design_project plant_spatial_configuration_organization_item = design_project plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment {organization_assignment.role ->> organization_role organization_role.name = 'project_owner'} organization_assignment.assigned_organization ->> organization organization.name

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
design_project to project_design_ assignment	PATH			design_project <= organization <- organization_assignment.assigned_organization organization_assignment => design_project_assignment
DUCTING_COMPONENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= (product_category) (product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category -> product_category) product_category.name = 'ducting_component'}
ELECTRICAL_COMPON ENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= product_category product_category.name = 'electrical_component'}
EQUIPMENT_ BREACHING	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'equipment_breaching'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category -> product_category product_category.name = 'ducting_component']}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
FUNCTIONAL_- DESIGN_VIEW	(plant_item_definition) (externally_defined_plant_item_- definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {product_definition product_definition.frame_of_reference ->> product_definition_context <= application_context_element (application_context_element.name = 'functional_definition') (application_context_element.name = 'functional_occurrence')}
tag_number	product_definition.id	41		(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition product_definition.id
functional_design_view to functional_plant_item_ satisfaction	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship {product_definition_relationship product_definition_relationship.name = 'plant_item_satisfaction'}
FUNCTIONAL_PLANT_- ITEM_SATISFACTION	product_definition_relationship	41		{product_definition_relationship product_definition_relationship.name = 'plant_item_satisfaction'}
HIERARCHICAL_ASSEM BLY	assembly_component_usage	44		{assembly_component_usage <= product_definition_usage <= product_definition_relationship (product_definition_relationship.name = 'hierarchical_assembly') (product_definition_relationship.name = 'connected_hierarchical_assembly')}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
HVAC_COMPONENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'hvac_component'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category -> product_category product_category.name = 'ducting_component']}
INSTALLED_PHYSICAL _DESIGN_VIEW	product_definition.description	41		{product_definition.definition [product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)] [product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element (application_context_element.name = 'physical_definition') (application_context_element.name = 'physical_occurrence')]}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
INSTRUMENT	product	41		{product <- [product_related_product_category.products[i] product_related_product_category <= product_category product_category.name = 'instrument'] [product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition <- product_definition_relationship.related_product_definition product_definition_relationship product_definition_relationship.relating_product_definition -> product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product product.name = 'control_loop'}
actuation_type	product_definition_formation.description	41		product <- product_definition_formation.of_product product_definition_formation product_definition_formation.description
control_loop_id	product_definition.id	41		product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition product_definition.id

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
instrument_type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'instrument'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
signal_type	product_definition.description	41		product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition product_definition.description
INSTRUMENTATION_-AND_CONTROL_-COMPONENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= (product_category) (product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category) product_category.name = 'instrumentation_and_control_component'}
INSULATION	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= product_category product_category.name = 'insulation'}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
JACKETED_PIPING	inline_equipment	227		inline_equipment <= piping_component_definition <= {product_definition product_definition.description = 'jacketed_piping'} product_definition
MATERIAL_SPECIFICATION_SELECTION	[material_property] [document]	45 41		{document document.kind ->> document_type document_type.product_data_type = 'material_specification'}
description	property_definition.description	41		material_property <= property_definition property_definition.description
material_specification_id	document.id	41		
required_or_optional	NO MAPPING			
selection_id	document_usage_constraint. subject_element	41		document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element
type	document_usage_constraint. subject_element_value	41		document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value
material_specification_selection to changed_material_specification_selection	IDENTICAL MAPPING			
material_specification_selection to material_specification_subset_reference	PATH			document <- document_relationship.relating_document {document_relationship document_relationship.description = 'subset'}
MATERIAL_SPECIFICATION_SUBSET_REFERENCE	document_relationship	41		{document_relationship document_relationship.description = 'subset'}
subset_id	document_relationship.name	41		

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
OFFLINE_INSTRUMENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= [product_category product_category.name = 'offline_instrument'] [product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category product_category.name = 'instrument']}
PHYSICAL_DESIGN_-VIEW	(plant_item_definition) (externally_defined_plant_item_-definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element (application_context_element.name = 'physical_definition') (application_context_element.name = 'physical_occurrence')}
physical_design_view to functional_plant_item_satisfaction	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.related_product_definition product_definition_relationship {product_definition_relationship product_definition_relationship.name = 'plant_item_satisfaction'}
physical_design_view to installed_physical_design_view	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition product_definition.description

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPING_SPOOL	plant_item_definition	227		plant_item_definition <= product_definition {product_definition.frame_of_reference ->>br>product_definition_context <= application_context_element application_context_element.name = 'fabrication_assembly'}
piping_spool_number	product_definition.id	41		plant_item_definition <= product_definition product_definition.id
piping_spool to piping_spool_assignment	PATH			plant_item_definition <= product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship => product_definition_usage
PIPING_SPOOL_ ASSIGNMENT	product_definition_usage	44		{product_definition_usage <= product_definition_relationship [product_definition_relationship.relating_product_definition ->> {product_definition => plant_item_definition} product_definition product_definition.frame_of_reference ->> product_definition_context <= application_context_element application_context_element.name = 'fabrication_assembly'] [product_definition_relationship.related_product_definition ->> {product_definition => plant_item_definition} product_definition product_definition.frame_of_reference ->> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence']}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PIPING_SYSTEM_COMPONENT	piping_component_definition	227		piping_component_definition <= product_definition {product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence'}
coating_reference	representation	43		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {[representation.name = 'coating'] [representation.items[i] -> representation_item => descriptive_representation_item]}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
heat_tracing_type	(heat_tracing_representation) ([heat_tracing_representation] [document_usage_constraint.subject_- element_value])	227 227 41		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation => (heat_tracing_representation) ([heat_tracing_representation] [heat_tracing_representation plant_spatial_configuration_document_item = heat_tracing_representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document <- document_usage_constraint.source document_usage_constraint document_usage_constraint.subject_element_value])

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
lining	representation	43		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {[representation.name = 'lining'] [representation.items[i] -> representation_item => descriptive_representation_item]}
piping_system_ component to equipment_ trim_piping	PATH			piping_component_definition <= product_definition <- product_definition_relationship.related_product_definition {product_definition_relationship product_definition_relationship.name = 'trim_piping'} product_definition_relationship
piping_system_ component to line_ piping_system_ component_assignment	PATH			piping_component_definition <= product_definition <- product_definition_relationship.related_product_definition {product_definition_relationship product_definition_relationship.name = 'realization'} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
piping_system_ component to piping_size_description	PATH			piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> {representation (representation.name = 'nominal_size') (representation.name = 'pipe_or_connector_size')} representation => shape_representation => shape_dimension_representation
PLANNED_PHYSICAL_- PLANT_ITEM	(plant_item_definition) (externally_defined_plant_item_- definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence'}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
type	product_category.name			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition product_definition.formation ->> product_definition_formation product_definition_formation.of_product ->> product <- product_related_product_category.products[i] product_related_product_category <= product_category product_category.name
planned_physical_plant_ item to plant_item_ connector_occurrence	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect => plant_item_connection
planned_physical_plant_ item to piping_spool_ assignment	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.related_product_definition product_definition_relationship => product_definition_usage

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
planned_physical_plant_item to support_usage (supported by)	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.related_product_definition {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship
planned_physical_plant_item to support_usage (supports)	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship
PLANT_ITEM	(plant_item_definition) (externally_defined_plant_item_-definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item])
description	product_definition.description	41		(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition product_definition.description

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
name	product.name	41		(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition product_definition.formation ->) product_definition_formation product_definition_formation.of_product ->) product product.name
plant_item_id	product_definition.id	41		(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition product_definition.id
plant_item to changed_plant_item	IDENTICAL MAPPING			
plant_item to construction_material	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition ->) product_definition {characterized_product_definition = product_definition characterized_product_definition <- material_designation.of_product}
plant_item to plant_item_collection (element)	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.related_product_definition product_definition_relationship <= product_definition_usage <= assembly_component_usage

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item to plant_item_collection (group)	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship <= product_definition_usage <= assembly_component_usage
plant_item to plant_item_design_view	IDENTICAL MAPPING			
plant_item to plant_item_shape	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape
plant_item to plant_item_weight	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation => plant_item_weight_representation

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item to reference_geometry	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect => derived_shape_aspect => reference_geometry
plant_item to required_ material_description	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition {product_definition_relationship => product_definition_usage => make_from_usage_option} product_definition_relationship product_definition_relationship.related_product_definition -> {product_definition characterized_product_definition = product_definition characterized_product_definition <- material_designation.of_product material_designation} product_definition

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_COLLECTION	assembly_component_usage	44		{assembly_component_usage <= product_definition_usage <= product_definition_relationship [product_definition_relationship.relating_product_definition ->] [product_definition_relationship.related_product_definition ->] product_definition => (plant_item_definition) (externally_defined_plant_item_definition)}
location_and_orientation	(axis2_placement_2d) (axis2_placement_3d)	42 42		{assembly_component_usage <= product_definition_usage <= product_definition_relationship characterized_product_definition = product_definition_relationship characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_DEFINITION	(plant_item_definition) (externally_defined_plant_item_-definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element (application_context_element.name = 'functional_definition') (application_context_element.name = 'physical_definition')}
plant_item_definition to catalogue_definition	PATH			(plant_item_definition) (externally_defined_plant_item_definition <= plant_item_definition) plant_spatial_configuration_document_item = plant_item_definition plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document ->document <- document_usage_constraint.source {document_usage_constraint document_usage_constraint.subject_element = 'item_definition'} document_usage_constraint
plant_item_definition to catalogue_item	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition ->product_definition => plant_item_definition => externally_defined_plant_item_definition => catalogue_item

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item_definition to connector_definition	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect => plant_item_connector
plant_item_definition to planned_physical_plant_item	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_definition'} product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition -> {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence'} product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item_definition to specification_item_family	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship product_definition_relationship.related_product_definition -> product_definition => product_definition_with_associated_documents => plant_item_definition_class
PLANT_ITEM_DESIGN_-VIEW	(plant_item_definition) (externally_defined_plant_item_-definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element (application_context_element.name = 'functional_definition') (application_context_element.name = 'functional_occurrence') (application_context_element.name = 'physical_definition') (application_context_element.name = 'physical_occurrence')}
plant_item_design_view to changed_plant_item_design_view	IDENTICAL MAPPING			

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_INSTANCE	(plant_item_definition) (externally_defined_plant_item_-definition)	227 227		(plant_item_definition <= product_definition) (externally_defined_plant_item_definition <= [plant_item_definition <= product_definition] [externally_defined_item]) {product_definition product_definition.frame_of_reference ->product_definition_context <= application_context_element (application_context_element.name = 'functional_occurrence') (application_context_element.name = 'physical_occurrence')}
plant_item_instance to plant_item_interference (first item)	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.relating_product_definition product_definition_relationship => plant_item_interference
plant_item_instance to plant_item_interference (second item)	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition <- product_definition_relationship.related_product_definition product_definition_relationship => plant_item_interference

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item_instance to plant_item_location	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition {property_definition => product_definition_shape} property_definition <- property_definition_representation.definition {property_definition_representation => shape_definition_representation} property_definition_representation property_definition_representation.used_representation -> {representation => shape_representation} representation <- representation_map.mapped_representation representation_map <- mapped_item.mapping_source mapped_item
plant_item_instance to project_design_ assignment	PATH			(plant_item_definition) (externally_defined_plant_item_definition <= plant_item_definition) design_project_item = plant_item_definition design_project_item <- design_project_assignment.items[i] design_project_assignment

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item_instance to relative_item_location	PATH			(plant_item_definition <=) (externally_defined_plant_item_definition <= plant_item_definition <=) product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition {property_definition => product_definition_shape} property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)} representation_item <- mapped_item.mapping_target mapped_item
PLANT_ITEM_LOCATION	mapped_item	43		
location_and_orientation	(axis2_placement_2d) (axis2_placement_3d)	42 42		mapped_item mapped_item.mapping_target -> representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)
location_id	representation_item.name	43		mapped_item <= representation_item representation_item.name

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_WEIGHT	plant_item_weight_representation	227		plant_item_weight_representation <= property_definition_representation {property_definition_representation.used_representation ->> representation representation.name = 'item_weight'}
centre_of_gravity	geometric_representation_item	42		plant_item_weight_representation <= property_definition_representation property_definition_representation.used_representation ->> representation representation.items[i] ->> {representation_item representation_item.name = 'centre_of_gravity'} representation_item => geometric_representation_item
weight_state	descriptive_representation_item	45		plant_item_weight_representation <= property_definition_representation property_definition_representation.used_representation ->> representation representation.items[i] ->> {representation_item representation_item.name = 'weight_state'} representation_item => {descriptive_representation_item (descriptive_representation_item.description = 'empty') (descriptive_representation_item.description = 'full') (descriptive_representation_item.description = 'operating') (descriptive_representation_item.description = 'shipping') (descriptive_representation_item.description = 'test')} descriptive_representation_item

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
weight_value	measure_representation_item	45		plant_item_weight_representation <= property_definition_representation property_definition_representation.used_representation ->> representation representation.items[i] ->> {representation_item (representation_item.name = 'weight_value') (representation_item.name = 'mass_value')} representation_item => measure_representation_item
PLANT_VOLUME	(plant_item_route) (reserved_space) (system_space) (product_definition_shape) (shape_aspect)	227 227 227 41 41		(plant_item_route <= product_definition_shape) (reserved_space <= shape_aspect) (system_space <= product_definition_shape)
type	(property_definition.name) (shape_aspect.name)	41 41		((plant_item_route <= product_definition_shape <=) (system_space <= product_definition_shape <=) (product_definition_shape <=) property_definition property_definition.name) ((reserved_space <= shape_aspect) (shape_aspect) shape_aspect.name)

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PROCESS_DUCTING	piping_component_definition	227		piping_component_definition <= product_definition {product_definition product_definition.formation -> product_definition_formation product_definition_formation.of_product -> product <- product_related_product_category.products[i] product_related_product_category <= product_category product_category.name product_category.name = 'ducting_component'}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
gauge	measure_representation_item	45		piping_component_definition <= product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape [shape_aspect <- shape_aspect_relationship.relating_shape_aspect] [shape_aspect <- shape_aspect_relationship.related_shape_aspect] shape_aspect_relationship => dimensional_location dimensional_characteristic = dimensional_location dimensional_characteristic <- dimensional_characteristic_representation.dimension dimensional_characteristic_representation dimensional_characteristic_representation.representation -> shape_dimension_representation <= shape_representation <= representation {representation.name = 'process_ducting_dimensional_shape'} representation.items[i] -> {representation_item representation_item.name = 'gauge'} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PROJECT_DESIGN_ASSIGNMENT	design_project_assignment	227		design_project_assignment <= organization_assignment {organization_assignment.assigned_organization ->> organization => design_project}
RELATIVE_ITEM_LOCATION	mapped_item	43		{mapped_item mapped_item.mapping_target -> [representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)] [representation_item <- representation.items[i] representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)}
REQUIRED_-MATERIAL_-DESCRIPTION	product_definition	41		{product_definition characterized_product_definition = product_definition characterized_product_definition <- material_designation.of_product material_designation}
description	product_definition.description	41		

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
material_requirement_id	product.id	41		product_definition product_definition.formation ->> product_definition_formation product_definition_formation.of_product ->> product product.id
required_material_ description to changed_ required_material_ description	IDENTICAL MAPPING			
required_material_ description to material_ specification_selection	PATH			product_definition [characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => material_property] [plant_spatial_configuration_document_item = product_definition plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document]

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
RESERVED_SPACE	reserved_space	227		reserved_space <= shape_aspect {shape_aspect shape_aspect.of_shape -> product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)}
ROUTE	plant_item_route	227		plant_item_route <= product_definition_shape {product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition product_definition.frame_of_reference -> product_definition_context <= application_context_element application_context_element.name = 'physical_occurrence'}

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
route to piping_system_line_segment	PATH			plant_item_route <= product_definition_shape <= property_definition property_definition.definition ->> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition <- product_definition_relationship.related_product_definition product_definition_relationship product_definition_relationship.relating_product_definition product_definition => plant_line_segment_definition
SPECIFICATION_ITEM_-FAMILY	plant_item_definition_class	227		plant_item_definition_class <= product_definition_with_associated_documents
family_classification_description	document_usage_constraint	41		plant_item_definition_class <= product_definition_with_associated_documents product_definition_with_associated_documents.documentation_ids[i] ->> {document document.kind ->> document_type document_type.product_data_type = 'piping_specification'} document <- document_usage_constraint.source document_usage_constraint

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
specification_item_family to line_piping_system_ component_assignment	PATH			plant_item_definition_class <= product_definition_with_associated_documents <= product_definition <- product_definition_relationship.relating_product_definition {product_definition_relationship product_definition_relationship.name = 'family_member'} product_definition_relationship product_definition_relationship.related_product_definition -> {product_definition => piping_component_definition} product_definition <- product_definition_relationship.related_product_definition {product_definition_relationship product_definition_relationship.name = 'realization'} product_definition_relationship
STRUCTURAL_COMPON ENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= product_category product_category.name = 'structural_component'}
exact_section	shape_aspect	41		product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
size_designator	descriptive_representation_item	45		product <- product_definition_formation.of_product product_definition_formation <- product_definition.formation product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> {representation plant_spatial_configuration_document_item = representation plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document} representation representation.items[i] -> {representation_item representation_item.name = 'size_designator'} representation_item => descriptive_representation_item

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
type	product_category.name	41		product <- product_related_product_category.products[i] product_related_product_category <= {product_category product_category.name = 'structural_component'} product_category <- product_category_relationship.category product_category_relationship product_category_relationship.sub_category ->product_category product_category.name
SUPPORT_COMPONENT	product	41		{product <- product_related_product_category.products[i] product_related_product_category <= (product_category) (product_category <- product_category_relationship.sub_category product_category_relationship product_category_relationship.category ->product_category) product_category.name = 'support_component'}
SUPPORT_CONSTRAINTS	support_constraint_representation	227		support_constraint_representation <= representation

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
gap	measure_representation_item	45		support_constraint_representation <= representation representation.items[i] ->{representation_item (representation_item.name = 'negative_x') (representation_item.name = 'positive_x') (representation_item.name = 'negative_y') (representation_item.name = 'positive_y') (representation_item.name = 'negative_z') (representation_item.name = 'positive_z') (representation_item.name = 'negative_x_rotation') (representation_item.name = 'positive_x_rotation') (representation_item.name = 'negative_y_rotation') (representation_item.name = 'positive_y_rotation') (representation_item.name = 'negative_z_rotation') (representation_item.name = 'positive_z_rotation')} representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => length_measure_with_unit}
k	measure_representation_item	45		support_constraint_representation <= representation representation.items[i] ->{representation_item => measure_representation_item {measure_representation_item <= measure_with_unit => ratio_measure_with_unit}
restrained	descriptive_representation_item	45		support_constraint_representation <= representation representation.items[i] ->{representation_item => descriptive_representation_item
support_constraint_id	representation.name	43		support_constraint_representation <= representation representation.name

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (negative x-direction)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'negative_x'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (positive x-direction)	PATH			support_constraint_representation <= {representation representation.items[i] ->> representation_item representation_item.name = 'positive_x'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition ->> property_definition property_definition.definition ->> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (negative y-direction)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'negative_y'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (positive y-direction)	PATH			support_constraint_representation <= {representation representation.items[i] ->> representation_item representation_item.name = 'positive_y'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition ->> property_definition property_definition.definition ->> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (negative z-direction)	PATH			support_constraint_representation <= {representation representation.items[i] ->> representation_item representation_item.name = 'negative_z'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition ->> property_definition property_definition.definition ->> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (positive z-direction)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'positive_z'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (negative rotation x-axis)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'negative_x_rotation'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (positive rotation x-axis)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'positive_x_rotation'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (negative rotation y-axis)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'negative_y_rotation'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (positive rotation y-axis)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'positive_y_rotation'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship
support_constraints to support_usage (negative rotation z-axis)	PATH			{representation representation.items[i] -> representation_item representation_item.name = 'negative_z_rotation'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship

Table 11 - Mapping table for plant_item_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
support_constraints to support_usage (positive rotation z-axis)	PATH			support_constraint_representation <= {representation representation.items[i] -> representation_item representation_item.name = 'positive_z_rotation'} representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition_relationship {product_definition_relationship (product_definition_relationship.name = 'support_usage') (product_definition_relationship.name = 'support_usage_connection')} product_definition_relationship
SUPPORT_USAGE	product_definition_relationship	41		{product_definition_relationship product_definition_relationship.name = 'support_usage'}
detail_sheet_reference	document	41		product_definition_relationship plant_spatial_configuration_document_item = product_definition_relationship plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> {document document.kind -> document_type document_type.product_data_type = 'drawing'} document
function	product_definition_relationship. description	41		

Table 11 - Mapping table for plant_item_characterization UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
SUPPORT_USAGE_CONNECTION	product_definition_relationship	41		{product_definition_relationship product_definition_relationship.name = 'support_usage_connection'}
support_usage_ connection to plant_item_ connection_occurrence	PATH			product_definition_relationship [product_definition_relationship.relating_product_definition ->] [product_definition_relationship.related_product_definition ->] {product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)} product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect => plant_item_connection
SYSTEM_SPACE	system_space	227		system_space <= product_definition_shape {product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => (electrical_system) (hvac_system) (instrumentation_and_control_system) (piping_system) (structural_system)

Table 12 - Mapping table for shape UoF

Application element	AIM element	Source	Rules	Reference path
DETAIL_SHAPE	representation.name	43		{representation.name = 'detail'}
ENVELOPE_SHAPE	representation.name	43		{representation.name = 'envelope'}
INTERFERING_SHAPE_-ELEMENT	interfering_shape_element	227		interfering_shape_element <= [shape_aspect_relationship] [shape_aspect]
interference_colour	descriptive_colour	227		interfering_shape_element <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item representation_item.name = 'interference_colour'} representation_item => descriptive_representation_item => {descriptive_colour <= colour} descriptive_colour
OUTLINE_SHAPE	representation.name	43		{representation.name = 'outline'}
PLANT_ITEM_CENTRELINE	centre_of_symmetry	47		
PLANT_ITEM_GEOMETRIC_ORIGIN	derived_shape_aspect	47		
PLANT_ITEM_INTERFERENCE	plant_item_interference	227		plant_item_interference <= product_definition_relationship

Table 12 - Mapping table for shape UoF (continued)

Application element	AIM element	Source	Rules	Reference path
interference_id	product_definition_relationship.name	41		plant_item_interference <= product_definition_relationship product_definition_relationship.name
type	product_definition_relationship. description	41		plant_item_interference <= product_definition_relationship product_definition_relationship.description
plant_item_interference to interfering_shape_ element	PATH			plant_item_interference <= product_definition_relationship product_definition_relationship.relating_product_definition ->product_definition characterized_product_definition = product_definition characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition => product_definition_shape <- shape_aspect.of_shape shape_aspect => interfering_shape_element

Table 12 - Mapping table for shape UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_item_interference to plant_item_ interference_status	PATH			plant_item_interference <= product_definition_relationship (plant_spatial_configuration_organization_item = product_definition_relationship plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment) (plant_spatial_configuration_person_item = product_definition_relationship plant_spatial_configuration_person_item <- plant_spatial_configuration_person_assignment.items[i] plant_spatial_configuration_person_assignment) (characterized_product_definition = product_definition_relationship characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation)
plant_item_interference to shape_interference_ zone_usage	PATH			plant_item_interference <= product_definition_relationship characterized_product_definition = product_definition_relationship characterized_product_definition characterized_definition = characterized_product_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> {representation => shape_representation} representation representation.items[i] -> representation_item => mapped_item

Table 12 - Mapping table for shape UoF (continued)

