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Entwurf

**Integration von Unternehmensführungs- und Leitsystemen –
Teil 2: Attribute des Objektmodells
(IEC 65E/290/FDIS:2013);
Englische Fassung FprEN 62264-2:2013**

Enterprise system integration –
Part 2: Object models and attributes
(IEC 65E/290/FDIS:2013);
English version FprEN 62264-2:2013

Intégration du système de commande d'Entreprise –
Partie 2: Modèles d'objets et attributs
(CEI 65E/290/FDIS:2013);
Version anglaise FprEN 62264-2:2013

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2013-10-11 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

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Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 168 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

Nationales Vorwort

Die Englische Fassung des europäischen Dokuments FprEN 62264-2:2013 „Integration von Unternehmensführungs- und Leitsystemen – Teil 2: Attribute des Objektmodells“, (Schluss-Entwurf) ist unverändert in diesen Norm-Entwurf übernommen worden.

Die Internationale Elektrotechnische Kommission (IEC) und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein bei IEC erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dem entsprechend ist das internationale Dokument IEC 65E/290/FDIS:2013 „Enterprise system integration – Part 2: Object models and attributes“ unverändert in den Schluss-Entwurf FprEN 62264-2:2013 übernommen worden.

Das internationale Dokument wurde vom SC 65E „Devices and integration in enterprise systems“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet.

Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

Für dieses Dokument ist das nationale Arbeitsgremium K 931 „Systemaspekte“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (www.dke.de) zuständig.

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf eine Norm ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnittsnummer, eine Tabelle, ein Bild usw.) bezieht sich die Verweisung auf die jeweils neueste gültige Ausgabe der in Bezug genommenen Norm.

Für den Fall einer datierten Verweisung im normativen Text bezieht sich die Verweisung immer auf die in Bezug genommene Ausgabe der Norm.

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für den vorliegenden Normentwurf erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der E DIN EN 62264-2 veröffentlicht. Zu deren Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA des vorliegenden Normentwurfs hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Normentwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Änderungen

Gegenüber DIN EN 62264-2:2008-07 wurden folgende Änderungen vorgenommen:

- Verweisungen auf den neuesten Stand gebracht, insbesondere diejenigen auf den ersten Teil der Normenreihe IEC 62443;
- Ergänzung von Objekt-Modellen für den Informationsaustausch in den Aktivitäten des Betriebsmanagements anstatt nur des Produktionsmanagements. Die ergänzten Objektmodelle sind Physisches Asset, Betriebsdefinition, Betriebsplanung, Betriebsleistung und Betriebsfähigkeit;
- Verlagerung der produktionsspezifischen Objektmodelle in Anhang A;

- d) Verschiebung der UML-Objekt-Modelle, die in der IEC 62264-1:2003 waren, in die vorliegende Norm, so dass die Objekt-Modelle und die zugeordnete Attributtabelle nun im selben Dokument stehen;
- e) Aufnahme der Hierarchiebereichsobjektdefinition und damit Ersatz des Ortsattributs;
- f) Aufnahme eines Wertetypabschnitts, um den Austausch von nicht-einfachen Werte-Typen zu definieren;
- g) Definition einfacher Werttypen unter Verwendung der ISO 15000-5.

Nationaler Anhang NA (informativ)

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach IEC 62264-1 und die folgenden Begriffe.

3.1.1

Ausrüstungsklasse

(en: **equipment class**)

Gruppierung von rollenbasierter Ausrüstung mit gleichartigen Eigenschaften

3.1.2

Ereignis

(en: **event**)

Repräsentation eines angeforderten oder nicht angeforderten Fakts, der eine Zustandsänderung im Unternehmen anzeigt

3.1.3

Ort

(en: **location**)

Teil eines Informationsaustausches, der durch ein Element der Ausrüstungshierarchie identifiziert ist

BEISPIEL Es kann die Vereinbarung bestehen, dass nur der „Bereich“ Name als Teil der ausgetauschten Information geliefert wird, weil Werk und Unternehmen implizit durch das Nachrichtensystem definiert sind.

3.1.4

Materialklasse

(en: **material class**)

Gruppierung von Material mit gleichartigen Eigenschaften

3.1.5

Materiallos oder -charge

(en: **material lot**)

eindeutig identifizierbare Menge eines Materials

ANMERKUNG 1 zum Begriff: Es beschreibt die tatsächliche oder geplante Gesamtmenge oder die verfügbare Menge an Material, dessen aktuellen Zustand und seine spezifischen Eigenschaften.

3.1.6

Materialdefinition

(en: **material definition**)

Definition der Eigenschaften einer Substanz

ANMERKUNG 1 zum Begriff: Dies beinhaltet Materialien, die als Rohmaterial, Zwischenprodukt, Fertigprodukt oder Verbrauchsmaterial bezeichnet werden.

3.1.7

Materialgebinde

(en: **material sublot**)

Eindeutig identifizierbare Untermenge eines Materialloses/einer Materialcharge

ANMERKUNG 1 zum Begriff: Das kann eine einzelne Einheit sein

3.1.8

Personenklasse

(en: **personnel class**)

Gruppierung von Personen mit gleichartigen Eigenschaften

3.1.9

Produkt

(en: **product**)

gewünschtes Ergebnis oder Nebenprodukt der Prozesse eines Unternehmens

ANMERKUNG 1 zum Begriff: Aus der Geschäftsperspektive kann dies ein Zwischen- oder Endprodukt sein.

ANMERKUNG 2 zum Begriff: In ISO 10303-1 auch definiert als: Eine Substanz, die durch einen natürlichen oder künstlichen Prozess produziert wurde.

3.1.10

Eigenschaft

(en: **Property**)

ausführungsspezifische Charakteristik einer Einheit/eines Objekts

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 2: Objects and attributes for enterprise-control system integration

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62264-2 has been developed by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, control and automation, and by ISO technical committee 184/SC5: Interoperability, integration and architectures for enterprise systems and automation applications. It is published as a double logo standard.

This standard is based upon ANSI/ISA-95.00.02-2010, Enterprise-Control System Integration, Part 2: Objects and attributes for Enterprise-Control System Integration. It is used with permission of the copyright holder, the Instrumentation, Systems and Automation Society (ISA). ISA encourages the use and application of its industry standards on a global basis.

This second edition cancels and replaces the first edition published in 2004. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) update of the first edition;
- b) addition of object models for exchange information used in manufacturing operations management activities, instead of just production operations management activities. The added object models were physical asset, operations definition, operations schedule, operations performance, and operations capability.
- c) displacement of the production specific object models in Annex A;
- d) displacement of the UML object models that were in IEC 62264-1:2003 into this standard so that the object models and the associated attribute tables were available in the same document;
- e) addition of the Hierarchy scope object definition to replace the Location attribute used in the previous edition;
- f) addition of a value type section to define the exchange of non-simple value types;
- g) definition of simple value types were defined using the ISO 15000-5.

The text of this standard is based on the following documents of IEC:

FDIS	Report on voting
65E/xxx/FDIS	65E/xxx/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by XX members out of XX having cast a vote.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62264 series, published under the general title *Enterprise control system integration* can be found on the IEC website.

In this publication, the following print types are used:

– *attributes: in italic type.*

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this publication the stability date is 2016.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 62264 further defines formal object models for exchange information described in IEC 62264-1 using UML object models, tables of attributes, and examples. The models and terminology defined in this part of IEC 62264:

- a) emphasize good integration practices of control systems with enterprise systems during the entire life cycle of the systems;
- b) can be used to improve existing integration capability of manufacturing control systems with enterprise systems; and
- c) can be applied regardless of the degree of automation.

Specifically, this part of IEC 62264 provides a standard terminology and a consistent set of concepts and models for integrating control systems with enterprise systems that will improve communications between all parties involved. Benefits produced will:

- a) reduce the user's time to reach full production levels for new products;
- b) enable vendors to supply appropriate tools for implementing integration of control systems to enterprise systems;
- c) enable users to better identify their needs;
- d) reduce the cost of automating manufacturing processes;
- e) optimize supply chains; and
- f) reduce life-cycle engineering efforts.

This standard may be used to reduce the effort associated with implementing new product offerings. The goal is to have enterprise systems and control systems that interoperate and easily integrate.

It is not the intent of the standards to:

- a) suggest that there is only one way of implementing integration of control systems to enterprise systems;
- b) force users to abandon their current way of handling integration; or
- c) restrict development in the area of integration of control systems to enterprise systems.

ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 2: Objects and attributes for enterprise-control system integration

1 Scope

This part of IEC 62264 specifies generic interface content exchanged between manufacturing control functions and other enterprise functions. The interface considered is between Level 3 manufacturing systems and Level 4 business systems in the hierarchical model defined in IEC 62264-1. The goal is to reduce the risk, cost, and errors associated with implementing the interface.

Since this standard covers many domains, and there are many different standards in those domains, the semantics of this standard are described at a level intended to enable the other standards to be mapped to these semantics. To this end this standard defines a set of elements contained in the generic interface, together with a mechanism for extending those elements for implementations.

The scope of IEC 62264-2 is limited to the definition of object models and attributes of the exchanged information defined in IEC 62264-1.

This part of IEC 62264 standard does not define attributes to represent the object relationships.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62264-1, *Enterprise-control system integration – Part 1: Models and terminology*

ISO/IEC 19501, *Information technology – Open Distributed Processing – Unified Modeling Language (UML) Version 1.4.2*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62264-1, as well as the following apply.

3.1.1

equipment class

grouping of role based equipment with similar characteristics

3.1.2

event

representation of a solicited or unsolicited fact indicating a state change in the enterprise

3.1.3**location**

scope of exchanged information as identified by an element of the equipment hierarchy

EXAMPLE There can be an agreement to only supply an “Area” name for exchanged information, because the site and enterprise are implicitly defined through the messaging system

3.1.4**material class**

grouping of materials with similar characteristics

3.1.5**material lot**

uniquely identifiable amount of a material

Note 1 to entry: It describes the actual or planned total quantity or amount of material available, its current state, and its specific property values.

