<AutomationML/>

The Glue for Seamless Automation Engineering

Whitepaper AutomationML
Part 2 – Semantics libraries

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Introduction

The data exchange format defined in IEC 62714 (Automation Markup Language, AML) is an XML schema based data format and has been developed in order to support the data exchange between engineering tools in a heterogeneous engineering tool landscape. IEC 62714-1 gives an overview about the format.

The goal of AML is to interconnect engineering tools from the existing heterogeneous tool landscape in their different disciplines, e.g. mechanical plant engineering, electrical design, process engineering, process control engineering, HMI development, PLC programming, robot programming, etc.

AML stores engineering information following the object oriented paradigm and allows modelling of physical and logical plant components as data objects encapsulating different aspects. An object may consist of other sub-objects and may itself be part of a larger composition or aggregation. Typical objects in plant automation comprise information on topology, geometry, kinematics and logic, whereas logic comprises sequencing, behaviour and control.

AML combines existing industry data formats that are designed for the storage and exchange of different aspects of engineering information. These data formats are used on an "as-is" basis within their own specifications and are not branched for AML needs.

The core of AML is the top-level data format CAEX that connects the different data formats. Therefore, AML has an inherent distributed document architecture.

Figure 1 illustrates the basic AML architecture and the distribution of topology, geometry, kinematic and logic information.

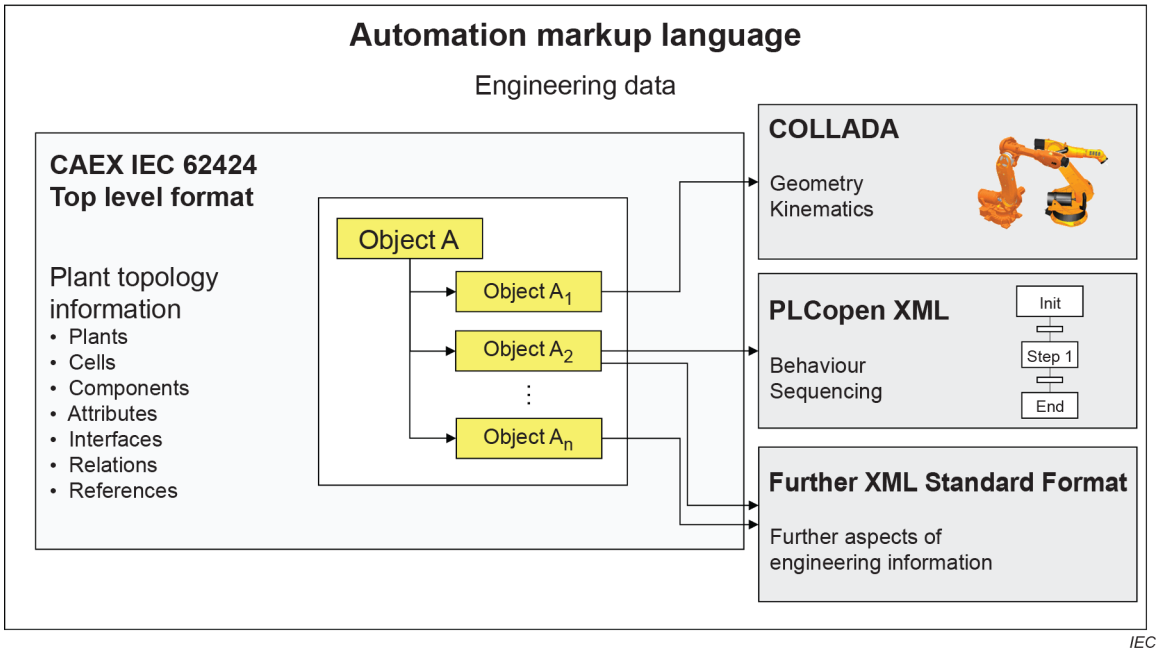


Figure 1 – Overview of the engineering data exchange format (AML)

Due to the different aspects of AML, IEC 62714 (all parts) consists of different parts focusing on different aspects.

- IEC 62714-1: Architecture and general requirements
  This part specifies the general AML architecture, the modelling of engineering data, classes, instances, relations, references, hierarchies, basic AML libraries and extended AML concepts.
- IEC 62714-2: Semantics libraries
  This part specifies AML role class libraries and the usage of AML attributes to represent semantics.
- IEC 62714-3: Geometry and kinematics
  This part specifies the modelling of geometry and kinematics information.
- IEC 62714-4: Logic
  This part specifies the modelling and referencing of logic information.

Further parts may be added in the future in order to interconnect further data standards to AML.

Clause 0 describes normative role class libraries within AML.

5.6 describes the informative AML extended role class library.

Annex B gives an informative example for the usage of AML role classes.

Annex C shows some user-defined role class libraries of different origins.

Annex D gives an informative XML representation of the libraries defined in this part of IEC 62714.

1 Scope

IEC 62714 (all parts) specifies an engineering data exchange format for use in industrial automation systems.

This part of IEC 62714 specifies normative as well as informative AML libraries for the modelling of engineering information for the exchange between engineering tools in the plant automation area by means of AML. Moreover, it presents additional user-defined libraries as an example. Its provisions apply to the export/import applications of related tools.

This part of IEC 62714 specifies AML role class libraries and the usage of AML attributes to represent semantics. Role classes provide semantics to AML objects, attribute types provide semantics to AML attributes. The association of role classes to AML objects or attribute types to AML attributes represent the possibility to add (also external) semantic to it. By associating a role class to an AML object or an attribute type to an AML attribute, it gets a semantic. This part of IEC 62714 does not define details of the data exchange procedure or implementation requirements for the import/export tools.

Note: In the future, it is possible to include AML attribute type libraries in this part of IEC 62714.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62714-1:2018, *Engineering data exchange format for use in industrial automation systems engineering – Automation Markup Language – Part 1: Architecture and general requirements*

IEC 61360, *IEC Common Data Dictionary* (available at https://cdd.iec.ch)

IEC 62424:2016, Representation of process control engineering – Requests in P&I diagrams and data exchange between P&ID tools and PCE-CAE tools

Extensible Markup Language (XML) 1.0:2008, *W3C Recommendation (available at* http://www.w3.org/TR/2008/REC-xml-20081126/)

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62714-1:2018, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1 Robot

industrial robot
automatically controlled, reprogrammable, multipurpose manipulator, programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications

[SOURCE: ISO 8373:2012, 2.9, modified – The preferred term “robot” has been added: the notes have been removed]

3.1.2 Sensor

part of a measuring instrument, or measuring chain, which is directly affected by the measurand and which generates a signal related to the value of the measurand

[SOURCE: IEC 60050-311:2001, 311-05-01]

EXAMPLE Limit switch, proximity sensor, pressure transmitter, vibration transducer, strain gauge, photo detector.

3.1.3 Measurand

particular quantity subject to measurement

[SOURCE: IEC 60050-311:2001, 311-01-03]

3.1.4 Actuator

functional unit that generates the manipulated variable, required to drive the final controlling element, from the output variable of the controlling element

EXAMPLE Contactor, variable speed drive.

[SOURCE: IEC 60050-351:2013, 351-49-07, modified – the notes, example, and figures have been removed, a new example has been added]

3.2 Abbreviated terms

For the purposes of this document the abbreviated terms given in IEC 62714-1:2018, as well as those given in Table 1, apply.

Table 1 – Abbreviations

AGV	Automated guided vehicle
IPC	Industrial PC
NC	Numerical controller
PAC	Programmable automation controller
PLC	Programmable logic controller
PC	Personal computer

4 Conformity

To claim conformity to this part of IEC 62714 with respect to the support of AML, the requirements of Clause 0 shall be fulfilled.

5 AML role classes

5.1 Location and inheritance relationship of role classes in role class libraries

The storage of role classes is organized in hierarchies within role class libraries.

The location inside this hierarchy is called "path for element reference" in the context of this document.

NOTE The relation from one AML object to a role class is described in IEC 62714-1:2018 in 5.5.2 “Class-instance-relations”.

The "path for element reference" is used to address the role class from other AML objects (see the example in Figure 2).

```
<InstanceHierarchy Name="RoleExample">
  <InternalElement Name="Cell" ID="{d6d584a2-4f97-42a8-9354-c9b3ee7d5362}">
    <InternalElement Name="Ressource" ID="{39eb3ed9-c6ea-44c8-8227-ab4b1667c593}">
      <InternalElement Name="RB1" RefBaseSystemUnitPath="ExampleSystemUnitClassLib/Roboter" ID="{a62705df-2951-4a2f-8562-f65cdc4eabc4}">
        <SupportedRoleClass RefRoleClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Robot"/>
      </InternalElement>
```

IEC

Figure 2 – Example addressing of role class "Robot" in AML object "RB1"

The "semantic base" of a role class within a role class library describes which role class it is semantically inherited from.

This describes the heritage relation of role classes regardless of their storage location inside a role class library.

Even if the role class library includes a flat list of role classes, the inheritance relationship can be more complex (see the example in Figure 3).

```
<RoleClassLib Name="AutomationMLExtendedRoleClassLib">
    <RoleClass Name="Conveyor" RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport">
```

IEC

Figure 3 – Example inheritance relationship

NOTE This semantic base is called "Parent class" in IEC 62714-1.

5.2 AML role class libraries

Table 2 gives an overview about the AML related role class libraries specified in IEC 62714-1 and this part of IEC 62714.

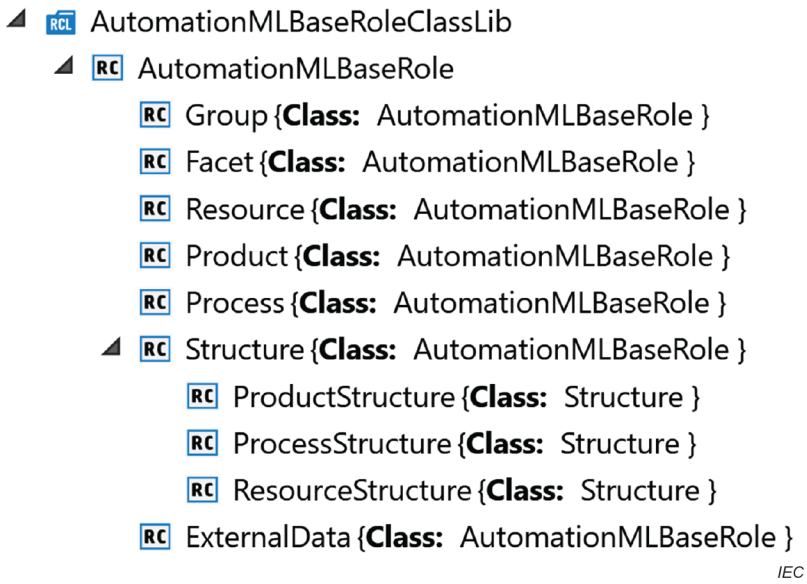
Table 2 – Structure of AML role class libraries

AutomationMLBaseRoleClassLib	IEC 62714-1 – normative
AutomationMLDMIRoleClassLib AutomationMLCMIRoleClassLib AutomationMLBMIRoleClassLib AutomationMLCSRoleClassLib	IEC 62714-2 – normative
AutomationMLExtendedRoleClassLib	IEC 62714-2 – informative
UserDefinedRoleClassLib_RedBookVDMA UserDefinedRoleClassLibCompanySpecificStructure UserDefinedRoleClassLibISA106	IEC 62714-2 – informative, user-defined examples

NOTE 1 The concept of role class libraries, especially user-defined role class libraries is described in IEC 62424:2008 and IEC 62714-1:2018, 7.5.