Application element	AIM element	Source	Rules	Reference path
PLANT_ITEM_INTERFERENCE_STATUS	(plant_spatial_configuration_-organization_assignment) (plant_spatial_configuration_person_-assignment) (representation)	227 227 43		(plant_spatial_configuration_organization_assignment <= organization_assignment) (plant_spatial_configuration_person_assignment <= person_assignment)
assessor	(organization.name) ([person.first_name] [person.last_name])	41 41 41		(plant_spatial_configuration_organization_assignment <= organization_assignment organization_assignment.assigned_organization -> organization organization.name) (plant_spatial_configuration_person_assignment <= person_assignment person_assignment.assigned_person -> person [person.first_name] [person.last_name])
status	descriptive_representation_item	45		representation representation.items[i] -> {representation_item representation_item.name = 'interference_status'} representation_item => descriptive_representation_item
PLANT_ITEM_SHAPE	product_definition_shape	41		{product_definition_shape <= property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_product_definition characterized_product_definition characterized_product_definition = product_definition product_definition => (plant_item_definition) (plant_item_definition => externally_defined_plant_item_definition)}

Table 12 - Mapping table for shape UoF (continued)

Application element	AIM element	Source	Rules	Reference path
clash_detection_class	property_definition.description	41		product_definition_shape <= property_definition {property_definition (property_definition.description = 'hard') (property_definition.description = 'ignore') (property_definition.description = 'soft')} property_definition.description
shape_id	property_definition.name	41		product_definition_shape <= property_definition property_definition.name
plant_item_shape to changed_plant_item_ shape	IDENTICAL MAPPING			
plant_item_shape to shape_representation	PATH			product_definition_shape <= property_definition <- property_definition_representation.definition property_definition_representation
REFERENCE_GEOMETRY	reference_geometry	227		reference_geometry <= derived_shape_aspect
name	shape_aspect.name	41		reference_geometry <= derived_shape_aspect <= shape_aspect shape_aspect.name

Table 12 - Mapping table for shape UoF (continued)

Application element	AIM element	Source	Rules	Reference path
reference_geometry_ id	representation_item.name	43		reference_geometry <= derived_shape_aspect <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> representation_item representation_item.name
reference_geometry to changed_reference_ geometry	IDENTICAL MAPPING			
reference_geometry to shape_representation_ element	PATH			reference_geometry <= derived_shape_aspect <= shape_aspect shape_definition = shape_aspect shape_definition characterized_definition = shape_definition characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation => shape_representation => (advanced_csg_shape_representation) (piping_design_csg_shape_representation) (hybrid_shape_representation)

Table 12 - Mapping table for shape UoF (continued)

Application element	AIM element	Source	Rules	Reference path
SHAPE_INTERFERENCE_ZONE_USAGE	mapped_item	43		
SHAPE_REPRESENTATION	property_definition_representation	41		
shape_representation to shape_representation_element_usage	PATH			property_definition_representation property_definition_representation.used_representation -> representation => shape_representation => (advanced_csg_shape_representation) (piping_design_csg_shape_representation) (hybrid_shape_representation)
SHAPE_REPRESENTATION_ELEMENT	representation_item	43		
element_id	representation_item.name	43		
shape_representation_element to shape_interference_zone_usage	PATH			representation_item <- representation_map.mapping_origin representation_map <- mapped_item.mapping_source mapped_item
shape_representation_element to shape_representation_element_usage	PATH			representation_item <- representation.items[i] representation => shape_representation => (advanced_csg_shape_representation) (piping_design_csg_shape_representation) (hybrid_shape_representation)
SHAPE_REPRESENTATION_ELEMENT_USAGE	(advanced_csg_shape_representation) (piping_design_csg_shape_-representation) (hybrid_shape_representation)	227 227 227		(advanced_csg_shape_representation <=) (piping_design_csg_shape_representation <=) (hybrid_shape_representation <=) shape_representation

Table 12 - Mapping table for shape UoF (continued)

Application element	AIM element	Source	Rules	Reference path
element_colour	descriptive_colour	227		(advanced_csg_shape_representation <=) (piping_design_csg_shape_representation <=) (hybrid_shape_representation <=) shape_representation <= representation representation.items[i] ->{representation_item representation_item.name = 'element_colour'} representation_item => descriptive_representation_item => {descriptive_colour <= colour} descriptive_colour
layer	presentation_layer_assignment	46		(advanced_csg_shape_representation <=) (piping_design_csg_shape_representation <=) (hybrid_shape_representation <=) shape_representation <= representation representation.items[i] ->representation_item layered_item = representation_item layered_item <- presentation_layer_assignment.assigned_items[i] presentation_layer_assignment

Table 12 - Mapping table for shape UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
shape_representation_ element_usage to interfering_shape_ element	PATH			(advanced_csg_shape_representation <=) (piping_design_csg_shape_representation <=) (hybrid_shape_representation <=) shape_representation <= representation <- property_definition_representation.representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = shape_definition shape_definition shape_definition = shape_aspect shape_aspect => interfering_shape_element

Table 13 - Mapping table for site_characterization UoF

Application element	AIM element	Source	Rules	Reference path
BREAKLINE	polyline	42		
breakline to survey_point	PATH			polyline polyline.points[i] ->cartesian_point
BUILDING	site_building	227		site_building <= property_definition
building_id	representation	43		site_building <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->representation {representation.name = 'building_number'}
location_and_orientation	representation	43		site_building <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->representation {representation.name = 'building_location_and_orientation'}
name	property_definition.name	41		site_building <= property_definition property_definition.name
shape	shape_representation	41		site_building <= property_definition {=> product_definition_shape} <- property_definition_representation.definition property_definition_representation {=> shape_definition_representation} property_definition_representation.used_representation ->representation => shape_representation

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
building to location_in_building	PATH			site_building <= property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)} representation_item <- mapped_item.mapping_target mapped_item
FACET	poly_loop	42		
facet to survey_point	PATH			poly_loop poly_loop.polygon[i] -> cartesian_point
FACETED_TERRAIN_MODEL	site_representation	227		site_representation <= shape_representation

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
faceted_terrain_model to breakline	PATH			site_representation <= shape_representation <= representation representation.items[i] ->> representation_item => topological_representation_item => connected_face_set connected_face_set.cfs_faces[i] ->> face face.bounds[i] ->> face_bound face_bound.bound ->> loop => edge_loop <= path path.edge_list[i] ->> oriented_edge oriented_edge.edge_element ->> edge => edge_curve edge_curve.edge_geometry ->> curve => bounded_curve => polyline

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
faceted_terrain_model to facet	PATH			site_representation <= shape_representation <= representation representation.items[i] ->> representation_item => topological_representation_item => connected_face_set connected_face_set.cfs_faces[i] ->> face {=> face_surface} face.bounds[i] ->> face_bound face_bound.bound ->> loop => poly_loop
LOCATION_IN_BUILDING	mapped_item	43		{mapped_item mapped_item.mapping_target ->> [representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)] [representation_item <- representation.items[i] representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition ->> property_definition => site_building]}

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
LOCATION_IN_SITE	mapped_item	43		{mapped_item mapped_item.mapping_target -> [representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)] [representation_item <- representation.items[i] representation <- property_definition_representation.used_representation property_definition_representation {=> shape_definition_representation} property_definition_representation.definition -> property_definition {=> product_definition_shape} property_definition.definition -> characterized_definition characterized_definition = characterized_object characterized_object => site]}
POINT_TERRAIN_ MODEL	site_representation	227		site_representation <= shape_representation
point_terrain_model to breakline	PATH			site_representation <= shape_representation <= representation representation.items[i] -> representation_item => geometric_representation_item => geometric_set {=> geometric_curve_set} geometric_set.elements[i] -> geometric_set_select geometric_set_select = curve curve => bounded_curve => polyline

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
point_terrain_model to survey_point	PATH			site_representation <= shape_representation <= representation representation.items[i] ->> representation_item => geometric_representation_item => geometric_set {=> geometric_curve_set} geometric_set.elements[i] ->> geometric_set_select geometric_set_select = point point => cartesian_point
SITE	site	227		site <= [characterized_object] [property_definition]
address	representation	43		site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'site_address'}
coordinates	representation	43		site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'site_coordinates'}

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
elevation	representation	43		site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'site_elevation'}
environmental_ references	document.id	41		site plant_spatial_configuration_document_item = site plant_spatial_configuration_document_item <- plant_spatial_configuration_document_reference.items[i] plant_spatial_configuration_document_reference <= document_reference document_reference.assigned_document -> document document.id
locality	representation	43		site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'site_locality'}
name	characterized_object.description	41		site <= characterized_object characterized_object.description

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
orientation	representation	43		site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation {representation.name = 'site_orientation'}

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
owners	(person) (organization) (person_and_organization)	41 41 41		site (plant_spatial_configuration_person_item = site plant_spatial_configuration_person_item <- plant_spatial_configuration_person_assignment.items[i] plant_spatial_configuration_person_assignment <= person_assignment {person_assignment.role ->> person_role person_role.name = 'owner'} person_assignment.assigned_person ->> person) (plant_spatial_configuration_organization_item = site plant_spatial_configuration_organization_item <- plant_spatial_configuration_organization_assignment.items[i] plant_spatial_configuration_organization_assignment <= organization_assignment {organization_assignment.role ->> organization_role organization_role.name = 'owner'} organization_assignment.assigned_organization ->> organization) (plant_spatial_configuration_person_and_organization_item = site plant_spatial_configuration_person_and_organization_item <- plant_spatial_configuration_person_and_organization_assignment.items[i] plant_spatial_configuration_person_and_organization_assignment <= person_and_organization_assignment {person_and_organization_assignment.role ->> person_and_organization_role person_and_organization_role.name = 'owner'} person_and_organization_assignment.assigned_person_and_organization ->> person_and_organization)
site_id	characterized_object.name	41		site <= characterized_object characterized_object.name

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
site to building	PATH			site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition => site_building
site to location_in_site	PATH			site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)} representation_item <- mapped_item.mapping_target mapped_item
site to sited_plant	PATH			site <= property_definition property_definition.definition
site to site_feature	PATH			site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition => site_feature

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
site to terrain_model	PATH			site <= characterized_object characterized_definition = characterized_object characterized_definition <- property_definition.definition property_definition {=> product_definition_shape} property_definition.used_representation ->> representation => shapc_representation => site_representation
SITE_FEATURE	site_feature	227		site_feature <= property_definition
location_and_orientation	representation	43		site_feature <= property_definition <- property_definition_representation.definition property_dcfinition_representation property_definition_representation.used_representation -> representation
shape	shape_representation	41		site_feature <= property_definition {=> product_definition_shape} <- property_definition_representation.definition property_definition_representation {=> shape_definition_representation} property_definition_representation.used_representation -> representation => shape_representation
site_feature_id	property_definition.name	41		site_feature <= property_definition property_definition.name
type	represcntation	43		site_feature <= property_dcfinition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation
SITED_PLANT	property_definition.definition	41		

Table 13 - Mapping table for site_characterization UoF (continued)

Application element	AIM element	Source	Rules	Reference path
plant_site_location	(axis2_placement_2d) (axis2_placement_3d)	42 42		property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation -> representation representation.items[i] -> {representation_item <- mapped_item.mapping_target mapped_item <= representation_item <- representation.items[i] representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition -> property_definition property_definition.definition -> characterized_definition characterized_definition = characterized_object characterized_object => site} representation_item => geometric_representation_item => placement => (axis2_placement_2d) (axis2_placement_3d)

Table 13 - Mapping table for site_characterization UoF (concluded)

Application element	AIM element	Source	Rules	Reference path
plant_site_orientation	(axis2_placement_2d) (axis2_placement_3d)	42 42		property_definition.definition property_definition <- property_definition_representation.definition property_definition_representation property_definition_representation.used_representation ->representation representation.items[i] ->{representation_item <- mapped_item.mapping_target mapped_item <= representation_item <- representation.items[i] representation <- property_definition_representation.used_representation property_definition_representation property_definition_representation.definition ->property_definition property_definition ->characterized_definition characterized_definition = characterized_object characterized_object =>site} representation_item =>geometric_representation_item =>placement =>(axis2_placement_2d) (axis2_placement_3d)
sited_plant to changed_sited_plant	IDENTICAL MAPPING			
SURVEY_POINT	cartesian_point	42		
TERRAIN_MODEL	site_representation	227		site_representation <=shape_representation
terrain_model_id	representation.name	43		site_representation <=shape_representation <=representationrepresentation.name

Table 14 - Mapping table for wireframe_and_b_rep_geometry UoF

Application element	AIM element	Source	Rules	Reference path
B_REP_ELEMENT	manifold_solid_brep	42		
CONIC	conic	42		
CURVE	curve	42		
FREE_FORM_CURVE	b_spline_curve	42		
LINE	line	42		
POINT	point	42		
POLYGON	polyline	42		
SURFACE	surface	42		
VECTOR	vector	42		
WIRE_AND_SURFACE_ ELEMENT	geometric_representation_item	42		

The following rules are referenced in the preceding table:

1) approval_requires_approval_date_time
2) approval_requires_approval_person_organization
3) catalogue_requires_vendor
4) change_action_requires_date
5) change_item_requires_creation_date
6) change_item_requires_id
7) change_life_cycle_stage_usage_requires_approval
8) change_life_cycle_stage_usage_requires_stage
9) versioned_action_request_requires_change_action

5.2 AIM EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources and the AICs and contains the types, entity specializations, rules and functions that are specific to this part of ISO 10303. This clause also specifies modifications to the textual material for constructs that are imported from the integrated resources and the AICs. The definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. Requirements stated in the integrated resources which refer to such items and subtypes apply exclusively to those items which are imported into the AIM.

EXPRESS specification:

```
*)
SCHEMA plant_spatial_configuration;

USE FROM action_schema
  (action_directive,
   action_method_relationship,
   action_relationship,
   action_request_solution,
   action_request_status,
   action_status,
   directed_action,
   versioned_action_request);

USE FROM application_context_schema
  (application_context_element,
   application_protocol_definition);

USE FROM approval_schema
  (approval,
   approval_date_time,
   approval_person_organization);

USE FROM date_time_schema
  (calendar_date,
   date_and_time);
```

```
USE FROM document_schema
  (document,
   document_relationship,
   document_usage_constraint);

USE FROM external_reference_schema
  (external_source,
   externally_defined_item);

USE FROM geometric_model_schema
  (block,
   boolean_result,
   brep_with_voids,
   csg_solid,
   extruded_area_solid,
   extruded_face_solid,
   faceted_brep,
   geometric_curve_set,
   geometric_set,
   geometric_set_replica,
   manifold_solid_brep,
   revolved_area_solid,
   revolved_face_solid,
   right_circular_cone,
   right_circular_cylinder,
   solid_model,
   sphere,
   swept_face_solid,
   swept_area_solid,
   torus);

USE FROM geometry_schema
  (axis2_placement_2d,
   axis2_placement_3d,
   b_spline_curve,
   b_spline_curve_with_knots,
   b_spline_surface,
   b_spline_surface_with_knots,
   bezier_curve,
   bezier_surface,
   boundary_curve,
   bounded_curve,
   bounded_pcurve,
   bounded_surface,
   bounded_surface_curve,
   cartesian_point,
   circle,
   composite_curve,
   composite_curve_on_surface,
   composite_curve_segment,
   conic,
   conical_surface,
   curve_bounded_surface,
   curve_replica,
   cylindrical_surface,
   degenerate_pcurve,
   degenerate_toroidal_surface,
   elementary_surface,
   ellipse,
```

```
    evaluated_degenerate_pcurve,
    hyperbola,
    intersection_curve,
    line,
    offset_curve_2d,
    offset_curve_3d,
    offset_surface,
    parabola,
    pcurve,
    plane,
    point,
    point_on_curve,
    point_on_surface,
    point_replica,
    polyline,
    quasi_uniform_curve,
    quasi_uniform_surface,
    rational_b_spline_curve,
    rational_b_spline_surface,
    reparametrised_composite_curve_segment,
    rectangular_composite_surface,
    rectangular_trimmed_surface,
    seam_curve,
    spherical_surface,
    surface_curve,
    surface_of_linear_extrusion,
    surface_of_revolution,
    surface_patch,
    surface_replica,
    swept_surface,
    toroidal_surface,
    trimmed_curve,
    uniform_curve,
    uniform_surface);

USE FROM group_schema
  (group);

USE FROM management_resources_schema
  (action_assignment,
   action_request_assignment,
   approval_assignment,
   date_and_time_assignment,
   date_assignment,
   document_reference,
   group_assignment,
   name_assignment,
   organization_assignment,
   person_and_organization_assignment,
   person_assignment);

USE FROM material_property_definition_schema
  (characterized_material_property,
   material_designation,
   material_designation_relationship,
   material_property,
   property_definition_relationship);
```

```
USE FROM measure_schema
  (amount_of_substance_measure,
   amount_of_substance_measure_with_unit,
   amount_of_substance_unit,
   area_measure,
   area_measure_with_unit,
   area_unit,
   context_dependent_measure,
   context_dependent_unit,
   conversion_based_unit,
   count_measure,
   derived_unit,
   length_measure,
   length_measure_with_unit,
   length_unit,
   mass_measure,
   mass_measure_with_unit,
   mass_unit,
   named_unit,
   numeric_measure,
   parameter_value,
   plane_angle_measure_with_unit,
   plane_angle_unit,
   positive_length_measure,
   positive_plane_angle_measure,
   positive_ratio_measure,
   ratio_measure,
   ratio_measure_with_unit,
   ratio_unit,
   si_unit,
   solid_angle_measure,
   solid_angle_measure_with_unit,
   solid_angle_unit,
   thermodynamic_temperature_measure,
   thermodynamic_temperature_measure_with_unit,
   thermodynamic_temperature_unit,
   time_measure,
   time_measure_with_unit,
   time_unit,
   volume_measure,
   volume_measure_with_unit,
   volume_unit);

USE FROM qualified_measure_schema
  (descriptive_representation_item,
   measure_representation_item);

USE FROM person_organization_schema
  (organization,
   organizational_project);

USE FROM presentation_organization_schema
  (presentation_layer_assignment);

USE FROM presentation_resource_schema
  (colour,
   colour_rgb);
```

```
USE FROM product_definition_schema
  (product,
   product_category,
   product_category_relationship,
   product_definition,
   product_definition_formation,
   product_definition_formation_relationship,
   product_definition_formation_with_specified_source,
   product_definition_relationship,
   product_definition_substitute,
   product_definition_with_associated_documents,
   product_related_product_category);

USE FROM product_property_definition_schema
  (characterized_object,
   product_definition_shape,
   property_definition,
   shape_aspect,
   shape_aspect_relationship);

USE FROM product_property_representation_schema
  (property_definition_representation,
   shape_definition_representation,
   shape_representation);

USE FROM product_structure_schema
  (assembly_component_usage,
   make_from_usage_option,
   product_definition_usage);

USE FROM representation_schema
  (mapped_item,
   representation,
   representation_item);

USE FROM shape_aspect_definition_schema
  (centre_of_symmetry,
   derived_shape_aspect);

USE FROM shape_dimension_schema
  (angular_location,
   dimensional_characteristic_representation,
   dimensional_location,
   dimensional_size,
   shape_dimension_representation);

USE FROM topology_schema
  (connected_face_set,
   edge,
   edge_curve,
   edge_loop,
   face,
   face_bound,
   face_surface,
   loop,
   oriented_closed_shell,
   oriented_edge,
   oriented_open_shell,
```

```
   path,
   poly_loop,
   topological_representation_item);
(*
```

Note – The schemas referenced above can be found in the following parts of ISO 10303:

action_schema	ISO 10303-41
application_context_schema	ISO 10303-41
approval_schema	ISO 10303-41
date_time_schema	ISO 10303-41
document_schema	ISO 10303-41
external_reference_schema	ISO 10303-41
geometric_model_schema	ISO 10303-42
geometry_schema	ISO 10303-42
group_schema	ISO 10303-41
management_resources_schema	ISO 10303-41
material_property_definition_schema	ISO 10303-45
measure_schema	ISO 10303-41
person_organization_schema	ISO 10303-41
presentation_organization_schema	ISO 10303-46
presentation_resource_schema	ISO 10303-46
product_definition_schema	ISO 10303-41
product_property_definition_schema	ISO 10303-41
product_property_representation_schema	ISO 10303-41
product_structure_schema	ISO 10303-44
qualified_measure_schema	ISO 10303-45
representation_schema	ISO 10303-43
shape_aspect_definition_schema	ISO 10303-47
shape_dimension_schema	ISO 10303-47
topology_schema	ISO 10303-42

5.2.1 Fundamental concepts and assumptions

For a given item, non-shape properties are handled through a **property_definition**. All non-shape properties are grouped together and evaluated by a function for consistency. Shape properties are dealt with as a subtype and evaluated separately using **shape_definition**.

5.2.2 Plant spatial configuration type definitions

5.2.2.1 approval_item

An **approval_item** identifies a **change_action** to indicate its approval status.

EXPRESS specification:

```
*)
TYPE approval_item = SELECT
```

```
  (change_action);
END_TYPE;
(*
```

5.2.2.2 change_delta_item

A **change_delta_item** identifies the **assembly_component_usage**, **line_branch_connection**, **line_plant_item_branch_connection**, **line_plant_item_connection**, **line_termination_connection**, **plant**, or **product_definition_relationship** that is the association between a two **change_item**s.

EXPRESS specification:

```
*)
TYPE change_delta_item = SELECT
  (assembly_component_usage,
   line_branch_connection,
   line_plant_item_branch_connection,
   line_plant_item_connection,
   line_termination_connection,
   plant,
   product_definition_relationship);
END_TYPE;
(*
```

5.2.2.3 change_item

A **change_item** identifies the **change_delta_item**, **electrical_system**, **externally_defined_plant_item_definition**, **hvac_system**, **instrumentation_and_control_system**, **material_property**, **piping_system**, **plant_item_connection**, **plant_item_connector**, **plant_item_definition**, **plant_line_definition**, **plant_line_segment_definition**, **plant_line_segment_termination**, **product_definition**, **product_definition_shape**, **process_capability**, **property_definition**, **reference_geometry**, or **structural_system** that can be modified or for which there is a request to modify.

EXPRESS specification:

```
*)
TYPE change_item = SELECT
  (change_delta_item,
   electrical_system,
   externally_defined_plant_item_definition,
   hvac_system,
   instrumentation_and_control_system,
   material_property,
   piping_system,
   plant_item_connection,
   plant_item_connector,
   plant_item_definition,
   plant_line_definition,
   plant_line_segment_definition,
   plant_line_segment_termination,
   process_capability,
```

```
   product_definition,
   product_definition_shape,
   property_definition,
   reference_geometry,
   structural_system);
END_TYPE;
(*
```

5.2.2.4 classification_item

A **classification_item** identifies the **plant_item_connection**, **plant_item_connector**, or **piping_component_definition** that is classified.

EXPRESS specification:

```
*)
TYPE classification_item = SELECT
  (plant_item_connection,
   plant_item_connector,
   piping_component_definition);
END_TYPE;
(*
```

5.2.2.5 design_project_item

A **design_project_item** identifies the **plant_item_definition** that is assigned to a **design_project**.

EXPRESS specification:

```
*)
TYPE design_project_item = SELECT
  (plant_item_definition);
END_TYPE;
(*
```

5.2.2.6 plant_spatial_configuration_action_request_item

A **plant_spatial_configuration_action_request_item** identifies the **product** that is assigned to an **action_request**, indicating a request for purchase.

EXPRESS specification:

```
*)
TYPE plant_spatial_configuration_action_request_item = SELECT
  (product);
END_TYPE;
(*
```

5.2.2.7 plant_spatial_configuration_date_and_time_item

A **plant_spatial_configuration_date_and_time_item** identifies the **product** to which a **date_and_time** is assigned.

