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DMM Data Models (1 / 3)

Common and Resource Models

Data Manager for Manufacturing

Microsoft Cloud for Manufacturing

Table of Contents

- DMM Models 3
 - 1 Common Models: 3
 - 1.1 Hierarchy scope 3
 - 1.2 Spatial definition 4
 - 1.3 Operational location information 6
 - 2 Resource models 10
 - 2.1 Personnel information 10
 - 2.2 Role-based equipment information 16
 - 2.3 Physical asset information 25
 - 2.4 Material information 32
 - 2.5 Process segment information 46

DMM Models

This document describes the Common and Resource data models used within DMM.

The common data models describe certain common patterns (example hierarchies) or models that describe spatial or location data. The spatial models specify where a manufacturing operation is getting performed.

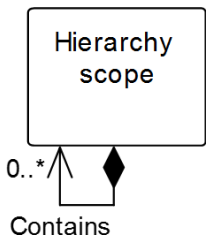
The Resource models describe the logical or physical resources that are needed to perform any operation step in manufacturing. These steps can be related to production, quality, inventory or maintenance operations. The resource models contain the equipment (usually expressed as logical hierarchies), personnel with certain skillsets, material (with certain properties and corresponding stock information) and physical assets. The resource model also contains a process definition view in the form of process segment that describes the collection of steps and their relationships needed to perform any manufacturing related activity in the production, maintenance, quality or inventory departments.

Together, the Common Data models and Resource models provide the context for any manufacturing activity by answering basic questions like what materials, equipment or personnel skills are needed in what quantity to produce an item or where it can be produced etc.

In the two sections that follow, we look deeper into the Common data models and Resource data models.

1 Common DMM Models:

1.1 HierarchyScope



The hierarchy scope identifies where the exchanged information fits within the role-based equipment hierarchy. It defines the scope of the exchanged information, such as a site or area for which the information is relevant. The hierarchy scope identifies the associated instance in the role-based equipment hierarchy.

EXAMPLE 1 A hierarchy scope can identify a site, such as WEST-END. An operation's performance can have a hierarchy scope attribute that identifies the WEST-END site.

EXAMPLE 2 A hierarchy scope can identify an area within a site, such as WEST-END/HOLDING-AREA. Operation's capability can have a hierarchy scope attribute that identifies the area.

EXAMPLE 3 A hierarchy scope can identify a work center within an area or site, such as WEST-END/HOLDING- AREA/CHIPPING-BIN #1.

EXAMPLE 4 A hierarchy scope can identify a work center without an area or site identification because the area or site are already known due to the exchange mechanism, such as CHIPPING-BIN #1.

EXAMPLE 5 A hierarchy scope can identify a complete hierarchy of enterprise, site, area and work center.

HierarchyScope relationship roles

Related object	Role	Multiplicity	Relationship name	Description
HierarchyScope	Hierarchy scope child	0..*	Contains	The child <i>hierarchy scope(s)</i> contained within this <i>hierarchy scope</i> .

HierarchyScope attributes

Attribute name	Description	Examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of an <i>equipment</i> element		string	true	AK
equipmentID	A unique identification of an <i>equipment</i> element	Work Center 23	String	true	AK (alternate key combination)
equipmentLevel	Identification of the <i>equipment level</i> if the <i>equipment</i> element is defined	Work Center	Enum: "enumValues": ["Enterprise", "Site", "Area", "Work Center", "Work Unit", "Process Cell", "Production Unit", "Production Line", "Storage Zone", "Unit", "Work Cell", "Storage Unit"]]	true	AK

1.2 SpatialDefinition

The spatial definition provides a means of communicating zero-dimensional points, one-dimensional line, or two-dimensional shape or three-dimensional solid geospatial location data for planning/scheduling, actuals, resources, and analytics. Spatial definition identifies a value and the predefined coordinate reference system using the following attributes:

- a) value;
- b) format;
- c) spatial reference identifier (SRID); and
- d) SRID authority.

A fully qualified spatial definition exchange has all four attributes as a minimum. In some information exchanges, sending and receiving applications may have a specified agreement on format, SRID, and SRID authority.

Spatial definition is distinct from and separate from storage location and physical location. Storage location attribute is defined for material lots and material sublots as a nonspatial definition of location. The physical location attribute logically identifies a "place", which is actual physical location of the physical asset.

Attributes of SpatialDefinition

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
value	A string to uniquely identify a spatial definition. EXAMPLE 1 UN/CEFACT CCTS: TextType) of the geospatial information in the format indicated in the format attribute.	lat="45.35" lon="24.15"	string	false	
format	An enumerator that determines the format of the value attribute.	GPX	string	false	
SRID	SRID is the Spatial Reference Identifier, which identifies the coordinate reference system to identify a predefined coordinate reference system (preconfigured into communication systems). An identifier from the SRID Authority.	4326 (WGS84)	string	false	
SRIDauthority	The <i>SRID authority</i> identifies the authority that defines the coordinate reference system identified by the <i>SRID</i> . EXAMPLE 2 EPSG (see http://www.epsg-registry.org/). An organization can choose to define its own SRIDs. EXAMPLE 3 Reference to its own authority.	EPSG	string	false	

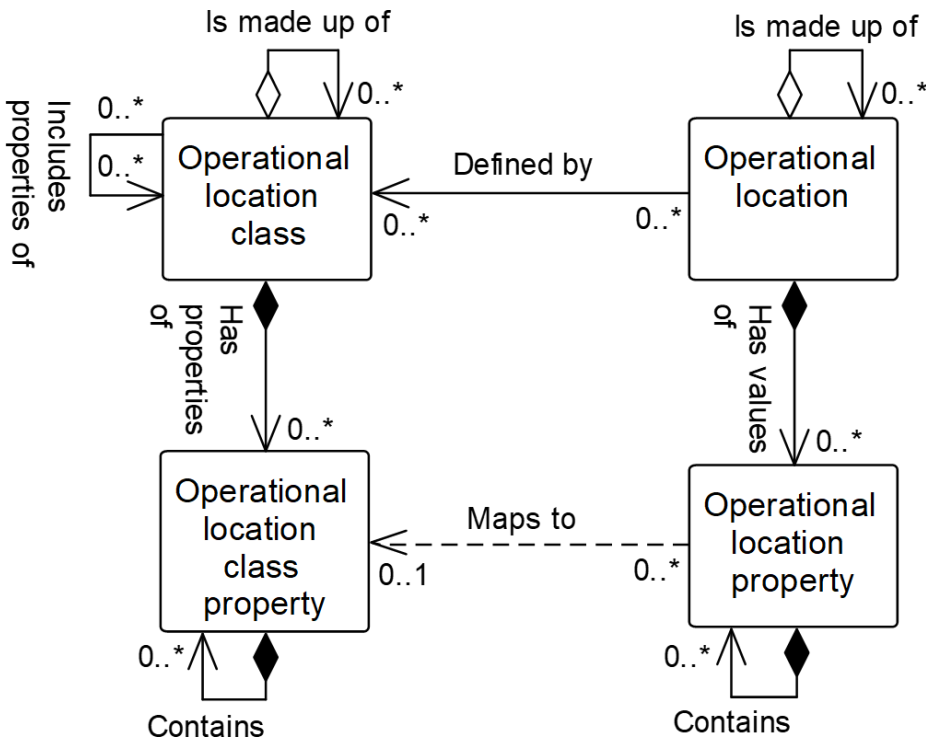
EXAMPLE 4 Format attribute options can include but aren't limited to:

- WKT (Well-known text): a text mark-up language defined by the open geospatial consortium (OGC) and used to represent vector geometry objects. WKT is defined in the ISO/IEC 13249-3:2011 standard, "Information technology – Database languages – SQL multimedia and application packages – Part 3: Spatial" (SQL/MM);
- WKB (Well-known binary): a binary representation of WKT defined in the ISO/IEC 13249-3:2011 standard, "Information technology – Database languages – SQL multimedia and application packages – Part 3: Spatial" (SQL/MM);
- GML (Geography markup language): GML defined by the Open Geospatial Consortium (OGC) and used to express geographical features. ISO 19136:2007 defines the OpenGIS® Geography Mark-up Language Encoding Standard (GML) or the Geography Markup Language (GML), version OGC 10-129r1;
- KML (Keyhole markup language): KML Version 2.2 is defined by the Open Geospatial Consortium (OGC) and used for the visualization of geographic information;
- GPX (GPS Exchange Format): GPX, 1.1 schema is the primary format for working with GPS data from mobile devices. GPX was released on August 9, 2004;
- GeoJSON: designed for representing simple geographical features based on JavaScript Object Notation (JSON) . The current version is GeoJSON 1.0, 2008; and

- g) SVG (Scalable Vector Graphics): SVG is an XML-based vector image format for two-dimensional graphics with support for interactivity and animation. The SVG specification is an open standard developed by the World Wide Web Consortium (W3C) since 1999. The current version is SVG 2.0.

The spatial definition attribute can represent a point, line, 2D or 3D polygon or 2D or 3D solid for any resource. The value attribute is used to uniquely identify a point, line, polygon or solid. The advantage over other more complex spatial definition approaches is that the spatial definition attribute relies on an external format.

1.3 Operational location information



Operational locations define the logical or physical places in which resources are located or are expected to be located within a plant. Operational locations may be made up of smaller operational locations. An operational location may belong to one or more operational location classes. An operational location class may be a specialization of one or more operational location classes.

1.3.1 OperationalLocationClass

A representation of a grouping of operational locations with similar characteristics for a definite purpose such as manufacturing operations definition, scheduling, capability and performance shall be presented as an operational location class. Any operational location may be a member of zero or more operational location classes.

OperationalLocationClass relationship roles

Related object	Role	Multiplicity	Relationship name	Description
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OperationalLocationClass	Operational location class parent type	0..*	includesPropertiesOf	The <i>operational location class(es)</i> include properties of the <i>operational location class</i> .
OperationalLocationClass	Operational location class child	0..*	isMadeUpOf	The parent <i>operational location class</i> is the whole of the child <i>operational location class(es)</i> as the part.
OperationalLocationClassProperty	Operational location class property	0..*	hasPropertiesOf	The <i>operational location class property(ies)</i> of this <i>operational location class</i> .
HierarchyScope			hierarchyScopeRel	Optional relationship to hierarchy.

OperationalLocationClass attributes

Attribute Name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>location class</i> , within the <i>hierarchy scope</i> of the <i>operational location class</i> .	SST	string	true	AK
description	Additional information about the <i>operational location class</i> .	Stainless Steel Tote	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope may define the scope of the <i>operational location class</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	

1.3.2 OperationalLocationClassProperty

Properties of an *operational location class* shall be defined as *operational location class property(s)*. An *operational location class property* may contain nested *operational location class property(s)*. An *operational location class property* may have zero or more *operational location property(s)* mapping to it

OperationalLocationClassProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Description
OperationalLocationClassProperty	Operational location class property child	0..*	contains	The child <i>operational location class property(s)</i> of this <i>operational location class property</i> .

OperationalLocationClassProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>operational location class property</i> within the operational location class.	Capacity	string	true	AK
description	Additional information about the <i>operational location class property</i> .	The storage capacity of the operational location	String	false	
value	The value, set of values, or range of the property.	n/a	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	n/a	String	true	AK
propertyType	Defines the type of property. Defined types are <ul style="list-style-type: none"> – class type: the property value is defined for the class and there's no value associated with an instance; – instance type: the property value of the class is undefined; and – default type: the property value is defined for the class as the default instance value, but individual instances of the class may redefine specific values. 	InstanceType	Enum "enumValues": ["ClassType", , "InstanceType", "DefaultType"]	false	

1.3.3 OperationalLocation

A logical or physical location where a material lot, material subplot, equipment, physical asset or person is located or expected to be located shall be presented as an operational location. Operational locations may be made up of other operational locations.

EXAMPLE Operational locations can include bin 28, hatch 3 and stockpile footprint A1.

OperationalLocation relationship roles

Related object	Role	Multiplicity	Relationship name	Description
OperationalLocationClass	Operational location class	0..*	definedBy	The <i>operational location class(s)</i> to which this <i>operational location</i> belongs.
OperationalLocation	Operational location child	0..*	isMadeUpOf	The child <i>operational location(s)</i> contained within this <i>operational location</i> .
OperationalLocationProperty	Operational location property	0..*	hasValuesOf	The <i>operational location property(s)</i> of this <i>operational location</i> .

HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.
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OperationalLocation attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>operational location</i> , within the <i>hierarchy scope</i> of the <i>operational location</i> .	SST57	string	true	AK
description	Contains additional information and descriptions of the <i>operational location</i> .	Stainless Steel Tote #57	String	false	
hierarchyScope	Identifies where the exchange information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>operational location</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
spatialDefinition	Spatially defines the <i>operational location</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	// WKT / POLYGON ((- 646.99 676.18, -645.14 683.09, - 646.99 676.18))	String	false	

1.3.4 OperationalLocationProperty

Properties of operational locations shall be presented as operational location properties. An operational location shall have zero or more operational location properties. These properties specify the current property values of the operational location for the associated operational location class property. Operational location properties may include a unit of measure. Operational location properties may contain nested operational location properties .

OperationalLocationProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Description
OperationalLocationProperty	Operational location property child	0..*	contains	The child <i>operational location property(s)</i> of this <i>operational location property</i> .
OperationalLocationClassProperty	Operational location class property	0..1	mapsTo	The <i>operational location class property</i> to which this <i>operational location class property</i> maps.

OperationalLocationProperty attributes

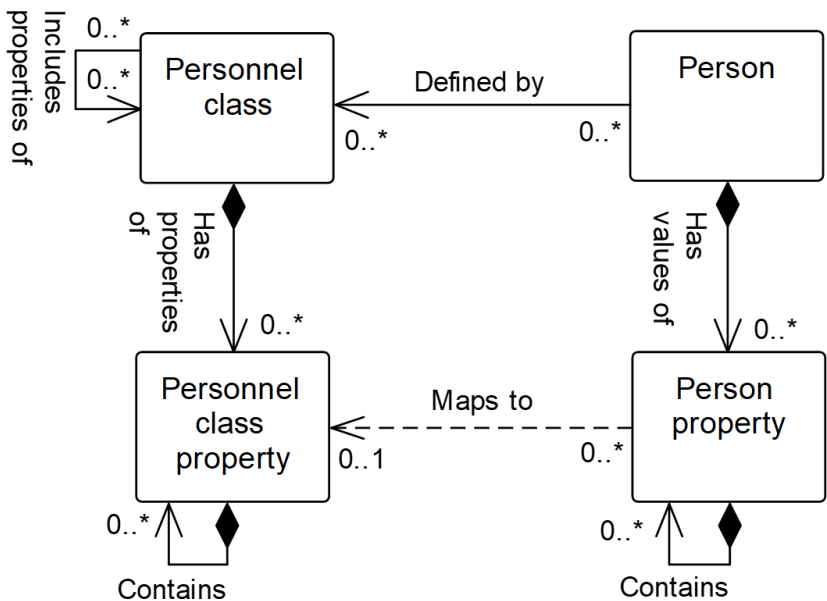
Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)

id	A unique identification of a specific <i>operational location property</i> within the <i>operational location</i> .	Capacity	string	true	AK
description	Additional information about the <i>operational location property</i> .	The storage capacity of the operational location	String	false	
value	The value, set of values, or range of the property.	180	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	kT	String	true	AK

2 Resource models

2.1 Personnel information

The personnel model contains information about specific *personnel*, *classes of personnel*, and qualifications of *personnel*.



2.1.1 PersonnelClass

A representation of a grouping of people with similar characteristics for a definite purpose such as manufacturing operations definition, scheduling, capability, and performance shall be presented as a personnel class. Any person may be a member of zero or more personnel classes. A personnel class may be defined as a specialization of zero or more personnel class. A personnel class may be made up of zero or more personnel class(s).

A personnel class may be evaluated by the test specification criteria in the test specification that references the evaluated property and may be recorded in an evaluated criterion result attribute in the test result.

PersonnelClass relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PersonnelClass	Personnel class parent type	0..*	includesPropertiesOf	The <i>personnel class</i> (s) includes properties of the <i>personnel class</i> .
PersonnelClassProperty	Personnel class property	0..*	hasPropertiesOf	The <i>personnel class property</i> (s) of this <i>personnel class</i> .
TestSpecification	Test specification	0..*	specifies	The <i>test specification</i> (s) used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

PersonnelClass attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>personnel class</i> . These aren't necessarily job titles but identify classes that are referenced in other parts of the model.	Widget assembly operator	String	true	AK
description	Additional information and description about the <i>personnel class</i> .	General information about widget assembly operators.	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>personnel class</i> definition, such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
hrsystemrefid	Workforce System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

2.1.2 PersonnelClassProperty

Properties of a personnel class shall be presented as personnel class properties. Each personnel class shall have zero or more recognized properties.

EXAMPLE 1 Personnel class properties for the personnel class operators can be class 1 certified, class 2 certified, night shift, and exposure hours.

Operations requests may specify required personnel class property requirements for an operations segment.

A personnel class property is tested to the evaluated property in a test specification where the measured results are recorded in a property measurement attribute in a test result. The measured results can also be evaluated to the test specification criteria in the test specification that references the evaluated property where they are recorded in an evaluated criterion result attribute in the test result.

Personnel class property(s) can contain nested personnel class property(s).

PersonnelClassProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Descriptions
PersonnelClassProperty	Personnel class property child	0..*	contains	The nested <i>personnel class property(s)</i> makes up part of this <i>personnel class property</i> as a whole.

PersonnelClassProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific property, unique under the scope of the parent <i>personnel class</i> object. EXAMPLE 2 The property “ <i>Has Class 1 Safety Training</i> ” (with values of <i>Yes</i> or <i>No</i>) can be defined under several different <i>personnel class</i> definitions, such as forklift operator and pipe fitter classes but has a different meaning for each class.	Class 1 Certified	string	true	AK
description	Additional information and description about the <i>personnel class property</i> .	Indicates the certification level of the operator.	String	false	

propertyType	Defines the type of property. Defined types are class type: the property value is defined for the class and there's no value associated with an instance; instance type: the property value of the class is undefined; and default type: the property value is defined for the class as the default instance value, but individual instances of the class may redefine specific values.	InstanceType	Enum "enumValues": ["ClassType" , "InstanceType", "DefaultType"]	false	
value	The value, set of values, or range of the property. This value presents a range of possible numerical values, a list of possible values, or it can be empty if any value is valid.	<True, False>	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property values.	Boolean	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	

2.1.3 Person

A representation of an identified individual shall be presented as a person. A person maybe a member of zero or more personnel classes.

A person may be tested by the evaluation of the test specification criteria in the test specification that references the evaluated property and may be recorded in an evaluated criterion result attribute in the test result. A person shall include a unique identification of the individual.

Person relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PersonnelC lass	Personnel class	0..*	definedBy	<i>Personnel classes</i> are supported by this <i>person</i> . This <i>person</i> supports the <i>personnel class</i> <i>property(s)</i> associated with the <i>personnel class</i> .

PersonProperty	Person property	0..*	hasValuesOf	The <i>person property</i> values of this <i>person</i> .
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

Person attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>person</i> , within the scope of the information exchanged (<i>operations capability</i> , <i>operations schedule</i> , <i>operations performance</i> , ...).. The ID is used in other parts of the model when the <i>person</i> needs to be identified, such as the <i>operations capability</i> for this person, or an <i>operations response</i> identifying the person	Employee 23	string	true	AK
description	Additional information about the resource.	Person Information	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>person</i> definition.	South Shore (Site) / Work Line (Area)	String	false	
name	The name of the individual. This value is meant for extra identification of the resource, but only as information and not as a unique value.	Jane	string	true	
spatialDefinition	Spatially defines the <i>person</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid,	// WKT / POLYGON ((-646.99 676.18, -645.14 683.09, -646.99 676.18))	Alphanumeric	false	
operationalLocation	Identifies the operational location of the <i>person</i> .	SST57	string	false	

operationalLocationType	Indicates whether the operational location attribute refers to an <i>operational location</i> object or contains a description of the operational location. Mandatory where an operational location attribute is specified. Defined values are operational location: operational location attribute references an <i>operational location</i> ; description: operational location attribute contains a description of the operational location, such as a street address.	Operational Location	Enum: "enumValues": ["Operational Location", "description"]	false	
hrsystemrefid	Workforce System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing Execution System Ref ID		Alphanumeric	false	

2.1.4 PersonProperty

Properties of a person shall be presented as person properties. Each person shall have zero or more person properties. These properties specify the current property values of the person for the associated personnel class property.

EXAMPLE A person property can be night shift and its value would be available. Another person property can be exposure hours available, and its value would be 4.

Person properties may include the current availability of a person and other current information, such as location and assigned activity, and the unit of measure of the current information.

A person property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attributed to a test result. The measured results may also be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result. Person properties may contain nested person properties.

PersonProperty relationship roles

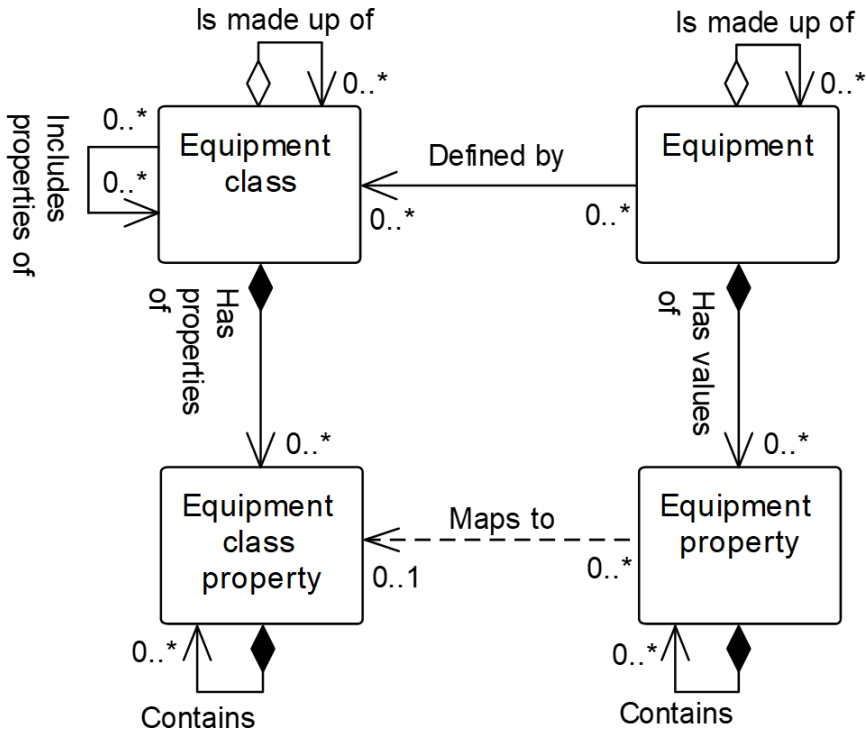
Related object	Role	Multiplicity	Relationship name	Description
PersonProperty	Person property	0..*	contains	This nested <i>person property(s)</i> is part of the <i>person property</i> as a whole.
PersonnelClassProperty	Personnel class property	0..1	mapsTo	If the <i>person</i> supports the parent <i>personnel class</i> , the <i>personnel class property(s)</i> is applied in this <i>person property(s)</i> . This <i>person property</i> maps to the corresponding <i>personnel class property</i> .

PersonProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
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ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific property.	Exposure Hours Available	string	true	AK
description	Additional information about the <i>person property</i> .	Indicates number of exposure hours available this month	String	false	
value	The value, set of values, or range of the property. The value(s) is assumed to be within the range or set of defined values for the related <i>personnel class property</i> .	4	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	Hours	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	

2.2 Role-based equipment information



2.2.1 EquipmentClass

A representation of a grouping of equipment with similar characteristics for a definite purpose such as manufacturing operations definition, scheduling, capability, and performance shall be presented as an equipment class. Any piece of equipment may be a member of zero or more equipment classes. An equipment class may be defined as a specialization of zero or more equipment classes. An equipment class may be made up of zero or more equipment classes.

An equipment class may be tested by the evaluation of the test specification criteria in the test specification that references the evaluated property and may be recorded in an evaluated criterion result attribute in the test result

EquipmentClass relationship roles

Related object	Role	Multiplicity	Relationship name	Description
EquipmentC lass	Equipment class parent type	0..*	includesPropertiesOf	This <i>equipment class</i> (s) includes properties of the <i>equipment class</i> .
EquipmentC lass	Equipment class child	0..*	isMadeUpOf	This parent <i>equipment class</i> is the whole of the child <i>equipment class</i> (s) as the part.
EquipmentClassProp erty	Equipment class property	0..*	hasPropertiesOf	The <i>equipment class property</i> (s) of this <i>equipment class</i> .
TestSpecification	Test specification	0..*	specifies	The <i>test specification</i> (s) used to evaluate this <i>testable object</i> .
TestableObjectProp erty	Testable object property		hasTestableObjectProperty ValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

EquipmentClass attributes

Attribute name	Description	examples	Datatype	Man dator y	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>equipment class</i> , within the scope of the information exchanged (<i>operations capability</i> , <i>operations schedule</i> , <i>operations performance</i> , ...) The ID is used in other parts of the model when the <i>equipment class</i> needs to be identified, such as the <i>production capability</i> for this <i>equipment class</i> , or an <i>operations response</i> identifying the <i>equipment class</i> used.	WJ6672892	string	true	AK
description	Additional information about the <i>equipment class</i> .	Jigs used to assemble widgets	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>equipment class</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
equipmentLevel	An identification of the level in the role-based equipment hierarchy.	workUnit	Enum "enumValues": ["enterprise", "site", "area", "workCenter", "workUnit", "processCell", "productionUnit", "productionLine", "storageZone", "unit", "workCell", "Storage Unit",]]	false	
assetsystemrefid	Asset, machinery, or device registry System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

2.2.2 EquipmentClassProperty

Properties of an equipment class shall be presented as equipment class properties. Each may have zero or more recognized properties.