3.1.6**material definition**

definition of the properties for a substance

Note 1 to entry: This includes material that can be identified as raw, intermediate, final material, or consumable.

3.1.7**material subplot**

uniquely identifiable subset of a material lot

Note 1 to entry: This can be a single item.

3.1.8**personnel class**

grouping of persons with similar characteristics

3.1.9**product**

desired output or by-product of the processes of an enterprise

Note 1 to entry: A product can be an intermediate product or end product from a business perspective.

Note 2 to entry: Also defined in ISO 10303-1 as: a substance produced by a natural or artificial process.

3.1.10**property**

implementation specific characteristic of an entity

3.2 Abbreviations

For purposes of this standard the following abbreviations apply.

MOM Manufacturing Operations Management

UML Unified Modeling Language

4 Production operations models and generic operations models**4.1 Information models**

Common objects used in information exchange that relate to personnel, equipment, physical assets, and material are defined in Clause 5.

The information described in IEC 62264-1 for production operations management are represented in the Production Schedule model, the Production Performance model, Product Definition model, and the Production Capability models, as shown in Figure 1. These objects are defined in Annex A.

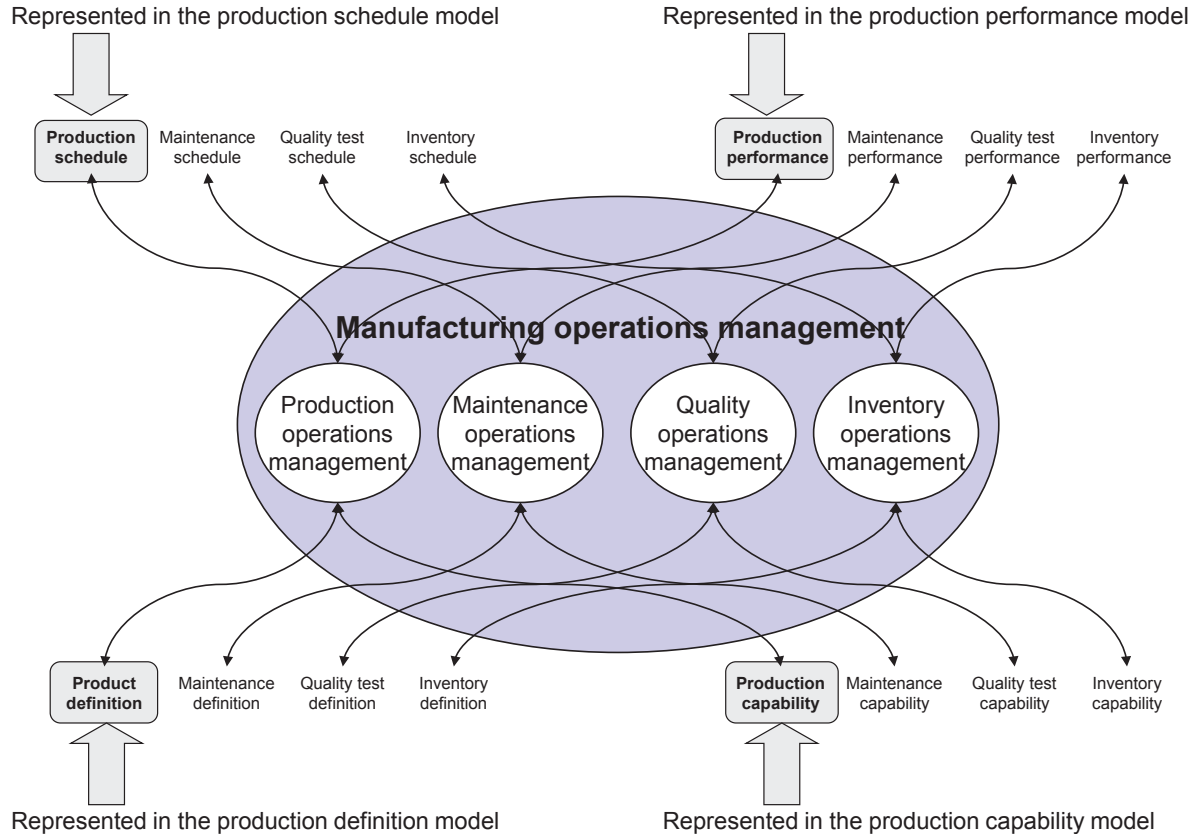


Figure 1 – Production operations management information models

A generic operations management information model is used to represent the information from other operations management areas which may be exchanged when more than production information is required. This is illustrated in Figure 2. These objects are defined in Clause 6.

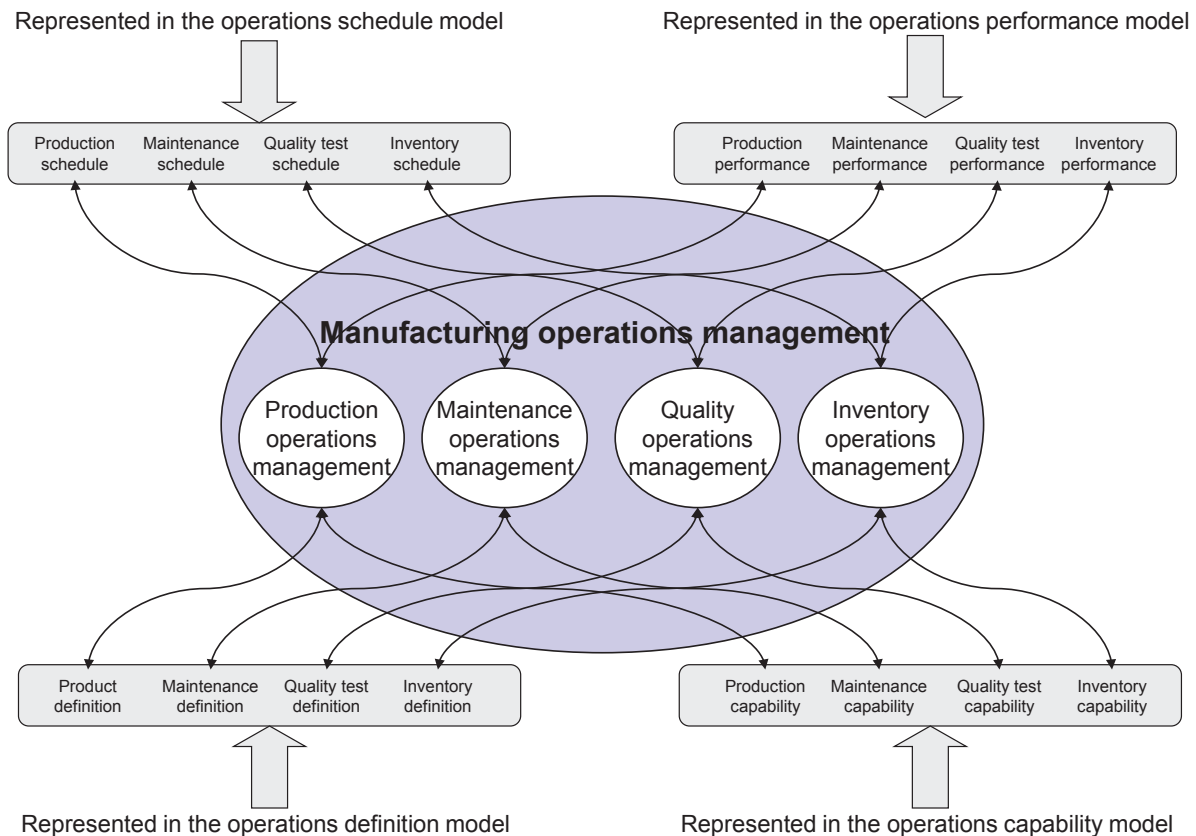


Figure 2 – Operations information models for operations management

4.2 General modeling information

This subclause describes the object models and attributes for information exchanged in enterprise-control system integration. The attributes are part of the definition of terms.

In this standard, the word “class” used as part of an object definition name is to be considered as a category, not as a “class” in the UML specification.

EXAMPLE “Personnel class” is to be considered a “personnel category”, in the sense of distinguishing between the kinds of personnel in the real world.

A minimum set of industry-independent information has been defined as attributes. However, values for all attributes may not be required depending on the actual usage of the models. If additional information, including industry- and application-specific information, is needed, it shall be presented as property objects. This mechanism is the extension capability referenced in the Scope of this standard. This solution increases the usability through the use of standard attributes, and allows flexibility and extensibility through the use of properties. This was included to make the standard as widely applicable as practical.

4.3 Extensibility of attributes through properties

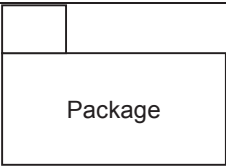
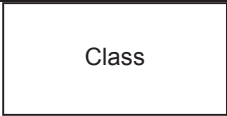
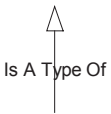
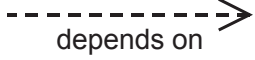
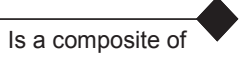
For particular applications the objects defined in the object models will need to be extended through the addition of attributes to object class definitions. Accordingly this standard provides for attributes that are application or industry specific, to be modeled in terms of properties and represented in property classes in the model. For example, the personnel class property would be used to define application or industry specific attributes for personnel classes, and person property would be used to contain instance values for the properties.

4.4 Object model structure

The object models are depicted using the Unified Modeling Language (UML) notational methodology, as defined in ISO/IEC 19501.

Table 1 defines the UML notations used in the object diagrams.