EXPRESS specification:

```
*)
TYPE plant_spatial_configuration_date_and_time_item = SELECT
  (product);
END_TYPE;
(*
```

5.2.2.8 plant_spatial_configuration_dated_item

A **plant_spatial_configuration_dated_item** identifies the **change_action**, **action_directive**, **product**, or **change_item** to which a **date** is assigned.

EXPRESS specification:

```
*)
TYPE plant_spatial_configuration_dated_item = SELECT
  (change_action,
   action_directive,
   product,
   change_item);
END_TYPE;
(*
```

5.2.2.9 plant_spatial_configuration_document_item

A **plant_spatial_configuration_document_item** identifies the **external_source**, **heat_tracing_representation**, **piping_component_definition**, **piping_system**, **plant_item_connector**, **plant_item_definition**, **plant_line_segment_definition**, **product**, **product_definition**, **product_definition_relationship**, **property_definition_representation**, **shape_dimension_representation**, or **site** that is associated with a **document**.

EXPRESS specification:

```
*)
TYPE plant_spatial_configuration_document_item = SELECT
  (external_source,
   heat_tracing_representation,
   piping_component_definition,
   piping_system,
   plant_item_connector,
   plant_item_definition,
   plant_line_segment_definition,
   product,
```

```
   product_definition,
   product_definition_relationship,
   property_definition,
   representation,
   shape_dimension_representation,
   site);
END_TYPE;
(*
```

5.2.2.10 plant_spatial_configuration_organization_item

A **plant_spatial_configuration_organization_item** identifies the **change_action**, **design_project**, **document**, **plant**, **product**, **product_definition_relationship** or **site**, or that is associated with an **organization**.

EXPRESS specification:

```
*)
TYPE plant_spatial_configuration_organization_item = SELECT
  (change_action,
   design_project,
   document,
   plant,
   product,
   product_definition_relationship,
   site);
END_TYPE;
(*
```

5.2.2.11 plant_spatial_configuration_person_item

A **plant_spatial_configuration_person_item** identifies the **document**, **plant**, **product_definition_-relationship** or **site** that is associated with a **person**.

EXPRESS specification:

```
*)
TYPE plant_spatial_configuration_person_item = SELECT
  (document,
   plant,
   product_definition_relationship,
   site);
END_TYPE;
(*
```

5.2.2.12 plant_spatial_configuration_person_and_organization_item

A **plant_spatial_configuration_person_and_organization**_item identifies the **change_item**, **plant**, or **site** that is associated with a **person_or_organization**.

EXPRESS specification:

```
*)
TYPE plant_spatial_configuration_person_and_organization_item = SELECT
  (change_item,
   plant,
   site);
END_TYPE;
(*
```

5.2.2.13 purchase_item

A **purchase_item** identifies a **product** that is purchased.

EXPRESS specification:

```
*)
TYPE purchase_item = SELECT
  (product);
END_TYPE;
(*
```

5.2.3 Plant spatial configuration entity definitions

5.2.3.1 advanced_csg_shape_representation

An **advanced_csg_shape_representation** is a **shape_representation** that is composed of CSG primitives and boolean operators.

EXPRESS specification:

```
*)
ENTITY advanced_csg_shape_representation
  SUBTYPE OF (shape_representation);
WHERE
  WR1: (rep_item_set_has_free_form(
              class_rep_item_in_set(SELF.items)) = FALSE);
  WR2: SIZEOF (QUERY (i <* SELF\representation.items |
       SIZEOF (['PLANT_SPATIAL_CONFIGURATION.BOOLEAN_RESULT',
                'PLANT_SPATIAL_CONFIGURATION.CSG_SOLID',
                'PLANT_SPATIAL_CONFIGURATION.TRUNCATED_PYRAMID',
                'PLANT_SPATIAL_CONFIGURATION.BLOCK',
                'PLANT_SPATIAL_CONFIGURATION.TORUS',
                'PLANT_SPATIAL_CONFIGURATION.RIGHT_CIRCULAR_CYLINDER',
                'PLANT_SPATIAL_CONFIGURATION.SPHERE',
                'PLANT_SPATIAL_CONFIGURATION.RIGHT_CIRCULAR_CONE',
                'PLANT_SPATIAL_CONFIGURATION.EXTRUDED_AREA_SOLID',
                'PLANT_SPATIAL_CONFIGURATION.REVOLVED_AREA_SOLID',
                'PLANT_SPATIAL_CONFIGURATION.AXIS2_PLACEMENT_3D',
                'PLANT_SPATIAL_CONFIGURATION.MEASURE_REPRESENTATION_ITEM',
                'PLANT_SPATIAL_CONFIGURATION.MAPPED_ITEM'] *
```

```
                TYPEOF(i)) = 0
      )) = 0;
  WR3: SIZEOF (QUERY (mi <* QUERY (item <* SELF\representation.items |
      ('PLANT_SPATIAL_CONFIGURATION.MAPPED_ITEM' IN TYPEOF(item))) |
      NOT ('PLANT_SPATIAL_CONFIGURATION.' +
           'ADVANCED_CSG_SHAPE_REPRESENTATION' IN
      TYPEOF(mi\mapped_item.mapping_source.mapped_representation))
      )) = 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: An **advanced_csg_shape_representation** shall not have any **b_spline_curve**s or **b_spline_surface**s directly or indirectly in its set of **items**.

WR2: An **advanced_csg_shape_representation** shall not have any **representation_item** instances in its set of **items** that are not of type **boolean_result**, **csg_solid**, **truncated_pyramid**, **block**, **torus**, **right_circular_cylinder**, **sphere**, **right_circular_cone**, **extruded_area_solid**, **revolved_area_solid**, **axis2_placement_3d**, **measure_representation_item**, or **mapped_item**.

WR3: If there is a **mapped_item** in an **advanced_csg_shape_representation**, the source of the **mapped_item** shall be an **advanced_csg_shape_representation**.

5.2.3.2 blank_fitting_classification

A **blank_fitting_classification** is a type of **group** that classifies the items that are assigned to it as blank fittings.

EXPRESS specification:

```
*)
ENTITY blank_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **blank_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'blank_fitting_dimensional_shape', and shall have at least two **representation_item**s with the names 'outside_diameter' and 'thickness'.

IP2: If the name of a **blank_fitting_classification** is 'paddle_blank', the **representation** shall contain **representation_item**s with the names 'paddle_length' and 'paddle_width'.

IP3: If the name of a **blank_fitting_classification** is 'spectacle_blind', the **representation** shall contain **representation_item**s with the names 'arm_length', 'centre_to_centre' and 'inside_ring_diameter'.

5.2.3.3 bushing_fitting_classification

A **bushing_fitting_classification** is a type of **group** that classifies the items that are assigned to it as bushing fittings.

EXPRESS specification:

```
*)
ENTITY bushing_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **bushing_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'bushing_fitting_dimensional_shape', and shall have at least one **representation_item** with the name 'end_to_end_length'.

5.2.3.4 catalogue_item

A **catalogue_item** is an **externally_defined_plant_item_definition** that identifies an item whose characteristics are standardized and have been categorized in a library or catalogue.

EXPRESS specification:

```
*)
ENTITY catalogue_item
  SUBTYPE OF (externally_defined_plant_item_definition);
WHERE
  WR1: SIZEOF (QUERY (pscdr <* USEDIN (SELF,
             'PLANT_SPATIAL_CONFIGURATION.' +
       'PLANT_SPATIAL_CONFIGURATION_DOCUMENT_REFERENCE.ITEMS') |
       SIZEOF (QUERY (duc <* USEDIN (pscdr.assigned_document,
       'PLANT_SPATIAL_CONFIGURATION.DOCUMENT_USAGE_CONSTRAINT.SOURCE') |
       duc.subject_element = 'item_definition')) = 1)) = 1;
  WR2: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATING_PRODUCT_DEFINITION') |
       'PLANT_SPATIAL_CONFIGURATION.' +
       'EXTERNALLY_DEFINED_PLANT_ITEM_DEFINITION'
       IN TYPEOF (pdr.related_product_definition))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **catalogue_item** shall be assigned exactly one **document** that is the source of a **document_usage_constraint** with a **subject_element** of 'item_definition'.

WR2: A **catalogue_item** shall be related to exactly one **externally_defined_plant_item_definition**.

5.2.3.5 change_action

A **change_action** is a type of **directed_action** that identifies a change, or a request for a change.

EXPRESS specification:

```
*)
ENTITY change_action
  SUBTYPE OF (directed_action);
WHERE
  WR1: SIZEOF (QUERY (ca <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'ACTION_ASSIGNMENT.ASSIGNED_ACTION') |
       ('PLANT_SPATIAL_CONFIGURATION.' +
       'PLANT_SPATIAL_CONFIGURATION_CHANGE_ASSIGNMENT' IN TYPEOF (ca))
       )) >= 1;
  WR2: SIZEOF (QUERY (ar <* SELF\directed_action.directive.requests |
       NOT (SIZEOF (USEDIN (ar, 'PLANT_SPATIAL_CONFIGURATION.' +
                            'ACTION_REQUEST_SOLUTION.SOLUTION'
       )) = 1)
       )) = 0;
  WR3: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.ACTION_STATUS.' +
       'ASSIGNED_ACTION')) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **change_action** shall be assigned by at least one **plant_spatial_configuration_change_-assignment**.

WR2: Each **versioned_action_request** that is referenced by a **change_action** shall have exactly one **action_request_solution**.

WR3: Each **change_action** shall be assigned exactly one **action_status**.

5.2.3.6 change_from_assignment

A **change_from_assignment** assigns a **change_action** to a set of one or more **change_delta_item**.

EXPRESS specification:

```
*)
ENTITY change_from_assignment
  SUBTYPE OF (action_assignment);
  items : SET [1:?] OF change_delta_item;
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.CHANGE_ACTION'
       IN TYPEOF (SELF.assigned_action);
```

```
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **change_delta_items** to which an action is assigned.

Formal propositions:

WR1: The assigned action shall be a **change_action**.

5.2.3.7 change_item_id_assignment

A **change_item_id_assignment** assigns a name to one or more **change_items**.

EXPRESS specification:

```
*)
ENTITY change_item_id_assignment
  SUBTYPE OF (name_assignment);
  items : SET [1:?] OF change_item;
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **change_items** to which a name is assigned.

5.2.3.8 change_to_assignment

A **change_to_assignment** assigns a **change_action** to a set of one or more **change_delta_item**.

EXPRESS specification:

```
*)
ENTITY change_to_assignment
  SUBTYPE OF (action_assignment);
  items : SET [1:?] OF change_delta_item;
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.CHANGE_ACTION'
       IN TYPEOF (SELF.assigned_action);
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **change_delta_items** to which an action is assigned.

Formal propositions:

WR1: The assigned action shall be a **change_action**.

5.2.3.9 classification_assignment

A **classification_assignment** assigns a classification to a **plant_item_connection**, **plant_item_connector**, or **piping_component_definition**.

EXPRESS specification:

```
*)
ENTITY classification_assignment
  SUBTYPE OF (group_assignment);
  items : SET [1:?] OF classification_item;
WHERE
  WR1: (NOT (SIZEOF (QUERY (item <* SELF.items |
       NOT ('PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_CONNECTION' IN
       TYPEOF(item)))) = 0)) XOR (SIZEOF (TYPEOF (SELF.assigned_group) *
       ['PLANT_SPATIAL_CONFIGURATION.CONNECTION_FUNCTIONAL_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.CONNECTION_MOTION_CLASSIFICATION'])
       >= 1);
  WR2: (NOT (SIZEOF (QUERY (item <* SELF.items |
       NOT ('PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_CONNECTOR' IN
       TYPEOF(item)))) = 0)) XOR
       (SIZEOF (TYPEOF (SELF.assigned_group) *
       ['PLANT_SPATIAL_CONFIGURATION.CONNECTOR_END_TYPE_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.ELECTRICAL_CONNECTOR_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.PIPING_CONNECTOR_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.' +
       'STRUCTURAL_LOAD_CONNECTOR_CLASSIFICATION']) >= 1);
  WR3: (NOT (SIZEOF (QUERY (item <* SELF.items |
       NOT ('PLANT_SPATIAL_CONFIGURATION.PIPING_COMPONENT_DEFINITION' IN
       TYPEOF(item)))) = 0)) XOR
       (SIZEOF (TYPEOF (SELF.assigned_group) *
       ['PLANT_SPATIAL_CONFIGURATION.BLANK_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.BUSHING_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.COUPLING_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.CROSS_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.ELBOW_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.FLANGE_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.' +
       'FLANGE_FITTING_NECK_TYPE_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.INSERT_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.' +
       'LAP_JOINT_STUB_END_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.LATERAL_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.OLET_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.ORIFICE_PLATE_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.PIPE_CAP_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.PIPE_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.REDUCER_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.SPACER_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.SPECIALTY_ITEM_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.SWAGE_FITTING_CLASSIFICATION',
       'PLANT_SPATIAL_CONFIGURATION.TEE_FITTING_CLASSIFICATION',
```

```
        'PLANT_SPATIAL_CONFIGURATION.UNION_FITTING_CLASSIFICATION',
        'PLANT_SPATIAL_CONFIGURATION.VALVE_CLASSIFICATION',
        'PLANT_SPATIAL_CONFIGURATION.WYE_FITTING_CLASSIFICATION']) >= 1);
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **plant_item_connection**, **plant_item_connector**, or **piping_component_definition** to that are assigned to a **group**.

Formal propositions:

WR1: A **plant_item_connection** shall be assigned either a **connection_functional_classification**, a **connection_motion_classification**, or a combination of these.

WR2: A **plant_item_connector** shall be assigned either a **connector_end_type_classification, electrical_-connector_classification**, **piping_connector_classification**, **structural_load_connector_classification**, or a combination of these.

WR3: A **piping_component_definition** shall be assigned either a **blank_fitting_classification**, **bushing_-fitting_classification**, **coupling_fitting_classification**, **cross_fitting_classification**, **elbow_fitting_-classification**, **flange_fitting_classification**, **flange_fitting_neck_type_classification**, **insert_fitting_-classification**, **lap_joint_stub_end_fitting_classification**, **lateral_fitting_classification**, **olet_fitting_-classification**, **orifice_plate_fitting_classification**, **pipe_cap_fitting_classification**, **pipe_classification**, **reducer_fitting_classification**, **spacer_fitting_classification**, **specialty_item_classification**, **swage_-fitting_classification**, **tee_fitting_classification**, **union_fitting_classification**, **valve_classification**, **wye_-fitting_classification**, or a combination of these.

5.2.3.10 connection_functional_classification

A **connection_functional_classification** is a **group** that classifies items that are assigned to it as belonging to a common functional classification of connections.

EXPRESS specification:

```
*)
ENTITY connection_functional_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.11 connection_motion_classification

A **connection_motion_classification** is a type of **group** that classifies the connection motion of the items that are assigned to it.

EXPRESS specification:

```
*)
ENTITY connection_motion_classification
  SUBTYPE OF (group);
WHERE
  WR1: SELF.name IN ['flexible', 'locked_orientation'];
END_ENTITY;
(*
```

Formal propositions:

WR1: The name of the **connection_motion_classification** shall be 'flexible' or 'locked_orientation'.

5.2.3.12 connection_node

A **connection_node** is a type of **shape_aspect** that is part of the definition of a piping system, and connects more than two **line_termination_connections**.

EXPRESS specification:

```
*)
ENTITY connection_node
  SUBTYPE OF (shape_aspect);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.PIPING_SYSTEM'
       IN TYPEOF (SELF.of_shape.definition);
  WR2: SIZEOF (QUERY (sar <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.SHAPE_ASPECT_RELATIONSHIP.' +
       'RELATING_SHAPE_ASPECT') |
       ('PLANT_SPATIAL_CONFIGURATION.LINE_TERMINATION_CONNECTION' IN
        TYPEOF (sar))
       )) >= 3;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **connection_node** shall be an aspect of the definition of the shape of a **piping_system**.

WR2: A **connection_node** shall be the **relating_shape_aspect** for at least three **line_termination_-connections**.

5.2.3.13 connector_end_type_classification

A **connector_end_type_classification** is a type of **group** that classifies the end type of the connectors that are assigned to it.

EXPRESS specification:

```
*)
ENTITY connector_end_type_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.14 coupling_fitting_classification

A **coupling_fitting_classification** is a type of **group** that classifies the items that are assigned to it as coupling fittings.

EXPRESS specification:

```
*)
ENTITY coupling_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **coupling_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'coupling_fitting_dimensional_shape', and shall have at least one **representation_item** with the name 'end_to_end_length'.

5.2.3.15 cross_fitting_classification

A **cross_fitting_classification** is a type of **group** that classifies the items that are assigned to it as cross fittings.

EXPRESS specification:

```
*)
ENTITY cross_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **cross_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'cross_fitting_dimensional_shape', and shall have at least four **representation_item**s with the names 'centre_to_end_1_length', 'centre_to_end_2_length', 'centre_to_end_3_length', and 'centre_to_end_4_length'.

5.2.3.16 descriptive_colour

A **descriptive_colour** is a type of **descriptive_representation_item** that identifies a colour.

EXPRESS specification:

```
*)
ENTITY descriptive_colour
  SUBTYPE OF (colour, descriptive_representation_item);
END_ENTITY;
(*
```

5.2.3.17 design_project

A **design_project** is a type of **organization** that identifies a task with a defined scope and purpose.

EXPRESS specification:

```
*)
ENTITY design_project
  SUBTYPE OF (organization);
WHERE
  WR1: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
     'ORGANIZATION_ASSIGNMENT.ASSIGNED_ORGANIZATION')) >= 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: Each **design_project** shall be assigned to product data by at least one **organization_assignment**.

5.2.3.18 design_project_assignment

A **design_project_assignment** assigns a **plant_item_definition** to a **design_project**.

EXPRESS specification:

```
*)
ENTITY design_project_assignment
  SUBTYPE OF (organization_assignment);
  items : SET [1:?] OF design_project_item;
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.DESIGN_PROJECT' IN
       TYPEOF (SELF.assigned_organization);
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **plant_item_definitions** that are assigned to a **design_project**.

Formal propositions:

WR1: The **organization** that is assigned by a **design_project_assignment** shall be a **design_project**.

5.2.3.19 elbow_fitting_classification

An **elbow_fitting_classification** is a type of **group** that classifies the items that are assigned to it as elbow fittings. The **name** of the **elbow_fitting_classification** further classifies the assigned items.

EXPRESS specification:

```
*)
ENTITY elbow_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **elbow_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'elbow_fitting_dimensional_shape', and shall have at least four **representation_item**s with the names 'centre_to_end_1_length', 'centre_to_end_2_length', 'centreline_radius', and 'sweep_angle'.

5.2.3.20 electrical_connector_classification

An **electrical_connector_classification** is a type of **group** that classifies the items that are assigned to it as being electrical connectors. The **name** of the **electrical_connector_classification** further classifies the assigned items.

EXPRESS specification:

```
*)
ENTITY electrical_connector_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.21 electrical_system

An **electrical_system** is a type of **product_definition** that identifies a system of wiring, switches, relays and other equipment associated with receiving and distributing electrical power.

EXPRESS specification:

```
*)
ENTITY electrical_system
```

```
  SUBTYPE OF (product_definition);
WHERE
  WR1: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
       ('PLANT_SPATIAL_CONFIGURATION.PLANT' IN TYPEOF
       (pdr.relating_product_definition.formation.of_product)) AND
       (pdr.relating_product_definition.frame_of_reference.name =
       'functional_occurrence'))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **electrical_system** shall be related to exactly one **product_definition** which is the definition of a plant and has a context of 'functional_occurrence'.

5.2.3.22 externally_defined_plant_item_definition

An **externally_defined_plant_item_definition** is a **plant_item_definition** that is defined by reference to an external source.

EXPRESS specification:

```
*)
ENTITY externally_defined_plant_item_definition
  SUBTYPE OF (plant_item_definition, externally_defined_item);
END_ENTITY;
(*
```

5.2.3.23 flange_fitting_classification

A **flange_fitting_classification** is a type of **group** that classifies the items that are assigned to it as flange fittings.

EXPRESS specification:

```
*)
ENTITY flange_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.24 flange_fitting_neck_type_classification

A **flange_fitting_neck_type_classification** is a type of **group** that classifies the neck type of the flange fittings items that are assigned to it.

EXPRESS specification:

```
*)
ENTITY flange_fitting_neck_type_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.25 heat_tracing_representation

A **heat_tracing_representation** is a **representation** that represents the means utilized to impart a temperature increase by an external wrapping or coiling.

EXPRESS specification:

```
*)
ENTITY heat_tracing_representation
  SUBTYPE OF (representation);
END_ENTITY;
(*
```

5.2.3.26 hvac_system

An **hvac_system** is a type of **product_definition** that identifies a system that controls the temperature, humidity, cleanliness, and circulation of environmental air.

EXPRESS specification:

```
*)
ENTITY hvac_system
  SUBTYPE OF (product_definition);
WHERE
  WR1: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
       ('PLANT_SPATIAL_CONFIGURATION.PLANT' IN TYPEOF
       (pdr.relating_product_definition.formation.of_product)) AND
       (pdr.relating_product_definition.frame_of_reference.name =
       'functional_occurrence'))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **hvac_system** shall be related to exactly one **product_definition** which is the definition of a plant and has a context of 'functional_occurrence'.

5.2.3.27 hybrid_shape_representation

A **hybrid_shape_representation** is a type of **shape_representation** that is composed of CSG primitives, boolean operators, manifold solid boundary representation solids, and curves.

EXPRESS specification:

```
*)
ENTITY hybrid_shape_representation
  SUBTYPE OF (shape_representation);
WHERE
WR1: SIZEOF (QUERY (i <* SELF\representation.items |
       SIZEOF (['PLANT_SPATIAL_CONFIGURATION.BOOLEAN_RESULT',
                'PLANT_SPATIAL_CONFIGURATION.CSG_SOLID',
                'PLANT_SPATIAL_CONFIGURATION.TRUNCATED_PYRAMID',
                'PLANT_SPATIAL_CONFIGURATION.BLOCK',
                'PLANT_SPATIAL_CONFIGURATION.TORUS',
                'PLANT_SPATIAL_CONFIGURATION.RIGHT_CIRCULAR_CYLINDER',
                'PLANT_SPATIAL_CONFIGURATION.SPHERE',
                'PLANT_SPATIAL_CONFIGURATION.RIGHT_CIRCULAR_CONE',
                'PLANT_SPATIAL_CONFIGURATION.EXTRUDED_AREA_SOLID',
                'PLANT_SPATIAL_CONFIGURATION.REVOLVED_AREA_SOLID',
                'PLANT_SPATIAL_CONFIGURATION.AXIS2_PLACEMENT_3D',
                'PLANT_SPATIAL_CONFIGURATION.MANIFOLD_SOLID_BREP',
                'PLANT_SPATIAL_CONFIGURATION.CONIC',
                'PLANT_SPATIAL_CONFIGURATION.CURVE',
                'PLANT_SPATIAL_CONFIGURATION.B_SPLINE_CURVE',
                'PLANT_SPATIAL_CONFIGURATION.LINE',
                'PLANT_SPATIAL_CONFIGURATION.POINT',
                'PLANT_SPATIAL_CONFIGURATION.POLYLINE',
                'PLANT_SPATIAL_CONFIGURATION.SURFACE',
                'PLANT_SPATIAL_CONFIGURATION.VECTOR',
                'PLANT_SPATIAL_CONFIGURATION.' +
                'GEOMETRIC_REPRESENTATION_ITEM',
                'PLANT_SPATIAL_CONFIGURATION.MEASURE_REPRESENTATION_ITEM',
                'PLANT_SPATIAL_CONFIGURATION.MAPPED_ITEM'] *
               TYPEOF(i)) = 0
       )) = 0;
  WR2: SIZEOF (QUERY (mi <* QUERY (item <* SELF\representation.items |
       ('PLANT_SPATIAL_CONFIGURATION.MAPPED_ITEM' IN TYPEOF(item))) |
       NOT (SIZEOF (['PLANT_SPATIAL_CONFIGURATION.' +
                     'ADVANCED_CSG_SHAPE_REPRESENTATION',
                     'PLANT_SPATIAL_CONFIGURATION.' +
                     'HYBRID_SHAPE_REPRESENTATION'] *
       TYPEOF(mi\mapped_item.mapping_source.mapped_representation)) = 1)
       )) = 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **hybrid_shape_representation** shall not have any **representation_item** instances in its set of **items** that are not of type **boolean_result**, **csg_solid**, **truncated_pyramid**, **block**, **torus**, **right_circular_-cylinder**, **sphere**, **right_circular_cone**, **extruded_area_solid**, **revolved_area_solid**, **manifold_solid_brep**,

conic, **curve**, **b_spline_curve**, **line**, **point**, **polyline**, **surface**, **vector**, **geometric_representation_item**, **axis2_placement_3d**, **measure_representation_item**, or **mapped_item**.

WR2: If there is a **mapped_item** in a **hybrid_shape_representation**, the source of the **mapped_item** shall be an **advanced_csg_shape_representation** or a **hybrid_shape_representation**.

5.2.3.28 inline_equipment

An **inline_equipment** is a type of **piping_component_definition** that identifies an item that is inserted into the flow of a process stream.

EXPRESS specification:

```
*)
ENTITY inline_equipment
  SUBTYPE OF (piping_component_definition);
END_ENTITY;
(*
```

5.2.3.29 insert_fitting_classification

An **insert_fitting_classification** is a type of **group** that classifies the items that are assigned to it as insert fittings.

EXPRESS specification:

```
*)
ENTITY insert_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to an **insert_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'insert_fitting_dimensional_shape', and shall have at least one **representation_item** with the name 'end_to_end_length'.