An *equipment class property* may be tested to the *evaluated property* in a test specification where the measured results may be recorded in a *property measurement attribute* in a test result. The measured results may also be evaluated to the test specification criteria in the test specification that references the *evaluated property* where they may be recorded in an *evaluated criterion result attribute* in the test result. *Equipment class properties* may contain nested *equipment class properties*.

EXAMPLE *Equipment class properties for the equipment class reactor unit can be lining material, BTU extraction rate, and volume.*

EquipmentClassProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Descriptions
EquipmentClassProperty	Equipment class property child	0..*	contains	The nested <i>equipment class property(s)</i> makes up part of this <i>equipment class property</i> as the whole.

EquipmentClassProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific property.	Template Size	string	true	AK
description	Additional information about the <i>equipment class property</i> .	Range of template sizes for widget machines.	String	false	
propertyType	Defines the type of property. Defined types are class type: the property value is defined for the class and there's no value associated with an instance; instance type: the property value of the class is undefined; and default type: the property value is defined for the class as the default instance value, but individual instances of the class may redefine specific values.	InstanceType	Enum "enumValues": ["ClassType" , "InstanceType", "DefaultType"	false	
value	The value, set of values, or range of the property.	{10,20,30,40,100,200,300}	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	Cm	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreference dictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreference uri	URI locator for External reference		URIreference	false	

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2.2.3 Equipment

A representation of the elements of the equipment hierarchy model shown in ISA-95.00.01 shall be presented as equipment. Equipment may be a listing of any of the following: enterprise, site, area, work center, work unit, process cell, unit, production line, production unit, work cell, storage zone, and storage unit.

Equipment may be tested by the execution of the test specification criteria in the test specification that references the evaluated property and may be recorded in an evaluated criterion result attribute in the test result.

Equipment may be made up of other equipment, as presented in the equipment hierarchy model.

Equipment relationship roles

Related object	Role	Multiplicity	Relationship name	Description
EquipmentClass	Equipment class	0..*	definedBy	<i>Equipment classes</i> supported by this <i>equipment</i> . This <i>equipment</i> supports the <i>equipment class property(s)</i> associated with the <i>equipment class</i> .
EquipmentProperty	Equipment property	0..*	hasValuesOf	The <i>equipment property</i> values of this <i>equipment</i> .
Equipment	Equipment child	0..*	isMadeUpOf	The related object(s) makes up part of this <i>equipment</i> as a whole.
PhysicalAsset	NA	0..1	implementedBy	The physical asset implements the <i>equipment</i> as a role in a <i>process segment</i>
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

Equipment attributes

Attribute name	Description	Production examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)

id	<p>A unique identification of a specific piece of <i>equipment</i>, within the scope of the information exchanged (manufacturing operations definition, scheduling, capability, and performance).</p> <p>The equipment ID is used in other parts of the model when the <i>equipment</i> needs to be identified, such as the <i>operations capability</i> for a piece of equipment, or an <i>operations response</i> identifying the <i>equipment</i> used.</p>	Jig 347	string	true	AK
description	Additional information about the <i>equipment</i> .	This is the east side, north building, widget jig.	String	false	
hierarchyScope	<p>Identifies where the exchanged information fits within the role-based equipment hierarchy.</p> <p>Optionally, hierarchy scope defines the scope of the <i>equipment</i> definition, such as the site or area where it's defined.</p>	South Shore (Site) / Work Line (Area)	String	false	
equipmentLevel	An identification of the level in the role-based equipment hierarchy.	productionLine	<p>Enum</p> <p>"enumValues": [</p> <p>"enterprise",</p> <p>"site",</p> <p>"area",</p> <p>"workCenter",</p> <p>"workUnit",</p> <p>"processCell",</p> <p>"productionUnit",</p> <p>"productionLine",</p> <p>,</p> <p>"storageZone",</p> <p>"unit",</p> <p>"workCell",</p> <p>"Storage Unit"</p> <p>]</p>		

spatialDefinition	Spatially defines the <i>equipment</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	// WKT / POLYGON ((- 646.99 676.18, -645.14 683.09, - 646.99 676.18))	String	false	
operationalLocation	Identifies operational location of equipment		string	false	
operationalLocationType	Indicates whether the operational location attribute refers to an <i>operational location</i> object or contains a description of the operational location. Mandatory where an operational location attribute is specified. Defined values are – operational location: operational location attribute references an <i>operational location</i> ; – description: operational location attribute contains a description of the operational location, such as a street address.	Operational Location	Enum: "enumValues": ["Operational Location", "Description"]	false	
assetsystemrefid	Asset, machinery, or device registry System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

2.2.4 EquipmentProperty

Properties of equipment shall be presented as equipment properties. An equipment shall have zero or more equipment properties. These properties specify the current property values of the equipment for the associated equipment class property.

Equipment properties may include a unit of measure.

An equipment property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attribute in a test result. The measured results may also be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result. Equipment property(s) may contain nested equipment properties.

NOTE An equipment property can exist without an associated equipment class property, however all parties in an exchange must have a common understanding of the equipment property.

EXAMPLE 1 An equipment class property can be volume with a value of {10 000 – 50 000} with a unit of measure of liters, an equipment property can be volume with a value of 30 000 and a unit of measure of liters.

EXAMPLE 2 Equipment properties are

- other current information, such as when calibration is needed;
- maintenance status;
- the current state of the equipment; and
- performance values.

EquipmentProperty relationships

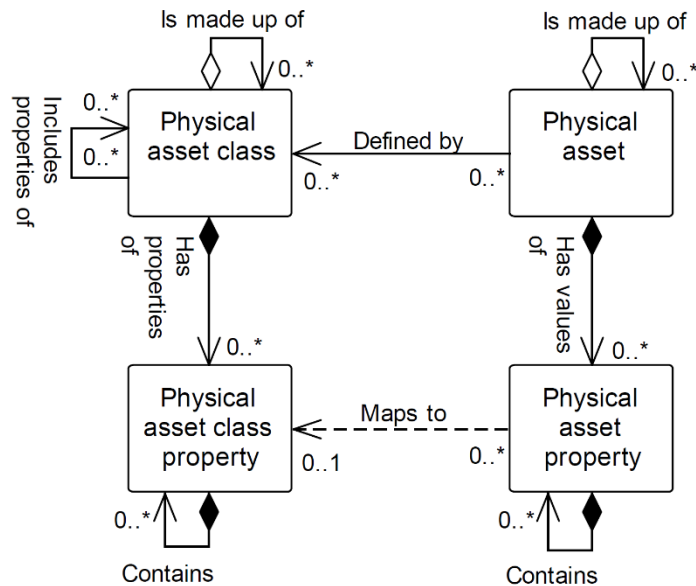
Related object	Role	Multiplicity	Relationship name	Description
EquipmentProperty	Equipment property child	0..*	contains	The nested <i>equipment property(s)</i> makes up part of this <i>equipment property</i> as a whole.
EquipmentClassProperty	Equipment class property	0..*	mapsTo	If the parent <i>equipment</i> supports an <i>equipment class</i> , the <i>equipment class property(s)</i> is applied in this <i>equipment property(s)</i> . This <i>equipment property</i> maps to the corresponding <i>equipment class property</i> .

EquipmentProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific property.	Run Rate	string	true	AK
description	Additional information about the <i>equipment property</i> .	Widget making average run rate	String	false	
value	The value, set of values, or range of the property. The <i>value(s)</i> is assumed to be within the range or set of defined values for the related <i>equipment property</i> .	59	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	Widgets/Hour	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	

externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	

2.3 Physical asset information

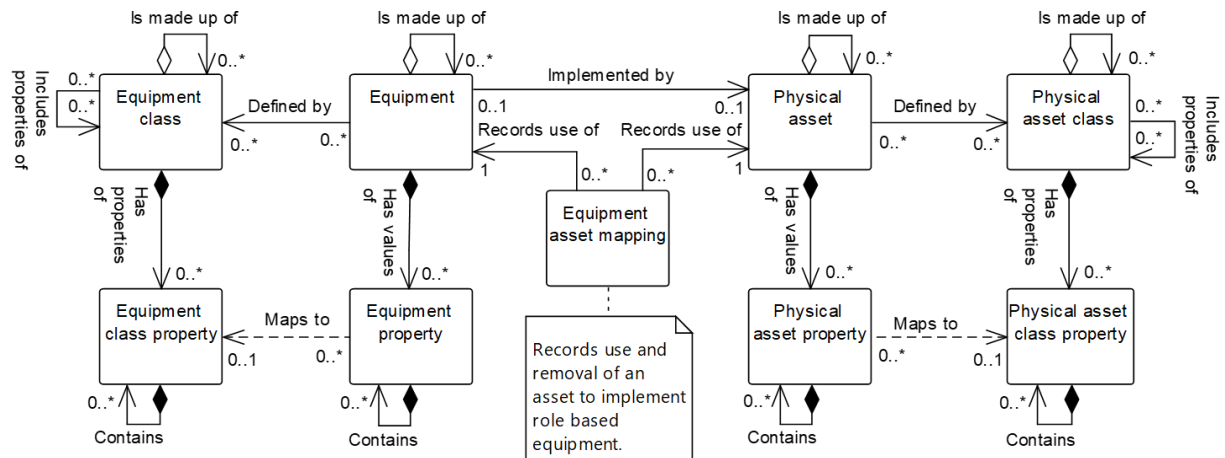


Physical asset model

The physical asset model contains information about the physical piece of equipment, managed as a physical asset within the enterprise often utilizing a specific serial number. An object in the equipment model defines a role for the equipment, and an object in the physical asset model defines the physical asset ID and properties of a piece of equipment.

EXAMPLE Equipment IDs can be represented as tag, which define a role such as TC184 for a temperature controller, while the temperature controller is an asset and has a serial number (TC_WED_9982002 922). **NOTE 1** The physical asset can be replaced and in that case the tag won't change, but a new physical asset with a unique serial number takes the place of the old physical asset. Therefore, two separate IDs would be used one for the role (equipment ID) and one for the physical asset (physical asset ID).

While assets have Level 4 significance because they have an economic value, the standard focuses on the Level 3 significance of the asset. The physical asset model defines a physical asset as a representation of a physical piece of equipment. Hierarchy levels in the physical asset hierarchy aren't defined in the standard; however, the role-based equipment hierarchy names should be used if they're equivalent.



Relationship between Physical asset model and Equipment Model

2.3.1 PhysicalAssetClass

PhysicalAssetClass relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PhysicalAssetClass	Physical asset class parent type	0..*	includesPropertiesOf	This <i>physical asset class</i> (s) includes properties of the <i>physical asset class</i> .
PhysicalAssetClass	Physical asset class child	0..*	isMadeUpOf	This parent <i>physical asset class</i> is the whole of the child <i>physical asset class</i> (s) as the part.
PhysicalAssetClassProperty	Physical asset class property	0..*	hasPropertiesOf	The <i>physical asset class property</i> (s) of this <i>physical asset class</i> .
TestSpecification	Test specification	0..*	specifies	The <i>test specification</i> (s) used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

PhysicalAssetClass attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
manufacturer	An identification of the manufacturer.	Smith Pumps.	String	true	
id	The manufacture's identification of the specific <i>physical asset class</i> . EXAMPLE Model number	2HPWP	string	true	AK
description	Additional information about the <i>physical asset class</i> .	Pump	String	false	
hierarchyScope	Identifies where the exchange information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>physical asset class</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
assetsystemrefid	Asset, machinery, or device registry System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

2.3.2 PhysicalAssetClassProperty

Properties of a physical asset class shall be presented as physical asset class properties. Each may have zero or more recognized properties.

A physical asset class property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attribute in a test result. The measured results may also be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result.

Physical asset class property(s) may contain nested physical asset class property(s).

PhysicalAssetClassProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PhysicalAssetClassProperty	Physical asset property class child	0..*	contains	The nested <i>physical asset class property(s)</i> makes up part of this <i>physical asset class property</i> as the whole.

PhysicalAssetClassProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific property.	Throughput	string	true	AK
description	Additional information about the property.	Pump throughput	String	false	
propertyType	Defines the type of property. Defined types are class type: the property value is defined for the class and there's no value associated with an instance; instance type: the property value of the class is undefined; and default type: the property value is defined for the class as the default instance value, but individual instances of the class may redefine specific values.	Instance Type	Enum "enumValues": ["ClassType" , "InstanceType", "DefaultType"]	false	
value	The value, set of values, or range of the property. The value(s) is assumed to be within the range or set of defined values for the related <i>asset property</i> .	400	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	L / min	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	

externalreferenceuri	URI locator for External reference		URIreference	false	
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2.3.3 PhysicalAsset

A physical piece of equipment shall be presented as a physical asset.

A physical asset may be tested by the evaluation of the test specification criteria in the test specification that references the evaluated property and may be recorded in an evaluated criterion result attribute in the test result.

Physical assets may be made up of other physical assets.

EXAMPLE 1 A packaging line can be made up of conveyor sections, motors, and sensors.

PhysicalAsset relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PhysicalAssetClasses	Physical asset class	0..*	definedBy	<i>Physical asset classes supported by this physical asset.</i> <i>This physical asset supports the physical asset class property(s) associated with the physical asset class.</i>
PhysicalAssetProperty	Physical asset property	0..*	hasValuesOf	The <i>physical asset property</i> values of this <i>physical asset</i> .
PhysicalAsset	Physical asset	0..*	isMadeUpOf	The related object(s) makes up part of this <i>physical asset</i> as a whole.
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

PhysicalAsset attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	Defines a unique identification of a <i>physical asset</i> .	SN5246\$9	string	true	AK
description	Contains additional information and descriptions of the <i>physical asset</i> .	2 HP Pump	String	false	
hierarchyScope	Identifies where the exchange information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>physical asset</i> definition, such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	

fixedAssetID	Contains a unique identification for financial tracking as required by laws or regulations	2000291	string	true	
vendorID	Contains a vendor's serial number	AT55628	String	false	
spatialDefinition	Spatially defines the <i>physical asset</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	// WKT / POLYGON ((- 646.99 676.18, -645.14 683.09, - 646.99 676.18))	String	false	
physicalLocation	Identifies the physical location of the <i>physical asset</i> .	SST57	String	false	
physicalLocationType	Indicates whether the physical location attribute refers to an <i>operational location</i> object or contains a description of the physical location. Mandatory where a physical location attribute is specified. Defined values are operational location: physical location attribute references the <i>operational location</i> ; description: physical location attributes contain a description of the physical location, such as a street address.	operationalLocation	Enum: "enumValues": ["operationalLocation", "description"]	false	
assetsystemrefid	Asset, machinery, or device registry System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

2.3.4 PhysicalAssetProperty

Properties of physical assets shall be presented as physical asset properties. A physical asset shall have zero or more physical asset properties. These properties specify the current property values of the physical asset for the associated physical asset class property. Physical asset properties may include a unit of measure.

A physical asset property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attribute in a test result. The measured results may also be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result. Physical asset property(s) may contain nested physical asset property(s).

PhysicalAssetProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PhysicalAssetProperty	Physical asset property child	0..*	contains	The nested <i>physical asset property(s)</i> makes up part of this <i>physical asset property</i> as a whole.
PhysicalAssetClassProperty	Physical asset class property	0..*	mapsTo	If the parent <i>physical asset</i> supports a <i>physical asset class</i> , the <i>physical asset class property(s)</i> is applied in this <i>physical asset property(s)</i> . This <i>physical asset property</i> maps to the corresponding <i>physical asset class property</i> .

PhysicalAssetProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific property.	Date of Manufacture	string	true	AK
description	Additional information about the <i>asset property</i> .	Name plate date of production	String	false	
value	The value, set of values, or range of the property. The value(s) is assumed to be within the range or set of defined values for the related <i>asset property</i> .	2023/10/23	string	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	Date	string	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	

externalreferenceuri	URI locator for External reference		URIreference	false	
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2.3.5 EquipmentAssetMapping

The relationship between a physical asset and an equipment shall be presented as an equipment asset mapping.

The equipment asset mapping records the time when an equipment object and a physical asset object were associated.

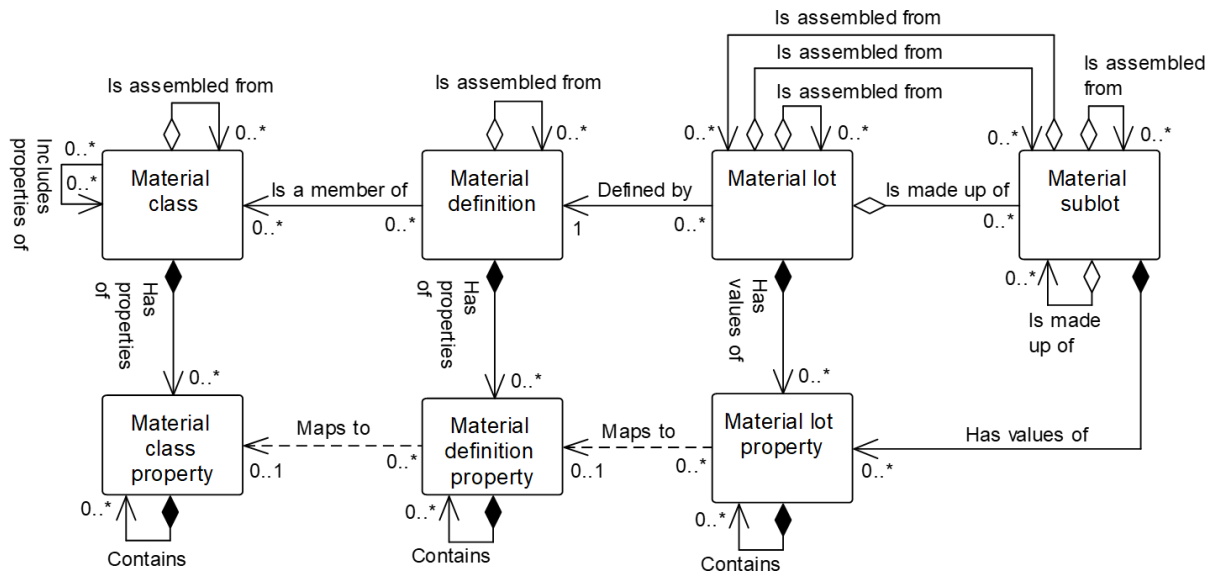
EquipmentAssetMapping relationship roles

Related object	Role	Multiplicity	Relationship name	Description
Equipment	Equipment	1	RecordsUseOfEquipment	The <i>equipment</i> performing the manufacturing function.
PhysicalAsset	Physical asset	1	RecordsUseOfPhysicalAsset	The <i>physical asset</i> that is associated with the <i>equipment</i> if the <i>physical asset</i> associated with a manufacturing function.
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

EquipmentAssetMapping attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific <i>equipment asset mapping</i> .	111	string	true	AK
description	Additional information about the <i>mapping</i> element.	(not applicable)	String	false	
hierarchyScope	Identifies where the exchange information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>physical asset class</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
startTime	The starting time of the association.	1997-02-10	DateTime	false	
endTime	The ending time of the association.	2004-12-10	DateTime	false	

2.4 Material information



2.4.1 MaterialClass

A representation of groupings of material definitions for a definite purpose such as manufacturing operations definition, scheduling, capability, and performance shall be presented as a material class. A material definition shall belong to zero or more material classes. A material class may be defined as a specialization of zero or more material classes. A material class may be made up of zero or more material classes. A material class may be defined as follows by containing an assembly of material classes and as part of an assembly of material classes.

- A material class may define an assembly of zero or more material classes.
- A material class may be an assembly element of zero or more material classes.
- An assembly may be defined as a permanent or transient assembly of material classes.
- An assembly may be defined as physical or a logical assembly of material classes.

A material class may be tested by the evaluation of the test specification criteria in the test specification that references the evaluated property and may be recorded in an evaluated criterion result attribute in the test result.

EXAMPLE 1 A material class can be a sweetener with members of fructose, corn syrup, and sugar cane syrup.

EXAMPLE 2 A material class can be water with members of the city water, recycled water, and spring water.

MaterialClass relationship roles

Related object	Role	Multiplicity	Relationship name	Description
MaterialClass	Material class parent type	0..*	IncludesPropertiesOf	This <i>material class</i> (s) include properties of the <i>material class</i> .
MaterialClass	Material class child	0..*	isAssembledFrom	This parent <i>material class</i> is whole of the child <i>material class</i> (s) as the part.
MaterialClassProperty	Material class property	0..*	hasPropertiesOf	The <i>material class property</i> (s) of this <i>material class</i> .
TestSpecification	Test specification	0..*	specifies	The <i>test specification</i> (s) used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object

HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.
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MaterialClass attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	<p>A unique identification of a specific <i>material class</i>, within the scope of the information exchanged (<i>operations capability</i>, <i>operations schedule</i>, <i>operations performance</i>, ...)</p> <p>The ID is used in other parts of the model when the <i>material class</i> needs to be identified, such as the <i>operations capability</i> for this <i>material class</i>, or an <i>operations response</i> identifying the <i>material class</i> used.</p>	Polymer sheet stock 1001A	string	true	AK
description	Additional information about the <i>material class</i> .	Solid polymer resin	String	false	
hierarchyScope	<p>Identifies where the exchanged information fits within the role-based equipment hierarchy.</p> <p>Optionally, hierarchy scope defines the scope of the <i>material class</i>, such as the site or area where it's defined.</p>	South Shore (Site) / Work Line (Area)	String	false	
assemblyType	<p>Defines the type of assembly.</p> <p>Defined types are</p> <ul style="list-style-type: none"> physical: the components of the assembly are physically connected or in the same area; logical: the components of the assembly aren't necessarily physically connected or in the same area. 	Physical	"enumValues": ["Physical", "Logical"]	false	
assemblyRelationship	<p>Defines the type of relationships.</p> <p>Defined types are</p> <ul style="list-style-type: none"> permanent: an assembly that isn't intended to be split during the production process; transient: a temporary assembly using during production, such as a pallet of different materials or a batch kit. 	Permanent	Enum: "enumValues": ["Permanent", "Transient"]	false	

inventorymanagementssystemrefid	Product Master or Inventory System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

2.4.2 MaterialClassProperty

Properties of a material class shall be presented as material class properties. A material class may define zero or more material class properties.

A material class property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attribute in a test result. The measured results may also be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result.

Material class property(s) may contain nested material class property(s).

EXAMPLE Material class properties include density, pH factor, and material strength.

The material class properties often list the nominal or standard values for the material. A material property value doesn't have to match the value of the corresponding material class property.

MaterialClassProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Descriptions
MaterialClassProperty	Class material class property	0..*	contains	The nested <i>material class property(s)</i> makes up part of this <i>material class property</i> as the whole.

MaterialClassProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of a specific <i>material class property</i> .	Polyethylene sheet thickness	string	true	AK
description	Additional information about the <i>material class property</i> .	Sheet Thickness	String	false	
propertyType	Defines the type of property. Defined types are class type: the property value is defined for the class and there's no value associated with an instance; instance type: the property value of the class is undefined; and default type: the property value is defined for the class as the default instance value, but individual instances of the class may redefine specific values.	InstanceType	Enum: "enumValues": ["ClassType" , "InstanceType", "DefaultType"]	false	

value	The value, set of values, or range of the property.	{5, 10, 25}	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	mm	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreference dictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreference uri	URI locator for External reference		URIreference	false	

2.4.3 MaterialDefinition

A representation of a material with similar characteristics for the purpose of manufacturing operations definition, scheduling, capability, and performance shall be presented as a material definition.

A material definition may be tested by the evaluation of the test specification criteria in the test specification that references the evaluated property and may be recorded in an evaluated criterion result attribute in the test result.

EXAMPLE Material definitions can include city water, hydrochloric acid from Vendor A, and grade B aluminum.

Any material lot shall be associated with one material definition.