NOTE 2 The role class tree (see Figure 4) does not necessarily reflect the inheritance relations between the classes, but only serves for better readability. The inheritance relation is depicted by the class referenced in curly brackets.

All role class libraries defined in this part of IEC 62714 are based on the AutomationMLBaseRoleClassLib defined in IEC 62714-1:2018 which is shown in Figure 4.



IEC

Figure 4 – AutomationMLBaseRoleClassLib defined in IEC 62714-1:2018

Subclause 0 defines a normative AML role class library for the discrete manufacturing industry (AutomationMLDMIRoleClassLib).

NOTE 3 The terms discrete, continuous, and batch manufacturing are used according to IEC 62264-1:2013.

Subclause 5.3.2 defines a normative AML role class library for the continuous manufacturing industry (AutomationMLCMIRoleClassLib).

Subclause **Fehler! Verweisquelle konnte nicht gefunden werden.** defines a normative AML role class library for the batch manufacturing industry (AutomationMLBMIRoleClassLib).

Subclause 5.5 defines a normative AML role class library for the control system (AutomationMLCSRoleClassLib).

5.6 shows an informative AML extended role class library (AutomationMLExtendedRoleClassLib).

Annex B shows an example for the usage of AML role classes.

Annex C shows some exemplary user-defined role class libraries.

As defined in IEC 62714-1:2018, the version of AML is defined in the CAEX element "AdditionalInformation" as child of the CAEXFile root element. The AML version addressed in this document is "2.0". Additionally, every role class library contains an individual library version which is defined in the CAEX element "Version" of the "RoleClassLib" element.

Role classes in AML can contain attributes according to IEC 62424:2008. The definition of the attribute shall be placed within the CAEX element "Description". Attributes shall be defined in an AttributeTypeLib. Attributes shall be defined by

1) referencing the Common Data Dictionary (IEC 61360-4) or, if not possible,
2) referencing existing IEC standards or, if not possible,
3) user-defined textual explanations.

5.3 AML role class library for discrete manufacturing industry – AutomationMLDMIRoleClassLib

5.3.1 General

NOTE 1 The version of this AML discrete manufacturing industry role class library is 2.4.0.

Figure 5, Figure 6, and Figure 7 present the normative AutomationMLDMIRoleClassLib as an object tree. This library provides a set of basic discrete manufacturing industry related role classes. Details to each role class are given in 5.3.2 to 5.3.11.

NOTE 2 According to IEC 62424:2008, user-defined attributes can be added.

- AutomationMLDMIRoleClassLib
  - DiscManufacturingEquipment {**Class:** Resource }
    - Transport {**Class:** DiscManufacturingEquipment }
    - Storage {**Class:** DiscManufacturingEquipment }
    - Fixture {**Class:** DiscManufacturingEquipment }
    - Gate {**Class:** DiscManufacturingEquipment }
    - Robot {**Class:** DiscManufacturingEquipment }
    - Tool {**Class:** DiscManufacturingEquipment }
    - Carrier {**Class:** DiscManufacturingEquipment }
    - Machine {**Class:** DiscManufacturingEquipment }
    - StaticObject {**Class:** DiscManufacturingEquipment }

IEC

Figure 5 – AutomationMLDMIRoleClassLib

RoleClassLib				
	Name	AutomationMLDMIRoleClassLib		
	Description	Automation Markup Language Discrete Manufacturing Industry Role Class Library		
	Version	2.4.0		
	RoleClass			
		Name	DiscManufacturingEquipment	
		RefBaseClassPa...	AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource	
		RoleClass (9)		
			Name	RefBaseClassPath
		1	Transport	DiscManufacturingEquipment
		2	Storage	DiscManufacturingEquipment
		3	Fixture	DiscManufacturingEquipment
		4	Gate	DiscManufacturingEquipment
		5	Robot	DiscManufacturingEquipment
		6	Tool	DiscManufacturingEquipment
		7	Carrier	DiscManufacturingEquipment
		8	Machine	DiscManufacturingEquipment
		9	StaticObject	DiscManufacturingEquipment

IEC

Figure 6 – XML grid of the AutomationMLDMIRoleClassLib

```
<RoleClassLib Name="AutomationMLDMIRoleClassLib">
  <Description>Automation Markup Language  Discrete Manufacturing Industry Role Class Library</Description>
  <Version>2.4.0</Version>
  <RoleClass Name="DiscManufacturingEquipment" RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource">
    <RoleClass Name="Transport" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="Storage" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="Fixture" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="Gate" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="Robot" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="Tool" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="Carrier" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="Machine" RefBaseClassPath="DiscManufacturingEquipment"/>
    <RoleClass Name="StaticObject" RefBaseClassPath="DiscManufacturingEquipment"/>
  </RoleClass>
</RoleClassLib>
```

IEC

Figure 7 – XML text of the AutomationMLDMIRoleClassLib

5.3.2 RoleClass DiscManufacturingEquipment

Table 3 specifies the role class "DiscManufacturingEquipment".

Table 3 – RoleClass DiscManufacturingEquipment

Class name	DiscManufacturingEquipment
Description	The role class "DiscManufacturingEquipment" shall be used for equipment related to discrete manufacturing industries.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment

5.3.3 RoleClass Transport

Table 4 specifies the role class "Transport".

Table 4 – RoleClass Transport

Class name	Transport
Description	The role class "Transport" shall be used for equipment that performs transport processes to transfer items.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport

EXAMPLE Conveyor, turntable, lift/lifter, AGV (automated guided vehicle), band conveyor, roll conveyor, rotating tower, lifting table, crane.

5.3.4 RoleClass Storage

Table 5 specifies the role class "Storage".

Table 5 – RoleClass Storage

Class name	Storage
Description	The role class "Storage" shall be used for equipment that is used to buffer products or material temporarily within the plant. It can also be used to feed products or materials into the production process or to export products or materials out of the production process.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Storage

EXAMPLE Buffer, LCA (low cost automation).

5.3.5 RoleClass Fixture

Table 6 specifies the role class "Fixture".

Table 6 – RoleClass Fixture

Class name	Fixture
Description	The role class "Fixture" shall be used for equipment that reduces the degrees of freedom of an item.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Fixture

EXAMPLE Fixing element, clamp, restraint.

5.3.6 RoleClass Gate

Table 7 specifies the role class "Gate".

Table 7 – RoleClass Gate

Class name	Gate
Description	The role class "Gate" shall be used for equipment that can block or monitor an entrance, departure, or a passage way.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Gate

EXAMPLE Safety door, equipment that monitors or controls a transit area.

5.3.7 RoleClass Robot

Table 8 specifies the role class "Robot".

Table 8 – RoleClass Robot

Class name	Robot
Description	The role class "Robot" shall be used for robots.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Robot

5.3.8 RoleClass Tool

Table 9 specifies the role class "Tool".

Table 9 – RoleClass Tool

Class name	Tool
Description	The role class "Tool" shall be used for equipment used by resources that is necessary to or aids in the performance of an operation on the product.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Tool

EXAMPLE Manipulating, controlling, proofing or assembling tool, chisel, welding gun, milling tool.

5.3.9 RoleClass Carrier

Table 10 specifies the role class "Carrier".

Table 10 – RoleClass Carrier

Class name	Carrier
Description	The role class "Carrier" shall be used for transport equipment that carries items.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Carrier

EXAMPLE Palette, container, handling aids, skid.

5.3.10 RoleClass Machine

Table 11 specifies the role class "Machine".

Table 11 – RoleClass Machine

Class name	Machine
Description	The role class "Machine" shall be used for mechanic or mechatronic equipment that creates added value on products and is designed expressly to perform specific tasks.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Machine

EXAMPLE Milling machine, welding machine, grinding machine.

5.3.11 RoleClass StaticObject

Table 12 specifies the role class "StaticObject".

Table 12 – RoleClass StaticObject

Class name	StaticObject
Description	The role class "StaticObject" shall be used for passive, static items positioned in the production environment.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment
Path for element reference	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/StaticObject

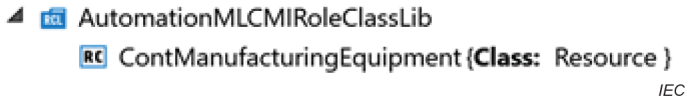
5.4 AML role class library for continuous manufacturing industry – AutomationMLCMIRoleClassLib

NOTE 1 The version of this AML continuous manufacturing industry role class library is 1.1.0.

Figure 8, Figure 9 and Figure 10 present the normative AutomationMLCMIRoleClassLib as object tree. Role classes of continuous manufacturing industry shall be derived directly or indirectly from an element of this library.

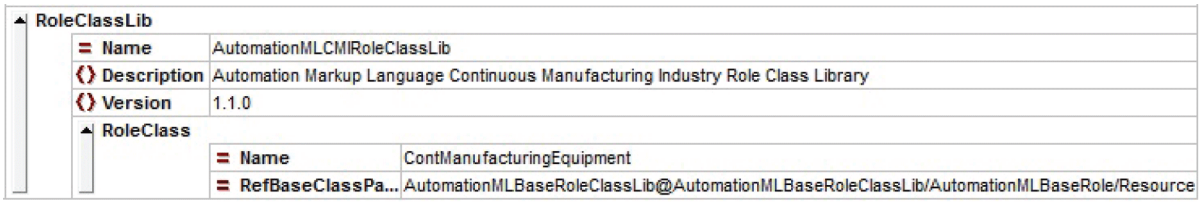
NOTE 2 User-defined attributes can be added.

NOTE 3 The role class ContManufacturingEquipment can be used to derive further role classes.



IEC

Figure 8 – AutomationMLCMIRoleClassLib



IEC

Figure 9 – XML grid of the AutomationMLCMIRoleClassLib

```
<RoleClassLib Name="AutomationMLCMIRoleClassLib">
  <Description>Automation Markup Language Continuous Manufacturing Industry Role Class Library</Description>
  <Version>1.1.0</Version>
  <RoleClass Name="ContManufacturingEquipment" RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource" />
</RoleClassLib>
```

IEC

Figure 10 – XML text of the AutomationMLCMIRoleClassLib

5.4.1 RoleClass ContManufacturingEquipment

Table 13 specifies the role class "ContManufacturingEquipment".

Table 13 – RoleClass ContManufacturingEquipment

Class name	ContManufacturingEquipment
Description	The role class "ContManufacturingEquipment" shall be used for equipment related to continuous manufacturing.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource
Path for element reference	AutomationMLCMIRoleClassLib/ContManufacturingEquipment

5.4.2 RoleClass ContManufacturingEquipment

Table 14 specifies the role class “ContManufacturingEquipment”.

Class name	ContManufacturingEquipment
Description	The role class “ContManufacturingEquipment” shall be used for equipment related to continuous manufacturing.
Parent class	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource

Table 14 – RoleClass ContManufacturingEquipment

5.5 AML role class library for batch manufacturing industry – AutomationMLBMIRoleClassLib

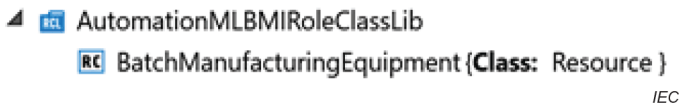
5.5.1 General

NOTE 1 The version of this AML batch manufacturing industry role class library is 1.1.0.