Table 1 – UML notation used

Symbol	Definition
	Defines a package, a collection of object models, state models, use cases, and other UML models. Packages are general-purpose grouping mechanisms used to organize semantically related model elements. In this document a package is used to specify an external model, such as a production rule model, or a reference to another part of the model.
	Represents a UML class of objects, each with the same types of attributes. Each object is uniquely identifiable or enumerable. No operations or methods are listed for the classes.
	An association between elements of a class and elements of another or the same class. Each association is identified. Can have the expected number or range of members of the subclass, when 'n' indicates an indeterminate number. For example, 0..n means that zero or more members of the subclass can exist.
	Generalization (arrow points to the super class) shows that an element of the class is a specialized type of the super class.
	Dependence is a weak association that shows that a modeling element depends on another modeling element. The item at the tail depends on the item at the head of the relationship.
	Aggregation (made up of) shows that an element of the class is made up of elements of other classes.
	Composite shows a strong form of aggregation, which requires that a part instance be included in at most one composite at a time and that the composite object has sole responsibility for disposition of its parts.

4.5 Explanation of tables

4.5.1 Tables of attributes

This subclause gives the meaning of the attribute tables. This includes a listing of the object identification, data types, and presentation of the examples in the tables.

All attributes in the tables shall be considered optional, except where specified as required in the attribute description.

4.5.2 Object identification

Many objects in the information model require unique identifications (IDs). These IDs shall be unique within the scope of the exchanged information. This may require translations:

- from the internal ID of the source system to the interface content ID,
- from the interface content ID to the internal ID of the target system.

EXAMPLE A unit can be identified as “X6777” in the interface content, as resource “R100011” in the business system, and as “East Side Reactor” in the control system.

A unique identification set shall be agreed to in order to exchange information.

The object IDs are used only to identify objects within related exchanged information sets. The object ID attributes are not global object IDs or database index attributes.

Generally, objects that are elements of aggregations, and are not referenced elsewhere in the model, do not require unique IDs.

4.5.3 Data types

The attributes presented are abstract representations, without any specific data type specified. A specific implementation will show how the information is represented.

EXAMPLE 1 An attribute can be represented as a string in one implementation and as a numeric value in another implementation.

EXAMPLE 2 A date/time value can be represented in ISO standard format in one implementation and in Julian calendar format in another. Attributes for date or time can contain values for a date, a date and time or a time value, the standard does not enforce the value semantics. Each implementation will have to negotiate the value semantics.

EXAMPLE 3 An object or attribute relationship can be represented by key fields in data base tables, or by parent/child elements in an XML by nested hierarchy.

4.5.4 Presentation of examples

Examples are included with each attribute given. Examples are presented for each of the main operations categories defined in IEC 62264-1. See Table 2 below for how the example rows and columns are used.

Table 2 – Example table

Attribute name	Description	Production example	Maintenance example	Quality example	Inventory examples
Name of first attribute	Description of first attribute	Production example	Maintenance example	Quality example	Inventory example
Name of second attribute	Description of second attribute	Production example	Maintenance example	Quality example	Inventory example
Name of third attribute	Description of third attribute	Production example	Maintenance example	Quality example	Inventory example

When an example value is a set of values, or a member of a set of values, the set of values is given within a set of braces, {}.

The examples are purely fictional. They are provided to further describe attributes in the model. No attempt was made to make the examples complete or representative of any manufacturing enterprise.

NOTE 1 Within a table the columns for Production, Maintenance, Quality and Inventory can be examples where the four operations management categories are coordinated or they can be separate examples. For example when one system is coordinating multiple operations management categories the IDs used in each column can be the same. When different systems coordinate multiple operations management categories the IDs can be different. Example attributes are meant to be illustrative, and do not imply requirements.

NOTE 2 Time and date attributes can illustrate a general or specific time horizon. For example a yearly or quarterly plan can use general dates with no specific time, while a detailed schedule can include a specific time stamp down to the minute.

Data resolution for the examples will be fit for purpose, which means that each implementation will negotiate the appropriate resolution required for each attribute.

NOTE 3 When (not applicable) is used as an example this is only illustrative that there is not a value for this attribute in this example. It does not imply there can never be a value. This is also true when all four columns contain (not applicable).

4.5.5 References to resources

The models used to document a reference to a resource, in another package, using the class or instance, with additional optional specification using properties, are not fully illustrated in the object model figures. This relationship is not conformant to the Unified Modeling Language (UML) modeling methodology, but was used to keep the diagrams simpler. Figure 3 below illustrates how it is currently presented, on the left side, and how it could be more accurately modeled in UML on the right side. UML was used in this standard as a visualization method and not meant to describe implementations. The simplified relationship diagram method is used for the following objects and their relationship to another package:

Personnel Capability

Material Capability

Equipment Segment Capability

Physical Asset Capability

Personnel Segment Specification

Material Segment Specification

Personnel Specification

Material Specification

Personnel Requirement

Material Requirement

Personnel Actual

Material Actual

Equipment Capability

Personnel Segment Capability

Material Segment Capability

Physical Asset Segment Capability

Equipment Segment Specification

Physical Asset Segment Specification

Equipment Specification

Physical Asset Specification

Equipment Requirement

Physical Asset Requirement

Equipment Actual

Physical Asset Actual

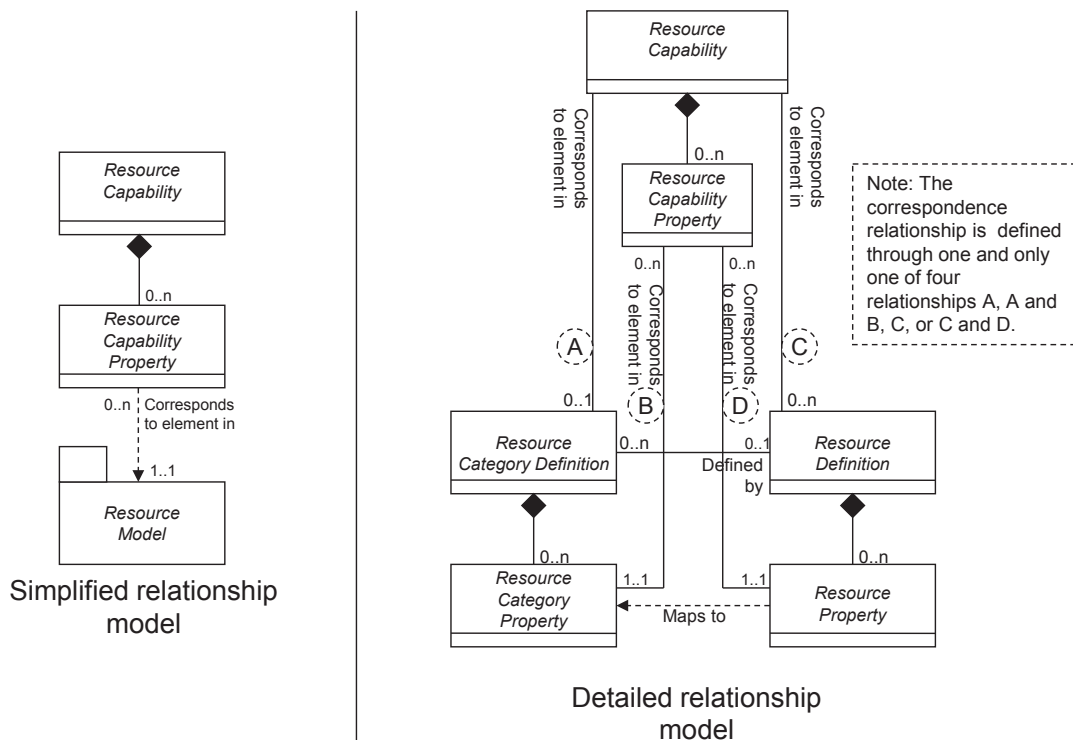


Figure 3 – Detailed resource relationship in models

The correspondence relationship is determined through one and only one of four possible relationships:

- 1) to the *resource category definition*;
- 2) to the *resource category definition* and *resource category property*;
- 3) to the *resource definition*;
- 4) to the *resource definition* and *resource property*.

In the model above the term *resource category* indicates: *personnel class*, *equipment class*, *physical asset class*, *material class*, and *material definitions*. The term *resource* indicates: *person*, *equipment*, *physical asset*, *material lot*, and *material subplot*. The term *resource capability* indicates the use in the capability models, *process segment capability model*, the *process segment model*, *operations definition model*, *operations schedule model*, *operations performance model*, *product definition model*, *production schedule model*, and *production performance model*.

4.5.6 Object relationships

This part of IEC 62264 does not define attributes to represent the object relationships.

NOTE Different implementations of the object models will have different methods for representing the object relationships. While the relationships can be represented as additional attributes on one implementation, such as a database, they could be represented as containment in another implementation, such as an XML document.

4.6 Relationship of models

The common information object models in Clause 5 describe the different types of resources and their uses in describing a (business) *process segment*. These object models are also used to describe the other (manufacturing) operations management information object models in Clauses 6, 7 and 8.

The operations management information object models described in Clause 6 shall be used for any manufacturing operations category, such as, production, maintenance, quality, inventory, and inventory handling, as defined in IEC 62264-1. Although the generic object model can also be used to describe operations management information models for user-defined operations categories, conformance can be evaluated only if user-specific conformance testing scenarios are available.

Also additional explanations to assist in applying these object definitions to describe the interoperability among the following operations management categories are provided in Annex E:

- production operations;
- maintenance operations;
- quality operations;
- inventory (handling) operations;
- mixed operations;
- user-defined operations.

The production information models described in Annex A reproduce the models in earlier versions of this standard in order to ensure the conformance of existing implementations of the standard.

- An *operations definition* for production operations is the equivalent of a *product definition*.
- An *operations schedule* for production operations is the equivalent of a *production schedule*.

- An *operations performance* for production operations is the equivalent of a *production performance*.
- An *operations capability* for production operations is the equivalent of a *production capability*.

However, for future implementations, it is recommended to use the operation models in Clause 6.

4.7 Hierarchy scope

Hierarchy scope is an attribute used in many other objects. The *hierarchy scope* attribute 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.

The *hierarchy scope* attribute is optional and is not needed if the context of the exchanged information can be determined based on the exchange mechanism used.

EXAMPLE 1 A *hierarchy scope* can identify a Site, such as WEST-END. A *Production 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. A *Production 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 these 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, Work Center.