5.2.3.30 instrumentation_and_control_system

An **instrumentation_and_control_system** is a type of **product_definition** that identifies a system of wiring, switches, controls, and other equipment associated with monitoring and controlling performance characteristics.

EXPRESS specification:

```
*)
ENTITY instrumentation_and_control_system
  SUBTYPE OF (product_definition);
WHERE
  WR1: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
       ('PLANT_SPATIAL_CONFIGURATION.PLANT' IN TYPEOF
       (pdr.relating_product_definition.formation.of_product)) AND
       (pdr.relating_product_definition.frame_of_reference.name =
       'functional_occurrence'))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **instrumentation_and_control_system** shall be related to exactly one **product_definition** which is the definition of a plant and has a context of 'functional_occurrence'.

5.2.3.31 interfering_shape_element

An **interfering_shape_element** identifies a portion of the shape of an item that interferes with the shape of another item.

EXPRESS specification:

```
*)
ENTITY interfering_shape_element
  SUBTYPE OF (shape_aspect, shape_aspect_relationship);
END_ENTITY;
(*
```

5.2.3.32 lap_joint_stub_end_fitting_classification

A **lap_joint_stub_end_fitting_classification** is a type of **group** that classifies the items that are assigned to it.

EXPRESS specification:

```
*)
ENTITY lap_joint_stub_end_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.33 lateral_fitting_classification

A **lateral_fitting_classification** is a type of **group** that classifies the items that are assigned to it as lateral fittings.

EXPRESS specification:

```
*)
ENTITY lateral_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **lateral_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'lateral_fitting_dimensional_shape', and shall have at least four **representation_item**s with the names 'centre_to_end_1_length', 'centre_to_end_2_length', 'centre_to_end_3_length', and 'branch_angle'.

5.2.3.34 line_branch_connection

A **line_branch_connection** is a type of **shape_aspect_relationship** that identifies the connection between a line and a branch.

EXPRESS specification:

```
*)
ENTITY line_branch_connection
  SUBTYPE OF (shape_aspect_relationship);
WHERE
  WR1: SELF.description = 'branch_location';
  WR2: 'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_DEFINITION'
       IN TYPEOF (SELF.relating_shape_aspect.of_shape.definition);
  WR3: 'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_TERMINATION'
       IN TYPEOF (SELF.related_shape_aspect);
END_ENTITY;
(*
```

Formal propositions:

WR1: The value of **line_branch_connection.description** shall be 'branch_location'.

WR2: The **product_definition** to which the **relating_shape_aspect** of a **line_branch_connection** is related shall be a **plant_line_segment_definition**.

WR3: The **related_shape_aspect** of a **line_branch_connection** shall be a **plant_line_segment_-termination**.

5.2.3.35 line_less_piping_system

A **line_less_piping_system** is a type of **product_definition** that identifies a piping system that is nor part of a line.

EXPRESS specification:

```
*)
ENTITY line_less_piping_system
  SUBTYPE OF (product_definition);
END_ENTITY;
(*
```

5.2.3.36 line_plant_item_branch_connection

A **line_plant_item_branch_connection** is a **shape_aspect_relationship** that identifies the connection between a branch and a connector.

EXPRESS specification:

```
*)
ENTITY line_plant_item_branch_connection
  SUBTYPE OF (shape_aspect_relationship);
END_ENTITY;
(*
```

5.2.3.37 line_plant_item_connection

A **line_plant_item_ connection** is a **shape_aspect_relationship** that identifies the connection between a line segment and a connector.

EXPRESS specification:

```
*)
ENTITY line_plant_item_connection
  SUBTYPE OF (shape_aspect_relationship);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_TERMINATION'
       IN TYPEOF (SELF.relating_shape_aspect);
  WR2: 'PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_CONNECTOR'
       IN TYPEOF (SELF.related_shape_aspect);
  WR3: ('PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_DEFINITION' IN
       TYPEOF (SELF.related_shape_aspect.of_shape.definition));
END_ENTITY;
(*
```

Formal propositions:

WR1: The **relating_shape_aspect** of a **line_plant_item_connection** shall be a **plant_line_segment_-termination**.

WR2: The **related_shape_aspect** of a **line_plant_item_connection** shall be a **plant_item_connector**.

WR3: The **product_definition** to which the **related_shape_aspect** of a **line_plant_item_connection** is related shall be a **plant_item_definition** or an **externally_defined_plant_item_definition**.

5.2.3.38 line_termination_connection

A **line_termination_connection** is a type of **shape_aspect_relationship** that identifies a connection between two line segment terminations, or between a line segment termination and a connection node.

EXPRESS specification:

```
*)
ENTITY line_termination_connection
  SUBTYPE OF (shape_aspect_relationship);
WHERE
  WR1: SIZEOF (TYPEOF (SELF.relating_shape_aspect) *
       ['PLANT_SPATIAL_CONFIGURATION.CONNECTION_NODE',
        'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_TERMINATION']
       ) >= 1;
  WR2: 'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_TERMINATION'
       IN TYPEOF (SELF.related_shape_aspect);
END_ENTITY;
(*
```

Formal propositions:

WR1: The **relating_shape_aspect** of a **line_termination_connection** shall be a **connection_node** or a **plant_line_segment_termination**.

WR2: The **related_shape_aspect** of a **line_termination_connection** shall be a **plant_line_segment_-termination**.

5.2.3.39 olet_fitting_classification

An **olet_fitting_classification** is a type of **group** that classifies the items that are assigned to it as olet fittings.

EXPRESS specification:

```
*)
ENTITY olet_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.40 orifice_plate_fitting_classification

An **orifice_plate_fitting_classification** is a type of **group** that classifies the items that are assigned to it as orifice plate fittings.

EXPRESS specification:

```
*)
ENTITY orifice_plate_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.41 pipe_cap_fitting_classification

A **pipe_cap_fitting_classification** is a type of **group** that classifies the items that are assigned to it as pipe cap fittings. The name of the **pipe_cap_fitting_classification** may further classify the assigned items.

EXPRESS specification:

```
*)
ENTITY pipe_cap_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.42 pipe_classification

A **pipe_classification** is a type of **group** that classifies the items are assigned to it as pipes. The name of the **pipe_classification** may further classify the assigned items.

EXPRESS specification:

```
*)
ENTITY pipe_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.43 piping_component_definition

A **piping_component_definition** is a type of **product_definition** that defines a piping component.

EXPRESS specification:

```
*)
ENTITY piping_component_definition
  SUBTYPE OF (product_definition);
WHERE
  WR1: (SIZEOF (USEDIN (SELF\product_definition.formation.of_product,
        'PLANT_SPATIAL_CONFIGURATION.' +
        'PRODUCT_RELATED_PRODUCT_CATEGORY.PRODUCTS')) =1)
        AND
       (SIZEOF (QUERY (prpc <*
        USEDIN (SELF\product_definition.formation.of_product,
        'PLANT_SPATIAL_CONFIGURATION.' +
```

```
        'PRODUCT_RELATED_PRODUCT_CATEGORY.PRODUCTS') |
        prpc\product_category.name IN
        ['ducting_component', 'equipment', 'fitting', 'instrument'] )) =1);
  WR2: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'MATERIAL_DESIGNATION.OF_PRODUCT')) = 1;
  WR3: SIZEOF (QUERY (pscdr <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.' +
       'PLANT_SPATIAL_CONFIGURATION_DOCUMENT_REFERENCE.ITEMS') |
       pscdr\document_reference.assigned_document.kind.product_data_type
       = 'material_specification')) >= 1;
  WR4: SIZEOF (QUERY (prop_def <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.PROPERTY_DEFINITION.DEFINITION') |
       SIZEOF (QUERY (pdr <* USEDIN (prop_def,
       'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
       NOT (('PLANT_SPATIAL_CONFIGURATION.SHAPE_DEFINITION_REPRESENTATION'
         IN TYPEOF (pdr))
       AND
       ('PLANT_SPATIAL_CONFIGURATION.SHAPE_DIMENSION_REPRESENTATION' IN
         TYPEOF (pdr.used_representation))
       AND
       (pdr.used_representation.name = 'nominal_size')
       AND
       (SIZEOF (pdr.used_representation.items) = 1)
       AND
       (SIZEOF (QUERY (it <* pdr.used_representation.items |
        NOT ('PLANT_SPATIAL_CONFIGURATION.LENGTH_MEASURE_WITH_UNIT' IN
        TYPEOF (it)))) = 0)
       ))) = 0
       )) = 1;
  WR5: SIZEOF (QUERY (prop_def <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.PROPERTY_DEFINITION.DEFINITION') |
       SIZEOF (QUERY (pdr <* USEDIN (prop_def,
       'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
       NOT (
       (pdr.used_representation.name = 'design_pressure_rating')
       AND
       (SIZEOF (pdr.used_representation.items) = 1)
       AND
       ('PLANT_SPATIAL_CONFIGURATION.MEASURE_WITH_UNIT' IN
        TYPEOF (pdr.used_representation.items[1]))
       ))) = 0
       )) > 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **piping_component_definition** shall have a **product** which is in one of the product categories 'ducting_component', 'equipment', 'fitting', or 'instrument'.

WR2: A **piping_component_definition** shall be referenced by exactly one **material_designation**.

WR3: A **piping_component_definition** shall be referenced by at least one **plant_spatial_configuration_-document_reference** that references a document whose document type is a material specification.

WR4: A **piping_component_definition** shall be referenced by exactly one **shape_definition_-representation** whose **representation** is a **shape_dimension_representation** that has a name of 'nominal_size' that contains exactly one item, and whose single item is a **length_measure_with_unit**.

WR5: A **piping_component_definition** shall be referenced by at least one **property_definition_-representation** whose **representation** has a name of 'design_pressure_rating' and whose single item is a **measure_with_unit**.

5.2.3.44 piping_connector_classification

A **piping_connector_classification** is a type of **group** that classifies the items that are assigned to it as being piping connectors.

EXPRESS specification:

```
*)
ENTITY piping_connector_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.45 piping_design_csg_shape_representation

A **piping_design_csg_shape_representation** is a type of **shape_representation** that is composed of CSG primitives and boolean operators and is used to represent the shape of the piping design.

EXPRESS specification:

```
*)
ENTITY piping_design_csg_shape_representation
  SUBTYPE OF (shape_representation);
WHERE
  WR1: SIZEOF (QUERY (i <* SELF\representation.items |
       SIZEOF (['PLANT_SPATIAL_CONFIGURATION.BOOLEAN_RESULT',
                'PLANT_SPATIAL_CONFIGURATION.CSG_SOLID',
                'PLANT_SPATIAL_CONFIGURATION.AXIS2_PLACEMENT_3D',
                'PLANT_SPATIAL_CONFIGURATION.MAPPED_ITEM'] *
               TYPEOF(i)) = 0
       )) = 0;
  WR2: SIZEOF (QUERY (mi <* QUERY (item <* SELF\representation.items |
       ('PLANT_SPATIAL_CONFIGURATION.MAPPED_ITEM' IN TYPEOF(item))) |
       NOT ('PLANT_SPATIAL_CONFIGURATION.' +
            'PIPING_DESIGN_CSG_SHAPE_REPRESENTATION' IN
       TYPEOF(mi\mapped_item.mapping_source.mapped_representation))
       )) = 0;
```

```
END_ENTITY;
(*
```

Formal propositions:

WR1: A **piping_design_csg_shape_representation** shall not have any **representation_item** instances in its set of **items** that are not of type **boolean_result**, **csg_solid**, **axis2_placement_3d**, or **mapped_item**.

WR2: If there is a **mapped_item** in a **piping_design_csg_shape_representation**, the source of the **mapped_item** shall be a **piping_design_csg_shape_representation**.

5.2.3.46 piping_system

A **piping_system** is a type of **product_definition** that identifies a system of interconnected objects convey fluid, vapour, or particulate flow.

EXPRESS specification:

```
*)
ENTITY piping_system
  SUBTYPE OF (product_definition);
WHERE
  WR1: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
       ('PLANT_SPATIAL_CONFIGURATION.PLANT' IN TYPEOF
       (pdr.relating_product_definition.formation.of_product)) AND
       (pdr.relating_product_definition.frame_of_reference.name =
       'functional_occurrence'))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **piping_system** shall be related to exactly one **product_definition** which is the definition of a plant and has a context of 'functional_occurrence'.

5.2.3.47 plant

A **plant** is a type of **product** that identifies a process plant facility.

EXPRESS specification:

```
*)
ENTITY plant
  SUBTYPE OF (product);
WHERE
  WR1: (SIZEOF (QUERY (pscoa <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.'+
        'PLANT_SPATIAL_CONFIGURATION_ORGANIZATION_ASSIGNMENT.ITEMS')  |
```

```
        pscoa\organization_assignment.role.name =
        'plant_operator')) +
        SIZEOF (QUERY (pscpaoa <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.'+
        'PLANT_SPATIAL_CONFIGURATION_PERSON_AND_ORGANIZATION_ASSIGNMENT.' +
        'ITEMS') | (pscpaoa\person_and_organization_assignment.role.name =
        'plant_operator')))) <= 1;
  WR2: (SIZEOF (QUERY ( pscoa <* USEDIN(SELF,
        'PLANT_SPATIAL_CONFIGURATION.'+
        'PLANT_SPATIAL_CONFIGURATION_ORGANIZATION_ASSIGNMENT.ITEMS') |
        pscoa\organization_assignment.role.name = 'plant_owner')) +
        SIZEOF( QUERY( pscpaoa <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.'+
        'PLANT_SPATIAL_CONFIGURATION_PERSON_AND_ORGANIZATION_ASSIGNMENT.' +
        'ITEMS') | (pscpaoa\person_and_organization_assignment.role.name =
        'plant_owner'))) +
        SIZEOF (QUERY (pscpa <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.'+
        'PLANT_SPATIAL_CONFIGURATION_PERSON_ASSIGNMENT.ITEMS') |
        (pscpa\person_assignment.role.name = 'plant_owner')))) >= 1;
  WR3: (SIZEOF (QUERY (pscoa <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.'+
        'PLANT_SPATIAL_CONFIGURATION_ORGANIZATION_ASSIGNMENT.ITEMS')  |
        (pscoa\organization_assignment.role.name =
        'plant_project_owner'))) +
        SIZEOF (QUERY (pscpaoa <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.'+
        'PLANT_SPATIAL_CONFIGURATION_PERSON_AND_ORGANIZATION_ASSIGNMENT.' +
        'ITEMS') | (pscpaoa\person_and_organization_assignment.role.name =
        'plant_project_owner')))) >= 1;
  WR4:  SIZEOF (QUERY (pdf <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.' +
        'PRODUCT_DEFINITION_FORMATION.OF_PRODUCT') |
        NOT (SIZEOF (QUERY (pd <* USEDIN (pdf,
        'PLANT_SPATIAL_CONFIGURATION.PRODUCT_DEFINITION.FORMATION') |
        (pd.frame_of_reference.name = 'functional_occurrence'))) <= 1))) =
        0;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **plant** is associated with zero or one **person_and_organization** or **organization** in the role of plant operator.

WR2: A **plant** is associated with at least one **organization**, **person_and_organization**, or **person** in the role of plant owner.

WR3: A **plant** is associated with at least one **person_and_organization** or **organization** in the role of plant project owner.

WR4: A **plant** shall be related to at most one **product_definition** which has a context of 'functional_-occurrence'.

5.2.3.48 plant_item_connection

A **plant_item_connection** is a type of **shape_aspect** and **shape_aspect**_relationship that identifies a connection between plant items.

EXPRESS specification:

```
*)
ENTITY plant_item_connection
  SUBTYPE OF(shape_aspect, shape_aspect_relationship);
WHERE
  WR1: SELF\shape_aspect_relationship.name IN
       ['connection_definition', 'connection_occurrence'];
  WR2: 'PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_CONNECTOR' IN
       TYPEOF (SELF\shape_aspect_relationship.relating_shape_aspect);
  WR3: 'PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_CONNECTOR' IN
       TYPEOF (SELF\shape_aspect_relationship.related_shape_aspect);
  WR4: SELF\shape_aspect.of_shape.definition.frame_of_reference.name IN
       ['functional_occurrence', 'physical_occurrence',
        'functional_definition', 'physical_definition'];
  WR5: (SELF\shape_aspect_relationship.relating_shape_aspect.
             of_shape.definition.frame_of_reference.name =
        SELF\shape_aspect_relationship.related_shape_aspect.
             of_shape.definition.frame_of_reference.name);
  WR6: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'CLASSIFICATION_ASSIGNMENT.ITEMS')) > 0;
  WR7: SIZEOF (QUERY (pscca <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.CLASSIFICATION_ASSIGNMENT.ITEMS') |
       NOT (
       SIZEOF (['PLANT_SPATIAL_CONFIGURATION.' +
                'CONNECTION_FUNCTIONAL_CLASSIFICATION',
                'PLANT_SPATIAL_CONFIGURATION.' +
                'CONNECTION_MOTION_CLASSIFICATION'] *
       TYPEOF (pscca\group_assignment.assigned_group)) > 1
       ))) = 0;
  WR8: SIZEOF (QUERY (pdr <* USEDIN (SELF\shape_aspect.of_shape.definition,
       'PLANT_SPATIAL_CONFIGURATION.PRODUCT_DEFINITION_RELATIONSHIP.' +
       'RELATED_PRODUCT_DEFINITION') |
       (pdr.name = 'support_usage_connection'))) <= 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The name of a **plant_item_connection** shall be 'connection_definition' or 'connection_occurrence'.

WR2: The **relating_shape_aspect** of a **plant_item_connection** shall be a **plant_item_connector**.

WR3: The **related_shape_aspect** of a **plant_item_connection** shall be a **plant_item_connector**.

WR4: The **application_context_element** that applies to a **plant_item_connection** shall have the name 'functional_occurrence', 'physical_occurrence', 'functional_definition', or 'physical_definition'.

WR5: The **application_context_element**s that apply to the **relating_shape_aspect** and the **related_shape_aspect** of a **plant_item_connection** shall have the same name.

WR6: A **plant_item_connection** shall be classified at least once.

WR7: A **plant_item_connection** shall be classified as a **connection_functional_classification**, as a **connection_functional_classification**, or as both.

WR8: The **product_definition** of the **plant_item_connection** shall be the related **product_definition** in at most one **product_definition_relationship** with a name of 'support_usage_connection'.

5.2.3.49 plant_item_connector

A **plant_item_connector** is a type of **shape_aspect** that identifies a feature of a plant item that is designed to connect to another connector.

EXPRESS specification:

```
*)
ENTITY plant_item_connector
  SUBTYPE OF(shape_aspect);
WHERE
  WR1: SELF.of_shape.definition.frame_of_reference.name IN
       ['functional_definition', 'physical_definition',
        'functional_occurrence', 'physical_occurrence'];
  WR2: SIZEOF (QUERY (pic <*
     (bag_to_set (USEDIN (SELF,'PLANT_SPATIAL_CONFIGURATION.' +
     'SHAPE_ASPECT_RELATIONSHIP.RELATED_SHAPE_ASPECT')) +
     bag_to_set (USEDIN (SELF,'PLANT_SPATIAL_CONFIGURATION.' +
     'SHAPE_ASPECT_RELATIONSHIP.RELATING_SHAPE_ASPECT'))) |
     'PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_CONNECTION' IN
     TYPEOF (pic))) <= 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **application_context_element** that applies to a **plant_item_connector** (as its **product_definition_context**) shall have the name 'functional_definition', 'physical_definition' 'functional_occurrence', or 'physical_occurrence'.

WR2: The **plant_item_connector** shall be the connector in at most one **plant_item_connection**.

5.2.3.50 plant_item_definition

A **plant_item_definition** is a type of **product_definition** that identifies an item or piece of equipment that may be used as a component of a plant.

EXPRESS specification:

```
*)
ENTITY plant_item_definition
  SUBTYPE OF (product_definition);
WHERE
  WR1: SELF.frame_of_reference\application_context_element.name IN
       ['functional_definition', 'physical_definition',
        'functional_occurrence', 'physical_occurrence',
        'fabrication_assembly'];
  WR2: (NOT (SELF.frame_of_reference.name = 'physical_occurrence')) OR
       (SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
       SIZEOF (TYPEOF (pdr) *
         ['PLANT_SPATIAL_CONFIGURATION.PRODUCT_DEFINITION_USAGE',
          'PLANT_SPATIAL_CONFIGURATION.MAKE_FROM_USAGE_OPTION',
          'PLANT_SPATIAL_CONFIGURATION.ASSEMBLY_COMPONENT_USAGE']) = 1
       )) <= 1);
  WR3: (NOT (SELF.frame_of_reference.name = 'physical_definition')) OR
       (SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATING_PRODUCT_DEFINITION') |
       pdr.related_product_definition.frame_of_reference.name =
       'physical_occurrence')) <= 1);
  WR4: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATING_PRODUCT_DEFINITION') |
       ('PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_DEFINITION_CLASS'
       IN TYPEOF (pdr.related_product_definition)) )) <= 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **name** of the **product_definition_context** of a **plant_item_definition** shall be 'functional_-definition', 'physical_definition', 'functional_occurrence', 'physical_occurrence', or 'fabrication_assembly'.

WR2: If the **name** of the **product_definition_context** is 'physical_occurrence', the **plant_item_definition** shall be the related **product_definition** in at most one **product_definition_usage**, **make_from_usage_-option**, or **assembly_component_usage**.

WR3: If the **name** of the **product_definition_context** is 'physical_definition', the **plant_item_definition** shall be related to at most one **product_definition** that has a **name** of 'physical_occurrence' for the **product_definition_context**.

WR4: The **plant_item_definition** shall be related to at most one **plant_item_definition_class**.

5.2.3.51 plant_item_definition_class

A **plant_item_definition_class** is a type of **product_definition_with_associated_documents** that identifies the documents that define a specification class associated with a **plant_item_definition**.

EXPRESS specification:

```
*)
ENTITY plant_item_definition_class
  SUBTYPE OF (product_definition_with_associated_documents);
END_ENTITY;
(*
```

5.2.3.52 plant_item_interference

A **plant_item_interference** is a type of **product_definition_relationship** that identifies interference between plant items.