MaterialDefinition relationship roles

Related object	Role	Multiplicity	Relationship name	Description
MaterialDefinition	Material definition child	0..*	isAssembledFrom	This <i>material definition</i> is part of the related object as a whole.
MaterialDefinitionProperty	Material definition property	0..*	hasPropertiesOf	The <i>material definition property(s)</i> of this <i>material definition</i> .
MaterialClass	Material class	0..*	isAMemberOfClass	These <i>material definition</i> objects support this <i>material class</i> . These <i>material definition</i> objects support the <i>material class property(s)</i> associated with the <i>material class</i> .
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

MaterialDefinition attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	<p>A unique identification of a specific <i>material definition</i>, within the scope of the information exchanged (<i>operations capability</i>, <i>operations schedule</i>, <i>operations performance</i>, ...)</p> <p>The ID is used in other parts of the model when the <i>material definition</i> needs to be identified, such as the <i>operations capability</i> for this <i>material definition</i>, or an <i>operations response</i> identifying the <i>material definition</i> used.</p>	Sheet stock 1443a	string	true	AK
description	Additional information about the <i>material definition</i> .	General purpose sheet stock	String	false	
hierarchyScope	<p>Identifies where the exchanged information fits within the role-based equipment hierarchy.</p> <p>Optionally, hierarchy scope defines the scope of the <i>material definition</i>, such as the site or area where it's defined.</p>	South Shore (Site) / Work Line (Area)	String	false	
spatialDefinition	Spatially defines the <i>material definition</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid	// WKT / POLYGON (-646.99 676.18, - 645.14 683.09, - 646.99 676.18))	String	false	
assemblyType	<p>Defines the type of assembly.</p> <p>Defined types are</p> <ul style="list-style-type: none"> physical: the components of the assembly are physically connected or in the same area; logical: the components of the assembly aren't necessarily physically connected or in the same area. 	Physical	Enum: "enumValues": ["Physical", "Logical"]	false	
assemblyRelationship	<p>Defines the type of relationships.</p> <p>Defined types are</p> <ul style="list-style-type: none"> permanent: an assembly that isn't intended to be split during the production process; transient: a temporary assembly using during production, such as a pallet of different materials or a batch kit. 	Permanent	Enum: "enumValues": ["Permanent", "Transient"]	false	
inventoryManagementSystemRefid	Product Master or Inventory System of Record Identifier		Alphanumeric	false	

messystemrefid	Manufacturing execution system Ref ID		Alphanum eric	false	
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2.4.4 MaterialDefinitionProperty

Properties of a material definition shall be presented as material definition properties. A material definition may define zero or more material definition properties.

A material definition property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attribute in a test result. The measured results may also be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result.

Material definition property(s) may contain nested material definition property(s).

EXAMPLE Material definition property can include density, pH factor, or material strength.

Properties may present the nominal or standard values for the material.

MaterialDefinitionProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Descriptions
MaterialDefinitionProperty	Material definition property child	0..*	contains	The nested <i>material definition property(s)</i> makes up part of this <i>material definition property</i> as the whole.
MaterialClassProperty	Material class property	0..1	mapsTo	If the parent <i>material definition</i> supports a <i>material class</i> , the <i>material class property(s)</i> is applied in the <i>material definition property(s)</i> . This <i>material definition property</i> maps to the corresponding <i>material class property</i> .

MaterialDefinitionProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific <i>material definition property</i> .	1443a5mm	string	true	AK
description	Additional information about the <i>material definition property</i> .	5 mm sheet	String	false	
propertyType	Defines the type of property. Defined types are <ul style="list-style-type: none"> class type: the property value is defined for the material definition and there's no value associated with an instance; 	InstanceType	Enum: "enumValues": ["ClassType" , "InstanceTy	false	

	– instance type: the property value of the <i>material definition</i> is undefined; and default type: the property value is defined for the <i>material definition</i> as the default instance value, but individual instances of the class may redefine specific values.		pe", "DefaultType"]		
value	The value, set of values, or range of the property.	{4,85 .. 5,15}	String	true	AK
valueUnitOf Measure	The unit of measure of the associated property value.	Mm	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreference dictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreference uri	URI locator for External reference		URIreference	false	

2.4.5 MaterialLot

A uniquely identified specific amount of material, either countable or weighable shall be presented as a material lot. A material lot describes the planned or actual total quantity or amount of material available, its current state, and its specific property values.

A material lot may be tested by the evaluation of a test specification.

A material lot shall include

- a) the unique identification of the lot;
- b) the amount of material;
EXAMPLE 1 Count, volume, weight, etc.
- c) the unit of measure of the material;
EXAMPLE 2 Parts, liters, kg, etc.
- d) the storage location for the material; and
- e) any status of the lot.

A material lot may be made up of material sublots. Material lots and material sublots may be used for traceability when they contain unique identifications.

MaterialLot relationship roles

Related object	Role	Multiplicity	Relationship name	Description
MaterialLot	Material lot	0..*	isAssembledFrom	This <i>material lot</i> is part of the related object as a whole.

MaterialLotProperty	Material lot property	0..*	hasValuesOf	The <i>material lot</i> property(s) of this <i>material lot</i> .
MaterialDefinition	Material definition	1	definedBy	The <i>material definition</i> that defines this <i>material lot</i> . The <i>material lot</i> objects support the <i>material definition property(s)</i> associated with the <i>material definition</i> . The <i>material lot</i> can function as a container for other objects where it doesn't have <i>material definition</i> association.
MaterialSublot	Material subplot	0..*	isSsembledFromSublot	This <i>material lot</i> is part of the related object as a whole.
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

MaterialLot attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>material lot</i> , within the scope of the information exchanged (<i>operations capability</i> , <i>operations schedule</i> , <i>operations performance</i> , ...) The ID is used in other parts of the model when the <i>material lot</i> needs to be identified, such as the <i>operations capability</i> for this <i>material lot</i> or an <i>operations response</i> identifying the <i>material lot</i> used.	L66738-99	string	true	AK
description	Additional information about the <i>material lot</i> .	PlastiFab 10/31 shipment	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>material lot</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
spatialDefinition	Spatially defines the <i>material lot</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	4326 / EPSG / GPX / lat="45.35" lon="24.15"	String	false	
storageLocation	Identifies the storage location of the <i>material lot</i> .	Work Center 1	String	false	

storageLocationType	<p>Indicates whether the storage location attribute refers to an <i>operational location</i>, <i>equipment</i>, or <i>physical asset</i> object, or contains a description of the storage location.</p> <p>Mandatory where a storage location is specified.</p> <p>Defined values are</p> <ul style="list-style-type: none"> operational location: storage location attribute references an <i>operational location</i>; equipment: storage location attribute references an <i>equipment</i> object; physical asset: storage location attribute references a <i>physical asset</i>; and description: storage location attribute contains a description of the storage location, such as a street address. 	Equipment	<p>Enum:</p> <p>"enumValues": [</p> <p>"Operational location",</p> <p>"Equipment",</p> <p>"Physical asset",</p> <p>"Description"</p> <p>]</p>	false	
assemblyType	<p>Defines the type of assembly.</p> <p>Defined types are</p> <ul style="list-style-type: none"> physical: the components of the assembly are physically connected or in the same area; logical: the components of the assembly aren't necessarily physically connected or in the same area. 	Physical	<p>Enum:</p> <p>"enumValues": [</p> <p>"Physical",</p> <p>"Logical"</p> <p>]</p>	false	
assemblyRelationship	<p>Defines the type of relationships.</p> <p>Defined types are</p> <ul style="list-style-type: none"> permanent: an assembly that isn't intended to be split during the production process; transient: a temporary assembly using during production, such as a pallet of different materials or a batch kit. <p>If <i>material lots</i> (or <i>sublots</i>) are merged or absorbed, then it becomes a new <i>material lot</i>.</p> <p>EXAMPLE 3</p> <p>A blended material lot</p>	Permanent	<p>Enum:</p> <p>"enumValues": [</p> <p>"Permanent",</p> <p>"Transient"</p> <p>]</p>	false	
status	<p>Status of the <i>material lot</i> in manufacturing operations.</p> <p>Values defined by implementation.</p> <p>EXAMPLE</p> <p>Released, approved, blocked, in process, and in quality check.</p>	In process	String	false	
disposition	<p>Planning and logistics disposition of a <i>material lot</i> or assembly of <i>material lots</i>.</p> <p>Defined values for the <i>disposition</i> of a <i>material lot</i> is</p> <ul style="list-style-type: none"> planned: a <i>material lot</i> that 	Planned	<p>Enum:</p> <p>"enumValues": [</p> <p>"Planned",</p> <p>"In</p>	false	

	<p>doesn't yet exist physically, is assigned to an <i>operations request (segment requirement) or work request or job order</i>;</p> <ul style="list-style-type: none"> – in process: the <i>material lot</i> is in the process of being worked on; – restricted: a <i>material lot</i> isn't permitted for normal use due to restriction conditions. <p>EXAMPLE</p> <p>A <i>material lot</i> can be awaiting a quality decision, or a <i>material lot</i> can be physically inaccessible.</p> <ul style="list-style-type: none"> – unrestricted: <i>material lot</i> is permitted for normal use without restriction; and <p>closed: <i>material lot</i> has been reconciled as completely consumed, sold, or disposed of.</p>		<p>process",</p> <p>"Restricted",</p> <p>"Unrestricted",</p> <p>"Closed"</p> <p>]</p>		
quantity	The quantity of the <i>material lot</i> .	1 200	Double	false	
quantityUnitOfMeasure	The unit of measure of the associated quantity.	sheets	String	false	
inventorymanagementsystemrefid	Inventory System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

2.4.6 MaterialLotProperty

Properties of a material lot shall be presented as material lot properties. Each material can have unique values for zero or more material lot properties, such as a specific pH value for the specific material lot, or a specific density for the material lot.

A material lot property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attribute in a test result. The measured results may be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result.

Material lot property(s) may contain nested material lot property(s).

MaterialLotProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Descriptions
MaterialLotProperty	Material lot property child	0..*	contains	The nested <i>material lot property(s)</i> makes up part of this <i>material lot property</i> as a whole.

MaterialDefinitionProperty	Material definition property	0..1	mapsTo	<p>If the parent <i>material lot</i> supports a <i>material definition</i>, the <i>material definition property(s)</i> is applied in the <i>material lot property(s)</i>.</p> <p>This <i>material lot property</i> maps to the corresponding <i>material definition property</i>.</p>
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MaterialLotProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of the specific <i>material lot property</i> .	Average sheet thickness	string	true	AK
description	Additional information about the <i>material lot property</i> .	Measured thickness	String	false	
value	The value, set of values, or range of the property.	5,002	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	mm	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	

2.4.7 MaterialSublot

Each separately identifiable quantity of the same material lot shall be presented as a material subplot. A material lot may be stored in separately identifiable quantities. All material sublots are part of the same material lot, so they have the material lot's property values. A material subplot may be just a single item.

Material sublots may have subplot specific properties.

A material subplot property may be tested to the evaluated property in a test specification where the measured results may be recorded in a property measurement attribute in a test result. The measured results may be evaluated to the test specification criteria in the test specification that references the evaluated property where they may be recorded in an evaluated criterion result attribute in the test result. Material subplot property(s) may contain nested material subplot property(s).

EXAMPLE 1 Material subplot properties can be RFID tag IDs or other identification properties, such that each material subplot has a different property value.

Each material subplot shall contain the location of the material subplot and the quantity or amount of material available in the material subplot.

Material sublots may contain other material sublots.

EXAMPLE 2 A material subplot can be a pallet, each box on the pallet can also be a subplot, and each material blister pack in the box can also be a material subplot.

A material subplot shall include

a unique identification of the material subplot,
the storage location of the material subplot,
the unit of measure of the material, and
any status of the material subplot.

MaterialSublot relationship roles

Related object	Role	Multiplicity	Relationship name	Description
MaterialSublot	Material subplot child	0..*	isMadeUpOf	This <i>material subplot</i> is part of the related object as a whole.
MaterialLotProperty	Material lot property	0..*	hasValuesOf	The <i>material lot property(s)</i> of this <i>material subplot</i> .
MaterialLot	Material lot	0..*	isAssembledFromLot	The related object(s) makes up part of this <i>material subplot</i> as the whole.
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>testable object</i> .
TestableObjectProperty	Testable object property		hasTestableObjectPropertyValuesOf	The testable object property values of this testable object
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

MaterialSublot attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>material subplot</i> , within the scope of the information exchanged (<i>operations capability, operations schedule, operations performance ...</i>) The ID is used in other parts of the model when the <i>material subplot</i> needs to be identified, such as the <i>operations capability</i> for this <i>material subplot</i> , or an <i>operations response</i> identifying the <i>material subplot</i> used.	1999-10-27-a67-B6653	string	true	AK
description	Additional information about the <i>material subplot</i> .	Pallet 2 of 6	String	false	

hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>material subplot</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
spatialDefinition	Spatially defines the <i>material subplot</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid. ¹	4326 / EPSG / GPX / lat="45.35" lon="24.15"	String	false	
storageLocation	Identifies the storage location of the <i>material subplot</i> .	Stainless Steel Tote #57	String	false	
storageLocationType	Indicates whether the storage location attribute refers to an <i>operational location</i> , <i>equipment</i> , or <i>physical asset</i> object, or contains a description of the storage location. Mandatory where a storage location is specified. Defined values are <ul style="list-style-type: none"> – <i>operational location</i>: storage location attribute references an <i>operational location</i>; – <i>equipment</i>: storage location attribute references an <i>equipment</i> object; – <i>physical asset</i>: storage location attribute references a <i>physical asset</i>; and description: storage location attribute contains a description of the storage location, such as a street address. 	Equipment	Enum: "enumValues": ["Operational location", "Equipment", "Physical asset", "Description"]	false	
assemblyType	Defines the type of assembly. Defined types are: Physical – The components of the assembly are physically connected or in the same area. Logical – The components of the assembly aren't necessarily physically connected or in the same area.	Physical	Enum: "enumValues": ["Physical", "Logical"]	false	
assemblyRelationship	Defines the type of relationships. Defined types are <ul style="list-style-type: none"> – permanent: an assembly that isn't intended to be split during the production process; – transient: a temporary assembly using during production, such as a pallet of different materials or a batch kit. If <i>material lots</i> (or <i>sublots</i>) are merged or absorbed, then it	Permanent	Enum: "enumValues": ["Permanent", "Transient"]	false	