Figure 11, Figure 12 and Figure 13 present the normative AutomationMLBMIRoleClassLib as object tree. Role classes of batch manufacturing industry shall be derived directly or indirectly from an element of this library.

NOTE 2 User-defined attributes can be added.

NOTE 3 The role class BatchManufacturingEquipment can be used to derive further role classes.



IEC

Figure 11 – AutomationMLBMIRoleClassLib

IEC

Figure 12 – XML grid of the AutomationMLBMIRoleClassLib

```
<RoleClassLib Name="AutomationMLBMIRoleClassLib">
  <Description>Automation Markup Language Batch Manufacturing Industry Role Class Library</Description>
  <Version>1.1.0</Version>
  <RoleClass Name="BatchManufacturingEquipment" RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource" />
</RoleClassLib>
```

IEC

Figure 13 – XML text of the AutomationMLBMIRoleClassLib

5.5.2 RoleClass BatchManufacturingEquipment

Table 15 specifies the role class "BatchManufacturingEquipment".

Table 15 – RoleClass BatchManufacturingEquipment

Class name	BatchManufacturingEquipment
Description	The role class "BatchManufacturingEquipment" shall be used for equipment related to batch manufacturing .
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource
Path for element reference	AutomationMLBMIRoleClassLib/BatchManufacturingEquipment

5.6 AML role class library for control systems – AutomationMLCSRoleClassLib

5.6.1 General

NOTE 1 The version of this AML control system role class library is 2.3.1.

Figure 14,

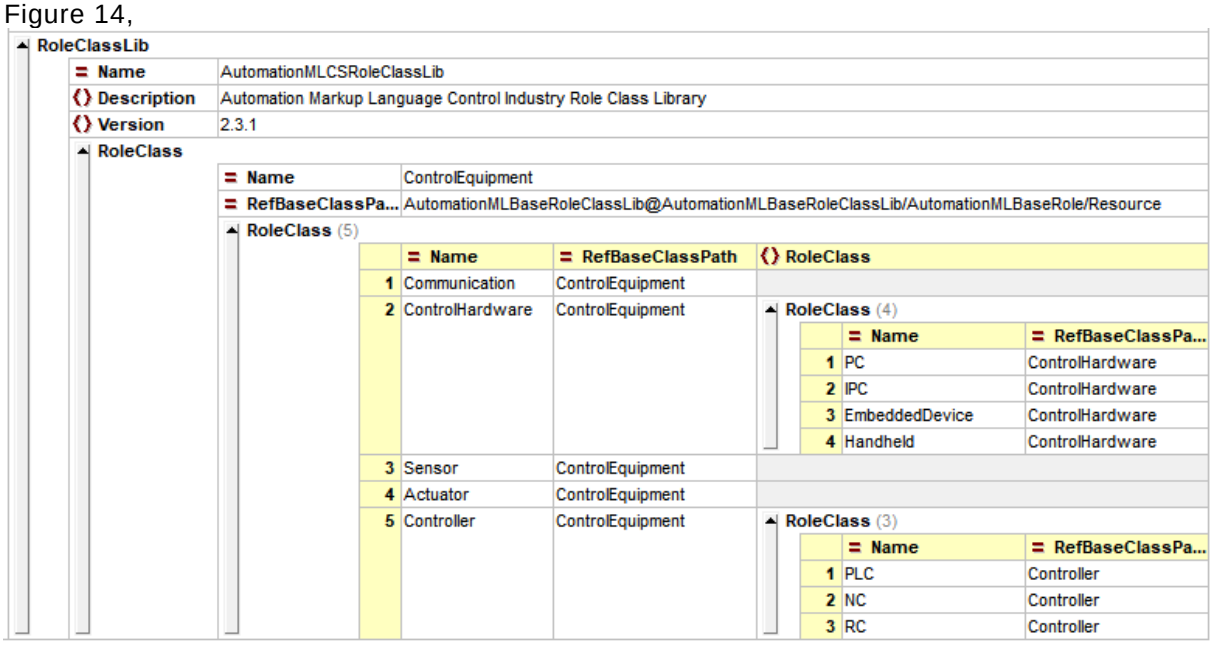


Figure 15, and

Figure 16 present the AutomationMLCSRoleClassLib as object tree, XML grid and XML text. Details to each role class are given in 5.6.2 to 0.

NOTE 2 User-defined attributes can be added.

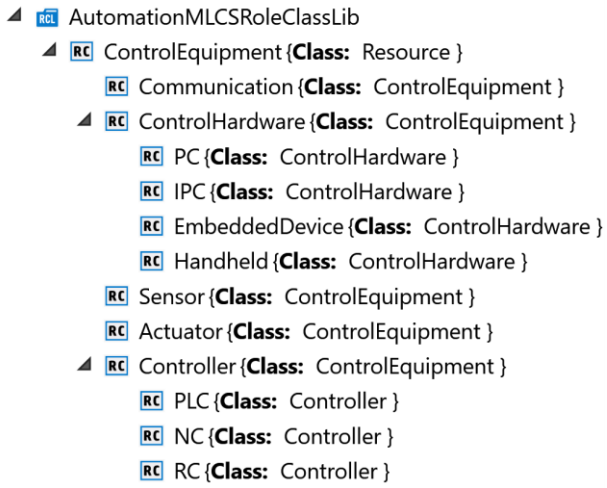


Figure 14 – AutomationMLCSRoleClassLib

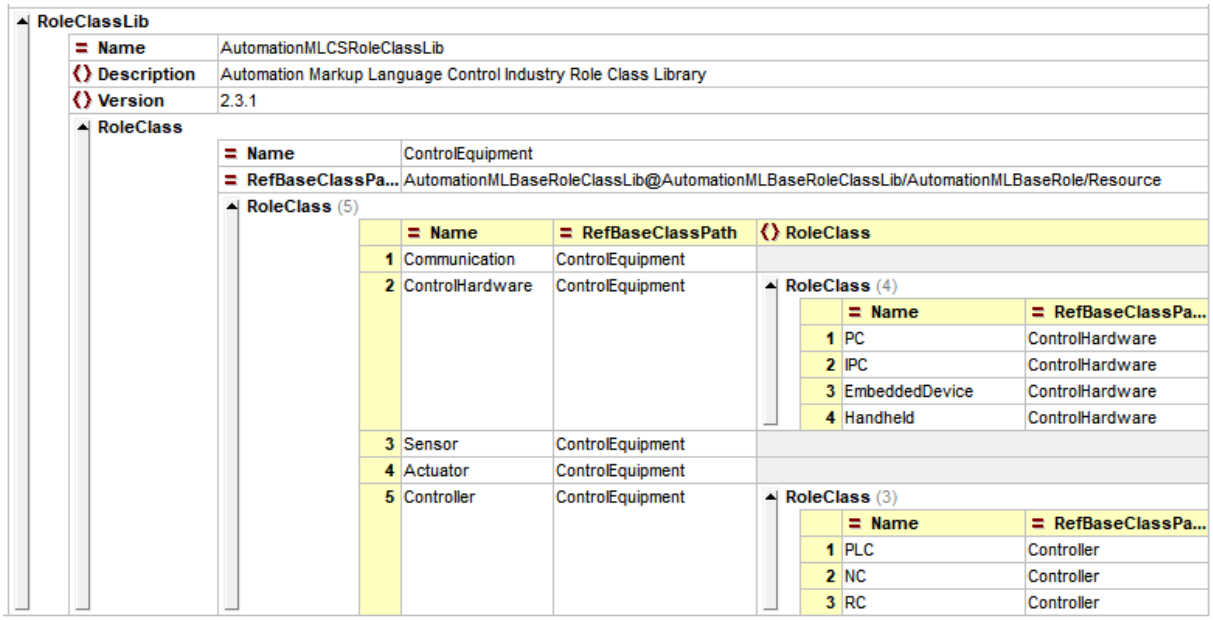


Figure 15 – XML grid of the AutomationMLCSRoleClassLib

```
<RoleClassLib Name="AutomationMLCSRoleClassLib">
  <Description>Automation Markup Language Control Industry Role Class Library</Description>
  <Version>2.3.1</Version>
  <RoleClass Name="ControlEquipment" RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource">
    <RoleClass Name="Communication" RefBaseClassPath="ControlEquipment"/>
    <RoleClass Name="ControlHardware" RefBaseClassPath="ControlEquipment">
      <RoleClass Name="PC" RefBaseClassPath="ControlHardware"/>
      <RoleClass Name="IPC" RefBaseClassPath="ControlHardware"/>
      <RoleClass Name="EmbeddedDevice" RefBaseClassPath="ControlHardware"/>
      <RoleClass Name="Handheld" RefBaseClassPath="ControlHardware"/>
    </RoleClass>
    <RoleClass Name="Sensor" RefBaseClassPath="ControlEquipment"/>
    <RoleClass Name="Actuator" RefBaseClassPath="ControlEquipment"/>
    <RoleClass Name="Controller" RefBaseClassPath="ControlEquipment">
      <RoleClass Name="PLC" RefBaseClassPath="Controller"/>
      <RoleClass Name="NC" RefBaseClassPath="Controller"/>
      <RoleClass Name="RC" RefBaseClassPath="Controller"/>
    </RoleClass>
  </RoleClass>
</RoleClassLib>
```

Figure 16 – XML text of the AutomationMLCSRoleClassLib

5.6.2 RoleClass ControlEquipment

Table 16 specifies the role class "ControlEquipment".

Table 16 – RoleClass ControlEquipment

Class name	ControlEquipment
Description	The role class "ControlEquipment" shall be used for equipment related to a control system. ControlEquipment can be used for every type of industry.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment

5.6.3 RoleClass Communication

Table 17 specifies the role class "Communication".

Table 17 – RoleClass Communication

Class name	Communication
Description	The role class "Communication" shall be used for items dedicated to communication.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/Communication

EXAMPLE router, switch, gateway.

5.6.4 RoleClass ControlHardware

Table 18 specifies the role class "ControlHardware".

Table 18 – RoleClass ControlHardware

Class name	ControlHardware
Description	The role class "ControlHardware" shall be used for hardware that provides runtime environments.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware

EXAMPLE PC, IPC. embeded device, handheld.

5.6.5 RoleClass PC

Table 19 specifies the role class "PC".

Table 19 – RoleClass PC

Class name	PC
Description	The role class "PC" shall be used for any general-purpose computer that provides runtime environments for software being executed on it.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware/PC

EXAMPLE Desktop, server, virtual machine

5.6.6 RoleClass IPC

Table 20 specifies the role class "IPC".

Table 20 – RoleClass IPC

Class name	IPC
Description	The role class "IPC" shall be used for any PC-based computing platform for industrial applications that provides runtime environments for software being executed on it.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware/IPC

5.6.7 RoleClass Handheld

Table 21 specifies the role class "Handheld".

Table 21 – RoleClass Handheld

Class name	Handheld
Description	The role class "Handheld" shall be used for any portable, programmable, electronic device with its own power supply for particular applications.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware/Handheld

5.6.8 RoleClass EmbeddedDevice

Table 22 specifies the role class "EmbeddedDevice".

Table 22 – RoleClass EmbeddedDevice

Class name	EmbeddedDevice
Description	The role class "EmbeddedDevice" shall be used for any device designed to perform one or a few dedicated software functions. It is embedded as part of another device often including hardware and mechanical parts.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware/EmbeddedDevice

5.6.9 RoleClass Sensor

Table 23 specifies the role class "Sensor".