The *hierarchy scope* attribute may be modeled using the model illustrated in Figure 4 with attributes for the *hierarchy scope* object defined in Table 3. Each *hierarchy scope* object defines one element in the equipment hierarchy,

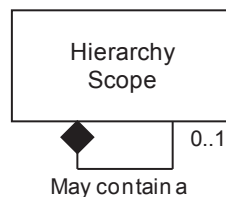


Figure 4 – Hierarchy scope model

Table 3 – Attributes of hierarchy scope

Attribute name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
Equipment ID	A unique identification of an equipment element	WorkCenter23	West End	Ajax	North Size
Equipment Element Level	Identification of the equipment level if the equipment element is defined	Work Center	Site	Enterprise	Area

4.8 Value types

4.8.1 Value use

Value attributes are used in properties, parameters, and data to exchange actual values.

Value attributes are also used to exchange the allowed or expected values in properties and parameters for *material definitions*, *material classes*, *equipment classes*, *personnel classes*, *physical asset classes*, *process segments*, *operations definitions*, and *product definitions*. Value types thus represent actual single values, actual arrays of values, and ranges of possible values, either as numerical or textual ranges or as sets of values.

4.8.2 Value syntax

The format for values in value attributes is not defined in this part of IEC 62264 and will be defined by implementations of the standard.

EXAMPLE The following syntax, defined in an EBNF (Extended Backus–Naur Form) notation from ISO 14977, can be used to represent single element values, range specifications, arrays of values, and a set of allowed values as delimited text strings.

```

<value>      ::=      <simpleValue>
                        | <arrayValue>
                        | <rangeValue>
                        | <seriesValue>

<arrayValue>  ::=      “[ <arrayElement> *( “,” <arrayElement> ) ”]”

<rangeValue>  ::=      “{ <rangeElement> *( “,” <rangeElement> }”

<seriesValue> ::=      “<” <simpleValue> *( “,” <simpleValue> ) “>”

<arrayElement> ::=      <simpleValue> | <arrayValue>

<rangeElement> ::=      <simpleValue> “..” <simpleValue>

<simpleValue> ::=      string

```

4.8.3 Simple value types

Simple value types should be derived from core component types that are compatible with the ISO-15000-5 Core Component Technical Specification (CCTS). The CCTS types are a common set of types that define specific terms with semantic meaning (e.g. the meaning of a quantity, currency, amount, and identifier).

Table 4 – Commonly used CCTS types for exchange

AmountType	Used to define a number of monetary units specified in a currency where the unit of currency is explicit or implied.
BinaryObjectType	Used to define a data types representing graphics, pictures, sound, video, or other forms of data that can be represented as a finite length sequence of binary octets.
CodeType	Used to define a character string that is used to represent an entry from a fixed set of enumerations.
DateTimeType	Used to define a particular point in time together with the relevant supplementary information to identify the timezone information. This is a specific instance on time using the ISO 8601 CE (Common Era) calendar extended format and abbreviated versions.
IdentifierType	Used to define a character string to identify and distinguish uniquely, one instance of an object in an identification scheme from all other objects in the same scheme.
IndicatorType	Used to define a list of two mutually exclusive Boolean values that express the only possible states of a Property. For example “True” or “False”.
MeasureType	Used to define a numeric value determined by measuring an object along with the specified unit of measure.
NumericType	Numeric information that is assigned or is determined by calculation, counting, or sequencing. It does not require a unit of quantity or unit of measure.
QuantityType	Used to define a counted number of non-monetary units, possibly including fractions.

TextType	Used to define a character string (i.e. a finite set of characters) generally in the form of words of a language.
----------	---

4.8.4 Unit of measure

This standard defines attributes for value, quantity, and other units of measure. The unit of measure was explicitly specified to ensure that it was not missed in information exchanges. Implementations of this standard may represent the unit of measure in the manner appropriate for the implementation.

4.8.5 Array value types

Arrays of values may be represented following the syntax defined in the EBNF above.

EXAMPLE 1: A set of values for a single dimension array with 6 values would be represented as:

[1 , 2 , 3 , 4 , 5 , 6]

EXAMPLE 2: A set of values for a two dimension array of size 2x3 would be represented as:

[[1 , 2] , [3 , 4] , [5 , 6]]

4.8.6 Range value types

Range specifications may be represented following the syntax defined in the EBNF above.

EXAMPLE 1: A simple range of values can be represented as:

{ 0 .. 100 }

EXAMPLE 2: A non-continuous range of values can be represented as:

{ a .. z , A .. Z }

{ 0 .. 100 , 200 .. 300 , 500 , 600 .. 650 }

4.8.7 Series value types

A specification defined as a set of allowed values may be represented following the syntax defined in the EBNF above.

EXAMPLE 1: A series of values that define colors can be represented as:

< Red , Green , Yellow , Blue >

EXAMPLE 2: A series of values that define equipment hierarchy levels can be represented as:

<Enterprise , Site , Area , WorkCenter , WorkUnit>

4.8.8 Structured value types

Structured data elements may be represented in this standard's property model by representing the atomic elements of the structure in a flattened name space, or by using nested properties to represent the data structure.

NOTE 1 The decision to use a flattened name space, nested properties, or a combination is determined by the specific implementation.

A structure may be modeled by flattening the name space and having a single property for each structure element.

NOTE 2 This standard specifies how to exchange information without regard to the specific exchange element's mapping. With structured elements there is no guarantee that the communicating entities would have the same structure for the data. Therefore flattening the structure to its individual elements provides a transportable format for structured data.

EXAMPLE 1: A structured element of data would be mapped to a flat name space as follows:

Structure Definition	Flattened Property Name
Struct ABC {	
Integer DEF;	ABC.DEF
Float GHI;	ABC.GHI
Array [3] of Integer JKI	ABC.JKI
}	

A structured data element may be represented by creating a property with no data value or unit of measure and with nested child properties and an identification of the element.

EXAMPLE 2: A structured data element can be mapped as follows:

C# Structure Definition	Equivalent Property
struct Simple {	Property [ID=" Simple "]
public int Position ;	Property [ID=" Simple] \ Property [ID=" Position "]
public bool Exists ;	Property [ID=" Simple] \ Property [ID=" Exists "]
public double LastValue ;	Property [ID=" Simple] \ Property [ID=" LastValue "]
};	

A grouping or collection of related properties may be represented by creating a property with nested child properties.

EXAMPLE 3: A collection of related nominal properties can be mapped as follows:

Collection of Properties	Property Structure
NominalRate	Property [ID=" Nominal "]
ExpectedRate	Property [ID=" Nominal] \ Property [ID=" NominalRate "]
LabelCode	Property [ID=" Nominal] \ Property [ID=" ExpectedRate "]
	Property [ID=" Nominal] \ Property [ID=" LabelCode "]

Nested property objects are only shown in the Personnel, Equipment, Physical Asset, and Material models. All property objects are also nested, as defined in the appropriate section in the text, but are not shown in the model figures in order to reduce the complexity of the figures.

5 Common object models

5.1 Personnel information

5.1.1 Personnel model

The personnel model shown in Figure 5 contains the information about specific personnel, classes of personnel, and qualifications of personnel.

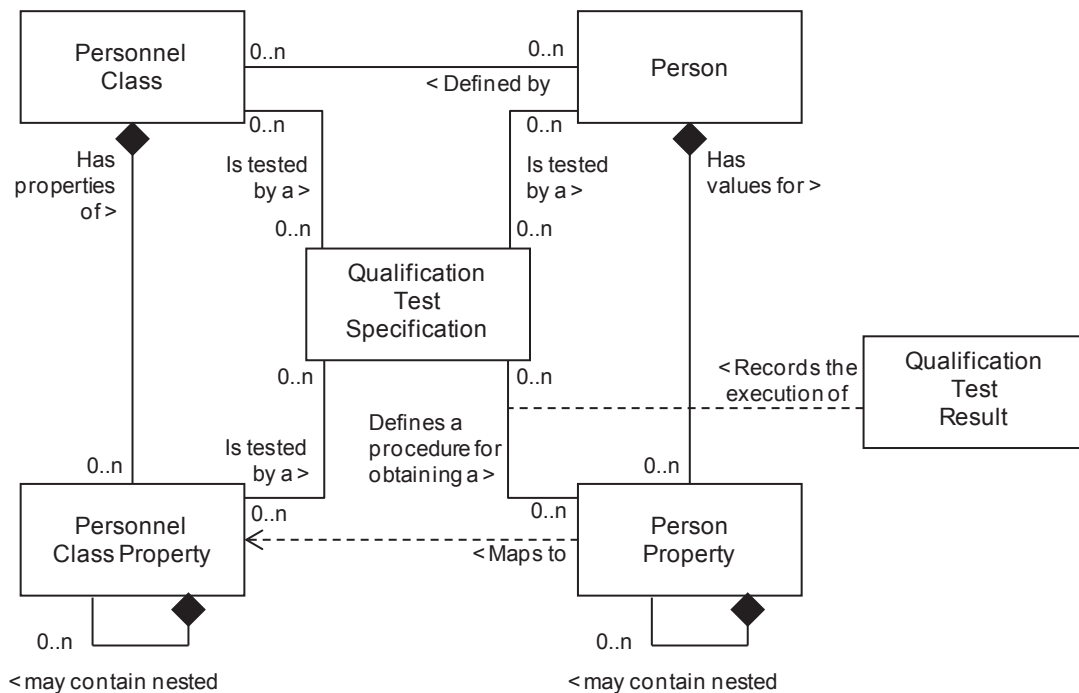


Figure 5 – Personnel model

5.1.2 Personnel class

A representation of a grouping of persons 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*. Table 5 lists the attributes of *personnel class*. A *personnel class* may be tested by the execution of a *qualification test specification*.

NOTE Examples of *personnel classes* are cook machine mechanics, slicing machine operators, cat-cracker operator, and zipper line inspectors.