	<p>becomes a new <i>material lot</i>.</p> <p>EXAMPLE A blended <i>material lot</i>.</p>				
status	<p>Status of the current <i>material subplot</i>.</p> <p>EXAMPLE Released, approved, blocked, in process, and in quality check.</p>	Released	String	false	
disposition	<p>Defines the <i>material subplot</i> disposition types of a <i>material subplot</i> or assembly of <i>material sublots</i>.</p> <p>Defined values for the disposition of a <i>material subplot</i> are</p> <ul style="list-style-type: none"> planned: a <i>material subplot</i> that doesn't yet exist is assigned to an <i>operations request (segment requirement)</i> or <i>work request (job order)</i>; in process: the <i>material subplot</i> is in the process of being worked on; restricted: a <i>material subplot</i> isn't permitted for normal use due to a restriction condition; <p>EXAMPLE A <i>material subplot</i> can be awaiting a quality decision or a <i>material subplot</i> can be physically inaccessible.</p> <ul style="list-style-type: none"> unrestricted: a <i>material subplot</i> is permitted for normal use without restriction; and <p>closed: a <i>material subplot</i> has been reconciled as completely consumed, sold, or disposed of.</p>	Planned	<p>Enum:</p> <pre>"enumValues": ["Planned", "In process", "Restricted", "Unrestricted", "Closed"]</pre>	false	
quantity	The quantity of the <i>material subplot</i> .	40	double	false	
quantityUnitOf Measure	The unit of measure of the associated quantity.	sheets	String	false	
inventorymanagementssystemrefid	Inventory System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

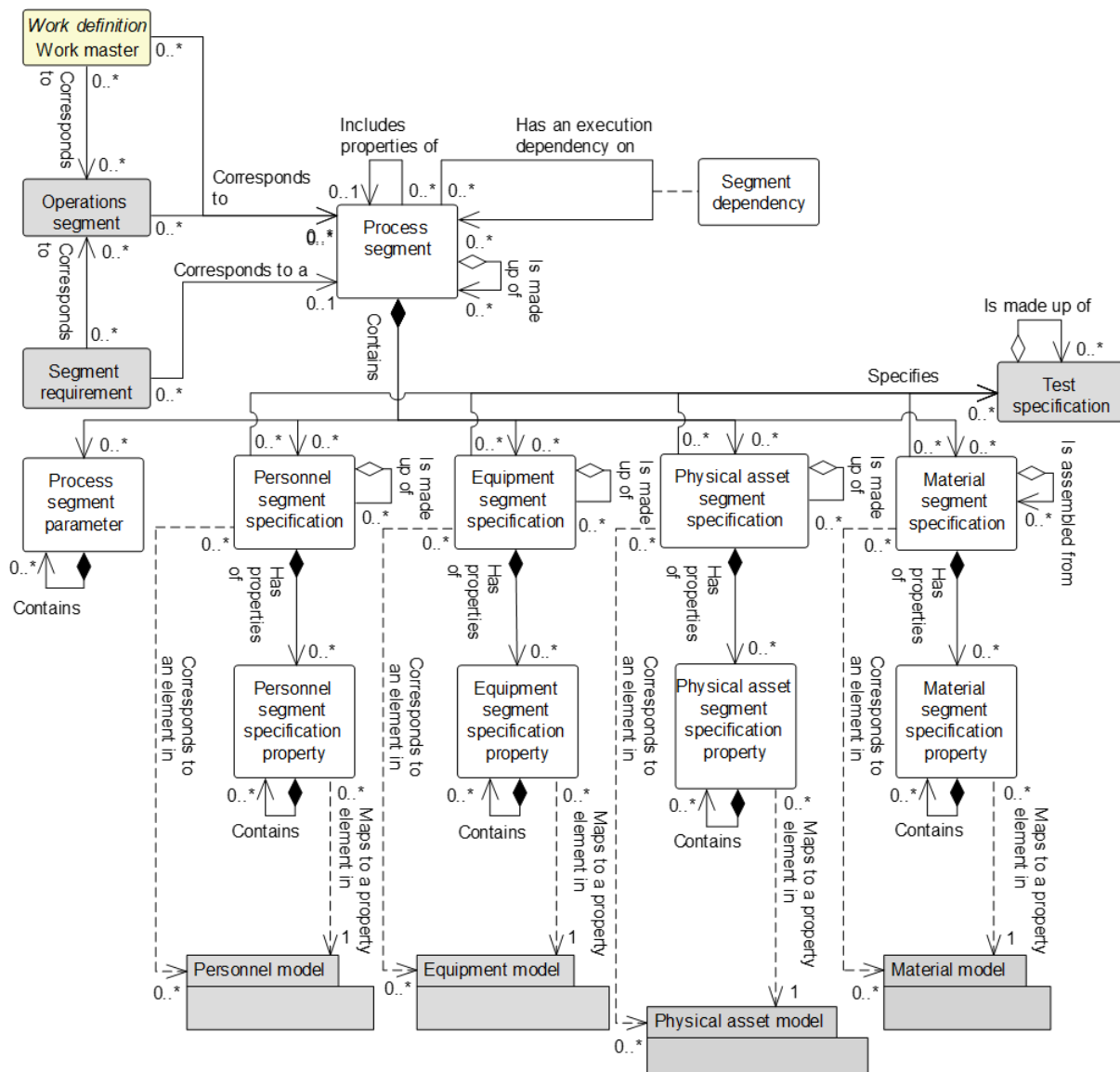
2.5 Process segment information

Process segments are the smallest elements of manufacturing activities that are visible to business processes. The process segment model is a hierarchical model, in which multiple levels of abstraction of manufacturing processes may be defined because there can be multiple business processes requiring visibility to manufacturing activities.

NOTE 1 The term, business process segment, is a synonym for process segment and can be used to reflect the business process aspect of the process segment.

Process segments are also logical grouping of personnel resources, equipment resources, physical asset resource and material required to perform a manufacturing operations step. A process segment defines the needed classes of personnel, equipment, physical assets, and material, and/or it may define specific resources, such as specific equipment needed. A process segment may define the quantity of the resource needed.

The manufacturing operations step may be a production operations step, inventory operations step, maintenance operations step, and quality operations step.



2.5.1 ProcessSegment

A process segment lists the classes of personnel, equipment, physical assets, and material needed, and/or it may present specific resources, such as specific equipment needed for the process segment. A process segment may list the quantity of the resources needed.

A process segment is something that occurs or can occur during manufacturing operations.

Process segment may identify

- a) the time duration associated with the resource;
EXAMPLE 1 Five hours or 5 h/100 kg.
- b) constraint rules associated with ordering or sequencing of segments; and
- c) a process segment may be made up of other process segments, in a hierarchy of definitions.

Process segments may contain specifications of specific resources required by the process segment. Process segments may contain parameters that can be listed in specific operations requests.

A process segment may be a specialization of another process segment. A process segment shall be defined as a "pattern" or an "instance". A pattern process segment defines a 'template', upon which other pattern or instance process segments may be based. Unlike instance process segments, pattern process segments shall not be directly scheduled or tracked. Therefore, segment requirements, segment responses and process segment capabilities shall not reference pattern process segments.

Where a process segment references a work master, the definition type (pattern or instance) of the referenced work master shall have the same value as the process segment.

The parameter, personnel, equipment, physical asset, and material specifications of a process segment may map to those of any pattern process segment upon which the process segment is based.

EXAMPLE 2 A pattern process segment can contain material segment specifications that reference material classes, while an instance process segment based on this pattern process segment can contain material segment specifications that reference material definitions belonging to the material classes.

EXAMPLE 3 A mining organization defines the following pattern and instance process segments.

Extraction (pattern):

- 1) open Cut Extraction (pattern), specialization of Extraction (pattern);
- 2) underground Extraction (pattern), specialization of Extraction (pattern);
- 3) Site S1 Open Cut Extraction (instance), specialization of Open Cut Extraction (pattern); and
- 4) Site S2 Underground Extraction (instance), specialization of Underground Extraction (pattern).

NOTE Pattern process segments provide a basis for standardization and reuse of pattern process segments across many instance process segments across and between plants.

ProcessSegment relationship roles

Related object	Role	Multiplicity	Relationship name	Description
ProcessSegment	Process segment child	0..*	isMadeUpOf	This parent <i>process segment</i> is the whole of the child <i>process segment(s)</i> as the part.
ProcessSegment	Process segment parent type	0..1	includesPropertiesOf	This <i>process segment class(s)</i> includes properties of the <i>process segment class</i> .

WorkMaster (Defined in Part 4)	NA	0..*	Corresponds to	This <i>process segment(s)</i> is applied in zero to many <i>work master(s)</i> .
ProcessSegment	Process segment	0..*	hasAnExecutionDependencyOn	<i>Process segments</i> have an association class relationship with <i>segment dependency</i> . The <i>process segment(s)</i> applying the ordering / sequencing rules from the <i>segment dependency</i> related to the <i>process segment</i> execution.
ProcessSegmentDependency	Segment dependency	0..*	hasAnExecutionDependencyOn	<i>Process segments</i> have an association class relationship with <i>segment dependency</i> . The ordering / sequencing rules related to the <i>process segment</i> execution.
ProcessSegmentParameter	Process segment parameter	0..*	containsParameter	The <i>process parameter specifications</i> related to this <i>process segment</i> .
PersonnelSegmentSpecification	Personnel segment specification	0..*	containsPersonnelSpecification	The <i>personnel specification(s)</i> defining part of this <i>process segment</i> .
EquipmentSegmentSpecification	Equipment segment specification	0..*	containsEquipmentSpecification	The <i>equipment specification(s)</i> defining part of this <i>process segment</i> .
PhysicalAssetSegmentSpecification	Physical asset segment specification	0..*	containsPhysicalAssetSpecification	The <i>physical asset specification(s)</i> defines part of this <i>process segment</i> .
MaterialSegmentSpecification	Material segment specification	0..*	containsMaterialSpecification	The <i>material specification(s)</i> defines part of this <i>process segment</i> .
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

ProcessSegment attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a <i>process segment</i> , within the scope of the information exchanged (<i>operations capability</i> , <i>operations schedule</i> , <i>operations performance</i> ...) The ID is used in other parts of the model when the <i>process segment</i> needs to be identified, such as the <i>operations capability</i> for this segment, or an <i>operations response</i> identifying the segment.	Widget Frame Milling	string	true	AK
description	Additional information about the <i>process segment</i> .	Frame milling operation, separately costed operation	String	false	

operationsType	Describes the category of the activity. . Defined values are production, maintenance, quality, inventory, or mixed. "Mixed" can be used when the activity contains several categories of <i>process segments</i> .	Production	Enum: "enumValues": ["Production" , "Maintenance", "Quality", "Inventory", "Mixed"]		
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>process segment</i> definition, such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
definitionType	Defines the type of the <i>process segment</i> . Defined values are <ul style="list-style-type: none"> – pattern: a <i>process segment</i> used as a template for other <i>process segments</i>; – instance: a <i>process segment</i> that may be directly scheduled and tracked. 	Pattern	Enum: "enumValues": ["Pattern", "Instance"]	false	
duration	Duration of process segment.	25	String	false	
durationUnitOfMeasure	The units of measure of the duration.	Minutes	String	false	

2.5.2 ProcessSegmentParameter

Specific parameters required for a process segment shall be presented as process segment parameters.

Process segment parameters may contain nested process segment parameters .

ProcessSegmentParameter relationship roles

Related object	Role	Multiplicity	Relationship name	Description
ParameterSegmentParameter	Parameter segment parameter child	0..*	contains	This <i>parameter segment parameter</i> is part of the <i>parameter segment parameter</i> as a whole.
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

ProcessSegmentParameter attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	Identification of the process segment parameter.	Milling Time	string	true	AK
description	Contains additional information.	Range of acceptable milling times.	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the object, such as the site or area.	South Shore (Site) / Work Line (Area)	String	false	
value	The value, set of values, or range of acceptable values	{5.10}	String	true	AK
valueUnitOfMeasure	Unit of measure of the values.	Minutes	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	

2.5.3 PersonnelSegmentSpecification

Personnel resources that are required for a process segment shall be presented as personnel segment specifications.