Table 23 – RoleClass Sensor

Class name	Sensor
Description	The role class "Sensor" shall be used for sensors.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/Sensor

5.6.10 RoleClass Actuator

Table 24 specifies the role class "Actuator".

Table 24 – RoleClass Actuator

Class name	Actuator
Description	The role class "Actuator" shall be used for actuators.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/Actuator

5.6.11 RoleClass Controller

Table 25 specifies the role class "Controller".

Table 25 – RoleClass Controller

Class name	Controller
Description	The role class "Controller" shall be used for self-acting functionalities that process signals according to a predefined logic and generate output signals in order to reach an intended behaviour of technical processes.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/Controller

NOTE Controller functionalities can be realized by software or hardware.

5.6.12 RoleClass PLC

Table 26 specifies the role class "PLC".

Table 26 – RoleClass PLC

Class name	PLC
Description	The role class "PLC" shall be used for programmable control functionality focusing on the processing of signals.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/Controller
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/Controller/PLC

NOTE PLC functionality can be realized by software or hardware.

5.6.13 RoleClass NC

Table 27 specifies the role class "NC".

Table 27 – RoleClass NC

Class name	NC
Description	The role class "NC" shall be used for programmable control functionality focusing on the processing of numerical signals.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/Controller
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/Controller/NC

NOTE NC functionality can be realized by software or hardware.

5.6.14 RoleClass RC

Table 28 specifies the role class "RC".

Table 28 – RoleClass RC

Class name	RC
Description	The role class "RC" shall be used for programmable control functionality driving robots in order to reach an intended behaviour of the robot kinematic system and corresponding connected periphery.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/Controller
Path for element reference	AutomationMLCSRoleClassLib/ControlEquipment/Controller/RC

NOTE RC functionality can be realized by software or hardware.

Annex A – AML extended role class library

A.1 General

The AutomationMLExtendedRoleClassLibrary is a recommended extension of the AutomationMLBaseRoleClassLib and the AutomationMLDMIRoleClassLib and covers a wide area of typical roles of the discrete manufacturing industry.

Figure A.1 presents the AutomationMLExtendedRoleClassLib as an object tree.

NOTE 1 The version of this AML extended role class library is 2.7.0.

NOTE 2 According to IEC 62424:2008, user-defined attributes can be added.

- AutomationMLExtendedRoleClassLib
  - PLCFacet {**Class:** Facet }
  - HMIFacet {**Class:** Facet }
  - Enterprise {**Class:** ResourceStructure }
  - Site {**Class:** ResourceStructure }
  - Area {**Class:** ResourceStructure }
  - ProductionLine {**Class:** ResourceStructure }
  - WorkCell {**Class:** ResourceStructure }
  - ProcessCell {**Class:** ResourceStructure }
  - Unit {**Class:** ResourceStructure }
  - ProductionUnit {**Class:** ResourceStructure }
  - StorageZone {**Class:** ResourceStructure }
  - StorageUnit {**Class:** ResourceStructure }
  - ConnectedWorld {**Class:** ResourceStructure }
  - WorkCenter {**Class:** ResourceStructure }
  - WorkUnit {**Class:** ResourceStructure }
  - Equipment {**Class:** ResourceStructure }
  - Station {**Class:** ResourceStructure }
  - EquipmentModule {**Class:** ResourceStructure }
  - ControlModule {**Class:** ResourceStructure }
  - ControlDevice {**Class:** ResourceStructure }
  - FieldDevice {**Class:** ResourceStructure }
  - Turntable {**Class:** Transport }
  - Conveyor {**Class:** Transport }
    - BeltConveyor {**Class:** Conveyor }
    - RollConveyor {**Class:** Conveyor }
    - ChainConveyor {**Class:** Conveyor }
    - PalletConveyor {**Class:** Conveyor }
    - OverheadConveyor {**Class:** Conveyor }
  - LiftingTable {**Class:** Transport }
  - AGV {**Class:** Transport }
  - Transposer {**Class:** Transport }
  - CarrierHandlingSystem {**Class:** Transport }
  - BodyStore {**Class:** Storage }
  - Lift {**Class:** Transport }
  - Rollerbed {**Class:** Transport }
  - StationaryTool {**Class:** Tool }
  - MovableTool {**Class:** Tool }
  - ControlCabinet {**Class:** ControlEquipment }
  - IODevice {**Class:** ControlEquipment }
  - HMI {**Class:** ControlEquipment }
    - WarningEquipment {**Class:** HMI }
  - ActuatingDrive {**Class:** Actuator }
  - MotionController {**Class:** ControlEquipment }
  - Panel {**Class:** ControlHardware }
  - MeasuringEquipment {**Class:** Resource }
  - Clamp {**Class:** Fixture }
  - ProcessController {**Class:** Controller }
  - Loader {**Class:** Storage }
  - Unloader {**Class:** Storage }

IEC

Figure A.1 – AutomationMLExtendedRoleClassLib

A.2 RoleClass PLCFacet

Table A.1 specifies the role class "PLCFacet".

Table A.1 – RoleClass PLCFacet

Class name	PLCFacet
Description	The role class "PLCFacet" should be used to model separate views concerning everything involved in PLC control code generators: PLC view on AML objects which points to information concerning PLC.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Facet
Path for element reference	AutomationMLExtendedRoleClassLib/PLCFacet

A.3 RoleClass HMIFacet

Table A.2 specifies the role class "HMIFacet".

Table A.2 – RoleClass HMIFacet

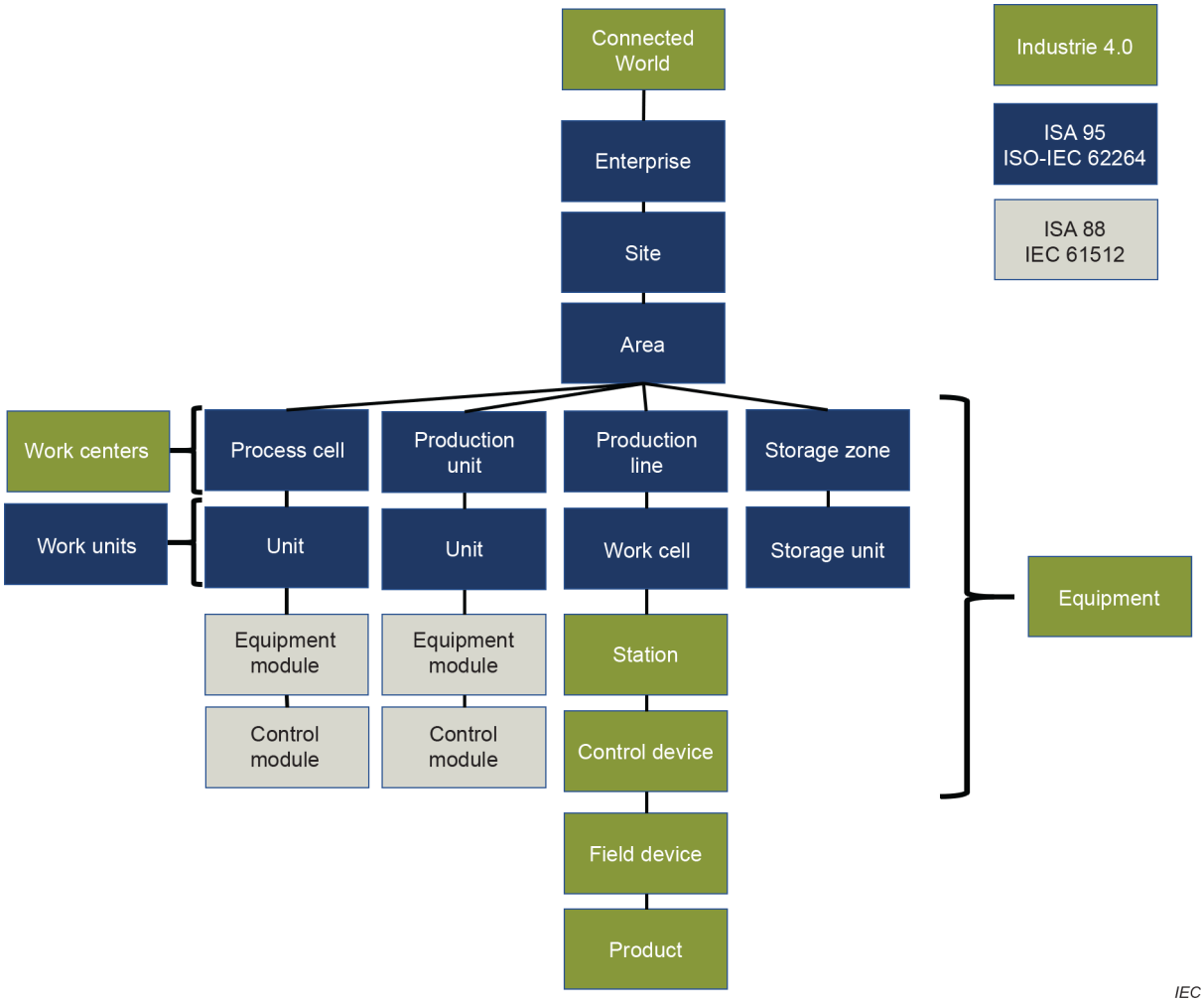
Class name	HMIFacet
Description	The role class "HMIFacet" should be used to model separate views concerning everything involved in HMI: HMI view on AML objects which points to information concerning HMI.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Facet
Path for element reference	AutomationMLExtendedRoleClassLib/HMIFacet

A.4 RoleClass Enterprise

Table A.3 specifies the role class "Enterprise". Figure A.2 illustrates the structure defined in IEC PAS 63088:2017, IEC 62264-1:2013, and IEC 61512-1:1997.

Table A.3 – RoleClass Enterprise

Class name	Enterprise
Description	The role class "Enterprise" should be used for business structures. The definition of an "Enterprise" is given in IEC 62264-1:2013, 5.3.2: "An enterprise is a collection of sites and areas and represents the top level of a role-based equipment hierarchy. The enterprise is responsible for determining what products will be manufactured, at which sites they will be manufactured, and in general how they will be manufactured."
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/Enterprise



NOTE ISA95/ISO-IEC 62264 corresponds to IEC 62264-1:2013, ISA88/IEC 61512 corresponds to IEC 61512-1:1997, and Industrie 4.0 corresponds to IEC PAS 63088:2017.

Figure A.2 – Resource structure [SOURCE: IEC PAS 63088:2017, adapted]

A.5 RoleClass Site

Table A.4 specifies the role class "Site".

Table A.4 – RoleClass Site

Class name	Site
Description	The role class "Site" should be used for the position determination of a site. It is also used as element of a hierarchical organisation. The definition of a "Site" is given in IEC 62264-1:2013, 5.3.3: "A site is a physical, geographical, or logical grouping determined by the enterprise. It may contain areas, production lines, process cells, and production units."
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/Site

EXAMPLE Plant, manufacturing facility.

A.6 RoleClass Area

Table A.5 specifies the role class "Area".

Table A.5 – RoleClass Area

Class name	Area
Description	The role class "Area" should be used for production buildings and their subdivisions (structure/hall). It is also used as element of a hierarchical organization. The definition of an "Area" is given in IEC 62264-1:2013, 5.3.4: "An area is a physical, geographical, or logical grouping determined by the site. It may contain work centers such as process cells, production units, production lines, and storage zones."
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/Area

EXAMPLE Facility, single process unit, production hall/building.