EXPRESS specification:

```
*)
ENTITY plant_item_interference
  SUBTYPE OF (product_definition_relationship);
END_ENTITY;
(*
```

5.2.3.53 plant_item_route

A **plant_item_route** is a type of **product_definition_shape** that identifies the 3D path of a **plant_line_definition** or a **plant_line_segment_definition**.

EXPRESS specification:

```
*)
ENTITY plant_item_route
  SUBTYPE OF (product_definition_shape);
WHERE
  WR1: SELF\property_definition.definition.
       frame_of_reference\application_context_element.name =
       'physical_occurrence';
  WR2: SIZEOF (TYPEOF (SELF\property_definition.definition) *
       ['PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_DEFINITION',
        'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_DEFINITION'])
       = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **name** of the **product_definition_context** to which a **plant_item_route** is related shall be 'physical_occurrence'.

WR2: A **plant_item_route** shall be the definition of the shape of a **plant_line_definition** or a **plant_line_segment_definition**.

5.2.3.54 plant_item_weight_representation

A **plant_item_weight_representation** is a type of **property_definition_representation** that identifies the weight of plant items.

EXPRESS specification:

```
*)
ENTITY plant_item_weight_representation
  SUBTYPE OF (property_definition_representation);
WHERE
  WR1: SELF.used_representation.name = 'item_weight';
  WR2: SIZEOF (SELF.used_representation.items) >= 2;
  WR3: SIZEOF (QUERY (it <* SELF.used_representation.items |
       ('PLANT_SPATIAL_CONFIGURATION.DESCRIPTIVE_REPRESENTATION_ITEM'
       IN TYPEOF (it)) AND
       (it.name = 'weight_state' ))) = 1;
  WR4: SIZEOF (QUERY (it <* SELF.used_representation.items |
       ('PLANT_SPATIAL_CONFIGURATION.MEASURE_REPRESENTATION_ITEM'
       IN TYPEOF (it)) AND
       (it.name IN ['weight_value', 'mass_value'] ))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **name** of the **representation** shall be 'item_weight'.

WR2: The **representation** shall contain at least two items.

WR3: The **representation** shall contain exactly one **descriptive_representation_item** that has a name of 'weight_state'.

WR4: The **representation** shall contain exactly one **measure_representation_item** that has a name of 'weight_value' or 'mass_value'.

5.2.3.55 plant_line_definition

A **plant_line_definition** is a type of **product_definition_with_associated_documents** that identifies a piping system line.

EXPRESS specification:

```
*)
ENTITY plant_line_definition
  SUBTYPE OF (product_definition_with_associated_documents);
WHERE
  WR1: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
         'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
```

```
        ('PLANT_SPATIAL_CONFIGURATION.PIPING_SYSTEM' IN
         TYPEOF (pdr.relating_product_definition))
        )) = 1;
  WR2: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
          'PRODUCT_DEFINITION_RELATIONSHIP.RELATING_PRODUCT_DEFINITION') |
        ('PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_DEFINITION' IN
         TYPEOF (pdr.related_product_definition))
        )) > 0;
  WR3: ((NOT(
        SIZEOF (QUERY( pd <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.PROPERTY_DEFINITION.DEFINITION') |
        SIZEOF (USEDIN (pd, 'PLANT_SPATIAL_CONFIGURATION.' +
        'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION')) > 0 )) = 0))
        XOR
        (SIZEOF (QUERY (pd <* USEDIN (SELF,
        'PLANT_SPATIAL_CONFIGURATION.PROPERTY_DEFINITION.DEFINITION') |
        (SIZEOF (QUERY (pdr <* USEDIN (pd,
        'PLANT_SPATIAL_CONFIGURATION.' +
        'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
        (SIZEOF (QUERY (rep <* USEDIN (
                pdr.used_representation.context_of_items,
        'PLANT_SPATIAL_CONFIGURATION.REPRESENTATION.CONTEXT_OF_ITEMS') |
        (SIZEOF (QUERY (prop_def_rep <* USEDIN( rep,
        'PLANT_SPATIAL_CONFIGURATION.' +
        'PROPERTY_DEFINITION_REPRESENTATION.USED_REPRESENTATION') |
        (SIZEOF (['PLANT_SPATIAL_CONFIGURATION.SITE',
                  'PLANT_SPATIAL_CONFIGURATION.SITE_BUILDING'] *
                 TYPEOF(prop_def_rep.definition)) = 0)
         AND
         (NOT ('PLANT_SPATIAL_CONFIGURATION.SITE' IN
         TYPEOF (prop_def_rep.definition.definition)))
         AND
         (NOT ('PLANT_SPATIAL_CONFIGURATION.PLANT' IN
         TYPEOF(prop_def_rep.definition.definition.formation.of_product)))
         )) > 0)
         )) > 0)
         )) > 0)
         )) = 0));
  WR4: SELF.frame_of_reference.life_cycle_stage = 'design';
  WR5: SELF.frame_of_reference\application_context_element.name =
       'system';
END_ENTITY;
(*
```

Formal propositions:

WR1: A **plant_line_definition** shall be related to exactly one **piping_system**.

WR2: A **plant_line_definition** shall be related to at least one **plant_line_segment_definition**.

WR3: If a **plant_line_definition** has a **representation**, that **representation** shall be in the context of a **site_building**, a **site**, or a **plant**.

WR4: A **plant_line_definition** shall have **product_definition_context.life_cycle_stage** of 'design'.

WR5: A **plant_line_definition** shall have an **application_context_element.name** of 'system'.

5.2.3.56 plant_line_segment_definition

A **plant_line_segment_definition** is a type of **product_definition** that identifies a line segment.

EXPRESS specification:

```
*)
ENTITY plant_line_segment_definition
  SUBTYPE OF (product_definition);
WHERE
  WR1: SIZEOF (QUERY (pdr <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
       'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_DEFINITION'
       IN TYPEOF(pdr.relating_product_definition)
       )) > 0;
  WR2: SIZEOF (QUERY( pd <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.PROPERTY_DEFINITION.DEFINITION') |
       ('PLANT_SPATIAL_CONFIGURATION.SHAPE_DEFINITION' IN TYPEOF (pd))
       )) > 1;
  WR3: SELF.frame_of_reference\application_context_element.name =
       'functional_definition';
END_ENTITY;
(*
```

Formal propositions:

WR1: A **plant_line_segment_definition** shall be the **related_product_definition** in a **product_definition_relationship** which has a **relating_product_definition** that is a **plant_line_definition**.

WR2: A **plant_line_segment_definition** shall be referenced by a **shape_definition**.

5.2.3.57 plant_line_segment_termination

A **plant_line_segment_termination** is a type of **shape_aspect** that identifies the termination of a line segment.

EXPRESS specification:

```
*)
ENTITY plant_line_segment_termination
  SUBTYPE OF (shape_aspect);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.PLANT_LINE_SEGMENT_DEFINITION'
       IN TYPEOF (SELF.of_shape.definition);
  WR2: SIZEOF (QUERY (sar <*
       (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
        'SHAPE_ASPECT_RELATIONSHIP.RELATING_SHAPE_ASPECT') +
        USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
```

```
        'SHAPE_ASPECT_RELATIONSHIP.RELATED_SHAPE_ASPECT')) |
      NOT (SIZEOF (TYPEOF (sar) *
      ['PLANT_SPATIAL_CONFIGURATION.LINE_BRANCH_CONNECTION',
       'PLANT_SPATIAL_CONFIGURATION.LINE_PLANT_ITEM_CONNECTION',
       'PLANT_SPATIAL_CONFIGURATION.LINE_TERMINATION_CONNECTION'])
      > 0
      ))) = 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **plant_line_segment_termination** is an aspect of the shape of a **plant_line_segment_definition**.

WR2: A **plant_line_segment_termination** is the **relating_shape_aspect** or the **related_shape_aspect** in at least one **shape_aspect_relationship** that is a **line_branch_connection**, **line_plant_item_connection**, or **line_termination_connection**.

5.2.3.58 plant_spatial_configuration_action_request_assignment

A **plant_spatial_configuration_action_request_assignment** assigns an **action_request** to one or more **products**.

```
*)
ENTITY plant_spatial_configuration_action_request_assignment
  SUBTYPE OF (action_request_assignment);
  items : SET [1:?] OF plant_spatial_configuration_action_request_item;
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **products** to which an **action_request** is assigned.

5.2.3.59 plant_spatial_configuration_approval_assignment

A **plant_spatial_configuration_approval_assignment** assigns an **approval** to one or more **change_actions**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_approval_assignment
  SUBTYPE OF (approval_assignment);
  items : SET [1:?] OF approval_item;
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **change_actions** to which an **approval** is assigned.

5.2.3.60 plant_spatial_configuration_change_assignment

A **plant_spatial_configuration_change_assignment** assigns a **change_action** to a set of one or more **change_items**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_change_assignment
  SUBTYPE OF (action_assignment);
  items : SET [1:?] OF change_item;
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.CHANGE_ACTION'
       IN TYPEOF (SELF.assigned_action);
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **change_items** to which an action is assigned.

Formal propositions:

WR1: The assigned action shall be a **change_action**.

5.2.3.61 plant_spatial_configuration_date_and_time_assignment

A **plant_spatial_configuration_date_and_time_assignment** assigns a **date_and_time** to a **product**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_date_and_time_assignment
  SUBTYPE OF (date_and_time_assignment);
  items : SET [1:?] OF plant_spatial_configuration_date_and_time_item;
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **products** to which a **date_and_time** is assigned.

5.2.3.62 plant_spatial_configuration_date_assignment

A **plant_spatial_configuration_date_assignment** assigns a **date** to a **change_action**, **action_directive**, **product**, or **change_item**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_date_assignment
  SUBTYPE OF (date_assignment);
  items : SET [1:?] OF plant_spatial_configuration_dated_item;
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **change_action**, **action_directive**, **product**, or **change_item** to which a **date** is assigned.

5.2.3.63 plant_spatial_configuration_document_reference

A **plant_spatial_configuration_document_reference** assigns a **document** to one or more **plant_item_connector**, **heat_tracing_representation**, **product_definition**, **site**, **shape_dimension_representation**, **piping_system**, **plant_line_segment_definition**, **piping_component_definition**, **product**, **property_definition**, **external_source**, **representation**, **product_definition_relationship** or **plant_item_definition**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_document_reference
  SUBTYPE OF (document_reference);
  items : SET [1:?] OF plant_spatial_configuration_document_item;
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **plant_item_connector**, **heat_tracing_representation**, **product_definition**, **site**, **shape_dimension_representation**, **piping_system**, **plant_line_segment_definition**, **piping_component_definition**, **product**, **property_definition**, **external_source**, **representation**, **product_definition_relationship** or **plant_item_definition** that is associated with a **document**.

5.2.3.64 plant_spatial_configuration_organization_assignment

A **plant_spatial_configuration_organization_assignment** assigns an **organization** to one or more **change_action**, **site**, **plant**, **design_project**, **product**, **product_definition_relationship**, or **document**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_organization_assignment
  SUBTYPE OF (organization_assignment);
  items : SET [1:?] OF plant_spatial_configuration_organization_item;
WHERE
  WR1: plant_spatial_configuration_organization_correlation (SELF);
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **change_action**, **site**, **plant**, **design_project**, **product**, **product_definition_relationship**, **document** to which an **organization** is assigned.

Formal propositions:

WR1: The **plant_spatial_configuration_organization_correlation** function that correlates roles of organizations to elements of product data shall be satisfied.

5.2.3.65 plant_spatial_configuration_person_and_organization_assignment

A plant_**spatial_configuration_person_and_organization_assignment** assigns a **person_and_-organization** to one or more **site**, **plant**, or **change_item**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_person_and_organization_assignment
  SUBTYPE OF (person_and_organization_assignment);
  items : SET [1:?] OF
          plant_spatial_configuration_person_and_organization_item;
WHERE
  WR1: plant_spatial_configuration_person_and_organization_correlation
       (SELF);
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **site**, **plant**, or **change_item** to which a **person_and_organization** is assigned.

Formal propositions:

WR1: The **plant_spatial_configuration_person_and_organization_correlation** function that correlates roles of persons and organizations to elements of product data shall be satisfied.

5.2.3.66 plant_spatial_configuration_person_assignment

A **plant_spatial_configuration_person_assignment** assigns a **person** to one or more **site**, **plant**, or **document**.

EXPRESS specification:

```
*)
ENTITY plant_spatial_configuration_person_assignment
  SUBTYPE OF (person_assignment);
  items : SET [1:?] OF plant_spatial_configuration_person_item;
WHERE
  WR1: plant_spatial_configuration_person_correlation (SELF);
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **site**, **plant**, or **document** to which a **person** is assigned.

Formal propositions:

WR1: The **plant_spatial_configuration_person_correlation** function that correlates roles of persons to elements of product data shall be satisfied.

5.2.3.67 process_capability

A **process_capability** is a type of **property_definition** that identifies the physical or chemical process that is, or is intended to be, carried out by a **plant**.

EXPRESS specification:

```
*)
ENTITY process_capability
  SUBTYPE OF (property_definition);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.PLANT' IN
       TYPEOF(SELF.definition\product_definition.formation.of_product);
  WR2: SIZEOF (QUERY (pdr <* USEDIN (SELF,
       'PLANT_SPATIAL_CONFIGURATION.PROPERTY_DEFINITION_REPRESENTATION.' +
       'DEFINITION') |
       (pdr.used_representation.name = 'production_capacity') AND
       (NOT (SIZEOF (QUERY (it <* pdr.used_representation.items |
       ('PLANT_SPATIAL_CONFIGURATION.DESCRIPTIVE_REPRESENTATION_ITEM'
       IN TYPEOF (it)) AND
       (it.name = 'production_type'))) = 1)))) = 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **process_capability** is a property of a **plant**.

WR2: The **representation** instances associated with a **process_capability** shall have a name of 'production_capacity' and shall contain exactly one **descriptive_representation_item** with a name of 'production_type'.

5.2.3.68 purchase_assignment

A **purchase_assignment** assigns a **product** to an **action** to identify that the **product** is purchased.

EXPRESS specification:

```
*)
ENTITY purchase_assignment
  SUBTYPE OF (action_assignment);
  items : SET [1:?] OF purchase_item;
END_ENTITY;
(*
```

Attribute definitions:

items: the set of **products** that are purchased.

5.2.3.69 reducer_fitting_classification

A **reducer_fitting_classification** is a type of **group** that classifies the items that are assigned to it as reducer fittings.

EXPRESS specification:

```
*)
ENTITY reducer_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **reducer_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'reducer_fitting_dimensional_shape', and shall have at least one **representation_item** with the name 'end_to_end_length'.

5.2.3.70 reference_geometry

A **reference_geometry** is a type of **derived_shape_aspect** that

EXPRESS specification:

```
*)
ENTITY reference_geometry
  SUBTYPE OF (derived_shape_aspect);
WHERE
  WR1: SIZEOF (QUERY (pd <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION.DEFINITION') |
       NOT (SIZEOF (USEDIN (pd, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION')) >= 1))) = 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: Each **reference_geometry** shall have at least one **representation**s.

5.2.3.71 reserved_space

A **reserved_space** is a type of **shape_aspect** that identifies a space that is reserved for a plant item.

```
*)
ENTITY reserved_space
  SUBTYPE OF (shape_aspect);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_DEFINITION'
       IN TYPEOF (SELF.of_shape.definition);
END_ENTITY;
(*
```

Formal propositions:

WR1: A **reserved_space** shall be an aspect of the definition of the shape of a **plant_item_definition**.

5.2.3.72 site

A **site** is a type of **characterized_object** and **property_definition** that identifies the geographic and topographic characteristics of the location of a plant.

EXPRESS specification:

```
*)
ENTITY site
  SUBTYPE OF (characterized_object,property_definition);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.PLANT' IN
```

```
        TYPEOF(SELF\property_definition.definition\product_definition.
               formation.of_product);
END_ENTITY;
(*
```

Formal propositions:

WR1: Each **site** shall be a property of a **plant**.

5.2.3.73 site_building

A **site_building** is a type of **property_definition** that identifies partially or totally enclosed structure located on a site.

EXPRESS specification:

```
*)
ENTITY site_building
  SUBTYPE OF (property_definition);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.SITE' IN
       TYPEOF (SELF.definition);
  WR2: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION')) > 2;
  WR3: coordinated_representation_names_and_item_types (SELF);
END_ENTITY;
(*
```

Formal propositions:

WR1: A **site_building** shall be a property of a site.

WR2: A **site_building** shall be referenced by three or more **property_definition_representation** instances.

WR3: The **representation** instances associated with a **site_building** shall have coordination between their names and the type of items. A **representation** with the name of 'building_number' shall contain items of type **descriptive_representation_item**. A **representation** with the name of 'building_location_and_-orientation' shall contain exactly one **axis2_placement_2d** or **axis2_placement_3d**, and one or more **length_measure_with_unit**. A **representation** with the name of 'building_shape' shall be a **shape_-representation**.

5.2.3.74 site_feature

A **site_feature** is a type of **property_definition** that identifies the composition, proportions, form or outward appearance of part of a site.

EXPRESS specification:

```
*)
ENTITY site_feature
  SUBTYPE OF (property_definition);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.SITE' IN
       TYPEOF(SELF.definition);
  WR2: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION')) = 3;
  WR3: coordinated_representation_names_and_item_types (SELF);
END_ENTITY;
(*
```

Formal propositions:

WR1: A **site_feature** is a property of a **site**.

WR2: A **site_feature** is referenced by exactly three **property_definition_representation** instances.

WR3: The **representation** instances associated with a **site_feature** shall have coordination between their names and the type of items. A **representation** with the name of 'site_feature_type' shall contain items of type **descriptive_representation_item**. A **representation** with the name of 'site_feature_location_-and_orientation' shall contain items of type **axis2_placement_2d** or **axis2_placement_3d**. A **representation** with the name of 'site_feature_shape' shall be a **shape_representation**.

5.2.3.75 site_representation

A **site_representation** is a type of **shape_representation** that represents the shape properties of a **site**.

EXPRESS specification:

```
*)
ENTITY site_representation
  SUBTYPE OF (shape_representation);
WHERE
  WR1: SIZEOF( QUERY( pdr <* USEDIN(SELF,'PLANT_SPATIAL_CONFIGURATION.'+
       'PROPERTY_DEFINITION_REPRESENTATION.USED_REPRESENTATION') |
       NOT('PLANT_SPATIAL_CONFIGURATION.SITE'
          IN TYPEOF(pdr.definition.definition)) )) = 0;
  WR2: ((SIZEOF( QUERY( item <* SELF\representation.items |
         (NOT ('PLANT_SPATIAL_CONFIGURATION.CONNECTED_FACE_SET'
               IN TYPEOF(item))))) = 0)
       XOR
       (SIZEOF( QUERY( item <* SELF\representation.items |
         (NOT ('PLANT_SPATIAL_CONFIGURATION.GEOMETRIC_CURVE_SET'
               IN TYPEOF(item))))) = 0));
  WR3: SIZEOF( QUERY( i <* SELF\representation.items |
         NOT( (NOT( 'PLANT_SPATIAL_CONFIGURATION.CONNECTED_FACE_SET'
                    IN TYPEOF(i)))
            OR
              (((rep_item_set_has_analytic(
                    connected_face_set_class_set(i)) = FALSE) AND
```

```
                (rep_item_set_has_free_form(
                    connected_face_set_class_set(i)) = FALSE)))
      ))) = 0;
  WR4: SIZEOF( QUERY( i <* SELF\representation.items |
       NOT( (NOT( 'PLANT_SPATIAL_CONFIGURATION.CONNECTED_FACE_SET'
                  IN TYPEOF(i)))
          OR
            (SIZEOF(QUERY(f <* i\connected_face_set.cfs_faces |
               NOT( (face_edge_count(f) = 3) OR
                    (face_edge_count(f) = 4)) )) = 0)
      ))) = 0;
  WR5: SIZEOF( QUERY( i <* SELF\representation.items |
       NOT( (NOT( 'PLANT_SPATIAL_CONFIGURATION.GEOMETRIC_CURVE_SET'
                  IN TYPEOF(i)))
          OR
            (SIZEOF(QUERY(e <* i\geometric_set.elements |
               ('PLANT_SPATIAL_CONFIGURATION.CURVE' IN TYPEOF(e)) AND
               (NOT('PLANT_SPATIAL_CONFIGURATION.POLYLINE' IN TYPEOF(e)))
            )) = 0)
      ))) = 0;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **site_representation** shall be used to represent a **site**.

WR2: A **site_representation** shall have in its set of items either **connected_face_set**s or **geometric_curve_set**s.

WR3: If one of the **items** is a **connected_face_set**, it shall not have any analytic or free form geometry.

WR4: If one of the **items** is a **connected_face_set**, all of its **face** instances shall have 3 or 4 edges.

WR5: If one of the **items** is a **geometric_curve_set**, all of its **curve** instances shall be instances of **polyline**.

5.2.3.76 spacer_fitting_classification

A **spacer_fitting_classification** is a type of **group** that classifies the items that are assigned to it as spacer fittings.

EXPRESS specification:

```
*)
ENTITY spacer_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **spacer_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'spacer_fitting_dimensional_shape', and shall have at least one **representation_item** with the name 'end_to_end_length'.

5.2.3.77 specialty_item_classification

A **specialty_item_classification** is a type of **group** that classifies the items are assigned to it as specialty items. The name of the **specialty_item_classification** may further classify the assigned items.

EXPRESS specification:

```
*)
ENTITY specialty_item_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.78 stream_design_case

A **stream_design_case** is a type of **property_definition** and **characterized_object** that identifies the characteristics of a gas, liquid, vapour, or particulate stream.

EXPRESS specification:

```
*)
ENTITY stream_design_case
  SUBTYPE OF (property_definition, characterized_object);
WHERE
  WR1: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION.DEFINITION')) >= 1;
  WR2: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION')) >= 2;
  WR3: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
       (pdr.used_representation.name = 'flow_rate'))) = 1;
  WR4: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
       (pdr.used_representation.name = 'pressure'))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **stream_design_case** shall have at least one **property_definition**.

WR2: A **stream_design_case** shall be represented by at least two **representations**.

WR3: A **stream_design_case** shall be represented by exactly one **representation** with the name 'flow_-rate'.

WR4: A **stream_design_case** shall be represented by exactly one **representation** with the name 'pressure'.

Informal propositions:

IP1: Each **property_definition** assigned to a **stream_design_case** shall have a name designating the stream phase.

5.2.3.79 stream_phase

A **stream_phase** is a type of **property_definition** that identifies the characteristics of a gas, liquid, vapour, or particulate phase.

EXPRESS specification:

```
*)
ENTITY stream_phase
  SUBTYPE OF (property_definition);
WHERE
  WR1: 'PLANT_SPATIAL_CONFIGURATION.STREAM_DESIGN_CASE' IN
       TYPEOF (SELF.DEFINITION);
  WR2: SIZEOF (USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION')) >= 3;
  WR3: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
       (pdr.used_representation.name = 'constituent_mole_fraction'))) = 1;
  WR4: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
       (pdr.used_representation.name = 'constituents'))) = 1;
  WR5: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION') |
       (pdr.used_representation.name = 'temperature'))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **stream_phase** shall define a property of a **stream_design_case**.

WR2: A **stream_phase** shall be represented by at least three **representations**.

WR3: A **stream_phase** shall be represented by exactly one **representation** with the name 'constituent_-mole_fraction'.

WR4: A **stream_phase** shall be represented by exactly one **representation** with the name 'constituents'.

WR5: A **stream_phase** shall be represented by exactly one **representation** with the name 'temperature'.

5.2.3.80 structural_load_connector_classification

A **structural_load_connector_classification** is a type of **group** that classifies the items that are assigned to it as being structural load connectors. The **name** of the **structural_connector_classification** further classifies the assigned items.

EXPRESS specification:

```
*)
ENTITY structural_load_connector_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.81 structural_system

A **structural_system** is a type of **product_definition** that identifies a system or assembly of structural components.