PersonnelSegmentSpecification relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PersonnelSegmentSpecification	Personnel segment specification child	0..*	isMadeUpOf	The related object(s) makes up part of this <i>personnel segment specification</i> as a whole.
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>personnel segment specification</i> .
PersonnelSegmentSpecificationProperty	Personnel segment specification property	0..*	hasPropertiesOf	The <i>personnel segment specification property(s)</i> of this <i>personnel segment specification</i> .
PersonnelClass	Personnel class	0..*	correspondsToPersonnelClass	A cross-model association to element in the personnel model as explained in Clause 3.3.8. Identifies the associated <i>personnel</i>

				<i>class</i> or set of <i>personnel classes</i> specified.
Person	Person	0..*	correspondsToPerson	<p>A cross-model association to element in the personnel model as explained in Clause 3.3.8.</p> <p>Identifies the associated <i>person</i> or set of <i>persons</i> specified.</p> <p>Typically, either <i>personnel class</i> or <i>person</i> is specified, but not both.</p>

PersonnelSegmentSpecification attributes

Attribute name	Description	Production examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>personnel segment specification</i> .	PS1-Employee 23	string	true	AK
description	Contains additional information and descriptions of the <i>personnel segment specification</i> definition.	Defines the time taken for the specific milling machine operators for each widget frame milling	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>personnel segment specification</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
spatialDefinition	Spatially defines the personnel resource(s) specified by this <i>personnel segment specification</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	4326 / EPSG / GPX / lat="45.35" lon="24.15"	String	false	
operationalLocation	Identifies the operational location of the personnel resource(s) specified by this <i>personnel segment specification</i> .	SST57	String	false	
operationalLocationType	Indicates whether the operational location attribute refers to an <i>operational location</i> object or contains a description of the operational location. Mandatory where an operational location attribute is specified. Defined values are <ul style="list-style-type: none"> operational location: operational location attribute references an <i>operational location</i>; description: operational location attribute contains a description of the 	OperationalLocation	Enum: "enumValues": ["OperationalLocation", "Description"]	false	

	operational location, such as a street address.				
personnelUse	Defines the expected use of the <i>personnel class</i> or <i>person</i> in the context of the <i>process segment</i> .	Allocated	String	true	AK
quantity	Specifies the <i>personnel</i> resource required for the parent <i>process segment</i> .	2	double	true	AK
quantityUnitOfMeasure	The unit of measure of the associated quantity.	Hours / piece	String	true	AK
hrsystemrefid	Workforce System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing Execution System Ref ID		Alphanumeric	false	

2.5.4 PersonnelSegmentSpecificationProperty

Specific properties that are required for personnel segment specifications shall be presented as personnel segment specification properties.

Personnel segment specification properties may contain nested personnel segment specification properties.

PersonnelSegmentSpecificationProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PersonnelSegmentSpecificationProperty	Personnel segment specification property child	0..*	contains	The <i>personnel segment specification property(s)</i> of this <i>personnel segment specification property</i> .
PersonnelSegmentSpecification	NA	1	Contains	The <i>personnel segment specification property(s)</i> of this <i>personnel segment specification property</i> .
PersonnelClassProperty	Personnel class property	0..*	maps ToClassProperty	A cross-model dependency to element in the personnel model as explained in Clause 3.3.8.
PersonProperty	Person property	0..*	mapsToProperty	A cross-model dependency to element in the personnel model as explained in Clause 3.3.8.

PersonnelSegmentSpecificationProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of a property of the associated <i>person property</i> or <i>personnel class property</i> .	Height	string	true	AK
description	Contains additional information and descriptions of the property.	Defines the required minimum height of a milling machine operator.	String	false	
value	The value, set of values, or range of the property.	150	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	cm	String	true	AK
quantity	Specifies the personnel resource required.	2	Double	true	AK
quantityUnitOfMeasure	The unit of measure of the associated quantity.	Hours / piece	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	

1.2.1 EquipmentSegmentSpecification

Equipment resources that are required for a process segment shall be presented as equipment segment specification

EquipmentSegmentSpecification relationship roles

Related object	Role	Multiplicity	Relationship name	Description
Process segment	NA	1	Contains	The <i>process segment</i> is defined in part by this <i>equipment segment specification</i> .
EquipmentSegmentSpecification	Equipment segment specification child	0..*	isMadeUpOf	The related object(s) makes up part of this <i>equipment segment specification</i> as the whole.
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>testable object</i>
EquipmentSegmentSpecificationProperty	Equipment segment specification property	0..*	hasPropertiesOf	The <i>equipment segment specification property(s)</i> of this <i>equipment segment specification</i> .

EquipmentClass	Equipment class	0..*	correspondsToEquipment Class	<p>A cross-model association to element in the equipment model as explained in Clause 3.3.8.</p> <p>Identifies the associated <i>equipment class</i> or set of <i>equipment classes</i> of the specification for a specific <i>process segment</i>.</p>
Equipment	Equipment	0..*	correspondsToEquipment	<p>A cross-model association to element in the equipment model as explained in Clause 3.3.8.</p> <p>Identifies the associated <i>equipment</i> or set of <i>equipment</i> of the specification for a specific <i>process segment</i>.</p> <p>Typically, either <i>equipment class</i> or <i>equipment</i> is defined.</p>

EquipmentSegmentSpecification attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>equipment segment specification</i> .	PS1-Employee 23	string	true	AK
description	Contains additional information and descriptions.	Equipment needed for widget milling process segment	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>equipment segment specification</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
spatialDefinition	Spatially defines the <i>equipment</i> specified by this <i>equipment segment specification</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	4326 / EPSG / GPX / lat="45.35" lon="24.15"	String	false	
operationalLocation	Identifies the operational location of the <i>equipment</i> specified by this <i>equipment segment specification</i> .	SST57	String	false	
operationalLocationType	Indicates whether the operational location attribute refers to an <i>operational location</i> object or contains a description of the operational location. Mandatory where an operational location attribute is specified. Defined values are – operational location:	Operational Location	Enum: "enumValues": ["Operational Location", "Description"]	false	

	operational location attribute references an <i>operational location</i> ; – description: operational location attribute contains a description of the operational location, such as a street address.				
equipmentUse	Defines the expected use of the <i>equipment class</i> or <i>equipment</i> in the context of the <i>process segment</i> .	Part Milling	String	true	AK
quantity	Specifies the amount of resources required.	1.3	Double	true	AK
quantityUnitOfMeasure	The unit of measure of the associated quantity.	Machine Hours / piece	String	true	AK
assetsystemrefid	Asset, machinery, or device registry System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

NOTE An *equipment segment specification* can specify both a spatial definition and an operational location attributes where it's necessary to specify the spatial definition of the specified *equipment* within a given *operational location*.

2.5.5 EquipmentSegmentSpecificationProperty

Specific properties that are required for equipment segment specifications shall be presented as

equipment segment specification properties Equipment segment specification properties may contain nested equipment segment specification properties.

EquipmentSegmentSpecificationProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Description
EquipmentSegmentSpecificationProperty	Equipment segment specification property child	0..*	contains	The <i>equipment segment specification property(s)</i> of this <i>equipment segment specification property</i> .
EquipmentClassProperty	Equipment class property	0..*	mapsToClassProperty	A cross-model dependency to element in the equipment model as explained in Clause 3.3.8.
Equipment property	Equipment property	0..*	mapsToProperty	A cross-model dependency to element in the equipment model as explained in Clause 3.3.8.

EquipmentSegmentSpecificationProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of a property of the associated <i>equipment property</i> or <i>equipment class property</i> .	Milling Direction	string	true	AK
description	Contains additional information and descriptions.	Only vertical milling machines are suitable for widget milling.	String	false	
value	The value, set of values, or range of the property. EXAMPLE Vertical, horizontal	Vertical	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	(not applicable)	String	true	AK
quantity	Specifies the amount of resources required.	1.0	Double	true	AK
quantityUnitOfMeasure	The unit of measure of the associated quantity.	Machine Hours/piece	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	

2.5.6 PhysicalAssetSegmentSpecification

Physical asset resources that are required for a process segment shall be presented as physical asset segment specifications .

PhysicalAssetSegmentSpecification relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PhysicalAssetSegmentSpecification	Physical asset segment specification child	0..*	isMadeUpOf	The related object(s) makes up part of this <i>physical asset segment specification</i> as a whole.
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>physical asset segment specification</i> .
PhysicalAssetSegmentSpecificationProperty	Physical asset segment specification property	0..*	hasPropertiesOf	The <i>physical asset segment specification property(s)</i> of this <i>physical asset segment specification</i> .

PhysicalAssetClass	Physical asset class	0..*	correspondsToPhysicalAssetClass	A cross-model association to element in the physical asset model as explained in Clause 3.3.8. Identifies the associated <i>physical asset class</i> or set of <i>physical asset classes</i> of the specification for a specific <i>process segment</i> .
PhysicalAsset	Physical asset	0..*	correspondsToPhysicalAsset	A cross-model association to element in the physical asset model as explained in Clause 3.3.8. Identifies the associated <i>physical asset</i> or set of <i>physical assets</i> of the specification for a specific <i>process segment</i> . Typically, either <i>physical asset class</i> or <i>physical asset</i> is specified, but not both.
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

PhysicalAssetSegmentSpecification attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>physical asset segment specification</i> .	PS1-Employee 23	string	true	AK
description	Contains additional information and descriptions.	Transmitter with the most recent calibration date	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the <i>physical asset segment specification</i> , such as the site or area where it's defined.	South Shore (Site) / Work Line (Area)	String	false	
spatialDefinition	Spatially defines the <i>physical asset(s)</i> specified by this <i>physical asset segment specification</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	4326 / EPSG / GPX / lat="45.35" lon="24.15"	String	false	
physicalLocation	Identifies the physical location of the <i>physical asset(s)</i> specified by this <i>physical asset segment specification</i> .	SST57	String	false	
physicalLocationType	Indicates whether the physical location attribute refers to an <i>operational location</i> object or contains a description of the physical location. Mandatory where a physical location attribute is specified. Defined values are	operationalLocation	Enum: "enumValues": ["operationalLocation", "description"]	false	

	<ul style="list-style-type: none"> operational location: physical location attribute references an <i>operational location</i>; description: physical location attribute contains a description of the physical location, such as a street address. 				
physicalAssetUse	Defines the expected use of the <i>physical asset class</i> or <i>physical asset</i> in the context of the <i>process segment</i> .	Temperature of granulation process	String	true	AK
quantity	Specifies the amount of resources required.	100 - 120	Double	true	AK
quantityUnitOfMeasure	The unit of measure of the associated quantity. Example Celsius or Kelvin	° C	String	true	AK
assetsystemrefid	Asset, machinery, or device registry System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

NOTE A physical asset segment specification can specify both a spatial definition and a physical location attributes where it's necessary to specify the spatial definition of the specified physical asset(s) within a given physical location.

2.5.7 PhysicalAssetSegmentSpecificationProperty

Specific properties that are required for physical asset segment specifications shall be presented as physical asset segment specification property(s).

Physical asset segment specification property(s) may contain nested physical asset segment specification property(s).

PhysicalAssetSegmentSpecificationProperty relationship roles

Related object	Role	Multiplicity	Relationship name	Description
PhysicalAssetSegmentSpecificationProperty	Physical asset segment specification property child	0..*	contains	The <i>physical asset segment specification property(s)</i> of this <i>physical asset segment specification property</i> .
PhysicalAssetClassProperty	Physical asset class property	0..*	mapsToClassProperty	A cross-model dependency to element in the physical asset model as explained in Clause 3.3.8.
PhysicalAssetProperty	Physical asset property	0..*	mapsToProperty	A cross-model dependency to element in the physical asset model as explained in Clause 3.3.8

PhysicalAssetSegmentSpecificationProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
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ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of a property of the associated <i>physical asset property</i> or <i>physical asset class property</i> .	Temperature calibration date	string	true	AK
description	Contains additional information and descriptions.	Calibration date no later than 6 months from use	String	false	
value	The value, set of values, or range of the property.	2022-12-31	string	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	Date	string	true	AK
quantity	Specifies the amount of resources required.	(not applicable)	Double	true	AK
quantityUnitOfMeasure	The unit of measure of the associated quantity.	(not applicable)	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreference dictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreference uri	URI locator for External reference		URIreference	false	

2.5.8 MaterialSegmentSpecification

Material resources that are required for a process segment shall be presented as material segment specifications.