A.7 RoleClass ProductionLine

Table A.6 specifies the role class "ProductionLine".

Table A.6 – RoleClass ProductionLine

Class name	ProductionLine
Description	The role class "ProductionLine" should be used for defining the role-based equipment hierarchy defined in IEC 62264-1:2013, 5.3.7, for discrete manufacturing at the work cell level: "Production lines and work cells are the lowest levels of equipment … for discrete manufacturing processes. Work cells are usually only identified when there is flexibility in the routing of work within a production line. Production lines and work cells may be composed of lower-level elements…. The major processing activity often identifies the production line."
Semantic base	AutomationMLExtendedRoleClassLib/WorkCenter
Path for element reference	AutomationMLExtendedRoleClassLib/ProductionLine

A.8 RoleClass WorkCell

Table A.7 specifies the role class "WorkCell".

Table A.7 – RoleClass WorkCell

Class name	WorkCell
Description	The role class "WorkCell" should be used for defining the role-based equipment hierarchy defined in IEC 62264-1:2013 at the work cell level: for sub units/sub production steps of units/production lines, stations, processes single components, cycle, location in which the production step takes place. It is used for hierarchization. The definition of a "WorkCell" is given in IEC 62264-1:2013, 5.3.7: "Production lines and work cells are the lowest levels of equipment … for discrete manufacturing processes. Work cells are usually only identified when there is flexibility in the routing of work within a production line. Production lines and work cells may be composed of lower-level elements…. The major processing activity often identifies the production line."
Semantic base	AutomationMLExtendedRoleClassLib/WorkUnit
Path for element reference	AutomationMLExtendedRoleClassLib/WorkCell

A.9 RoleClass ProcessCell

Table A.8 specifies the role class "ProcessCell".

Table A.8 – RoleClass ProcessCell

Class name	ProcessCell
Description	The role class "ProcessCell" should be used for sub units/sub production steps of units/production lines, station, processes single component, cycle, location in which the production step takes place. It is used for hierarchization. The definition of a "ProcessCell" is given in IEC 62264-1:2013, 5.3.8: "Process cells and units are the lowest level of … batch manufacturing processes. …. The major processing capability or family of products produced often identifies the process cell."
Semantic base	AutomationMLExtendedRoleClassLib/WorkCenter
Path for element reference	AutomationMLExtendedRoleClassLib/ProcessCell

A.10 RoleClass Unit

Table A.9 specifies the role class "Unit".

Table A.9 – RoleClass Unit

Class name	Unit
Description	The role class "Unit" should be used for linked chained production plants. It is used for hierarchization. The definition of a "Unit" is given in IEC 62264-1:2013, 5.3.8: "Process cells and units are the lowest level of equipment … for continuous or batch manufacturing processes. …. The major processing capability or family of products produced often identifies the process cell."
Semantic base	AutomationMLExtendedRoleClassLib/WorkUnit
Path for element reference	AutomationMLExtendedRoleClassLib/Unit

A.11 RoleClass WorkCenter

Table A.10specifies the role class "WorkCenter".

Table A.10 – RoleClass WorkCenter

Class name	WorkCenter
Description	The role class "WorkCenter" should be used for linked chained production plants. It is used for hierarchization. "WorkCenter" forms the semantic base for the roles Process cell, Production unit, Production line, and Storage zone.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/WorkCenter

A.12 RoleClass WorkUnit

Table A.11specifies the role class "WorkUnit".

Table A.11 – RoleClass WorkUnit

Class name	WorkUnit
Description	The role class "WorkUnit" should be used for linked chained production plants. It is used for hierarchization. "WorkUnit" forms the semantic base for the roles Unit, Work cell, Storage unit
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/WorkUnit

A.13 RoleClass ProductionUnit

Table A.12 specifies the role class "ProductionUnit".

Table A.12 – RoleClass ProductionUnit

Class name	ProductionUnit
Description	The role class "ProductionUnit" should be used for sub units/sub production steps of units/production lines, station, processes single component, cycle, location in which the production step takes place. It is used for hierarchization. The definition of a "ProductionUnit" is given in IEC 62264-1:2013, 5.3.6: "Production units and units are the lowest level of equipment … for continuous manufacturing processes. Production units are composed of units and units are composed lower level elements, such as equipment modules, sensors, and actuators…. A production unit generally encompasses all of the equipment required for a segment of continuous production that operates in a relatively autonomous manner. It generally converts, separates, or reacts one or more feed stocks to produce intermediate or final products. The major processing activity or product generated often identifies the production unit."
Semantic base	AutomationMLExtendedRoleClassLib/WorkCenter
Path for element reference	AutomationMLExtendedRoleClassLib/ProductionUnit

A.14 RoleClass StorageZone

Table A.13 specifies the role class "StorageZone".

Table A.13 – RoleClass StorageZone

Class name	StorageZone
Description	The role class "StorageZone" should be used for defining the role based equipment hierarchy defined in IEC 62264-1:2013 at the storage zone level: The definition of a "StorageZone" is given in IEC 62264-1: 2013, 5.3.9: "Storage zones and storage units are the lowest level of material movement equipment … for discrete, batch and continuous manufacturing processes. A storage zone is a type of work center and a storage unit is a type of work unit that is organized as elements within an area. These are the lower-level elements of an equipment hierarchy used in material storage and movement activities. A storage zone typically has the capability needed for the receipt, storage, retrieval, movement and shipment of materials. This may include the movement of materials from one work center to another work center within or between enterprises."
Semantic base	AutomationMLExtendedRoleClassLib/WorkCenter
Path for element reference	AutomationMLExtendedRoleClassLib/StorageZone

EXAMPLE Warehouse, tank farm, holding area.

A.15 RoleClass StorageUnit

Table A.14 specifies the role class "StorageUnit".

Table A.14 – RoleClass StorageUnit

Class name	StorageUnit
Description	The role class "StorageUnit" should be used for defining the role based equipment hierarchy defined in IEC 62264-1:2013 at the storage unit level: The definition of a "StorageUnit" is given in IEC 62264-1: 2013, 5.3.9: "Storage zones and storage units are the lowest level of material movement equipment … for discrete, batch and continuous manufacturing processes. A storage zone is a type of work center and a storage unit is a type of work unit that is organized as elements within an area. These are the lower-level elements of an equipment hierarchy used in material storage and movement activities. A storage zone typically has the capability needed for the receipt, storage, retrieval, movement and shipment of materials. This may include the movement of materials from one work center to another work center within or between enterprises. Storage units are typically managed at a finer level of detail than a storage zone. The physical location of a storage unit may change over time … . Storage units may be dedicated to a given material, group of materials, or a method of storage. Storage units can be further divided to address any hierarchical storage management scheme."
Semantic base	AutomationMLExtendedRoleClassLib/WorkUnit
Path for element reference	AutomationMLExtendedRoleClassLib/StorageUnit

EXAMPLE Rack, bin, slot, tank, pallet, barrel.

A.16 RoleClass ConnectedWorld

Table A.15 specifies the role class "ConnectedWorld".

Table A.15 – RoleClass ConnectedWorld

Class name	ConnectedWorld
Description	The role class "ConnectedWorld" should be used for defining a "hierarchy level, which reflects the horizontal market operations in value added networks." [ISO/IEC TR 63306-1:2021] The definition of a "Connected World" is given in in IEC PAS 63088: 2017, 5.4: "Connected world describes the relationship between an asset or combination of assets (such as an installation or company) and another asset or combination of assets (another installation or company)"
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/ConnectedWorld

A.17 RoleClass Equipment

Table A.16 specifies the role class "Equipment".

Table A.16 – RoleClass Equipment

Class name	Equipment
Description	The role class "Equipment" should be used for defining an assembly of devices. Equipment is a sub type of resource.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/Equipment

A.18 RoleClass Station

Table A.17 specifies the role class "Station".

Table A.17 – RoleClass Station

Class name	Station
Description	The role class "Station" should be used for defining a function group of equipment. A station is typically centered around a piece of discrete equipment. The definition of a "Station" is given in IEC 61512-1:1997, 3.16: "A functional group of equipment that can carry out a finite number of specific minor processing activities."
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/Station

EXAMPLE Visual inspection station.

A.19 RoleClass EquimentModule

Table A.18 specifies the role class "EquipmentModule".

Table A.18 – RoleClass EquipmentModule

Class name	EquipmentModule
Description	The role class "EquipmentModule" should be used for defining the device hierarchy level, which concatenates the equipment module and control module hierarchy of IEC 61512-1. The definition of an "Equipment Module" is given in IEC 61512-1:1997, 3.16: "A functional group of equipment that can carry out a finite number of specific minor processing activities. NOTE An equipment module is typically centered around a piece of process equipment (a weigh tank, a process heater, a scrubber, etc.). This term applies to both the physical equipment and the equipment entity."
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/EquipmentModule

EXAMPLE Dosing and weighing

A.20 RoleClass ControlModule

Table A.19 specifies the role class "ControlModule".

Table A.19 – RoleClass ControlModule

Class name	ControlModule
Description	The role class "ControlModule" should be used for defining the device hierarchy level, which concatenates the equipment module and control module hierarchy of IEC 61512-1. The definition of a "Control Module" is given in IEC 61512-1:1997, 3.10: "The lowest level grouping of equipment in the physical model that can carry out basic control. NOTE This term applies to both the physical equipment and the equipment entity."
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/ControlModule

A.21 RoleClass ControlDevice

Table A.20 specifies the role class "ControlDevice".

Table A.20 – RoleClass ControlDevice

Class name	ControlDevice
Description	The role class "ControlDevice" should be used for defining an electric device which executes a non-dividable process.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/ControlDevice

A.22 RoleClass FieldDevice

Table A.21 specifies the role class "FieldDevice".

Table A.21 – RoleClass FieldDevice

Class name	FieldDevice
Description	The role class "FieldDevice" should be used for the functional level of an (intelligent) field device, e. g. a (smart) sensor.
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure
Path for element reference	AutomationMLExtendedRoleClassLib/FieldDevice

A.23 RoleClass Turntable

Table A.22 specifies the role class "Turntable".

Table A.22 – RoleClass Turntable

Class name	Turntable
Description	The role class "Turntable" should be used for rotating transport equipment which changes the horizontal transport direction of a product and/or carrier.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/Turntable

A.24 RoleClass Conveyor

Table A.23 specifies the role class "Conveyor".

Table A.23 – RoleClass Conveyor

Class name	Conveyor
Description	The role class "Conveyor" should be used for generic equipment which performs linear transport.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/Conveyor

EXAMPLE Transport with start and stop points and without branching points.

A.25 RoleClass BeltConveyor

Table A.24 specifies the role class "BeltConveyor".

Table A.24 – RoleClass BeltConveyor

Class name	BeltConveyor
Description	The role class "BeltConveyor" should be used for equipment which performs linear transport realized by one or more belts as transport platform.
Semantic base	AutomationMLExtendedRoleClassLib/Conveyor
Path for element reference	AutomationMLExtendedRoleClassLib/Conveyor/BeltConveyor

A.26 RoleClass RollConveyor

Table A.25 specifies the role class "RollConveyor".