Table 5 – Attributes of personnel class

Attribute name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a specific <i>personnel class</i> . These are not necessarily job titles, but identify classes that are referenced in other parts of the model.	Widget assembly operator	Maintenance Technician Grade 1	Senior Lab Assistant	Warehouse Manager
Description	Additional information and description about the <i>personnel class</i> .	General information about widget assembly operators.	Highest grade for maintenance technician	Highest level of lab assistants	Person responsible for the warehouse

EXAMPLE A *personnel class* can be associated to a *qualification test specification* without reference to a property, such as a *qualification test specification* for a fork truck operator, in which the test determined if the person is a member of the class of fork truck operators.

5.1.3 Personnel class property

Properties of a *personnel class* shall be presented as *personnel class properties*. Each *personnel class* shall have zero or more recognized properties. Table 6 lists the attributes of *personnel class property*.

NOTE Examples of *personnel class properties* for the personnel class operators are 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* may be tested by the execution of a *qualification test specification*.

Personnel class properties may contain nested *personnel class properties*.

Table 6 – Attributes of personnel class property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific property, unique under the scope of the parent <i>personnel class</i> object. For example, 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 fork lift operator and pipe fitter classes, but has a different meaning for each class.	Class 1 Certified	Electrician Skills Class	LGC Model 1003 Certified Operator	Lift Truck Driver
Description	Additional information and description about the <i>personnel class property</i> .	Indicates the certification level of the operator.	Level of Skill Attained	Indicates if qualified to run equipment	Indicates if allowed to drive lift trucks
Value	The value, set of values, or range of the property. This presents a range of possible numeric values, a list of possible values, or it can be empty if any value is valid.	<True, False>	<Master, Journeyman, Apprentice>	<True, False>	<True, False>
Value Unit of Measure	The unit of measure of the associated property values, if applicable.	Boolean	String	Boolean	Boolean

5.1.4 Person

A representation of a specifically identified individual shall be presented as a *person*. A *person* may be a member of zero or more *personnel classes*.

A *person* may be tested by the execution of a *qualification test specification*.

Person shall include a unique identification of the individual.

Table 7 lists the attributes of *person*.

Table 7 – Attributes of person

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a specific <i>person</i> , within the scope of the information exchanged (<i>production capability</i> , <i>production schedule</i> , <i>production performance</i> , ...) The ID shall be used in other parts of the model when the <i>person</i> needs to be identified, such as the <i>production capability</i> for this person, or a <i>production response</i> identifying the person.	Employee 23	22828	999-123-4567	007
Description	Additional information about the resource.	Person Information	Maintenance Tech	Lab Tech	Driver
Name	The name of the individual. This is meant as an additional identification of the resource, but only as information and not as a unique value.	Jane	Jim	John	James

5.1.5 Person property

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

NOTE For example, a *person property* can be night shift and its value would be available, and a *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 by the execution of a *qualification test specification* with test results exchanged in a *qualification test result*.

Person properties may contain nested *person properties*.

Table 8 lists the attributes of *person property*.

Table 8 – Attributes of person property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific property.	Exposure Hours Available	Union ID	LGC Model 1003 Certified Operator	Lift Truck Driver
Description	Additional information about the <i>person property</i> .	Indicates number of exposure hours available this month	Union ID number	Indicates if qualified to run equipment	Indicates if allowed to drive lift trucks
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	CA55363	True	False
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	Hours	String	Boolean	Boolean

5.1.6 Qualification test specification

A representation of a qualification test shall be presented as a *qualification test specification*. A *qualification test specification* may be associated with a *personnel class*, a *personnel class property*, a *person*, or *person property*. This is typically used where a qualification test or properly demonstrated competency is required to ensure that a person has the correct training and/or experience for specific operations.

A *qualification test specification* may test for one or more properties.

A *qualification test specification* shall include:

- a) an identification of the test;
- b) the version of the test;
- c) the description of the test.

Table 9 lists the attributes of *qualification test specification*.

Table 9 – Attributes of qualification test specification

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of a test for certifying one or more values for one or more <i>person properties</i> . For example, this can be the name of a document that describes or defines the qualification test.	Class 1 Widget Assembly Certification Test	Union Renewal Test	LGC Model 1003 Certification Test	Fork Truck Driving Test
Description	Additional information and description about the <i>qualification test specification</i> .	Identifies the test for Class 1 Widget assembly certification – returns a True or False value for the <i>Class 1 widget assembly certification</i> property	Renewal for union membership	Identifies test for correct operation of LGC Model 1003	Identifies test for driving fork truck
Version	An identification of the version of the <i>qualification test specification</i> .	V23	01	A	23C

5.1.7 Qualification test result

The results from a qualification test for a specific person shall be presented as a *qualification test result*.

A *qualification test result* shall include:

- a) the date of the test;
- b) the result of the test (for example, passed or failed);
- c) the expiration date of the qualification.

Table 10 lists the attributes of *qualification test result*.

Table 10 – Attributes of qualification test result

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique instance identification that records the results from the execution of a test identified in a <i>qualification test specification</i> for a specific <i>person</i> . (For example, this can just be a number assigned by the testing authority.)	T5568700827	UR20070809	LGC553	77276
Description	Additional information and description about the <i>qualification test results</i> .	Results from Joe's widget assembly qualification test for October 1999.	Renewal	Particle Analyzer SOP Test	Fork lift driver safety SOP test
Date	The date and time of the qualification test.	1999-10-25 13:30	2007-08-09	2006-10-31 08:40	2002-01-30
Result	The result of the qualification test. For example: Pass, Fail	Pass	Pass	Fail	Fail
Result Unit of Measure	The unit of measure of the associated test result, if applicable.	<Pass, Fail>	<Pass, Fail>	<Pass, Fail>	<Pass, Fail>
Expiration	The date of the expiration of the qualification.	2000-10-25 13:30	2008-08-09	2008-10-31	(not applicable)

5.2 Role based equipment information

5.2.1 Role based equipment model

The *role based equipment model* shown in Figure 6 contains the information about specific equipment, the classes of equipment, and equipment capability tests.

The formal UML role based equipment model object is used to define the role based equipment hierarchy information that is defined in IEC 62264-1. The model contains the information that may be used to construct the hierarchical models used in manufacturing scenarios. For purposes of corresponding to the IEC 62264-1 models, the defined equipment levels, specified in the Equipment Level attributes, for role based equipment are: Enterprise, Site, Area, Work Center, Work Unit, Process Cell, Unit, Production Line, Production Unit, Work Cell, Storage Zone, and Storage Unit.

NOTE The types of work centers can be extended as needed for application specific role based equipment hierarchies where the defined types do not apply. When a new type is added it usually maintains the same relationship within the hierarchy as the defined work center types (within an area and contains work units).

EXAMPLE 1 A laboratory can be an extended equipment level that defines a Work Center that includes all equipment in a test lab.

EXAMPLE 2 A maintenance storage center can be an extended equipment level that defines a Work Center that includes all equipment used by maintenance activities.

EXAMPLE 3 A Mobile Equipment Center can be a work center that includes all mobile equipment which can be used at different work centers or areas at different points in time.

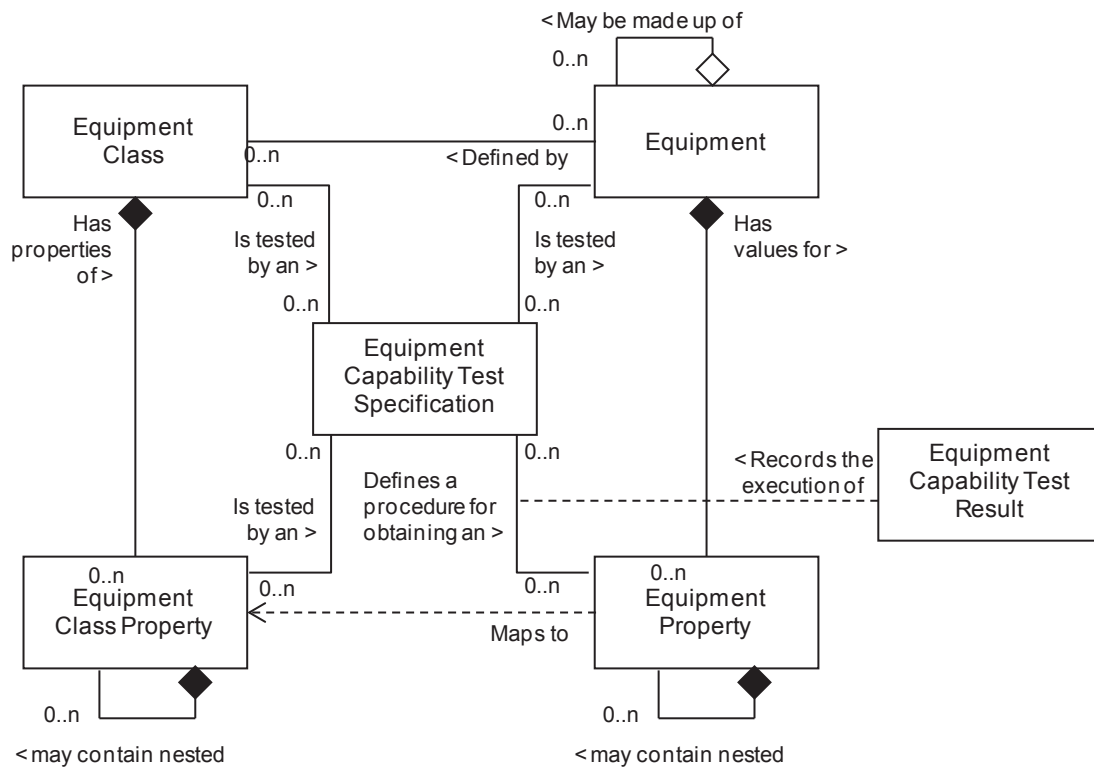


Figure 6 – Role based equipment model

5.2.2 Equipment class

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 tested by the execution of an *equipment capability test specification*.

NOTE Examples of *equipment classes* are reactor unit, bottling line, and horizontal drill press.

Table 11 lists the attributes of *equipment class*.