MaterialSegmentSpecification relationship roles

Related object	Role	Multiplicity	Relationship name	Description
MaterialSegmentSpecification	Material segment specification child	0..*	isAssembledFrom	The related object(s) makes up part of this <i>material segment specification</i> as a whole.
TestSpecification	Test specification	0..*	specifies	The <i>test specification(s)</i> used to evaluate this <i>material segment specification</i> .
MaterialSegmentSpecificationProperty	Material segment specification property	0..*	hasPropertiesOf	The <i>material segment specification property(s)</i> of this <i>material segment specification</i> .

MaterialClass	Material class	0..*	correspondsToClass	A cross-model association to element in the material model as explained in Clause 3.3.8. Identifies the associated <i>material class</i> or set of <i>material classes</i> of the specification for a specific <i>process segment</i> .
MaterialDefinition	Material definition	0..*	correspondsToDefinition	A cross-model association to element in the material model as explained in Clause 3.3.8. Identifies the associated <i>material definition</i> or set of <i>material definition</i> of the specification for a specific <i>process segment</i> .
MaterialLot	Material lot	0..*	correspondsToLot	A cross-model association to element in the material model as explained in Clause 3.3.8. Identifies the associated <i>material lot</i> or set of <i>material lot</i> of the specification for a specific <i>process segment</i> . Typically, either a <i>material class</i> or <i>material definition</i> is specified.
MaterialSublot	Material subplot	0..*	correspondsToSublot	A cross-model association to element in the material model as explained in Clause 3.3.8. Identifies the associated <i>material subplot</i> or set of <i>material subplot</i> of the specification for a specific <i>process segment</i> . Typically, either a <i>material class</i> or <i>material definition</i> is specified.
HierarchyScope	HierarchyScope		hierarchyScopeRel	Optional relationship to hierarchy.

MaterialSegmentSpecification attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	A unique identification of a specific <i>material segment specification</i> .	PS1-Employee 23	string	true	AK
description	Contains additional information and descriptions.	Defines the polymer required for a widget milling process segment.	String	false	
hierarchyScope	Identifies where the exchanged information fits within the role-based equipment hierarchy. Optionally, hierarchy scope defines the scope of the object, such as the site or area.	South Shore (Site) / Work Line (Area)	String	false	

spatialDefinition	Spatially defines the material resource(s) specified by this <i>material segment specification</i> as a zero-dimensional point, one-dimensional line, or two-dimensional shape or three-dimensional solid.	4326 / EPSG / GPX / lat="45.35" lon="24.15"	String	false	
storageLocation	Identifies the storage location of the material resource(s) specified by this <i>material segment specification</i> .	SST57	String	false	
storageLocationType	Indicates whether the storage location attribute refers to an <i>operational location</i> , <i>equipment</i> , or <i>physical asset</i> object, or contains a description of the storage location. Mandatory where a storage location is specified. Defined values are <ul style="list-style-type: none"> operational location: storage location attribute references an <i>operational location</i>; equipment: storage location attribute references an <i>equipment</i> object; physical asset: storage location attribute references a <i>physical asset</i>; and description: storage location attribute contains a description of the storage location, such as a street address.	Equipment	Enum: "enumValues": ["operationalLocation", "Equipment", "PhysicalAsset", "Description"]	false	
assemblyType	Defines the type of assembly. Defined types are <ul style="list-style-type: none"> physical: the components of the assembly are physically connected or in the same area; logical: the components of the assembly aren't necessarily physically connected or in the same area.	Physical	Enum: "enumValues": ["Physical", "Logical"]	false	
assemblyRelationship	Defines the type of relationships. Defined types are <ul style="list-style-type: none"> permanent: an assembly that isn't intended to be split during the production process; transient: a temporary assembly using during production, such as a pallet of different materials or a batch kit.	Permanent	Enum: "enumValues": ["Permanent", "Transient"]	false	
materialUse	Defines the expected use of the <i>material class</i> , <i>material definition</i> , <i>material lot</i> , or <i>material subplot</i> in the context of the <i>process segment</i> . Defined values for production operations are	Material consumed	Enum: "enumValues": ["Consumable", "Material"	true	AK

	<p>consumable, material consumed, material produced, by-product produced, co-product produced, and yield produced.</p> <p>Defined values for maintenance operations are</p> <p>consumable, material consumed, and material produced.</p> <p>Defined values for quality test operations are</p> <p>consumable, destructive sample, returned sample, and retained sample.</p> <p>Defined values for Inventory operations are</p> <p>consumable, material consumed, material produced, and inventoried.</p>		<p>consumed",</p> <p>"Material produced",</p> <p>"By-Product produced",</p> <p>"Co-Product produced",</p> <p>"Yield produced",</p> <p>"Destructive sample",</p> <p>"Returned sample",</p> <p>"Retained sample",</p> <p>"Inventoried"</p> <p>]</p>		
quantity	Specifies the amount of resources required.	0.35	Double	true	AK
quantityUnitOf Measure	The unit of measure of the associated property value.	Sheets / piece	String	true	AK
inventorysystemrefid	Product Master or Inventory System of Record Identifier		Alphanumeric	false	
messystemrefid	Manufacturing execution system Ref ID		Alphanumeric	false	

A material segment specification may be defined as follows by containing an assembly of material segment specifications and as part of an assembly of material segment specifications .

A material segment specification may define an assembly of zero or more material segment specifications.

A material segment specification may be an assembly element of zero or more material segment specifications.

An assembly may be defined as a permanent or transient assembly of material segment specifications.

An assembly may be defined as physical or a logical assembly of material segment specifications.

Defined values for the material use attribute for production operations are consumable, material consumed, material produced, co-product produced, by-product produced, and yield produced; the definitions of the defined values are

consumable: resources that aren't normally included in bills of material or aren't individually accounted for in specific operations requests or aren't lot tracked

material consumed: raw and intermediate material normally included in bills of material or are individually accounted for in specific operations requests or are material lots tracked;

material produced: finished goods material normally included in bills of material or are individually accounted for in specific operations requests or are material lots tracked;

co-product produced: a planned product typically produced with a main planned product per the material master. A product that is manufactured together or sequentially because of product or process similarities;

by-product produced: tracked waste, undesirable materials, material of value produced as a residual of or incidental to the production process. The ratio of by-product to primary product is predictable. By-products may be recycled, sold as-is, or used for other purposes;

yield produced: a work-in-progress measured material actual quantity that is tracked continuously across a long production run or batch. Yield produced is tracked against the amount of planned good or acceptable material during and at the completion of a process. Yield produced is typically used to compute a yield value where the amount of yield produced is divided by the measured material consumables or inputs per the operations bill of materials and expressed as a decimal or percentage. In manufacturing planning and control systems, the yield value is related to a specific process or routing step to determine the required scheduled amount to produce a specific number of finished goods EXAMPLE If a customer requires 50 units of a and you expect a yield of 70 percent , then 72 units (computed as 50 units divided by ,7) should be started in the manufacturing process."

Defined values for the material use attribute for maintenance operations are consumable, material consumed, and material produced; the definitions of the defined values are

consumable: resources that aren't normally included in bills of material or aren't individually accounted for in specific operations requests or aren't lot tracked;

material consumed: raw and intermediate material normally included in bills of material or are individually accounted for in specific operations requests or are material lots tracked;

material produced: finished goods material normally included in bills of material or are individually accounted for in specific operations requests or are material lots tracked.

Defined values for the material use attribute for quality test operations are consumable, destructive sample, returned sample, and retained sample; the definitions of the defined values are

consumable: resources that aren't normally included in bills of material or aren't individually accounted for in specific operations requests or aren't lot tracked ;

destructive sample: for a quality test to a test specification, a specified amount of consumed or produced material is collected during manufacturing operation due to being committed to requirement for destructive quality test activities. The material sample is normally included in bills of resources, individually accounted for in specific operations request, and sample life cycle (material lot) sample tracking;

returned sample: for a quality test to a test specification, a specified amount of material is made available for manufacturing operation scheduling and work activities. The available material is normally included in bills of resources, individually accounted for in specific operations request, and (material lot) sample life cycle tracking;

retained sample: for a quality test to a test specification, a specified amount of material isn't made available for manufacturing operation scheduling and work activities. The material is normally included in bills of resources, individually accounted for in specific operations request, and (material lot) sample life cycle tracking;

Defined values for the material use attribute for inventory operations are consumable, material consumed, material produced, and inventoried; the definitions of the defined values are:

consumable: resources that aren't normally included in bills of material or aren't individually accounted for in specific operations requests or aren't lot tracked;

material consumed: raw and intermediate material normally included in bills of material or are individually accounted for in specific operations requests or are material lots tracked.

material produced: finished goods material normally included in bills of material or are individually accounted for in specific operations requests or are material lots tracked.

inventoried: the material actual of periodic and/or on-demand inventory cycle counts of each inventory providing material consumables to the process and accumulating material produced, co-products produced, and by-products produced.

2.5.9 MaterialSegmentSpecificationProperty

Specific properties that are required for material segment specifications shall be presented as

material segment specification properties.

Material segment specification properties may contain nested material segment specification properties.

MaterialSegmentSpecificationProperty relationships

Related object	Role	Multiplicity	Relationship name	Description
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MaterialSegmentSpecificationProperty	Material segment specification property child	0..*	contains	The <i>material segment specification property(s)</i> of this <i>material segment specification property</i> .
MaterialClassProperty	Material class property	0..*	mapsToClassProperty	A cross-model dependency to element in the material model as explained in Clause 3.3.8.
MaterialDefinitionProperty	Material definition property	0..*	mapsToDefinitionProperty	A cross-model dependency to element in the material model as explained in Clause 3.3.8.
MaterialLotProperty	Material lot property	0..*	mapsToLotProperty	A cross-model dependency on element in the material model as explained in Clause 3.3.8.

MaterialSegmentSpecificationProperty attributes

Attribute name	Description	examples	Datatype	Mandatory	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	An identification of a property of the associated <i>material property</i> or <i>equipment class property</i> .	Average Surface Roughness	string	true	AK
description	Contains additional information and descriptions.	Defines the minimum polyethylene roughness quality.	String	false	
value	The value, set of values, or range of the property.	66,748	String	true	AK
valueUnitOfMeasure	The unit of measure of the associated property value.	Angstroms	String	true	AK
quantity	Specifies the amount of resources required.	0.10	Double	true	AK
quantityUnitOfMeasure	The unit of measure of the associated property value.	Sheets / piece	String	true	AK
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	

externalreference uri	URI locator for External reference		URIreference	false	
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2.5.10 ProcessSegmentDependency

Process dependencies that are independent of any product or operations task shall be presented as segment dependencies.
EXAMPLE A segment dependency can define that a testing segment is required to follow an assembly segment.

ProcessSegmentDependency relationship roles

Related object	Role	Multiplicity	Relationship name	Description
ProcessSegment	Process segment from	0..*	processSegmentFrom	The source <i>process segment(s)</i> that the target <i>process segment(s)</i> are dependent. <i>Process segment</i> has an association class relationship with <i>segment dependency</i> .
ProcessSegment	Process segment to	0..*	processSegmentTo	The target <i>process segment(s)</i> that are dependent on source <i>process segment(s)</i> . <i>Process segment</i> has an association class relationship with <i>segment dependency</i> .

ProcessSegmentDependency attributes

Attribute name	Description	examples	Datatype	Mandatory (Y/N)	Key Type
ROW ID	Globally unique Identifier for the entity row		string	true	PK (primary key)
id	The identification of the unique instance of the <i>segment dependency</i> .	PSD001	string	true	AK
description	Contains additional information and descriptions of the <i>segment dependency</i> definition.	Defines the ordering of assembly processes the Widget Assembly process segment	String	false	
dependencyType	Defines the execution dependency constraints of one segment to another segment as the type of the execution or dependency factor between the segments. Defined values are (explained using dependency type between segment A and segment B) - at start: start B at A start; - after start: start B after A start; - after end: start B after A end; - not follow: B can't follow A;	Start <i>Cleanout</i> - no earlier after start- (dependency factor) <i>Work</i> ,	Enum: "enumValues": ["at start", "after start", "after end", "not follow", "possible parallel", "not in parallel", "no later after start", "no earlier after start", "no later after end", "no earlier	false	

	<ul style="list-style-type: none"> - possible parallel: B may run in parallel to A; - not in parallel: B may not run in parallel to A; - no later after start: start B no later than dependency factor after A start; - no earlier after start: start B no earlier than dependency factor after A start; - no later after end: start B no later than dependency factor after A end; - no earlier after end: B no earlier than dependency factor after A end. 		after end",]		
dependencyFactor	Factor used by dependency	25	String	false	
dependencyFactorUnitOfMeasure	The units of measure of the dependency factor	Minutes	String	false	
externalreferenceid	Reference ID of an external dictionary entry, meta-model reference ID, ontology value or column in a DB table		Alphanumeric	false	
externalreferencedictionary	Reference of an external dictionary, meta-model reference, ontology, or a DB table		String	false	
externalreferenceuri	URI locator for External reference		URIreference	false	