Table A.25 – RoleClass RollConveyor

Class name	RollConveyor
Description	The role class "RollConveyor" should be used for equipment which performs linear transport realized by a sequence of rolls as transport platform.
Semantic base	AutomationMLExtendedRoleClassLib/Conveyor
Path for element reference	AutomationMLExtendedRoleClassLib/Conveyor/RollConveyor

A.27 RoleClass ChainConveyor

Table A.26 specifies the role class "ChainConveyor".

Table A.26 – RoleClass ChainConveyor

Class name	ChainConveyor
Description	The role class "ChainConveyor" should be used for equipment which performs linear transport driven by an endless chain as transport medium.
Semantic base	AutomationMLExtendedRoleClassLib/Conveyor
Path for element reference	AutomationMLExtendedRoleClassLib/Conveyor/ChainConveyor

A.28 RoleClass PalletConveyor

Table A.27 specifies the role class "PalletConveyor".

Table A.27 – RoleClass PalletConveyor

Class name	PalletConveyor
Description	The role class "PalletConveyor" should be used for equipment which is especially designed for linear transport of pallets.
Semantic base	AutomationMLExtendedRoleClassLib/Conveyor
Path for element reference	AutomationMLExtendedRoleClassLib/Conveyor/PalletConveyor

A.29 RoleClass OverheadConveyor

Table A.28 specifies the role class "OverheadConveyor".

Table A.28 – RoleClass OverheadConveyor

Class name	OverheadConveyor
Description	The role class "OverheadConveyor" should be used for equipment that performs overhead transport of hanging products or carriers.
Semantic base	AutomationMLExtendedRoleClassLib/Conveyor
Path for element reference	AutomationMLExtendedRoleClassLib/Conveyor/OverheadConveyor

A.30 RoleClass LiftingTable

Table A.29 specifies the role class "LiftingTable".

Table A.29 – RoleClass LiftingTable

Class name	LiftingTable
Description	The role class "LiftingTable" should be used for equipment that performs discrete vertical transport. The transport medium is also lifted. Normally used for minor heights. NOTE Minor typically means <1 m
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/LiftingTable

A.31 RoleClass AGV

Table A.30 specifies the role class "AGV".

Table A.30 – RoleClass AGV

Class name	AGV
Description	The role class "AGV" should be used for equipment that performs automated transportation of discrete units independent of other transport equipment.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/AGV

A.32 RoleClass Transposer

Table A.31 specifies the role class "Transposer".

Table A.31 – RoleClass Transposer

Class name	Transposer
Description	The role class "Transposer" should be used for transport equipment that performs the change of the transport medium. Changes the classification or relation of product to the carrier (one to another).
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/Transposer

A.33 RoleClass CarrierHandlingSystem

Table A.32 specifies the role class "CarrierHandlingSystem".

Table A.32 – RoleClass CarrierHandlingSystem

Class name	CarrierHandlingSystem
Description	The role class "CarrierHandlingSystem" should be used for equipment that performs an action to the carrier.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/CarrierHandlingSystem

EXAMPLE Forklift.

A.34 RoleClass BodyStore

Table A.33 specifies the role class "BodyStore".

Table A.33 – RoleClass BodyStore

Class name	BodyStore
Description	The role class "BodyStore" should be used for buffering discrete products.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Storage
Path for element reference	AutomationMLExtendedRoleClassLib/BodyStore

EXAMPLE Body buffer.

A.35 RoleClass Lift

Table A.34 specifies the role class "Lift".

Table A.34 – RoleClass Lift

Class name	Lift
Description	The role class "Lift" should be used for equipment that performs discrete vertical transport. Normally used for larger heights. NOTE Larger typically means greater than 1 m
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/Lift

EXAMPLE Lifter.

A.36 RoleClass Rollerbed

Table A.35 specifies the role class "Rollerbed".

Table A.35 – RoleClass Rollerbed

Class name	Rollerbed
Description	The role class "Rollerbed" should be used for a sequence of rolls. None of these rolls are driven.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport
Path for element reference	AutomationMLExtendedRoleClassLib/Rollerbed

A.37 RoleClass StationaryTool

Table A.36 specifies the role class "StationaryTool".

Table A.36 – RoleClass StationaryTool

Class name	StationaryTool
Description	The role class "StationaryTool" should be used for tools fixed at one place.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Tool
Path for element reference	AutomationMLExtendedRoleClassLib/StationaryTool

A.38 RoleClass MovableTool

Table A.37 specifies the role class "MovableTool".

Table A.37 – RoleClass MovableTool

Class name	MovableTool
Description	The role class "MovableTool" should be used for tools which can be moved by equipment e.g. robots.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Tool
Path for element reference	AutomationMLExtendedRoleClassLib/MovableTool

A.39 RoleClass ControlCabinet

Table A.38 specifies the role class "ControlCabinet".

Table A.38 – RoleClass ControlCabinet

Class name	ControlCabinet
Description	The role class "ControlCabinet" should be used for enclosed electrical and/or electronic assembly.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLExtendedRoleClassLib/ControlCabinet

EXAMPLE Switch cabinet, control box.

A.40 RoleClass IODevice

Table A.39 specifies the role class "IODevice".

Table A.39 – RoleClass IODevice

Class name	IODevice
Description	The role class "IODevice" should be used for devices providing the functionality to connect sensors or actuators with an automation system. IODevice can consist of different modules.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLExtendedRoleClassLib/IODevice

EXAMPLE Device consisting of analog/digital input/output modules.

A.41 RoleClass HMI

Table A.40 specifies the role class "HMI".

Table A.40 – RoleClass HMI

Class name	HMI
Description	The role class "HMI" should be used for the functionality to visualize an industrial control and monitoring system for the effective operation and control of the machine by humans.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment
Path for element reference	AutomationMLExtendedRoleClassLib/HMI

A.42 RoleClass WarningEquipment

Table A.41 specifies the role class "WarningEquipment".

Table A.41 – RoleClass WarningEquipment

Class name	WarningEquipment
Description	The role class "WarningEquipment" should be used for equipment providing warning functionality. NOTE The functionality can be realized in auditive, visual, haptic or other way.
Semantic base	AutomationMLExtendedRoleClassLib/HMI
Path for element reference	AutomationMLExtendedRoleClassLib/HMI/WarningEquipment

EXAMPLE Horn, signal light, vibration, siren, signal lamp.

A.43 RoleClass ActuatingDrive

Table A.42 specifies the role class "ActuatingDrive".

Table A.42 – RoleClass ActuatingDrive

Class name	ActuatingDrive
Description	The role class "ActuatingDrive" should be used for physical units used for driving mechanically actuated final controlling elements.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/Actuator
Path for element reference	AutomationMLExtendedRoleClassLib/ActuatingDrive

EXAMPLE Electric, hydraulic, pneumatic drive.

A.44 RoleClass MotionController

Table A.43 specifies the role class "MotionController".

Table A.43 – RoleClass MotionController

Class name	MotionController
Description	The role class "MotionController" should be used for logic to generate set points (the desired output or motion profile) and close a position or velocity feedback loop.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/Controller
Path for element reference	AutomationMLExtendedRoleClassLib/MotionController

A.45 RoleClass HMIPanel

Table A.44 specifies the role class "HMIPanel".

Table A.44 – RoleClass HMIPanel

Class name	HMIPanel
Description	The role class "HMIPanel" should be used for physical objects providing one possibility for humans to interact with machines.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware
Path for element reference	AutomationMLExtendedRoleClassLib/HMIPanel

EXAMPLE Scanner, monitoring panel, key panel.

A.46 RoleClass MeasuringEquipment

Table A.45 specifies the role class "MeasuringEquipment".

Table A.45 – RoleClass MeasuringEquipment

Class name	MeasuringEquipment
Description	The role class "MeasuringEquipment" should be used for defining equipment defined in IEC 60050-311:2001, 311-03-05: "assembly of measuring instruments intended for specified measurement purposes"
Semantic base	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource
Path for element reference	AutomationMLExtendedRoleClassLib/MeasuringEquipment

EXAMPLE Surface measuring machine, paint thickness gauge.

A.47 RoleClass Clamp

Table A.46 specifies the role class "Clamp".

Table A.46 – RoleClass Clamp

Class name	Clamp
Description	The role class "Clamp" should be used for equipment that performs fixation processes to hold items at one specific point.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Fixture
Path for element reference	AutomationMLExtendedRoleClassLib/Clamp

A.48 RoleClass ProcessController

Table A.47 specifies the role class "ProcessController".

Table A.47 – RoleClass ProcessController

Class name	ProcessController
Description	The role class "ProcessController" should be used for the control of a specific tool or machine that performs process steps on a product.
Semantic base	AutomationMLCSRoleClassLib/ControlEquipment/Controller
Path for element reference	AutomationMLExtendedRoleClassLib/ProcessController

EXAMPLE Welding control, technology control, glue control, combination of control and regulation of process.

A.49 RoleClass Loader

Table A.48 specifies the role class "Loader".

Table A.48 – RoleClass Loader

Class name	Loader
Description	The role class "Loader" should be used for equipment to introduce products into the production process.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Storage
Path for element reference	AutomationMLExtendedRoleClassLib/Loader

EXAMPLE Magazine loader.

A.50 RoleClass Unloader

Table A.49 specifies the role class "Unloader".

Table A.49 – RoleClass Unloader

Class name	Unloader
Description	The role class "Unloader" should be used for equipment to export products out of the production process.
Semantic base	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Storage
Path for element reference	AutomationMLExtendedRoleClassLib/Unloader

Annex B - Examples of usage of RoleClasses

B.1 General

RoleClasses are vendor independent and generic entities. They are used in order to assign generic semantics to an object instance and to describe requirements of this object instance. Additionally, they can help in mapping data models of different engineering tools.

Figure B.1 explains this by means of an example: An object RB1 in the data model of Tool1 is modelled in AML as InternalElement which is derived from the SystemUnitClass Type_RB and additionally associated with the RoleClass Robot. Tool2 has an InstanceHierarchy with an InternalElement 3285_AB which is of type Rob and points to the same RoleClass Robot. A mapping between these two models can be derived by the RoleClass Robot (common to both InternalElements).

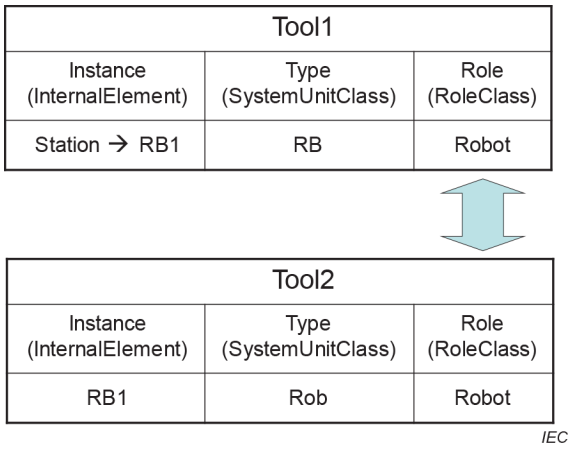


Figure B.1 – Usage of roles in the mapping process

B.2 Example plant unit

The usage of RoleClasses will be explained by means of a simple example cell. The plant cell is depicted in Figure B.2. It consists of three plant components, a conveyor, a robot and a turntable. The robot places parts on the conveyor. The conveyor transports the parts to the turntable and the turntable forwards the parts to further plant cells.