EXPRESS specification:

```
*)
ENTITY structural_system
  SUBTYPE OF (product_definition);
WHERE
  WR1: SIZEOF (QUERY (pdr <* USEDIN (SELF, 'PLANT_SPATIAL_CONFIGURATION.' +
       'PRODUCT_DEFINITION_RELATIONSHIP.RELATED_PRODUCT_DEFINITION') |
       ('PLANT_SPATIAL_CONFIGURATION.PLANT' IN TYPEOF
       (pdr.relating_product_definition.formation.of_product)) AND
       (pdr.relating_product_definition.frame_of_reference.name =
       'functional_occurrence'))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **structural_system** shall be related to exactly one **product_definition** which is the definition of a plant and has a context of 'functional_occurrence'.

5.2.3.82 support_constraint_representation

A **support_constraint_representation** is a type of **representation** that identifies limitations on the movement of a **plant_item_definition**.

EXPRESS specification:

```
*)
ENTITY support_constraint_representation
  SUBTYPE OF (representation);
WHERE
  WR1: SIZEOF (SELF.items) >= 3;
  WR2: SIZEOF (QUERY (it <* SELF.items |
       ('PLANT_SPATIAL_CONFIGURATION.MEASURE_REPRESENTATION_ITEM'
       IN TYPEOF (it)) AND
       (it.name IN ['negative_x', 'positive_x', 'negative_y',
                    'positive_y', 'negative_z', 'positive_z',
                    'negative_x_rotation', 'positive_x_rotation',
                    'negative_y_rotation', 'positive_y_rotation',
                    'negative_z_rotation', 'positive_z_rotation'] ))) = 1;
  WR3: SIZEOF (QUERY (it <* SELF.items |
       'PLANT_SPATIAL_CONFIGURATION.RATIO_MEASURE_WITH_UNIT'
       IN TYPEOF (it))) = 1;
  WR4: SIZEOF (QUERY (it <* SELF.items |
       'PLANT_SPATIAL_CONFIGURATION.DESCRIPTIVE_REPRESENTATION_ITEM'
       IN TYPEOF (it))) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: The **support_constraint_representation** shall contain at least three items.

WR2: The **support_constraint_representation** shall contain **measure_representation_item**s that have a name of 'negative_x', 'positive_x', 'negative_y', 'positive_y', 'negative_z', 'positive_z', 'negative_x_-rotation', 'positive_x_rotation', 'negative_y_rotation', 'positive_y_rotation', 'negative_z_rotation', or 'positive_z_rotation'.

WR3: The **support_constraint_representation** shall contain exactly one **ratio_measure_with_unit**.

WR4: The **support_constraint_representation** shall contain exactly one **descriptive_representation_-item**.

5.2.3.83 swage_fitting_classification

A **swage_fitting_classification** is a type of **group** that classifies the items that are assigned to it as swage fittings.

EXPRESS specification:

```
*)
ENTITY swage_fitting_classification
  SUBTYPE OF (group);
```

```
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **swage_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'swage_fitting_dimensional_shape', and shall have at least one **representation_item** with the name 'end_to_end_length'.

5.2.3.84 system_space

A **system_space** is a type of **product_definition_shape** that identifies the shape of an **electrical_system**, **hvac_system**, **instrumentation_and_control_system**, **piping_system**, or **structural_system**.

EXPRESS specification:

```
*)
ENTITY system_space
  SUBTYPE OF (product_definition_shape);
WHERE
  WR1: SIZEOF (TYPEOF (SELF.definition) *
       ['PLANT_SPATIAL_CONFIGURATION.ELECTRICAL_SYSTEM',
        'PLANT_SPATIAL_CONFIGURATION.HVAC_SYSTEM',
        'PLANT_SPATIAL_CONFIGURATION.' +
        'INSTRUMENTATION_AND_CONTROL_SYSTEM',
        'PLANT_SPATIAL_CONFIGURATION.PIPING_SYSTEM',
        'PLANT_SPATIAL_CONFIGURATION.STRUCTURAL_SYSTEM']) = 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **system_space** shall define the shape of an **electrical_system**, **hvac_system**, **instrumentation_-and_control_system**, **piping_system**, or **structural_system**.

5.2.3.85 tee_fitting_classification

A **tee_fitting_classification** is a type of **group** that classifies the items that are assigned to it as tee fittings.

EXPRESS specification:

```
*)
ENTITY tee_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

Informal propositions:

IP1: Each item that is assigned to a **tee_fitting_classification** shall have zero or one **representation**. If present, this **representation** shall have the name 'tee_fitting_dimensional_shape', and shall have at least three **representation_item**s with the names 'centre_to_end_1_length', 'centre_to_end_2_length', and 'centre_to_end_3_length'.

5.2.3.86 truncated_pyramid

A **truncated_pyramid** is a type of **boolean_result** that is a solid primitive with a square bottom face, a square top face of smaller size than the bottom face, and four trapezoidal faces that connect the top and bottom face.

EXPRESS specification:

```
*)
ENTITY truncated_pyramid
  SUBTYPE OF (boolean_result);
END_ENTITY;
(*
```

5.2.3.87 union_fitting_classification

A **union_fitting_classification** is a type of **group** that classifies the items that are assigned to it as union fittings.

EXPRESS specification:

```
*)
ENTITY union_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.88 valve_classification

A **valve_classification** is a type of **group** that classifies the items are assigned to it as valves. The name of the **valve_classification** may further classify the assigned items.

EXPRESS specification:

```
*)
ENTITY valve_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.3.89 wye_fitting_classification

A **wye_fitting_classification** is a type of **group** that classifies the items that are assigned to it as wye fittings.

EXPRESS specification:

```
*)
ENTITY wye_fitting_classification
  SUBTYPE OF (group);
END_ENTITY;
(*
```

5.2.4 Plant spatial configuration rule definitions

5.2.4.1 approval_requires_approval_date_time

Every **approval** shall have exactly one **approval_date_time**.

EXPRESS specification:

```
*)
RULE approval_requires_approval_date_time FOR
  (approval_date_time,
   approval);
WHERE
  WR1: SIZEOF (QUERY (app <* approval |
       NOT (SIZEOF (QUERY (adt <* approval_date_time |
       (app :=: adt.dated_approval))) = 1))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each **approval** there shall be exactly one **approval_date_time** that has the **approval** as its **dated_approval**.

5.2.4.2 approval_requires_approval_person_organization

Every **approval** shall have exactly one **approval_person_organization**.

EXPRESS specification:

```
*)
RULE approval_requires_approval_person_organization FOR
  (approval_person_organization,
   approval);
WHERE
  WR1: SIZEOF (QUERY (app <* approval |
       NOT (SIZEOF (QUERY (apo <* approval_person_organization |
```

```
       (app :=: apo.authorized_approval))) = 1))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each **approval** there shall be exactly one **approval_person_organization** that has the **approval** as its **authorized_approval**.

5.2.4.3 catalogue_requires_vendor

Every **document_usage_constraint** that has a **subject_element** of 'item_definition' shall have a vendor assigned to it.

EXPRESS specification:

```
*)
RULE catalogue_requires_vendor FOR
  (document_usage_constraint,
   plant_spatial_configuration_organization_assignment,
   plant_spatial_configuration_person_assignment);
WHERE
  WR1: SIZEOF (QUERY (duc <* document_usage_constraint |
       (duc.subject_element = 'item_definition') AND
       NOT ((SIZEOF (QUERY (pscoa <*
       plant_spatial_configuration_organization_assignment |
       (duc.source IN pscoa.items) AND
       (pscoa.role.name = 'vendor'))) = 1) XOR
       (SIZEOF (QUERY (pscpa <*
        plant_spatial_configuration_person_assignment |
       (duc.source IN pscpa.items) AND
       (pscpa.role.name = 'vendor'))) = 1)))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each **document_usage_constraint** with a **subject_element** of 'item_definition' there shall be exactly one **plant_spatial_configuration_organization_assignment** or **plant_spatial_configuration_-person_assignment** with a role of vendor that contains the source **document** in its set of **items**.

5.2.4.4 change_action_requires_date

Every **change_action** shall have a date assigned to it.

EXPRESS specification:

```
*)
RULE change_action_requires_date FOR
  (change_action,
```

```
   plant_spatial_configuration_date_assignment);
WHERE
  WR1: SIZEOF (QUERY (ca <* change_action |
       NOT (SIZEOF (QUERY (pscda <*
       plant_spatial_configuration_date_assignment |
       (ca IN pscda.items))) = 1))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each **change_action** there shall be exactly one **plant_spatial_configuration_date_assignment** that contains the **change_action** in its set of **items**.

5.2.4.5 change_item_requires_creation_date

Every item of a **plant_spatial_configuration_change_assignment** shall have a date assigned to it with the role of 'creation_date'.

EXPRESS specification:

```
*)
RULE change_item_requires_creation_date FOR
  (plant_spatial_configuration_change_assignment,
   plant_spatial_configuration_date_assignment);
WHERE
  WR1: SIZEOF (QUERY (pscca <*
           plant_spatial_configuration_change_assignment |
       NOT (SIZEOF (QUERY (ch_it <* pscca.items |
       NOT (SIZEOF (QUERY (pscda <*
           plant_spatial_configuration_date_assignment |
       (NOT (ch_it IN pscda.items) OR
       (pscda.role.name = 'creation_date')))) = 1))) = 0))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each item of a **plant_spatial_configuration_change_assignment** there shall be exactly one **plant_spatial_configuration_date_assignment** with a role of 'creation_date' that assigns a date to the item.

5.2.4.6 change_item_requires_id

Every item of a **plant_spatial_configuration_change_assignment** shall have an identification assigned to it.

EXPRESS specification:

```
*)
RULE change_item_requires_id FOR
```

```
  (plant_spatial_configuration_change_assignment,
   change_item_id_assignment);
WHERE
  WR1: SIZEOF (QUERY (pscca <*
           plant_spatial_configuration_change_assignment |
       NOT (SIZEOF (QUERY (ch_it <* pscca.items |
       NOT (SIZEOF (QUERY (ciia <* change_item_id_assignment |
       (ch_it IN ciia.items))) = 1))) = 0))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each item of a **plant_spatial_configuration_change_assignment** there shall be exactly one **change_item_id_assignment** that assigns an identification to the item.

5.2.4.7 change_life_cycle_stage_usage_requires_approval

Every **versioned_action_request** shall have an approval assigned to it.

EXPRESS specification:

```
*)
RULE change_life_cycle_stage_usage_requires_approval FOR
  (versioned_action_request,
   plant_spatial_configuration_approval_assignment);
WHERE
  WR1: SIZEOF (QUERY (vareq <* versioned_action_request |
       (NOT SIZEOF (QUERY (pscaa <*
       plant_spatial_configuration_approval_assignment |
       (vareq IN pscaa.items))) = 1))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each **versioned_action_request** there shall be exactly one **plant_spatial_configuration_-approval_assignment** that contains the **versioned_action_request** in its set of **items**.

5.2.4.8 change_life_cycle_stage_usage_requires_stage

Every **versioned_action_request** shall have a status assigned to it.

EXPRESS specification:

```
*)
RULE change_life_cycle_stage_usage_requires_stage FOR
  (versioned_action_request,
   action_request_status);
WHERE
```

```
  WR1: SIZEOF (QUERY (vareq <* versioned_action_request |
       (NOT SIZEOF (QUERY (ars <* action_request_status |
       (vareq :=: ars.assigned_request))) = 1))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each **versioned_action_request** there shall be exactly one **action_request_status** that has the **versioned_action_request** as its **assigned_request**.

5.2.4.9 versioned_action_request_requires_change_action

Every **versioned_action_request** shall be the request for exactly one **change_action**.

EXPRESS specification:

```
*)
RULE versioned_action_request_requires_change_action FOR
  (change_action,
   versioned_action_request);
WHERE
  WR1: SIZEOF (QUERY (vareq <* versioned_action_request |
       NOT (SIZEOF (QUERY (ca <* change_action |
       (vareq IN ca.directive.requests))) = 1))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: For each **versioned_action_request** there shall be exactly one **change_action** whose directive contains the **versioned_action_request** in its set of **requests**.

5.2.5 Plant spatial configuration function definitions

5.2.5.1 bag_to_set

The **bag_to_set** function converts BAGs into SETs.

> EXAMPLE 59 - It can be used to convert the BAGs returned by the USEDIN function into SETs that can be properly assigned to variables that are SETs.

EXPRESS specification:

```
*)
FUNCTION bag_to_set (the_bag: BAG OF GENERIC:intype) :
    SET OF GENERIC:intype;

  LOCAL
    the_set : SET OF GENERIC:intype := [];
```

```
    i       : INTEGER;
  END_LOCAL;
  IF SIZEOF(the_bag) > 0 THEN
    REPEAT i := 1 TO HIINDEX(the_bag) BY 1;
      the_set := the_set + the_bag[i];
    END_REPEAT;
  END_IF;
  RETURN(the_set);
END_FUNCTION;
(*
```

Argument definitions:

the_bag: the BAG that is to be converted into a SET.

5.2.5.2 boolean_result_class_set

The **boolean_result_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve**, **surface**, and **solid**, and returning them.

EXPRESS specification:

```
*)
FUNCTION boolean_result_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     return_set     : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.BOOLEAN_RESULT'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   return_set := return_set +
     boolean_result_class_set(rep_item\boolean_result.first_operand) +
     boolean_result_class_set(rep_item\boolean_result.second_operand) +
     csg_primitive_class_set(rep_item\boolean_result.first_operand) +
     csg_primitive_class_set(rep_item\boolean_result.second_operand) +
     csg_solid_class_set(rep_item\boolean_result.first_operand) +
     csg_solid_class_set(rep_item\boolean_result.second_operand) +
     manifold_solid_brep_class_set(rep_item\boolean_result.first_operand) +
     manifold_solid_brep_class_set(rep_item\boolean_result.
         second_operand) +
     swept_area_solid_class_set(rep_item\boolean_result.first_operand) +
     swept_area_solid_class_set(rep_item\boolean_result.second_operand);
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.3 class_rep_item_in_set

The **class_rep_item_in_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. An individual function returns the appropriate set for each type of **representation_item**. These sets are added together and the resulting set is returned.

EXPRESS specification:

```
*)
FUNCTION class_rep_item_in_set(
          rep_item_set : SET[1:?] OF representation_item)
                       : SET[0:?] OF representation_item;
LOCAL
     i          : INTEGER;
     return_set      : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( SIZEOF(rep_item_set) = 0 )
     THEN RETURN(FALSE);
   END_IF;
   REPEAT i := 1 TO HIINDEX(rep_item_set);
     return_set := return_set +
          manifold_solid_brep_class_set(rep_item_set[i]) +
          face_class_set(rep_item_set[i]) +
          connected_face_set_class_set(rep_item_set[i]) +
          curve_class_set(rep_item_set[i]) +
          surface_class_set(rep_item_set[i]) +
          swept_area_solid_class_set(rep_item_set[i]) +
          boolean_result_class_set(rep_item_set[i]) +
          csg_solid_class_set(rep_item_set[i]) +
          csg_primitive_class_set(rep_item_set[i]) +
          geometric_set_class_set(rep_item_set[i]);
   END_REPEAT;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item_set: (input) the set of **representation_item** instances to be checked.

5.2.5.4 connected_face_set_class_set

The **connected_face_set_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION connected_face_set_class_set(
          rep_item : representation_item)
                          : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
     i          : INTEGER;
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.CONNECTED_FACE_SET'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   REPEAT i := 1 TO HIINDEX(rep_item\connected_face_set.cfs_faces);
     return_set := return_set + face_class_set(
                     rep_item\connected_face_set.cfs_faces[i]);
   END_REPEAT;
   IF ('PLANT_SPATIAL_CONFIGURATION.ORIENTED_CLOSED_SHELL' IN
          TYPEOF(rep_item))
     THEN
        return_set := return_set + connected_face_set(
              rep_item\oriented_closed_shell.closed_shell_element);
   END_IF;
   IF ('PLANT_SPATIAL_CONFIGURATION.ORIENTED_OPEN_SHELL' IN
          TYPEOF(rep_item))
     THEN
        return_set := return_set + connected_face_set(
              rep_item\oriented_open_shell.open_shell_element);
   END_IF;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.5 coordinated_representation_names_and_item_types

The **coordinated_representation_names_and_item_types** boolean function returns TRUE if a **property_definition** is associated with a **representation** whose **name** attribute is coordinated with the type of **items** contained within the **representation**.

EXPRESS specification:

```
*)
FUNCTION coordinated_representation_names_and_item_types(
              input_entity : property_definition) : BOOLEAN;
LOCAL
     rep : representation;
     rep_set : SET[0:?] OF representation;
```

```
     prop_def_rep_set : SET[0:?] OF property_definition_representation;
     type_set : SET[1:?] OF STRING;
     i : INTEGER;
END_LOCAL;
     prop_def_rep_set := USEDIN(input_entity,'PLANT_SPATIAL_CONFIGURATION.'+
          'PROPERTY_DEFINITION_REPRESENTATION.DEFINITION');
     rep_set := [];
     REPEAT i := 1 TO HIINDEX(prop_def_rep_set);
          rep_set := rep_set + prop_def_rep_set[i].used_representation;
     END_REPEAT;
     type_set := TYPEOF(input_entity);
     IF ('PLANT_SPATIAL_CONFIGURATION.SITE_PROPERTY_DEFINITION'
          IN type_set) THEN
              REPEAT i := 1 TO HIINDEX(rep_set);
               IF ((rep_set[i].name = 'site_address') AND
                    (SIZEOF( QUERY( item <* rep_set[i].items |
                         (NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                              'DESCRIPTIVE_REPRESENTATION_ITEM'
                              IN TYPEOF(item)))
                    )) > 0) ) THEN
                         RETURN(FALSE);
               END_IF;
               IF ((rep_set[i].name = 'site_coordinate') AND
                    (SIZEOF( QUERY( item <* rep_set[i].items |
                         (NOT(
                         SIZEOF( ['PLANT_SPATIAL_CONFIGURATION.' +
                              'MEASURE_REPRESENTATION_ITEM',
                              'PLANT_SPATIAL_CONFIGURATION.' +
                              'PLANE_ANGLE_MEASURE'] * TYPEOF(item)
                         ) = 2))
                    )) > 0 )) THEN
                         RETURN(FALSE);
               END_IF;
               IF ((rep_set[i].name = 'site_elevation') AND
                    (SIZEOF( QUERY( item <* rep_set[i].items |
                         (NOT(
                         SIZEOF( ['PLANT_SPATIAL_CONFIGURATION.' +
                              'MEASURE_REPRESENTATION_ITEM',
                              'PLANT_SPATIAL_CONFIGURATION.' +
                              'LENGTH_ANGLE_MEASURE'] * TYPEOF(item)
                         ) = 2))
                    )) > 0 )) THEN
                         RETURN(FALSE);
               END_IF;
               IF ((rep_set[i].name = 'site_locality') AND
                    (SIZEOF( QUERY( item <* rep_set[i].items |
                         (NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                              'DESCRIPTIVE_REPRESENTATION_ITEM'
                              IN TYPEOF(item)
                         ))
                    )) > 0 )) THEN
                         RETURN(FALSE);
               END_IF;
               IF ((rep_set[i].name = 'site_shape') AND
                    (NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                        'SHAPE_REPRESENTATION'
                         IN TYPEOF(rep_set[i])
                    )) ) THEN
                    RETURN(FALSE);
```

```
            END_IF;
          END_REPEAT;
      RETURN(TRUE);
ELSE IF ('PLANT_SPATIAL_CONFIGURATION.SITE_BUILDING'
      IN type_set) THEN
          REPEAT i := 1 TO HIINDEX(rep_set);
           IF ((rep_set[i].name = 'building_number') AND
                (SIZEOF( QUERY( item <* rep_set[i].items |
                     (NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                          'DESCRIPTIVE_REPRESENTATION_ITEM'
                          IN TYPEOF(item)
                     ))
                )) > 0 )) THEN
                     RETURN(FALSE);
           END_IF;
           IF ((rep_set[i].name = 'building_location_and_orientation')
                AND (NOT((SIZEOF( QUERY( item <* rep_set[i].items |
                     (SIZEOF(['PLANT_SPATIAL_CONFIGURATION.' +
                         'AXIS2_PLACEMENT_2D',
                         'PLANT_SPATIAL_CONFIGURATION.' +
                         'AXIS2_PLACEMENT_3D'] * TYPEOF(item)
                     ) = 1)
                )) = 1)
                     AND
                (SIZEOF( QUERY( item <* rep_set[i].items |
                     (SIZEOF(['PLANT_SPATIAL_CONFIGURATION.' +
                         'LENGTH_MEASURE_WITH_UNIT',
                         'PLANT_SPATIAL_CONFIGURATION.' +
                         'MEASURE_REPRESENTATION_ITEM'] *
                         TYPEOF(item)
                     ) = 2)
                )) > 0)
                     AND
                (SIZEOF( QUERY( item <* rep_set[i].items |
                     (SIZEOF(['PLANT_SPATIAL_CONFIGURATION.' +
                         'LENGTH_MEASURE_WITH_UNIT',
                         'PLANT_SPATIAL_CONFIGURATION.' +
                         'MEASURE_REPRESENTATION_ITEM'] *
                         TYPEOF(item)
                     ) = 2)
                         OR
                     (SIZEOF(['PLANT_SPATIAL_CONFIGURATION.' +
                         'AXIS2_PLACEMENT_2D',
                         'PLANT_SPATIAL_CONFIGURATION.' +
                         'AXIS2_PLACEMENT_3D'] * TYPEOF(item)
                     ) = 1)
                )) = 0)
                )) ) THEN
                     RETURN(FALSE);
           END_IF;
           IF ((rep_set[i].name = 'building_shape') AND
                (NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                     'SHAPE_REPRESENTATION'
                     IN TYPEOF(rep_set[i])
                )) ) THEN
                RETURN(FALSE);
           END_IF;
          END_REPEAT;
```

```
        RETURN(TRUE);
ELSE IF ('PLANT_SPATIAL_CONFIGURATION.SITE_FEATURE'
     IN type_set) THEN
        REPEAT i := 1 TO HIINDEX(rep_set);
         IF ((rep_set[i].name = 'site_feature_type') AND
              (SIZEOF( QUERY( item <* rep_set[i].items |
                   NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                        'DESCRIPTIVE_REPRESENTATION_ITEM'
                        IN TYPEOF(item))
              )) > 0) )
         THEN RETURN(FALSE);
         END_IF;
         IF ((rep_set[i].name = 'site_feature_location_and_' +
         'orientation')
              AND (SIZEOF( QUERY( item <* rep_set[i].items |
                   NOT( SIZEOF(['PLANT_SPATIAL_CONFIGURATION.' +
                        'AXIS2_PLACEMENT_2D',
                        'PLANT_SPATIAL_CONFIGURATION.' +
                        'AXIS2_PLACEMENT_3D'] * TYPEOF(item)) = 1)
              )) > 0))
         THEN RETURN(FALSE);
         END_IF;
         IF ((rep_set[i].name = 'site_feature_shape') AND
              NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                   'SHAPE_REPRESENTATION' IN TYPEOF(rep_set[i])))
         THEN RETURN(FALSE);
         END_IF;
         RETURN(TRUE);
        END_REPEAT;
ELSE IF ('PLANT_SPATIAL_CONFIGURATION.PLANT_ITEM_' +
              'CONNECTOR_PROPERTY_DEFINITION'
     IN type_set) THEN
        REPEAT i := 1 TO HIINDEX(rep_set);
         IF ((rep_set[i].name = 'point') AND
              (SIZEOF( QUERY( item <* rep_set[i].items |
                   NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                        'POINT' IN TYPEOF(item))
              )) > 0) )
         THEN RETURN(FALSE);
         END_IF;
         IF ((rep_set[i].name = 'direction') AND
              (SIZEOF( QUERY( item <* rep_set[i].items |
                   NOT( 'PLANT_SPATIAL_CONFIGURATION.' +
                        'DIRECTION' IN TYPEOF(item))
              )) > 0) )
         THEN RETURN(FALSE);
         END_IF;
         IF ((rep_set[i].name = 'connector_location_and_orientation')
              AND (SIZEOF( QUERY( item <* rep_set[i].items |
                   NOT(SIZEOF(['PLANT_SPATIAL_CONFIGURATION.' +
                        'AXIS2_PLACEMENT_2D',
                        'PLANT_SPATIAL_CONFIGURATION.' +
                        'AXIS2_PLACEMENT_3D'] * TYPEOF(item)) = 1)
              )) > 0) )
         THEN RETURN(FALSE);
         END_IF;
         RETURN(TRUE);
        END_REPEAT;
      END_IF;
```

```
        END_IF;
      END_IF;
    END_IF;
    RETURN(TRUE);
END_FUNCTION;
(*
```

Argument definitions:

input_entity: the input **property_definition** to be checked.