Table 11 – Attributes of equipment class

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a specific <i>equipment class</i> , within the scope of the information exchanged (<i>production capability</i> , <i>production schedule</i> , <i>production performance</i> , ...) The ID shall be 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 equipment class, or a <i>production response</i> identifying the equipment class used.	WJ6672892	Welder	5662AT	DR-FLT
Description	Additional information about the <i>equipment class</i> .	Jigs used to assemble widgets.	Welder to be signed out	Auto Titration Tester	Deep Reach Fork Truck
Equipment Level	An identification of the level in the role based equipment hierarchy.	Production Line	Work Center	Site	Area

5.2.3 Equipment class property

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 by the execution of an *equipment capability test specification*.

Equipment class properties may contain nested *equipment class properties*.

NOTE Examples of *equipment class properties* for the *equipment class* reactor unit can be lining material, BTU extraction rate, and volume.

Table 12 lists the attributes of *equipment class property*.

Table 12 – Attributes of equipment class property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific property.	Template Size	Capacity	Resolution	Max Weight
Description	Additional information about the <i>equipment class property</i> .	Range of template sizes for widget machines.	Capacity of the welder	Minimum peak resolution	Maximum carrying weight for the truck
Value	The value, set of values, or range of the property.	{10,20,30,40, 100,200,300}	{10..400}	{1 ..10}	{2 000 .. 36 000}
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	cm	Amperes	ppm	Kg

5.2.4 Equipment

A representation of the elements of the equipment hierarchy model shown in IEC 62264-1 shall be presented as *equipment*. *Equipment* may be a listing of Sites, Areas, Production Units, Production Lines, Work Cells, Process Cells, Units, Storage Zones or Storage Units.

Equipment may be tested by the execution of an *equipment capability test specification*.

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

EXAMPLE 1 A production line can be made up of work cells.

EXAMPLE 2 A reactor can be made up of sensors, valves, an agitator, and level switches.

Table 13 lists the attributes of *equipment*.

Table 13 – Attributes of equipment

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a specific piece of equipment, within the scope of the information exchanged (manufacturing operations definition, scheduling, capability and performance) The equipment ID shall be used in other parts of the model when the equipment needs to be identified, such as the <i>production capability</i> for a piece of equipment, or a <i>production response</i> identifying the equipment used.	Jig 347	Wldr445	SN3883AT	VIN28203
Description	Additional information about the equipment.	This is the east side, north building, widget jig.	Welder for north building	Floor 2 lab auto titrator	Shipping dock lift truck
Equipment Level	An identification of the level in the role based equipment hierarchy.	Production Line	Work Center	Site	Area

5.2.5 Equipment property

Properties of *equipment* shall be presented as *equipment properties*. An *equipment* shall have zero or more *equipment properties*. These 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 by the execution of an *equipment capability test specification* with results exchanged in an *equipment capability test result*.

Equipment properties may contain nested *equipment properties*.

NOTE An *equipment property* can exist without an associated *equipment class property*, however all parties in an exchange will have to 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 Examples of equipment properties are

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

Table 14 lists the attributes of *equipment property*.

Table 14 – Attributes of equipment property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific property.	Run Rate	Capacity	Resolution	Max Weight
Description	Additional information about the <i>equipment property</i> .	Widget making average run rate	Capacity of the welder	Minimum peak resolution	Maximum carrying weight for the truck
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>equipment property</i> .	59	{10-200}	0,05	1
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	Widgets/Hour	Amperes	%	Tons

5.2.6 Equipment capability test specification

A representation of a capability test shall be presented as an *equipment capability test specification*. An *equipment capability test specification* may be associated with an *equipment class*, *equipment class property*, *equipment* or *equipment property*. This is typically used where a test is required to ensure that the equipment has the necessary capability and capacity.

An *equipment capability test specification* may test for one or more *equipment properties*.

An *equipment capability test specification* shall include:

- a) an identification of the test;
- b) a version of the test;
- c) a description of the test.

Table 15 lists the attributes of *equipment capability test specification*.

Table 15 – Attributes of equipment capability test specification

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of a test for certifying one or more values for one or more <i>equipment properties</i> . For example, this can be the name of a document that describes or defines the capability test.	WAJTT-101	Wldr_check	Att-Calibrate	Flt_Safety
Description	Additional information about the <i>equipment capability test specification</i> .	Widget assembly jig throughput test – returns the run rate for a specific machine	Welder Safety Check	Auto Titration tester Calibration	Lift truck safety truck
Version	An identification of the version of the capability test specification.	1,0	2,3	1,1	1,1

5.2.7 Equipment capability test result

The results from an equipment capability test for a specific piece of equipment shall be presented as an *equipment capability test result*.

An *equipment capability test* result shall include:

- the date of the test;
- the result of the test (passed-failed or quantitative result);
- the expiration date of the test.

Table 16 lists the attributes of *equipment capability test result*.

Table 16 – Attributes of equipment capability test result

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique instance identification that records the results from the execution of a test identified in a <i>capability test specification</i> for a specific piece of <i>equipment</i> . (For example, this can just be a number assigned by the testing authority.)	FQ101/01-10-2000	WC888	AT98765	FS7602
Description	Additional information about the <i>equipment capability test result</i> .	Results from run rate test for JIG 237 for October 1999.	Results from safety check	Results from calibrate	Results from safety check
Date	The date and time of the capability test.	1999-10-25 13:30	1999-10-25 13:30	1999-10-25 13:30	1999-10-25 13:30
Result	The result of the capability test.	48	Fail	Pass	Pass
Result Unit of Measure	The unit of measure of the associated test result, if applicable.	Widgets/Hour	<Pass, Fail>	<Pass, Fail>	<Pass, Fail>
Expiration	The date of the expiration of the capability.	2000-10-25 13:30	2000-10-25 13:30	2000-10-25 13:30	2000-10-25 13:30

5.3 Physical asset information

5.3.1 Physical asset model

The physical asset model contains information about the physical piece of equipment, usually 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 object in the asset model defines the physical ID and properties of a piece of equipment.

EXAMPLE Equipment IDs can be represented as TAGs, 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_9982002922).

NOTE The physical asset can be replaced (e.g. because it is broken) and in that case the TAG will not change, but a new physical asset with a unique serial number will take the place of the old physical asset. Therefore two separate ID's would be used one for the role (equipment ID) and one for the physical asset (physical asset ID).

While assets have Level 4 significance, usually because they have an economic value, this part of IEC 62264 of the standard focuses on the Level 3 significance of the asset. The asset model defines a physical asset as a representation of a physical piece of equipment.

Hierarchy levels in the physical asset hierarchy are not defined in this part of IEC 62264, however the role-based equipment hierarchy names should be used if they are equivalent.

A representation of physical asset equipment is illustrated in Figure 7.

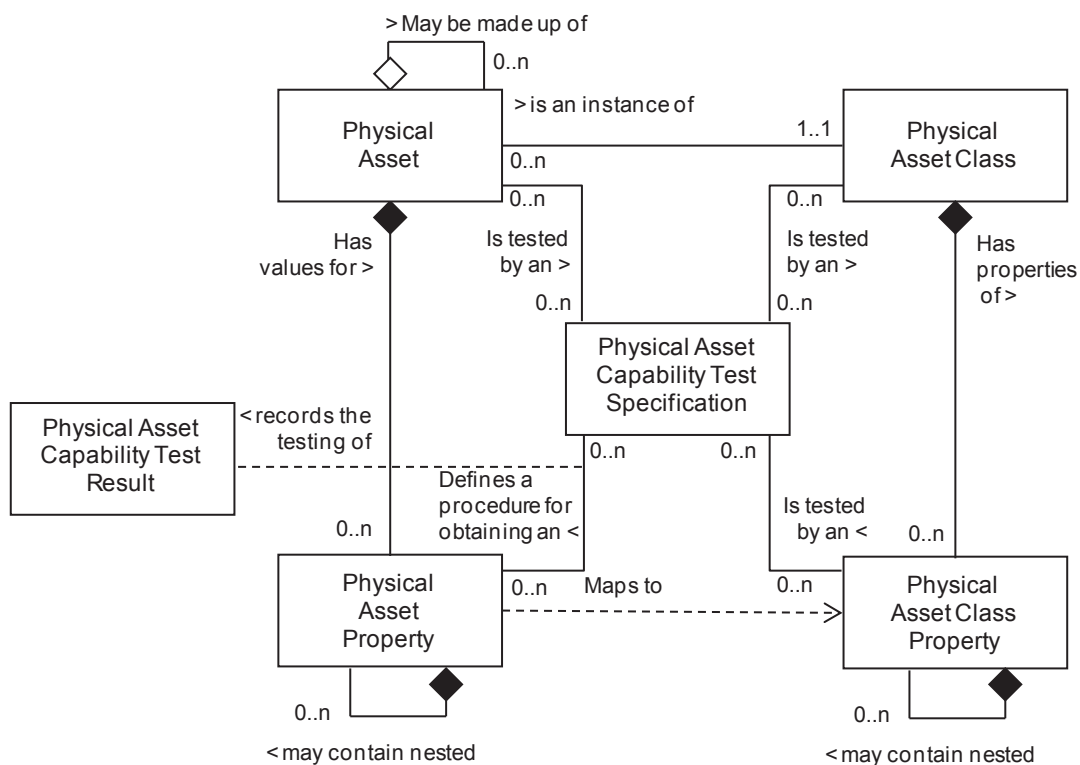
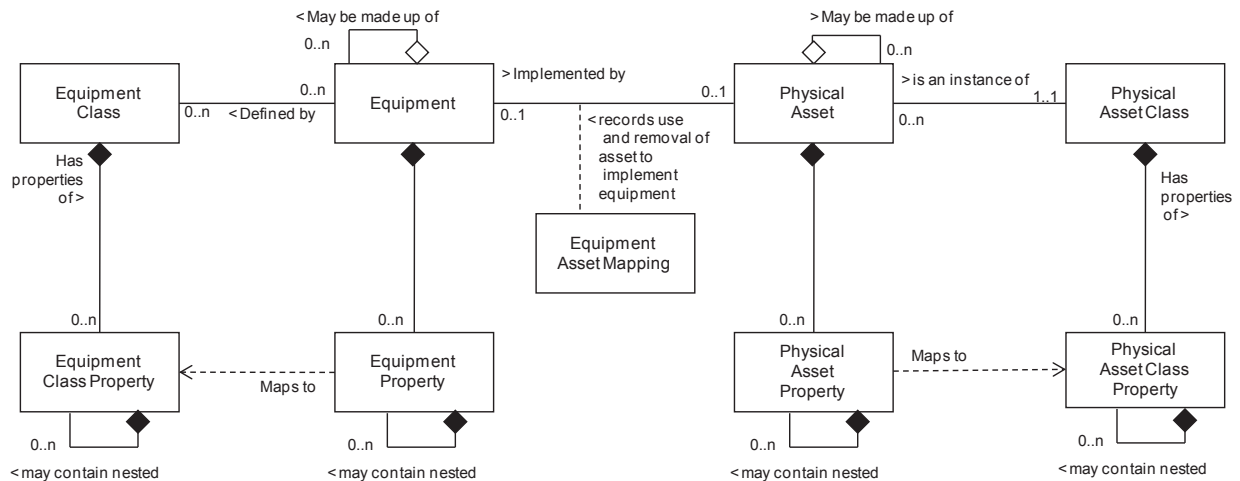