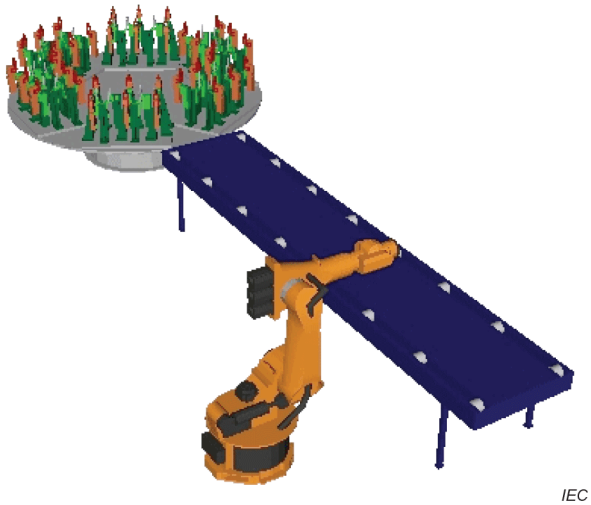


Figure B.2 – Example for usage of roles

The example (see Figure B.3) consists of the AML standard libraries (AutomationMLBaseRoleClassLib, AutomationMLDMIRoleClassLib, AutomationMLExtended-RoleClassLib), the concrete plant within an InstanceHierarchy (RoleExample), and different plant component types within a SytemUnitClass library (ExampleSystemUnitClassLib). The RoleClassLibs and the contained RoleClasses are explained in IEC 62714-1:2018, as well as Clause 0 and 5.6 of this part of IEC 62714.

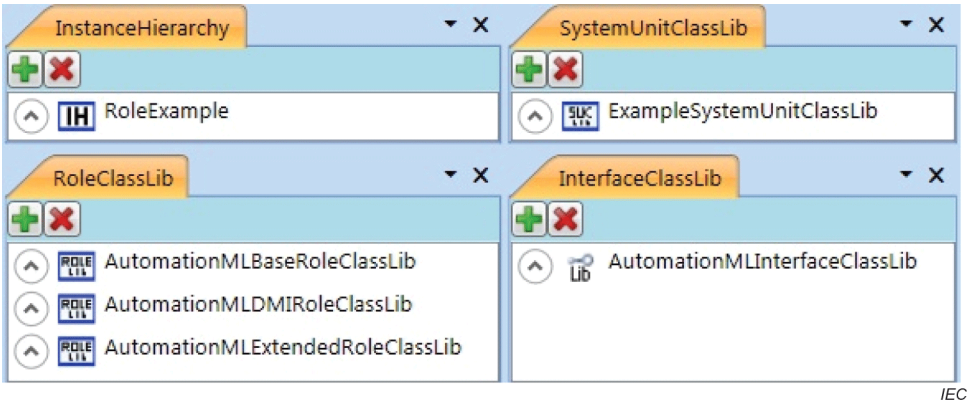


Figure B.3 – Example AML model

Figure B.4, Figure B.5, and Figure B.6 depict the InstanceHierarchy of the example called RoleExample. The example plant describes a cell which is indicated by the RoleClass WorkCell of the AutomationMLExtendedRoleClassLib. The reference to this role class means that the hierarchy element (InternalElement) describes a production line or a station in which the production step takes place. Additionally, the cell points to the RoleClass ResourceStructure of the AutomationMLBaseRoleClassLib. This means that the cell is a resource oriented object hierarchy.

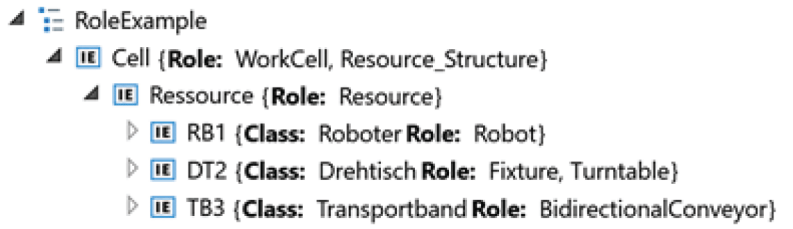


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Figure B.4 – Example InstanceHierarchy for usage of roles

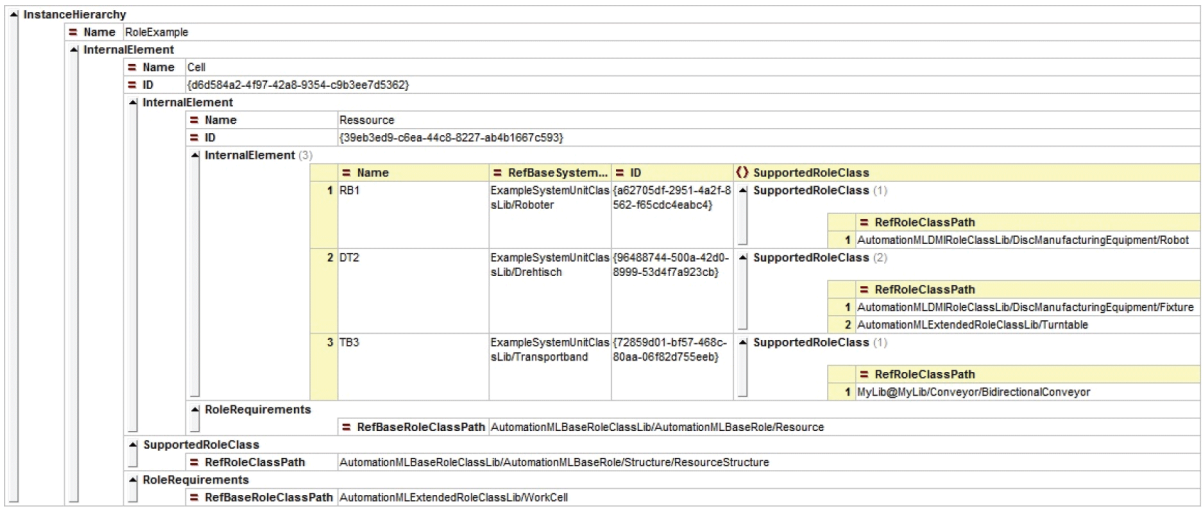

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Figure B.5 – XML grid of the example InstanceHierarchy for usage of roles

```
<InstanceHierarchy Name="RoleExample">
  <InternalElement Name="Cell" ID="{d6d584a2-4f97-42a8-9354-c9b3ee7d5362}">
    <InternalElement Name="Ressource" ID="{39eb3ed9-c6ea-44c8-8227-ab4b1667c593}">
      <InternalElement Name="RB1" RefBaseSystemUnitPath="ExampleSystemUnitClassLib/Roboter" ID="{a62705df-2951-4a2f-8562-f65cdc4eabc4}">
        <SupportedRoleClass RefRoleClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Robot"/>
      </InternalElement>
      <InternalElement Name="DT2" RefBaseSystemUnitPath="ExampleSystemUnitClassLib/Drehtisch" ID="{96488744-500a-42d0-8999-53d4f7a923cb}">
        <SupportedRoleClass RefRoleClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Fixture"/>
        <SupportedRoleClass RefRoleClassPath="AutomationMLExtendedRoleClassLib/Turntable"/>
      </InternalElement>
      <InternalElement Name="TB3" RefBaseSystemUnitPath="ExampleSystemUnitClassLib/Transportband" ID="{72859d01-bf57-468c-80aa-06f82d755eeb}">
        <SupportedRoleClass RefRoleClassPath="MyLib@MyLib/Conveyor/BidirectionalConveyor"/>
      </InternalElement>
      <RoleRequirements RefBaseRoleClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource"/>
    </InternalElement>
    <SupportedRoleClass RefRoleClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/ResourceStructure"/>
    <RoleRequirements RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/WorkCell"/>
  </InternalElement>
</InstanceHierarchy>
```

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Figure B.6 – XML text of the example InstanceHierarchy for usage of roles

On the next hierarchy level, the InternalElement “Cell” gets an explicit InternalElement named “Ressource” which references the RoleClass named “Resource” of the AutomationMLBaseRoleClassLib (AutomationMLBaseRoleClassLib/Resource). The concept of division into resource, product and process is described in IEC 62714-1:2018. Resources describe plants, equipment or other production resources.

Note: The RoleClass name “Ressource” is the German word for Resource.

Below the InternalElement named ‘Ressource’, there are three different plant components:

- The InternalElement RB1 which references the RoleClass Robot. This RoleClass is a standard AML RoleClass defined within the AutomationMLDMIRoleClassLib. This means that this InternalElement represents automatically controlled, reprogrammable, multipurpose manipulators, programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications. Furthermore, the technical implementation is given by the derivation from the SystemUnitClass Roboter described hereinafter.
- The InternalElement DT2 which references the RoleClass Turntable defined within the informative AutomationMLExtendedRoleClassLib. Furthermore, it possesses a reference to the standard RoleClass Fixture of the AutomationMLDMIRoleClassLib. This means that it represents rotating transport equipment which changes the horizontal transport direction of a product and/or carrier. But at the same time, the InternalElement is equipment that reduces the degrees of freedom of an item. Both RoleClasses are supported by this InternalElement. Furthermore, the technical implementation is given by the derivation from the SystemUnitClass Drehtisch described hereinafter.
- The InternalElement TB3 which references the RoleClass BidirectionalConveyor. This RoleClass is a user-defined RoleClass. The definition of the RoleClass can be found via the ExternalReference (see Figure B.7) which points to the file c://xyz_lib.aml on the localhost and is identified via the Alias MyLib. The RoleClass BidirectionalConveyor is referenced by means of the RefRoleClassPath element containing the string “MyLib@MyLib/Conveyor/BidirectionalConveyor" (see Figure B.8). This means that this InternalElement is a user-defined element which is because of restrictions of the AML specification derived directly or indirectly from the AutomationMLBaseRoleClass. Furthermore, the technical implementation is given by the derivation from the SystemUnitClass Transportband described hereinafter.

ExternalReference Path=../xyz_lib.aml Alias=MyLib

```
<ExternalReference Path="../xyz_lib.aml" Alias="MyLib"/>
```

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Figure B.7 – External RoleClassLib reference

3	TB3	ExampleSystemUnitClassLib/Transportband	{72859d01-bf57-468c-80aa-06f82d755eeb}	**SupportedRoleClass** (1)

	RefRoleClassPath
1	MyLib@MyLib/Conveyor/BidirectionalConveyor

```
<InternalElement Name="TB3" RefBaseSystemUnitPath="ExampleSystemUnitClassLib/Transportband" ID="{72859d01-bf57-468c-80aa-06f82d755eeb}">
  <SupportedRoleClass RefRoleClassPath="MyLib@MyLib/Conveyor/BidirectionalConveyor"/>
</InternalElement>
```

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Figure B.8 – Usage of external role class in example

Figure B.9, Figure B.10, and Figure B.11 depict the SystemUnitClass library of the example called ExampleSystemUnitClassLib. Within the library, three plant component types are modeled. These are:

- The class Roboter which points to the RoleClass Robot. This RoleClass is a standard AML RoleClass defined within the AutomationMLDMIRoleClassLib. This means that this SystemUnitClass represents automatically controlled, reprogrammable, multipurpose, manipulators programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications.
- The class Drehtisch which points to the RoleClass Turntable and Clamp defined within the informative AutomationMLExtendedRoleClassLib. This means that it represents rotating transport equipment which changes the horizontal transport direction of a product and/or carrier. But at the same time, the SystemUnitClass is able to perform fixation processes to hold items at one specific point. Both RoleClasses are supported by this SystemUnitClass.