5.2.5.6 csg_primitive_class_set

The **csg_primitive_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve**, **surface**, and **sold**, and returning them.

EXPRESS specification:

```
*)
FUNCTION csg_primitive_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( NOT(
          SIZEOF(['PLANT_SPATIAL_CONFIGURATION.TORUS' +
           'PLANT_SPATIAL_CONFIGURATION.RIGHT_CIRCULAR_CYLINDER' +
           'PLANT_SPATIAL_CONFIGURATION.SPHERE' +
           'PLANT_SPATIAL_CONFIGURATION.BLOCK' +
           'PLANT_SPATIAL_CONFIGURATION.RIGHT_CIRCULAR_CONE'] *
           TYPEOF(rep_item)) > 0 ))
     THEN RETURN(return_set);
   END_IF;
   return_set := return_set + rep_item;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.7 csg_solid_class_set

The **csg_solid_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve**, **surface**, and **solid**, and returning them.

EXPRESS specification:

```
*)
FUNCTION csg_solid_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( NOT('PLANT_SPATIAL_CONFIGURATION.CSG_SOLID'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   return_set := return_set +
     boolean_result_class_set(rep_item\csg_solid.tree_root_expression) +
     csg_primitive_class_set(rep_item\csg_solid.tree_root_expression);
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.8 curve_bounded_surface_class_set

The **curve_bounded_surface_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION curve_bounded_surface_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
     i          : INTEGER;
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.CURVE_BOUNDED_SURFACE'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   return_set := return_set +
     surface_class_set(rep_item\curve_bounded_surface.basis_surface);
   REPEAT i := 1 TO HIINDEX(rep_item\curve_bounded_surface.boundaries);
     return_set := return_set +
        curve_class_set(rep_item\curve_bounded_surface.boundaries[i]);
   END_REPEAT;
   RETURN(return_set);
```

```
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.9 curve_class_set

The **curve_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION curve_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
     i          : INTEGER;
END_LOCAL;
   IF ( NOT('PLANT_SPATIAL_CONFIGURATION.CURVE'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   IF (
     SIZEOF(['PLANT_SPATIAL_CONFIGURATION.POLYLINE',
            'PLANT_SPATIAL_CONFIGURATION.B_SPLINE_CURVE',
            'PLANT_SPATIAL_CONFIGURATION.CIRCLE',
            'PLANT_SPATIAL_CONFIGURATION.ELLIPSE',
            'PLANT_SPATIAL_CONFIGURATION.PARABOLA',
            'PLANT_SPATIAL_CONFIGURATION.HYPERBOLA',
            'PLANT_SPATIAL_CONFIGURATION.LINE'] *
           TYPEOF(rep_item)) > 0)
     THEN return_set := return_set + rep_item;
   END_IF;
   IF ('PLANT_SPATIAL_CONFIGURATION.COMPOSITE_CURVE' IN
     TYPEOF(rep_item))
     THEN
        REPEAT i := 1 TO HIINDEX(rep_item\composite_curve.segments);
          return_set := return_set +
             curve_class_set(
               rep_item\composite_curve.segments[i].parent_curve);
        END_REPEAT;
   END_IF;
   IF ('PLANT_SPATIAL_CONFIGURATION.TRIMMED_CURVE' IN
     TYPEOF(rep_item))
     THEN
        return_set := return_set +
          curve_class_set(rep_item\trimmed_curve.basis_curve);
   END_IF;
   IF ('PLANT_SPATIAL_CONFIGURATION.SURFACE_CURVE' IN
```

```
      TYPEOF(rep_item))
      THEN
         return_set := return_set +
           curve_class_set(rep_item\surface_curve.curve_3d);
         REPEAT i := 1 TO HIINDEX(rep_item\surface_curve.
               associated_geometry);
           return_set := return_set + surface_class_set(
                       rep_item\surface_curve.associated_geometry[i]);
         END_REPEAT;
   END_IF;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.10 elementary_surface_class_set

The **elementary_surface_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION elementary_surface_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.ELEMENTARY_SURFACE'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   return_set := return_set + rep_item;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.11 face_class_set

The **face_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION face_class_set(
          rep_item : representation_item)
                          : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
     i,j           : INTEGER;
     local_loop      : loop;
     local_oedge      : oriented_edge;
END_LOCAL;
   IF ( NOT( 'PLANT_SPATIAL_CONFIGURATION.FACE'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   REPEAT i := 1 TO HIINDEX(rep_item\face.bounds);
     local_loop:= rep_item\face.bounds[i].bound;
     IF ('PLANT_SPATIAL_CONFIGURATION.POLY_LOOP' IN
        TYPEOF(local_loop))
          THEN return_set := return_set + local_loop;
     END_IF;
     IF ('PLANT_SPATIAL_CONFIGURATION.EDGE_LOOP' IN
        TYPEOF(local_loop))
          THEN
             REPEAT j := 1 TO HIINDEX(local_loop\path.edge_list);
               local_oedge := local_loop\path.edge_list[j];
               return_set := return_set +
                  local_oedge.edge_element\edge_curve.edge_geometry;
             END_REPEAT;
     END_IF;
   END_REPEAT;
   IF ('PLANT_SPATIAL_CONFIGURATION.FACE_SURFACE' IN
     TYPEOF(rep_item) )
     THEN return_set := return_set + surface_class_set(
                    rep_item\face_surface.face_geometry);
   END_IF;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.12 face_edge_count

The **face_edge_count** function returns the number of edges for a face. An edge could be an instances of the entity **edge**, or it could be a line segment from a **polyline**.

EXPRESS specification:

```
*)
FUNCTION face_edge_count(face_with_edges : face) : INTEGER;
LOCAL
    i           : INTEGER;
    local_loop  : loop;
    edge_count  : INTEGER := 0;
END_LOCAL;
   IF ( NOT('PLANT_SPATIAL_CONFIGURATION.FACE' IN
          TYPEOF(face_with_edges) ))
     THEN RETURN(0);
   END_IF;
   REPEAT i := 1 TO HIINDEX(face_with_edges\face.bounds);
        local_loop := face_with_edges\face.bounds[i].bound;
        IF ('PLANT_SPATIAL_CONFIGURATION.EDGE_LOOP' IN TYPEOF(local_loop))
           THEN edge_count :=
                edge_count + HIINDEX(local_loop\path.edge_list);
        END_IF;
        IF ('PLANT_SPATIAL_CONFIGURATION.POLY_LOOP' IN TYPEOF(local_loop))
           THEN edge_count :=
                edge_count + HIINDEX(local_loop\poly_loop.polygon);
        END_IF;
   END_REPEAT;
   RETURN(edge_count);
END_FUNCTION;
(*
```

Argument_definitions:

face_with_edges: (input) the **face** whose edges are to be counted.

5.2.5.13 geometric_set_class_set

The **geometric_set_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION geometric_set_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     i          : INTEGER;
     return_set     : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( NOT( 'PLANT_SPATIAL_CONFIGURATION.GEOMETRIC_SET' IN
           TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   REPEAT i := 1 TO HIINDEX(rep_item\geometric_set.elements);
     return_set := return_set +
```

```
          curve_class_set(rep_item\geometric_set.elements[i]);
   END_REPEAT;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.14 manifold_solid_brep_class_set

The **manifold_solid_brep_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION manifold_solid_brep_class_set(
          rep_item : representation_item)
                        : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
     i          : INTEGER;
END_LOCAL;
   IF ( NOT( 'PLANT_SPATIAL_CONFIGURATION.MANIFOLD_SOLID_BREP'
          IN TYPEOF(rep_item) ))
     THEN RETURN(return_set);
   END_IF;
   return_set := return_set +
     connected_face_set_class_set (rep_item\manifold_solid_brep.outer);
   IF ( 'PLANT_SPATIAL_CONFIGURATION.BREP_WITH_VOIDS'
      IN TYPEOF(rep_item) )
     THEN
         REPEAT i := 1 TO HIINDEX(rep_item\brep_with_voids.voids);
          return_set := return_set +
                  connected_face_set_class_set(
               rep_item\brep_with_voids.voids[i]);
         END_REPEAT;
   END_IF;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.15 plant_spatial_configuration_organization_correlation

The **plant_spatial_configuration_organization_correlation** boolean function returns TRUE if the **name** attribute of the **organization_role** entity is coordinated with the type of entity selected in the **items** of a **plant_spatial_configuration_organization_assignment**.

EXAMPLE 60 - If the role for an **organization** is 'vendor', then all of the **items** in the set must be either **product** or **document**.

EXPRESS specification:

```
*)
FUNCTION plant_spatial_configuration_organization_correlation
  (e : plant_spatial_configuration_organization_assignment ) : BOOLEAN;
  LOCAL
    o_role : STRING;
  END_LOCAL;
    o_role := e\organization_assignment.role.name;
  CASE o_role OF
    'vendor'            : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          SIZEOF(['PLANT_SPATIAL_CONFIGURATION.PRODUCT',
                                  'PLANT_SPATIAL_CONFIGURATION.DOCUMENT'] *
                          TYPEOF (x)) = 1))
                          THEN RETURN(FALSE);
                          END_IF;
    'owner'             : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          SIZEOF(['PLANT_SPATIAL_CONFIGURATION.SITE',
                                  'PLANT_SPATIAL_CONFIGURATION.DOCUMENT'] *
                          TYPEOF (x)) = 1))
                          THEN RETURN(FALSE);
                          END_IF;
    'plant_operator'    : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          'PLANT_SPATIAL_CONFIGURATION.PLANT'
                          IN TYPEOF (x)))
                          THEN RETURN(FALSE);
                          END_IF;
    'plant_owner'       : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          'PLANT_SPATIAL_CONFIGURATION.PLANT'
                          IN TYPEOF (x)))
                          THEN RETURN(FALSE);
                          END_IF;
    'project_owner'     : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          'PLANT_SPATIAL_CONFIGURATION.DESIGN_PROJECT'
                          IN TYPEOF (x)))
                          THEN RETURN(FALSE);
                          END_IF;
    'assessor'          : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          'PLANT_SPATIAL_CONFIGURATION.' +
                          'PRODUCT_DEFINITION_RELATIONSHIP'
                          IN TYPEOF (x)))
```

```
                              THEN RETURN(FALSE);
                              END_IF;
    OTHERWISE : RETURN(TRUE);
  END_CASE;
  RETURN (TRUE);
END_FUNCTION;
(*
```

Argument definitions:

e: the input **plant_spatial_configuration_organization_assignment** to be checked.

5.2.5.16 plant_spatial_configuration_person_and_organization_correlation

The **plant_spatial_configuration_person_and_organization_correlation** boolean function returns TRUE if the **name** attribute of the **person_organization_role** entity is coordinated with the type of entity selected in the **items** of a **plant_spatial_configuration_person_and_organization_assignment**.

> EXAMPLE 61 - If the role for a **person_and_organization** is 'owner', then all of the **items** in the set must be either **site** or **change_item**.

EXPRESS specification:

```
*)
FUNCTION plant_spatial_configuration_person_and_organization_correlation
  (e : plant_spatial_configuration_person_and_organization_assignment )
  : BOOLEAN;
  LOCAL
    po_role : STRING;
  END_LOCAL;
    po_role := e\person_and_organization_assignment.role.name;
  CASE po_role OF
    'owner'              : IF SIZEOF (e.items) <>
                           SIZEOF (QUERY (x <* e.items |
                           SIZEOF(['PLANT_SPATIAL_CONFIGURATION.SITE',
                                   'PLANT_SPATIAL_CONFIGURATION.' +
                                   'CHANGE_ITEM'] *
                           TYPEOF (x)) = 1))
                           THEN RETURN(FALSE);
                           END_IF;
    'plant_owner'        : IF SIZEOF (e.items) <>
                           SIZEOF (QUERY (x <* e.items |
                           'PLANT_SPATIAL_CONFIGURATION.PLANT'
                           IN TYPEOF (x)))
                           THEN RETURN(FALSE);
                           END_IF;
    'plant_operator'     : IF SIZEOF (e.items) <>
                           SIZEOF (QUERY (x <* e.items |
                           'PLANT_SPATIAL_CONFIGURATION.PLANT'
                           IN TYPEOF (x)))
                           THEN RETURN(FALSE);
                           END_IF;
    OTHERWISE : RETURN(TRUE);
```

```
  END_CASE;
  RETURN (TRUE);
END_FUNCTION;
(*
```

Argument definitions:

e: the input **plant_spatial_configuration_person_and_organization_assignment** to be checked.

5.2.5.17 plant_spatial_configuration_person_correlation

The **plant_spatial_configuration_person_correlation** boolean function returns TRUE if the **name** attribute of the **person_role** entity is coordinated with the type of entity selected in the **items** of a **plant_spatial_configuration_person_assignment**.

EXAMPLE 62 - If the role for a **person** is 'owner', then all of the **items** in the set must be either **site** or **document**.

EXPRESS specification:

```
*)
FUNCTION plant_spatial_configuration_person_correlation
  (e : plant_spatial_configuration_person_assignment ) : BOOLEAN;
  LOCAL
    p_role : STRING;
  END_LOCAL;
    p_role := e\person_assignment.role.name;
  CASE p_role OF
    'vendor'            : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          'PLANT_SPATIAL_CONFIGURATION.DOCUMENT'
                          IN TYPEOF (x)))
                          THEN RETURN(FALSE);
                          END_IF;
    'owner'             : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          SIZEOF(['PLANT_SPATIAL_CONFIGURATION.SITE',
                                  'PLANT_SPATIAL_CONFIGURATION.DOCUMENT'] *
                          TYPEOF (x)) = 1))
                          THEN RETURN(FALSE);
                          END_IF;
    'plant_owner'       : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          'PLANT_SPATIAL_CONFIGURATION.PLANT'
                          IN TYPEOF (x)))
                          THEN RETURN(FALSE);
                          END_IF;
    'assessor'          : IF SIZEOF (e.items) <>
                          SIZEOF (QUERY (x <* e.items |
                          'PLANT_SPATIAL_CONFIGURATION.' +
                          'PRODUCT_DEFINITION_RELATIONSHIP'
                          IN TYPEOF (x)))
                          THEN RETURN(FALSE);
                          END_IF;
```

```
    OTHERWISE : RETURN(TRUE);
  END_CASE;
  RETURN (TRUE);
END_FUNCTION;
(*
```

Argument definitions:

e: the input **plant_spatial_configuration_person_assignment** to be checked.

5.2.5.18 rectangular_composite_surface_class_set

The **rectangular_composite_surface_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION rectangular_composite_surface_class_set(
          rep_item : representation_item)
                          : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
     patch           : surface_patch;
     i           : INTEGER;
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.RECTANGULAR_COMPOSITE_SURFACE'
          IN TYPEOF(rep_item) )
          )
     THEN RETURN(return_set);
   END_IF;
   REPEAT i := 1 TO HIINDEX(
               rep_item\rectangular_composite_surface.segments);
     patch := rep_item\rectangular_composite_surface.segments[i];
     return_set := return_set + surface_class_set(patch.parent_surface);
   END_REPEAT;
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.19 rectangular_trimmed_surface_class_set

The **rectangular_trimmed_surface_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION rectangular_trimmed_surface_class_set(
          rep_item : representation_item)
                          : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.RECTANGULAR_TRIMMED_SURFACE'
          IN TYPEOF(rep_item) )
          )
     THEN RETURN(return_set);
   END_IF;
   return_set := return_set + surface_class_set(
          rep_item\rectangular_trimmed_surface.basis_surface);
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the representation_item to be examined.

5.2.5.20 rep_item_set_has_analytic

The **rep_item_set_has_analytic** function determines whether or not a set of **representation_item** instances contains instances of **ellipse, parabola, hyperbola, conical_surface, cylindrical_surface, spherical_surface,** or **toroidal_surface**. A return of **TRUE** indicates that there are instances of these types, a return of **FALSE** indicates that there are no instances of these types.

EXPRESS specification:

```
*)
FUNCTION rep_item_set_has_analytic(
           rep_item_set : SET[0:?] OF representation_item) : BOOLEAN;
LOCAL
    set_iterator : INTEGER;
END_LOCAL;
   IF ( SIZEOF(rep_item_set) = 0 )
      THEN RETURN(FALSE);
   END_IF;
   REPEAT set_iterator := 1 TO HIINDEX(rep_item_set);
        IF ( SIZEOF(['PLANT_SPATIAL_CONFIGURATION.CIRCLE',
                     'PLANT_SPATIAL_CONFIGURATION.ELLIPSE',
                     'PLANT_SPATIAL_CONFIGURATION.PARABOLA',
                     'PLANT_SPATIAL_CONFIGURATION.HYPERBOLA',
                     'PLANT_SPATIAL_CONFIGURATION.CONICAL_SURFACE',
                     'PLANT_SPATIAL_CONFIGURATION.CYLINDRICAL_SURFACE',
                     'PLANT_SPATIAL_CONFIGURATION.SPHERICAL_SURFACE',
                     'PLANT_SPATIAL_CONFIGURATION.TOROIDAL_SURFACE'] *
               TYPEOF(rep_item_set[set_iterator]) > 0) )
          THEN RETURN(TRUE);
```

```
        END_IF;
   END_REPEAT;
   RETURN(FALSE);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item_set: (input) the set of **representation_item** instances to be checked.

5.2.5.21 rep_item_set_has_free_form

The **rep_item_set_has_free_form** function determines whether or not a set of **representation_item** instances contains instances of **b_spline_curve** or **b_spline_surface**. A return of **TRUE** indicates that there are instances of these types, a return of **FALSE** indicates that there are no instances of these types.

EXPRESS specification:

```
*)
FUNCTION rep_item_set_has_free_form(
          rep_item_set : SET[0:?] OF representation_item) : BOOLEAN;
LOCAL
     set_iterator : INTEGER;
END_LOCAL;
   IF ( SIZEOF(rep_item_set) = 0 )
     THEN RETURN(FALSE);
   END_IF;
   REPEAT set_iterator := 1 TO HIINDEX(rep_item_set);
     IF ( SIZEOF(['PLANT_SPATIAL_CONFIGURATION.B_SPLINE_CURVE',
                'PLANT_SPATIAL_CONFIGURATION.B_SPLINE_SURFACE']
                * TYPEOF(rep_item_set[set_iterator]) > 0) )
          THEN RETURN(TRUE);
     END_IF;
   END_REPEAT;
   RETURN(FALSE);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item_set: (input) the set of **representation_item** instances to be checked.

5.2.5.22 surface_class_set

The **surface_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION surface_class_set(
          rep_item : representation_item)
                          : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
     i          : INTEGER;
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.SURFACE'
          IN TYPEOF(rep_item) )
          )
     THEN RETURN(return_set);
   END_IF;
   IF ('PLANT_SPATIAL_CONFIGURATION.B_SPLINE_SURFACE' IN
     TYPEOF(rep_item) )
     THEN return_set := return_set + rep_item;
   END_IF;
   return_set := return_set +
          curve_bounded_surface_class_set(rep_item) +
          rectangular_composite_surface_class_set(
                          rep_item) +
          rectangular_trimmed_surface_class_set(
                          rep_item) +
          elementary_surface_class_set(rep_item);
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

5.2.5.23 swept_area_solid_class_set

The **swept_area_solid_class_set** function returns a set of **representation_item** instances that determines the class of **shape_representation**. This entails searching the attributes in an iterative manner to find all instances of **curve** and **surface**, and returning them.

EXPRESS specification:

```
*)
FUNCTION swept_area_solid_class_set(
          rep_item : representation_item)
                          : SET[0:?] OF representation_item;
LOCAL
     return_set      : SET[0:?] OF representation_item := [];
END_LOCAL;
   IF ( NOT(
          'PLANT_SPATIAL_CONFIGURATION.SWEPT_AREA_SOLID'
          IN TYPEOF(rep_item) )
          )
```

```
      THEN RETURN(return_set);
   END_IF;
   return_set := return_set + rep_item + curve_bounded_surface_class_set(
                    rep_item\swept_area_solid.swept_area);
   RETURN(return_set);
END_FUNCTION;
(*
```

Argument_definitions:

rep_item: (input) the **representation_item** to be examined.

```
*)
END_SCHEMA;
(*
```

6 Conformance requirements

Conformance to this part of ISO 10303 includes satisfying the requirements stated in this part, the requirements of the implementation methods supported, and the relevant requirements of the normative references.

An implementation shall support at least one of the following implementation methods:

— ISO 10303-21.

Requirements with respect to implementation methods are specified in annex C.

The protocol information conformance statement (PICS) proforma lists the conformance classes and any conformance options that may be included in the conformance statement and subsequent testing. The PICS proforma is provided in annex D.

NOTE 1 - ISO 10303-327:—[1)] defines the abstract test suite to be used in the assessment of conformance. ISO 10303-32:—[1)] describes the conformance assessment process.

This part of ISO 10303 specifies ten conformance classes that may be supported by an implementation. All conformance classes include information concerning plants, plant items, connectors, and change. The conformance classes are divided into four usage groups:

— logical or functional definition and connectivity of piping system lines;

— plant layout and arrangement information of plant systems;

[1)]To be published.

— detailed design information of a plant and plant systems;

— piping fabrication and installation information.

The first usage group does not contain shape information. Each of the other three usage groups can be combined with one of the following geometry based groups:

— advanced CSG representation;

— advanced CSG and piping design CSG representations;

— advanced CSG, piping design CSG, wireframe, and B-rep representations.

Table 15 defines the division of conformance classes with respect to the usage groups and the inclusion of each unit of functionality within a conformance class.

Conformance to a class is distinguished by the support of a particular usage group and by the geometric representation of shapes. Conformance to a particular class requires that all AIM elements defined as part of that class be supported. Table 16 defines the classes to which each AIM element belongs. The conformance classes are characterized as follows:

Class 1 - Basic logical design of piping, process, HVAC, and mechanical systems and identification of equipment. This class contains functional information of the piping system, but no geometric or other physical and spatial details.

NOTE 2 - The purpose of this conformance class is to provide an interface with ISO 10303-221:—[2)].

Class 2 - Physical and spatial layout and design of plants, plant systems, and equipment using CSG geometric representations. It contains site information, but no detailed information about the piping system, piping components, or connections. This conformance class supports spatial arrangement, physical design, and interference checking of a plant and plant systems.

Class 3 - Physical and spatial layout and design of plants, plant systems, and equipment using CSG, and piping design CSG geometric representations. It contains site information, but no detailed information about the piping system, piping components, or connections. This conformance class supports spatial arrangement, physical design, and interference checking of a plant and plant systems.