Figure 7 – Physical asset model

The relationship between the *physical asset* information and the *equipment* information is shown in Figure 8. There is a temporal relationship between the role of the *equipment* and the *physical asset*. The *physical asset* performing the role may change over time and the *equipment asset mapping* maintains the association.



NOTE This model shown in Figure 8 is consistent with the MIMOSA data models, but with various name differences due to their development history.

1. A MIMOSA Asset element maps to a Physical Asset object.
2. A MIMOSA Asset Utilization History element maps to an *equipment asset mapping* object.
3. A MIMOSA Segment element maps to an Equipment object.
4. A MIMOSA Model element maps to a Physical Asset Class object.

A MIMOSA Agent element would map to an attribute or property, where needed.

Figure 8 – Physical asset and equipment relationship

5.3.2 Physical asset

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

A *physical asset* may be tested by the execution of a *physical asset capability test specification*.

Physical assets may be made up of other *physical assets*. For example, a packaging line may be made up of conveyor sections, motors, and sensors.

Table 17 lists the attributes of a *physical asset*.

Table 17 – Attributes of physical asset

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	Defines a unique identification of a <i>physical asset</i> .	SN5246\$9	SN68928#1	SN5247\$3	VIN 55262528
Description	Contains additional information and descriptions of the <i>physical asset</i> .	2 HP Pump	High Performance Welder	Auto titration tester	Fork truck
Physical Location	Actual physical location of the physical asset	Area 54, Unit 3A	Storage Bay 9982	Floor 2 Lab	Docking Bay 3
Fixed Asset ID	Contains a unique identification for financial tracking as required by laws or regulations	2000291	2000292	2000293	2000294
Vendor ID	Contains a vendor's serial number	AT55628	667y62	W78GJ77	H2228

EXAMPLE Implementations could consider the following rules concerning the use of IDs:

1. The *physical asset* ID could be an enterprise wide identification.

2. If an information exchange is needed to handle assets across enterprises, then the ID could be a GUID (Globally Unique ID).
3. Common local practices may need to have other identifications of physical assets and additional correlated identifications represented as properties.

NOTE Materials used in maintenance operations can be represented in either the physical asset model, in the material model, or in both. When represented in both models the IDs used to identify the material in both models (Material Lot and Physical Asset ID) would normally be the same.

5.3.3 Physical asset property

Properties of *physical assets* shall be presented as *physical asset properties*. A *physical asset* shall have zero or more *physical asset properties*. These 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 by the execution of a *physical asset capability test specification* with results exchanged using a *physical asset capability test result*.

Physical asset properties may contain nested *physical asset properties*.

Table 18 lists the attributes of a *physical asset property*.

Table 18 – Attributes of physical asset property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific property.	Date of Manufacture	Assembly Drawing	Tracked Physical Asset	Tracked Physical Asset
Description	Additional information about the <i>asset property</i> .	Name plate date of production	Vendor assembly drawing ID	Indicates that the physical asset shall be signed out and tracked	Indicates the state of the physical asset
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> .	2008 10	ACC08-55642	<Tracked, Not Tracked,>	<Assigned, Issued, Available>
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	Date	String	Boolean	Boolean

5.3.4 Physical asset class

A representation of a grouping of physical assets with similar characteristics for purposes of repair and replacement shall be presented as a *physical asset class*. Any *physical asset* shall be a member of one *physical asset class*.

A *physical asset class* may be tested by the execution of a *physical asset capability test specification*.

Table 19 lists the attributes of a *physical asset class*.

Table 19 – Attributes of physical asset class

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
Manufacturer	An identification of the manufacturer.	Smith Pumps.	Jones Welders	Franz Testers	Chrysler Fleet Car
ID	The manufacture's identification of the specific <i>physical asset class</i> . For example: the model number	2HPWP	HPWLDR 103	ATT 99	Series K
Description	Additional information about the <i>physical asset class</i> .	Intrinsically Safe	(not applicable)	(not applicable)	(not applicable)

5.3.5 Physical asset class property

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 by the execution of a *physical asset capability test specification*.

Physical asset class properties may contain nested *physical asset class properties*.

Table 20 lists the attributes of a *physical asset class property*.

Table 20 – Attributes of physical asset class property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific property.	Throughput	Weld Rate	Test Speed	Charge Time
Description	Additional information about the <i>property</i> .	Pump throughput	Maximum speed of welder	Average test rate	Hours to recharge truck
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	5	1 315	5
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	L / min	cm/s	Samples / Hour	Hours

5.3.6 Physical asset capability test specification

A representation of a capability test for a *physical asset* shall be presented as a *physical asset capability test specification*. A *physical asset capability test specification* may be associated with a *physical asset property*. This is typically used where a test is required to ensure that the *physical asset* has the rated capability and capacity.

A *physical asset capability test specification* may test for one or more *physical asset properties*.

A *physical asset capability test specification* shall include:

- a) the identification of the test;
- b) the version of the test;
- c) the description of the test.

Table 21 lists the attributes of a *physical asset capability test specification*.

Table 21 – Attributes of physical asset capability test specification

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific physical asset capability test specification.	WPTT82	WR9	ATT00029	CTIME 99
Description	Additional information about the <i>test specification</i> .	Test of Pump Throughput	Test of Maximum speed of welder	Test of Average test rate	Test of Hours to recharge truck
Version	An identification of the version of the capability test specification.	00	1	2	3

5.3.7 Physical asset capability test result

The results from a qualification test for a specific *physical asset* shall be presented as a *physical capability test result*.

A *physical asset capability test result* shall include:

- a) the date of the test;
- b) the result of the test (passed-failed or quantitative result);
- c) the expiration date of the test.

Table 22 lists the attributes of a *physical asset capability test result*.

Table 22 – Attributes of physical asset capability test result

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific physical asset capability test result.	CPT-999	MT- 998	HD-878	IN-BX-7778
Description	Additional information about the <i>test result</i> .	the number of chrome plated widgets produced per hour	pH meter calibration result test	Hardness test of unit 878	Cold box storage temp. delta
Date	The date and time of the capability test.	1999-10-25 13:30	1999-10-25 13:30	1999-10-25 13:30	1999-10-25 13:30
Result	The result of the capability test.	48	7,000 1	<Pass, Fail>	1,2
Result Unit of Measure	The unit of measure of the associated test result, if applicable.	Widgets/Hour	pH	Boolean	°C
Expiration	The date of the expiration of the capability.	2000-10-25 13:30	2000-10-25 13:30	2000-10-25 13:30	2000-10-25 13:30

5.3.8 Equipment asset mapping

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

The *equipment asset mapping* records the time period when one *equipment* object and one *physical asset* object were associated.

Table 23 lists the attributes of an *equipment asset mapping*.

Table 23 – Attributes of equipment asset mapping

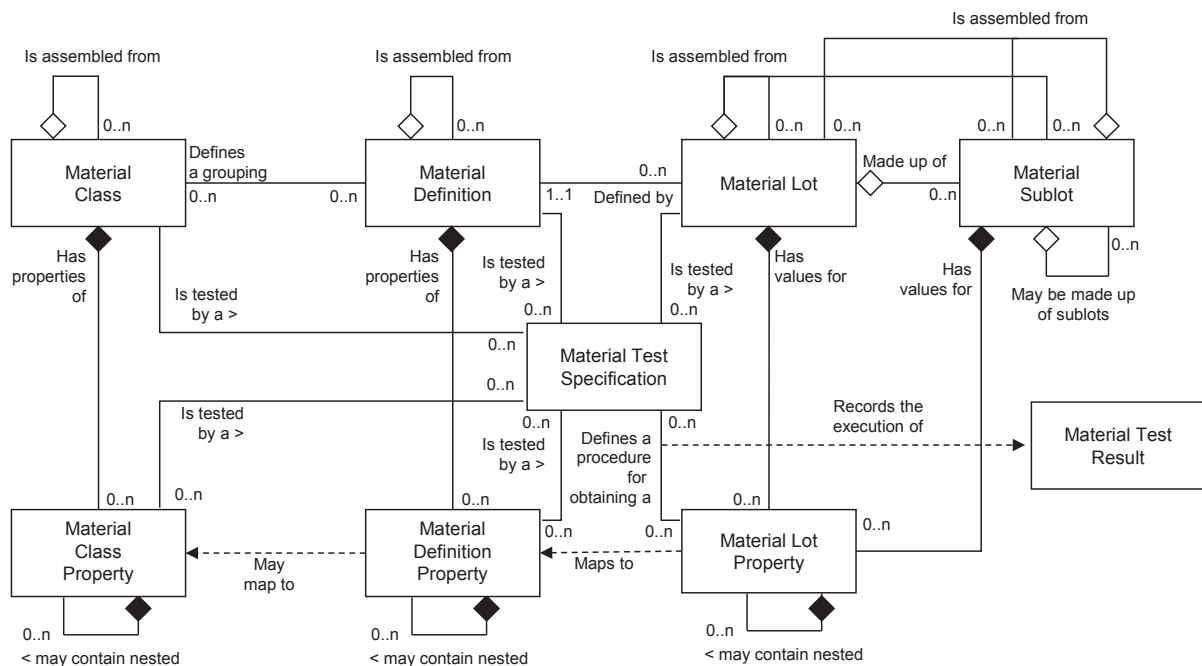
Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific equipment asset mapping.	111	112	113	114
Description	Additional information about the <i>mapping</i> element.	(not applicable)	Installed under work order 48423. Removed under work order 93823	(not applicable)	(not applicable)
Start Time	The starting time of the association.	1997-02-10	1997-02-10	2004-04-23	2005-04-30
End Time	The ending time of the association.	2004-12-10	2004-12-10	(not applicable)	(not applicable)

5.4 Material information

5.4.1 Material model

The material model shown in Figure 9 defines the actual materials, material definitions, and information about classes of material definitions. Material information includes the information of

raw, finished, intermediate materials, and consumables. The information about planned or actual material is contained in the material lot and material subplot information. Material classes are defined to organize materials.