Class 4 - Physical and spatial layout and design of plants, plant systems, and equipment using CSG, piping design CSG geometric, wireframe, and B-rep geometric representations. It contains site information, but no detailed information about the piping system, piping components, or connections. This conformance class supports spatial arrangement, physical design, and interference checking of a plant and plant systems.

[2)]To be published.

Table 15 - Conformance classes

Unit of functionality	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
change_information	X	X	X	X	X	X	X	X	X	X
plant_characterization	X	X	X	X	X	X	X	X	X	X
site_characterization		X	X	X	X	X	X			
piping_system_functional_characterization	X				X	X	X	X	X	X
plant_item_characterization	X	X	X	X	X	X	X	X	X	X
piping_component_characterization	X				X	X	X	X	X	X
equipment_characterization	X	X	X	X	X	X	X			
connector	X	X	X	X	X	X	X	X	X	X
connection	X				X	X	X	X	X	X
shape		X	X	X	X	X	X	X	X	X
advanced_csg_representation		X	X	X	X	X	X	X	X	X
piping_design_csg_representation			X	X		X	X		X	X
wireframe_and_b_rep_geometry				X			X			X

Class 5 - Detailed physical and spatial layout and design of plants and plant systems and equipment using CSG geometric representations. It contains all design and layout information for the plant. This conformance class supports detailed spatial and physical design and analysis of plants and plant systems.

Class 6 - Detailed physical and spatial layout and design of plants, plant systems, and equipment using CSG and piping design CSG geometric representations. It contains all design and layout information for the plant. This conformance class supports detailed spatial and physical design and analysis of plants and plant systems.

Class 7 - Detailed physical and spatial layout and design of plants, plant systems, and equipment using CSG, piping design CSG, wireframe, and B-rep geometric representations. It contains all design and layout information for the plant. This conformance class supports detailed spatial and physical design and analysis of plants and plant systems.

Class 8 - Physical and spatial layout and design of piping systems using CSG geometric representations. This conformance class supports the fabrication and installation of piping systems.

Class 9 - Physical and spatial layout and design of piping systems using CSG and piping design CSG geometric representations. This conformance class supports the fabrication and installation of piping systems.

Class 10 - Physical and spatial layout and design of piping systems using CSG, piping design CSG, wireframe, and B-rep geometric representations. This conformance class supports the fabrication and installation of piping systems.

Table 16 - Conformance classes elements

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
action	X	X	X	X	X	X	X	X	X	X
action_assignment	X	X	X	X	X	X	X	X	X	X
action_directive	X	X	X	X	X	X	X	X	X	X
action_method	X	X	X	X	X	X	X	X	X	X
action_method_relationship	X	X	X	X	X	X	X	X	X	X
action_relationship	X	X	X	X	X	X	X	X	X	X
action_request_assignment	X	X	X	X	X	X	X	X	X	X
action_request_solution	X	X	X	X	X	X	X	X	X	X
action_request_status	X	X	X	X	X	X	X	X	X	X
action_status	X	X	X	X	X	X	X	X	X	X
advanced_csg_shape_representation	-	X	X	X	X	X	X	X	X	X
amount_of_substance_measure_with_unit	X	X	X	X	X	X	X	X	X	X
amount_of_substance_unit	X	X	X	X	X	X	X	X	X	X
angular_location	-	X	X	X	X	X	X	X	X	X
application_context	X	X	X	X	X	X	X	X	X	X
application_context_element	X	X	X	X	X	X	X	X	X	X
application_protocol_definition	X	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
approval	X	X	X	X	X	X	X	X	X	X
approval_assignment	X	X	X	X	X	X	X	X	X	X
approval_date_time	X	X	X	X	X	X	X	X	X	X
approval_person_organization	X	X	X	X	X	X	X	X	X	X
approval_role	X	X	X	X	X	X	X	X	X	X
approval_status	X	X	X	X	X	X	X	X	X	X
area_measure_with_unit	-	X	X	X	X	X	X	X	X	X
area_unit	-	X	X	X	X	X	X	X	X	X
assembly_component_usage	X	X	X	X	X	X	X	X	X	X
axis1_placement	-	X	X	X	X	X	X	X	X	X
axis2_placement_2d	-	X	X	X	X	X	X	X	X	X
axis2_placement_3d	-	X	X	X	X	X	X	X	X	X
b_spline_curve	-	-	-	X	-	-	X	-	-	X
b_spline_curve_with_knots	-	-	-	X	-	-	X	-	-	X
b_spline_surface	-	-	-	X	-	-	X	-	-	X
b_spline_surface_with_knots	-	-	-	X	-	-	X	-	-	X
bezier_curve	-	-	-	X	-	-	X	-	-	X
bezier_surface	-	-	-	X	-	-	X	-	-	X
blank_fitting_classification	X	-	-	-	X	X	X	X	X	X
block	-	X	X	X	X	X	X	X	X	X
boolean_result	-	X	X	X	X	X	X	X	X	X
boundary_curve	-	-	-	X	-	-	X	-	-	X
bounded_curve	-	-	-	X	-	-	X	-	-	X
bounded_pcurve	-	-	-	X	-	-	X	-	-	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
bounded_surface	-	-	-	X	-	-	X	-	-	X
bounded_surface_curve	-	-	-	X	-	-	X	-	-	X
brep_with_voids	-	-	-	X	-	-	X	-	-	X
bushing_fitting_classification	X	-	-	-	X	X	X	X	X	X
calendar_date	X	X	X	X	X	X	X	X	X	X
cartesian_point	-	-	-	X	-	-	X	-	-	X
cartesian_transformation_operator	-	X	X	X	X	X	X	X	X	X
cartesian_transformation_operator_3d	-	X	X	X	X	X	X	X	X	X
catalogue_item	X	X	X	X	X	X	X	X	X	X
centre_of_symmetry	-	X	X	X	X	X	X	X	X	X
change_action	X	X	X	X	X	X	X	X	X	X
change_from_assignment	X	X	X	X	X	X	X	X	X	X
change_item_id_assignment	X	X	X	X	X	X	X	X	X	X
change_to_assignment	X	X	X	X	X	X	X	X	X	X
characterized_object	X	X	X	X	X	X	X	X	X	X
circle	-	-	-	X	-	-	X	-	-	X
classification_assignment	X	X	X	X	X	X	X	X	X	X
closed_shell	-	-	-	X	-	-	X	-	-	X
colour	-	X	X	X	X	X	X	X	X	X
colour_rgb	-	X	X	X	X	X	X	X	X	X
colour_specification	-	X	X	X	X	X	X	X	X	X
composite_curve	-	-	-	X	-	-	X	-	-	X
composite_curve_on_surface	-	-	-	X	-	-	X	-	-	X
composite_curve_segment	-	-	-	X	-	-	X	-	-	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
conic	-	-	-	X	-	-	X	-	-	X
conical_surface	-	-	-	X	-	-	X	-	-	X
connected_face_set	-	-	-	X	-	-	X	-	-	X
connection_functional_classification	X	-	-	-	X	X	X	X	X	X
connection_motion_classification	X	-	-	-	X	X	X	X	X	X
connection_node	X	-	-	-	X	X	X	X	X	X
connector_end_type_classification	X	X	X	X	X	X	X	X	X	X
context_dependent_unit	X	X	X	X	X	X	X	X	X	X
conversion_based_unit	X	X	X	X	X	X	X	X	X	X
coordinated_universal_time_offset	X	X	X	X	X	X	X	X	X	X
coupling_fitting_classification	X	-	-	-	X	X	X	X	X	X
cross_fitting_classification	X	-	-	-	X	X	X	X	X	X
csg_solid	-	X	X	X	X	X	X	X	X	X
curve	-	-	-	X	-	-	X	-	-	X
curve_bounded_surface	-	-	-	X	-	-	X	-	-	X
curve_replica	-	-	-	X	-	-	X	-	-	X
cylindrical_surface	-	-	-	X	-	-	X	-	-	X
date	X	X	X	X	X	X	X	X	X	X
date_and_time	X	X	X	X	X	X	X	X	X	X
date_and_time_assignment	X	X	X	X	X	X	X	X	X	X
date_assignment	X	X	X	X	X	X	X	X	X	X
date_role	X	X	X	X	X	X	X	X	X	X
date_time_role	X	X	X	X	X	X	X	X	X	X
definitional_representation	X	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
degenerate_pcurve	-	-	-	X	-	-	X	-	-	X
degenerate_toroidal_surface	-	-	-	X	-	-	X	-	-	X
derived_shape_aspect	-	X	X	X	X	X	X	X	X	X
derived_unit	X	X	X	X	X	X	X	X	X	X
derived_unit_element	X	X	X	X	X	X	X	X	X	X
descriptive_colour	-	X	X	X	X	X	X	X	X	X
descriptive_representation_item	X	X	X	X	X	X	X	X	X	X
design_project	X	X	X	X	X	X	X	X	X	X
design_project_assignment	X	X	X	X	X	X	X	X	X	X
dimensional_characteristic_representation	-	X	X	X	X	X	X	X	X	X
dimensional_exponents	-	X	X	X	X	X	X	X	X	X
dimensional_location	-	X	X	X	X	X	X	X	X	X
dimensional_size	-	X	X	X	X	X	X	X	X	X
directed_action	X	X	X	X	X	X	X	X	X	X
direction	-	-	-	X	-	-	X	-	-	X
document	X	X	X	X	X	X	X	X	X	X
document_reference	X	X	X	X	X	X	X	X	X	X
document_relationship	X	X	X	X	X	X	X	X	X	X
document_type	X	X	X	X	X	X	X	X	X	X
document_usage_constraint	X	X	X	X	X	X	X	X	X	X
edge	-	-	-	X	-	-	X	-	-	X
edge_curve	-	-	-	X	-	-	X	-	-	X
edge_loop	-	-	-	X	-	-	X	-	-	X
elbow_fitting_classification	X	-	-	-	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
electrical_connector_classification	X	X	X	X	X	X	X	X	X	X
electrical_system	X	X	X	X	X	X	X	X	X	X
elementary_surface	-	-	-	X	-	-	X	-	-	X
ellipse	-	-	-	X	-	-	X	-	-	X
evaluated_degenerate_pcurve	-	-	-	X	-	-	X	-	-	X
executed_action	X	X	X	X	X	X	X	X	X	X
external_source	X	X	X	X	X	X	X	X	X	X
externally_defined_item	X	X	X	X	X	X	X	X	X	X
externally_defined_plant_item_definition	X	X	X	X	X	X	X	X	X	X
extruded_area_solid	-	X	X	X	X	X	X	X	X	X
extruded_face_solid	-	X	X	X	X	X	X	X	X	X
face	-	-	-	X	-	-	X	-	-	X
face_bound	-	-	-	X	-	-	X	-	-	X
face_surface	-	-	-	X	-	-	X	-	-	X
faceted_brep	-	-	-	X	-	-	X	-	-	X
flange_fitting_classification	X	-	-	-	X	X	X	X	X	X
flange_fitting_neck_type_classification	X	-	-	-	X	X	X	X	X	X
functionally_defined_transformation	X	X	X	X	X	X	X	X	X	X
geometric_curve_set	-	-	-	X	-	-	X	-	-	X
geometric_representation_context	-	X	X	X	X	X	X	X	X	X
geometric_representation_item	-	X	X	X	X	X	X	X	X	X
geometric_set	-	-	-	X	-	-	X	-	-	X
geometric_set_replica	-	-	-	X	-	-	X	-	-	X
group	X	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
group_assignment	X	X	X	X	X	X	X	X	X	X
heat_tracing_representation	-	X	X	X	X	X	X	X	X	X
hvac_system	X	X	X	X	X	X	X	X	X	X
hybrid_shape_representation	-	-	-	X	-	-	X	-	-	X
hyperbola	-	-	-	X	-	-	X	-	-	X
inline_equipment	X	-	-	-	X	X	X	X	X	X
insert_fitting_classification	X	-	-	-	X	X	X	X	X	X
instrumentation_and_control_system	X	X	X	X	X	X	X	X	X	X
interfering_shape_element	-	X	X	X	X	X	X	X	X	X
intersection_curve	-	-	-	X	-	-	X	-	-	X
lap_joint_stub_end_fitting_classification	X	-	-	-	X	X	X	X	X	X
lateral_fitting_classification	X	-	-	-	X	X	X	X	X	X
length_measure_with_unit	-	X	X	X	X	X	X	X	X	X
length_unit	-	X	X	X	X	X	X	X	X	X
line	-	X	X	X	X	X	X	X	X	X
line_branch_connection	X	-	-	-	X	X	X	X	X	X
line_less_piping_system	-	X	X	X	X	X	X	X	X	X
line_plant_item_branch_connection	X	-	-	-	X	X	X	X	X	X
line_plant_item_connection	X	-	-	-	X	X	X	X	X	X
line_termination_connection	X	-	-	-	X	X	X	X	X	X
local_time	X	X	X	X	X	X	X	X	X	X
loop	-	-	-	X	-	-	X	-	-	X
make_from_usage_option	-	-	-	-	X	X	X	X	X	X
manifold_solid_brep	-	-	-	X	-	-	X	-	-	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
mapped_item	-	X	X	X	X	X	X	X	X	X
mass_measure_with_unit	-	X	X	X	X	X	X	X	X	X
mass_unit	-	X	X	X	X	X	X	X	X	X
material_designation	-	X	X	X	X	X	X	X	X	X
material_designation_relationship	-	X	X	X	X	X	X	X	X	X
material_property	-	X	X	X	X	X	X	X	X	X
measure_representation_item	-	X	X	X	X	X	X	X	X	X
measure_with_unit	-	X	X	X	X	X	X	X	X	X
name_assignment	X	X	X	X	X	X	X	X	X	X
named_unit	-	X	X	X	X	X	X	X	X	X
offset_curve_2d	-	-	-	X	-	-	X	-	-	X
offset_curve_3d	-	-	-	X	-	-	X	-	-	X
offset_surface	-	-	-	X	-	-	X	-	-	X
olet_fitting_classification	X	-	-	-	X	X	X	X	X	X
open_shell	-	-	-	X	-	-	X	-	-	X
organization	X	X	X	X	X	X	X	X	X	X
organization_assignment	X	X	X	X	X	X	X	X	X	X
organization_role	X	X	X	X	X	X	X	X	X	X
organizational_project	X	X	X	X	X	X	X	X	X	X
oriented_closed_shell	-	-	-	X	-	-	X	-	-	X
oriented_edge	-	-	-	X	-	-	X	-	-	X
oriented_face	-	-	-	X	-	-	X	-	-	X
oriented_open_shell	-	-	-	X	-	-	X	-	-	X
oriented_path	-	-	-	X	-	-	X	-	-	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
orifice_plate_fitting_classification	X	-	-	-	X	X	X	X	X	X
parabola	-	-	-	X	-	-	X	-	-	X
path	-	-	-	X	-	-	X	-	-	X
pcurve	-	-	-	X	-	-	X	-	-	X
person	X	X	X	X	X	X	X	X	X	X
person_and_organization	X	X	X	X	X	X	X	X	X	X
person_and_organization_assignment	X	X	X	X	X	X	X	X	X	X
person_and_organization_role	X	X	X	X	X	X	X	X	X	X
person_assignment	X	X	X	X	X	X	X	X	X	X
person_role	X	X	X	X	X	X	X	X	X	X
pipe_cap_fitting_classification	X	-	-	-	X	X	X	X	X	X
pipe_classification	X	-	-	-	X	X	X	X	X	X
piping_component_definition	X	-	-	-	X	X	X	X	X	X
piping_connector_classification	X	X	X	X	X	X	X	X	X	X
piping_design_csg_shape_representation	-	-	X	X	-	X	X	-	X	X
piping_system	X	X	X	X	X	X	X	X	X	X
placement	-	X	X	X	X	X	X	X	X	X
plane	-	-	-	X	-	-	X	-	-	X
plane_angle_measure_with_unit	-	X	X	X	X	X	X	X	X	X
plane_angle_unit	-	X	X	X	X	X	X	X	X	X
plant	X	X	X	X	X	X	X	X	X	X
plant_item_connection	X	-	-	-	X	X	X	X	X	X
plant_item_connector	X	X	X	X	X	X	X	X	X	X
plant_item_definition	X	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
plant_item_definition_class	X	X	X	X	X	X	X	X	X	X
plant_item_interference	-	X	X	X	X	X	X	X	X	X
plant_item_route	-	X	X	X	X	X	X	X	X	X
plant_item_weight_representation	-	X	X	X	X	X	X	X	X	X
plant_line_definition	X	X	X	X	X	X	X	X	X	X
plant_line_segment_definition	X	-	-	-	X	X	X	X	X	X
plant_line_segment_termination	X	-	-	-	X	X	X	X	X	X
plant_spatial_configuration_action_request_assignment	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_approval_assignment	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_change_assignment	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_date_and_time_assignment	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_date_assignment	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_document_reference	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_organization_assignment	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_person_and_organization_assignment	X	X	X	X	X	X	X	X	X	X
plant_spatial_configuration_person_assignment	X	X	X	X	X	X	X	X	X	X
point	-	X	X	X	X	X	X	X	X	X
point_on_curve	-	-	-	X	-	-	X	-	-	X
point_on_surface	-	-	-	X	-	-	X	-	-	X
point_replica	-	-	-	X	-	-	X	-	-	X
poly_loop	-	-	-	X	-	-	X	-	-	X
polyline	-	-	-	X	-	-	X	-	-	X
presentation_layer_assignment	-	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
process_capability	X	X	X	X	X	X	X	X	X	X
product	X	X	X	X	X	X	X	X	X	X
product_category	X	X	X	X	X	X	X	X	X	X
product_category_relationship	X	X	X	X	X	X	X	X	X	X
product_context	X	X	X	X	X	X	X	X	X	X
product_definition	X	X	X	X	X	X	X	X	X	X
product_definition_context	X	X	X	X	X	X	X	X	X	X
product_definition_formation	X	X	X	X	X	X	X	X	X	X
product_definition_formation_relationship	X	X	X	X	X	X	X	X	X	X
product_definition_formation_with_specified_source	X	X	X	X	X	X	X	X	X	X
product_definition_relationship	X	X	X	X	X	X	X	X	X	X
product_definition_shape	X	X	X	X	X	X	X	X	X	X
product_definition_substitute	X	X	X	X	X	X	X	X	X	X
product_definition_usage	X	X	X	X	X	X	X	X	X	X
product_definition_with_associated_documents	X	X	X	X	X	X	X	X	X	X
product_related_product_category	X	X	X	X	X	X	X	X	X	X
property_definition	X	X	X	X	X	X	X	X	X	X
property_definition_relationship	-	X	X	X	X	X	X	X	X	X
property_definition_representation	X	X	X	X	X	X	X	X	X	X
purchase_assignment	X	X	X	X	X	X	X	X	X	X
quasi_uniform_curve	-	-	-	X	-	-	X	-	-	X
quasi_uniform_surface	-	-	-	X	-	-	X	-	-	X
ratio_measure_with_unit	-	X	X	X	X	X	X	X	X	X
ratio_unit	-	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
rational_b_spline_curve	-	-	-	X	-	-	X	-	-	X
rational_b_spline_surface	-	-	-	X	-	-	X	-	-	X
rectangular_composite_surface	-	-	-	X	-	-	X	-	-	X
rectangular_trimmed_surface	-	-	-	X	-	-	X	-	-	X
reducer_fitting_classification	X	-	-	-	X	X	X	X	X	X
reference_geometry	-	X	X	X	X	X	X	X	X	X
reparametrised_composite_curve_segment	-	-	-	X	-	-	X	-	-	X
representation	X	X	X	X	X	X	X	X	X	X
representation_context	X	X	X	X	X	X	X	X	X	X
representation_item	X	X	X	X	X	X	X	X	X	X
representation_map	-	X	X	X	X	X	X	X	X	X
reserved_space	-	X	X	X	X	X	X	X	X	X
revolved_area_solid	-	X	X	X	X	X	X	X	X	X
revolved_face_solid	-	X	X	X	X	X	X	X	X	X
right_circular_cone	-	X	X	X	X	X	X	X	X	X
right_circular_cylinder	-	X	X	X	X	X	X	X	X	X
seam_curve	-	-	-	X	-	-	X	-	-	X
shape_aspect	X	X	X	X	X	X	X	X	X	X
shape_aspect_deriving_relationship	-	X	X	X	X	X	X	X	X	X
shape_aspect_relationship	-	X	X	X	X	X	X	X	X	X
shape_definition_representation	-	X	X	X	X	X	X	X	X	X
shape_dimension_representation	-	X	X	X	X	X	X	X	X	X
shape_representation	-	X	X	X	X	X	X	X	X	X
si_unit	-	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (continued)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
site	-	X	X	X	X	X	X	-	-	-
site_building	-	X	X	X	X	X	X	-	-	-
site_feature	-	X	X	X	X	X	X	-	-	-
site_representation	-	X	X	X	X	X	X	-	-	-
solid_angle_measure_with_unit	-	X	X	X	X	X	X	X	X	X
solid_angle_unit	-	X	X	X	X	X	X	X	X	X
solid_model	-	X	X	X	X	X	X	X	X	X
spacer_fitting_classification	X	-	-	-	X	X	X	X	X	X
specialty_item_classification	X	-	-	-	X	X	X	X	X	X
sphere	-	X	X	X	X	X	X	X	X	X
spherical_surface	-	-	-	X	-	-	X	-	-	X
stream_design_case	X	-	-	-	X	X	X	X	X	X
stream_phase	X	-	-	-	X	X	X	X	X	X
structural_load_connector_classification	X	X	X	X	X	X	X	X	X	X
structural_system	X	X	X	X	X	X	X	X	X	X
support_constraint_representation	-	-	-	-	X	X	X	X	X	X
surface	-	-	-	X	-	-	X	-	-	X
surface_curve	-	-	-	X	-	-	X	-	-	X
surface_of_linear_extrusion	-	X	X	X	X	X	X	X	X	X
surface_of_revolution	-	X	X	X	X	X	X	X	X	X
surface_patch	-	-	-	X	-	-	X	-	-	X
surface_replica	-	-	-	X	-	-	X	-	-	X
swage_fitting_classification	X	-	-	-	X	X	X	X	X	X
swept_area_solid	-	X	X	X	X	X	X	X	X	X

Table 16 - Conformance class elements (concluded)

AIM element	Class									
	Log-ical	Layout and arrangement			Detailed design			Fabrication and installation		
	1	2	3	4	5	6	7	8	9	10
swept_face_solid	-	X	X	X	X	X	X	X	X	X
swept_surface	-	-	-	X	-	-	X	-	-	X
system_space	-	X	X	X	X	X	X	X	X	X
tee_fitting_classification	X	-	-	-	X	X	X	X	X	X
thermodynamic_temperature_measure_with_unit	X	X	X	X	X	X	X	X	X	X
thermodynamic_temperature_unit	X	X	X	X	X	X	X	X	X	X
time_measure_with_unit	X	X	X	X	X	X	X	X	X	X
time_unit	X	X	X	X	X	X	X	X	X	X
topological_representation_item	-	-	-	X	-	-	X	-	-	X
toroidal_surface	-	-	-	X	-	-	X	-	-	X
torus	-	X	X	X	X	X	X	X	X	X
trimmed_curve	-	-	-	X	-	-	X	-	-	X
truncated_pyramid	-	X	X	X	X	X	X	X	X	X
uniform_curve	-	-	-	X	-	-	X	-	-	X
uniform_surface	-	-	-	X	-	-	X	-	-	X
union_fitting_classification	X	-	-	-	X	X	X	X	X	X
valve_classification	X	-	-	-	X	X	X	X	X	X
vector	-	-	-	X	-	-	X	-	-	X
versioned_action_request	X	X	X	X	X	X	X	X	X	X
vertex	-	-	-	X	-	-	X	-	-	X
volume_measure_with_unit	-	X	X	X	X	X	X	X	X	X
volume_unit	-	X	X	X	X	X	X	X	X	X
wye_fitting_classification	X	-	-	-	X	X	X	X	X	X