NOTE This corresponds to a resource model for material, as defined in ISO 10303.

Figure 9 – Material model

5.4.2 Material class

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 class* may be tested by the execution of a *material test specification*.

NOTE An example of a *material class* can be sweetener, with members of fructose, corn syrup, and sugar cane syrup. Another example of a *material class* can be water, with members of city water, recycled water, and spring water.

A *material definition* shall belong to zero or more *material classes*.

Table 24 lists the attributes of *material class*.

Table 24 – Attributes of material class

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a specific <i>material class</i> , within the scope of the information exchanged (<i>production capability</i> , <i>production schedule</i> , <i>production performance</i> , ...) The ID shall be used in other parts of the model when the <i>material class</i> needs to be identified, such as the <i>production capability</i> for this <i>material class</i>, or a <i>production response</i> identifying the <i>material class</i> used.	Polymer sheet stock 1001A	200 cP Oil (SAE 90)	RH5510	20 mil Wrap
Description	Additional information about the <i>material class</i> .	Solid polymer resin	Very High Viscosity Lubricating Oil	Oxidizing Agent	Wrap used to wrap pallets
Assembly Type	Optional: Defines the type of the assembly. The defined types are: Physical – The components of the assembly are physically connected or in the same area. Logical – The components of the assembly are not necessarily physically connected or in the same area.	Physical	Physical	Logical	Physical
Assembly Relationship	Optional: Defines the type of the relationships. The defined types are: Permanent – An assembly that is not 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	Transient	Permanent	Transient

A *material class* may be defined as containing an assembly of *material classes* and as part of an assembly of *material classes*:

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

5.4.3 Material class property

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 by the execution of a *material test specification*.

Material class properties may contain nested *material class properties*.

NOTE Examples of *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* does not have to match a *material class property*.

Table 25 lists the attributes of *material class property*.

Table 25 – Attributes of material class property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of a specific <i>material class property</i> .	Polyethylene sheet thickness	Oil Viscosity	pH	Weight
Description	Additional information about the <i>material class property</i> .	Sheet Thickness	Coefficient of viscosity	Acidity	Weight to be added to shipping label
Value	The value, set of values, or range of the property.	{5, 10, 25}	(not applicable)	{0..7}	(not applicable)
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	mm	Pa-s	pH	g / m ²

5.4.4 Material definition

A representation of goods with similar name 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 execution of a *material test specification*.

NOTE Examples of *material definitions* are city water, hydrochloric acid from Vendor A, and grade B aluminum.

Any *material lot* shall be associated with one *material definition*.

Table 26 lists the attributes of *material definition*.

Table 26 – Attributes of material definition

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	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> , ...) The ID shall be 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 a <i>production response</i> identifying the <i>material definition</i> used.	Sheet stock 1443a	DO200cpO	OA9929	PW882929
Description	Additional information about the <i>material definition</i> .	General purpose sheet stock	200 cP Oil from Dino Oil	Oxidizing Agent from RustItAll	General purpose 20 mil wrap
Assembly Type	Optional: Defines the type of the assembly. The defined types are: Physical – The components of the assembly are physically connected or in the same area. Logical – The components of the assembly are not necessarily physically connected or in the same area.	Physical	Physical	Logical	Physical
Assembly Relationship	Optional: Defines the type of the relationships. The defined types are: Permanent – An assembly that is not 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	Transient	Permanent	Transient

A *material definition* may be defined as containing an assembly of *material definitions* and as part of an assembly of *material definitions*:

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

5.4.5 Material definition property

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 by the execution of a *material test specification*.

Material definition properties may contain nested *material definition properties*.

NOTE Examples of *material definition property* include density, pH factor, or material strength.

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

Table 27 lists the attributes of *material definition property*.

Table 27 – Attributes of material definition property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific material definition property.	1443a5mm	Oil viscosity	pH	Weight
Description	Additional information about the <i>material definition property</i> .	5 mm sheet	Coefficient of viscosity	Acidity	Weight to be added to shipping label
Value	The value, set of values, or range of the property.	{4,85 .. 5,15}	$\{250 \times 10^{-3} \dots 255 \times 10^{-3}\}$	{3.99 .. 4.01}	20 .. 21
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	mm	Pa-s	pH	g / m ²

5.4.6 Material lot

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 execution of a *material test specification*.

A *material lot* shall include:

- the unique identification of the lot;
- the amount of material (count, volume, weight);
- the unit of measure of the material (for example, parts, liters, kg);
- the storage location for the material;
- 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.

Table 28 lists the attributes of *material lot*.

Table 28 – Attributes of material lot

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	A unique identification of a specific <i>material lot</i> , within the scope of the information exchanged (<i>operations capability, operations schedule, production performance, ...</i>) The ID shall be 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 a <i>operations response</i> identifying the <i>material lot</i> used.	L66738-99	L8828-81	L53920-02	L8626-33
Description	Additional information about the material lot.	PlastiFab 10/31 shipment	Oil	Reagent	Wrapping material
Assembly Type	Optional: Defines the type of the assembly. The defined types are: Physical – The components of the assembly are physically connected or in the same area. Logical – The components of the assembly are not necessarily physically connected or in the same area.	Physical	Physical	Logical	Physical
Assembly Relationship	Optional: Defines the type of the relationships. The defined types are: Permanent – An assembly that is not 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. NOTE If material lots (or sublots) are merged or absorbed (e.g. blended), then this is a new material lot.	Permanent	Transient	Permanent	Transient
Status	Status of the <i>material lot</i> . For example, released, approved, blocked, in process, in quality check.	In process	approved	blocked	approved
Storage Location	An identification of the storage location or a physical location of the <i>material lot</i> .	Work Center 1	Maintenance Shed 4S	Work Bench 10, Top Shelf	Warehouse 1
Quantity	The quantity of the <i>material lot</i> .	1 200	20	1	41
Quantity Unit of Measure	The unit of measure of the associated quantity, if applicable.	sheets	Cans	Liter	Rolls
NOTE 1 Representation of non-lot controlled items (for example consumable materials or bulk materials), can be represented in the <i>material lot</i> model through the use of a unique IDs for each different <i>material definition</i>. For example this could be the <i>material definition</i> ID or a system assigned ID, NOTE 2 If non-lot controlled items are maintained in multiple locations then the information can be represented in the <i>material subplot</i> model through the use of unique subplot IDs for each different location and <i>material definition</i>.					

A *material lot* or a *material subplot* may be defined as containing an assembly of *material lots* or *material sublots* and as part of an assembly of *material lots* or *material sublots*:

1. A *material lot* or a *material subplot* may define an assembly of zero or more *material lots* or *material sublots*.
2. A *material lot* or a *material subplot* may be an assembly element of zero or more *material lots* or a *material sublots*.
3. An assembly may be defined as a permanent or transient assembly of *material lots* or *material sublots*.

EXAMPLE 1 A transient assembly could be a temporary collection of material maintained as a batch kit on a pallet, the batch kit is identified with a unique identification and can contain specific properties, such as a pallet identification, location, and related batch ID.

EXAMPLE 2 A permanent assembly of material can be an automobile. The automobile has a unique vehicle identification number (VIN) and other properties. The automobile can contain an assembly of an engine, transmission, chassis, and wheels, each with their own unique identification and properties.

4. An assembly may be defined as physical or a logical assembly of *material lots* or *material sublots*. Assemblies of materials do not imply a manufacturing status.

EXAMPLE 3 A finished tractor is a physical assembly of materials.

EXAMPLE 4 An unassembled collection of tractor components that are separately shipped is a logical assembly of materials.

5.4.7 Material lot property

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 by the execution of a *material test specification* with results exchanged in a *material test specification result*.

Material lot properties may contain nested *material lot properties*.

A *material lot property* is associated with either a *material lot* or a *material subplot*. When associated with a *material lot* it specifies a property value for all *material sublots*, when associated with a *material subplot* it specifies a property value for a single subplot.

Table 29 lists the attributes of *material lot property*.

Table 29 – Attributes of material lot property

Attribute Name	Description	Production examples	Maintenance examples	Quality examples	Inventory examples
ID	An identification of the specific <i>material lot property</i> .	Average sheet thickness	Oil Viscosity	pH	Weight
Description	Additional information about the <i>material lot property</i> .	Measured thickness	Coefficient of viscosity	Acidity	Weight to be added to shipping label
Value	The value, set of values, or range of the property.	5,002	250×10^{-3}	4,01	20,3
Value Unit of Measure	The unit of measure of the associated property value, if applicable.	mm	Pa-s	pH	g / m ²

5.4.8 Material subplot

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*