- The class Transportband which points to the RoleClass Transport. This RoleClass is a standard AML RoleClass defined within the AutomationMLDMIRoleClassLib. This means that this SystemUnitClass is equipment that performs transport processes to transfer items from one location to another.

The SystemUnitClasses of this example describe the plant component types. This type can be system specific or language dependent. In the present case, the class names are in German. The roles make an independent understanding possible, even if German is not supported as a language.

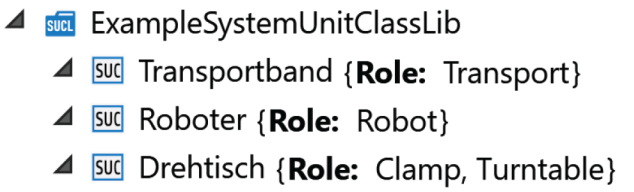

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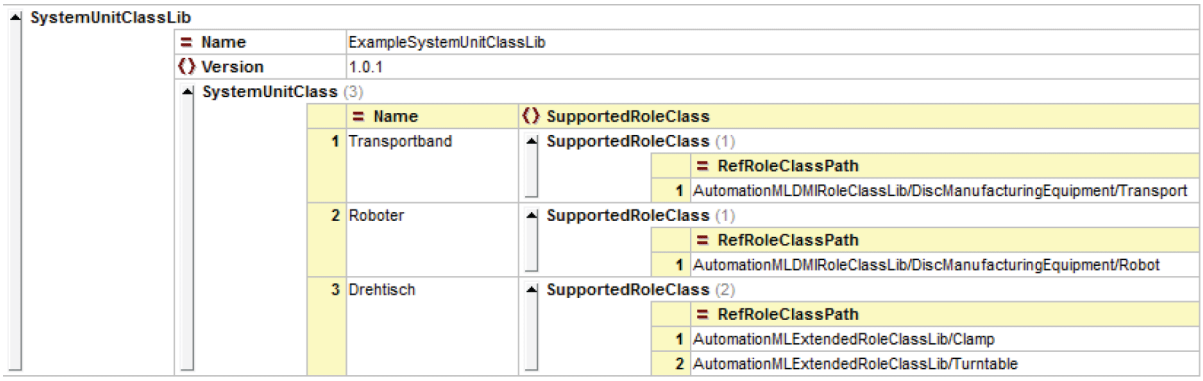
Figure B.9 – Example SystemUnitClass library for usage of roles



SystemUnitClassLib				
Name	ExampleSystemUnitClassLib			
Version	1.0.1			
SystemUnitClass (3)				
	Name	SupportedRoleClass		
1	Transportband	SupportedRoleClass (1)		
			RefRoleClassPath	
		1	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport	
2	Roboter	SupportedRoleClass (1)		
			RefRoleClassPath	
		1	AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Robot	
3	Drehtisch	SupportedRoleClass (2)		
			RefRoleClassPath	
		1	AutomationMLExtendedRoleClassLib/Clamp	
		2	AutomationMLExtendedRoleClassLib/Turntable	

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Figure B.10 – XML grid of the example SystemUnitClass library for usage of roles

```
<SystemUnitClassLib Name="ExampleSystemUnitClassLib">
  <Version>1.0.1</Version>
  <SystemUnitClass Name="Transportband">
    <SupportedRoleClass RefRoleClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Transport"/>
  </SystemUnitClass>
  <SystemUnitClass Name="Roboter">
    <SupportedRoleClass RefRoleClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Robot"/>
  </SystemUnitClass>
  <SystemUnitClass Name="Drehtisch">
    <SupportedRoleClass RefRoleClassPath="AutomationMLExtendedRoleClassLib/Clamp"/>
    <SupportedRoleClass RefRoleClassPath="AutomationMLExtendedRoleClassLib/Turntable"/>
  </SystemUnitClass>
</SystemUnitClassLib>
```

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Figure B.11 – XML text of the example SystemUnitClass library for usage of roles

Annex C - User-defined RoleClass libraries

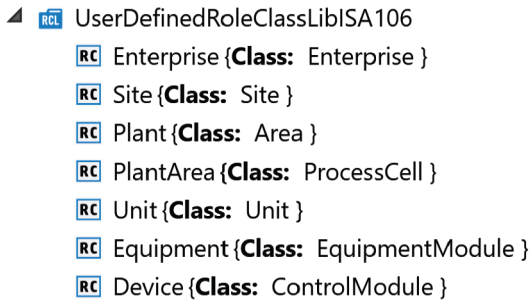
C.1 General

User-defined RoleClass libraries can be defined by each user of AutomationML.

One example is the mapping of hierarchical levels within ISA-TR106.00.01-2013. These roles are not part of the AutomationMLExtendedRoleClassLibary but can be mapped to the corresponding roles as proposed in ISA-TR106.00.01-2013 (see Table C.1).

Note: ISA88 (*ANSI//ISA-88.01-1995)* named in this example corresponds to the IEC 61512-1:1997 which is the base for the corresponding roles in the AMLExtendedRoleClassLib.

A RoleClass library for ISA-TR106.00.01-2013 can be created as user-defined RoleClass library as depicted in Figure C.1 named “UserDefinedRoleClassLibISA106”.




```
<RoleClassLib Name="UserDefinedRoleClassLibISA106">
    <Version>2.0.1</Version>
    <RoleClass Name="Enterprise" RefBaseClassPath="AutomationMLExtendedRoleClassLib/Enterprise"/>
    <RoleClass Name="Site" RefBaseClassPath="AutomationMLExtendedRoleClassLib/Site"/>
    <RoleClass Name="Plant" RefBaseClassPath="AutomationMLExtendedRoleClassLib/Area"/>
    <RoleClass Name="PlantArea" RefBaseClassPath="AutomationMLExtendedRoleClassLib/ProcessCell"/>
    <RoleClass Name="Unit" RefBaseClassPath="AutomationMLExtendedRoleClassLib/Unit"/>
    <RoleClass Name="Equipment" RefBaseClassPath="AutomationMLExtendedRoleClassLib/EquipmentModule"/>
    <RoleClass Name="Device" RefBaseClassPath="AutomationMLExtendedRoleClassLib/ControlModule"/>
</RoleClassLib>
```

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Figure C.1 – AML user-defined RoleClassLib ISA106

Table C.1– ISA-TR106.00.01-2013 mapping to *ANSI//ISA-88.01-1995*

ISA 106	ISA 88
Enterprise	Enterprise
Site	Site
Plant	Area
PlantArea	ProcessCell
Unit	Unit
Equipment	EquipmentModule
Device	ControlModule

Some existing user-defined libraries of different type and origin are listed here as an example. These consist of:

- UserDefinedRoleClassLibRedBookVDMA.aml
  One association-specific library from the VDMA (Verband Deutscher Maschinen- und

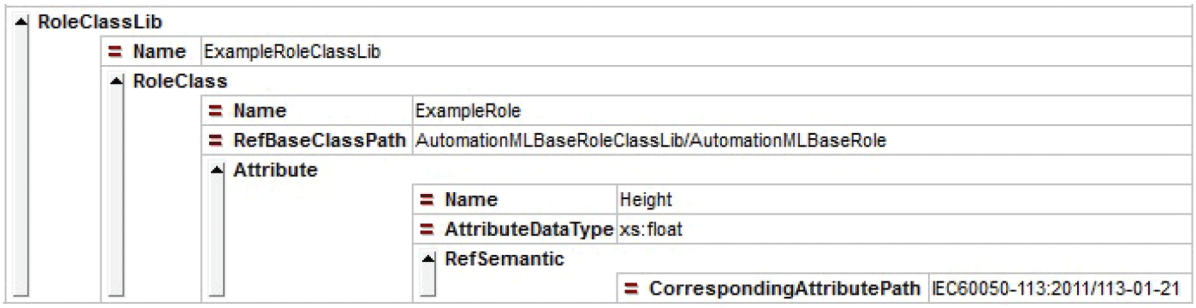
Anlagenbau – German Engineering Federation) and VDW (Verein Deutscher Werkzeugmaschinenhersteller – German Machine Tool Manufacturers Union) – the RedBook: Every one of the different types of machines supplied by German machine tool manufacturers can be found in this directory.

- UserDefinedRoleClassLibCompanySpecificStructure.aml
  One company-specific library including structure related classes. This library is a concrete working example which shows how to build up such libraries in practice.

These examples are not explained in detail within the IEC 62714 series. Further tool-specific libraries or libraries consisting of company standards are also possible.

C.2 External semantics of attributes

To include references to external definitions of attributes, the CAEX element "RefSemantic" can be used. This element enables referencing attribute semantics defined in other standards. In Figure C.2, the ExampleRole possesses an attribute Height. This attribute is defined in the IEC 60050-113:2011, 113-01-21, which is depicted by means of the CorrespondingAttributePath. This mechanism helps to reference externally defined attribute definitions.




```
<RoleClassLib Name="ExampleRoleClassLib">
  <RoleClass Name="ExampleRole" RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole">
    <Attribute Name="Height" AttributeDataType="xs:float">
      <RefSemantic CorrespondingAttributePath="IEC60050-113:2011/113-01-21" />
    </Attribute>
  </RoleClass>
</RoleClassLib>
```

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Figure C.2 – Example for external attribute semantics

Annex D - XML representation of AML libraries

D.1 AutomationMLDMIRoleClassLib

```
<CAEXFile xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://www.dke.de/CAEX" SchemaVersion="3.0"
FileName="AutomationMLDMIRoleClassLib.aml"
xsi:schemaLocation="http://www.dke.de/CAEX CAEX_ClassModel_V.3.0.xsd">
  <AdditionalInformation AutomationMLVersion="2.0" />
  <SuperiorStandardVersion>AutomationML 2.10</SuperiorStandardVersion>
  <SourceDocumentInformation OriginName="IEC SC65E WG 9" OriginID="IEC SC65E
WG 9" OriginVersion="1.0" LastWritingDateTime="2013-03-01T00:00:00+01:00"
OriginVendor="IEC" OriginVendorURL="www.iec.ch" OriginRelease="1.0.0"
OriginProjectTitle="Automation Markup Language Standard Libraries"
OriginProjectID="Automation Markup Language Standard Libraries" />
  <SourceDocumentInformation OriginName="AutomationML Editor"
OriginID="916578CA-FE0D-474E-A4FC-9E1719892369" OriginVersion="5.2.8.0"
LastWritingDateTime="2020-01-20T22:41:18.994478+01:00"
OriginProjectID="unspecified" OriginProjectTitle="unspecified"
OriginRelease="5.2.8.0" OriginVendor="AutomationML e.V."
OriginVendorURL="www.AutomationML.org" />
  <ExternalReference Path="AutomationMLBaseRoleClassLib.aml"
Alias="AutomationMLBaseRoleClassLib" />
  <RoleClassLib Name="AutomationMLDMIRoleClassLib">
    <Description>Automation Markup Language  Discrete Manufacturing Industry
Role Class Library</Description>
    <Version>2.4.0</Version>
    <RoleClass Name="DiscManufacturingEquipment"
RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/Au
tomationMLBaseRole/Resource">
      <RoleClass Name="Transport"
RefBaseClassPath="DiscManufacturingEquipment" />
      <RoleClass Name="Storage" RefBaseClassPath="DiscManufacturingEquipment"
/>
      <RoleClass Name="Fixture" RefBaseClassPath="DiscManufacturingEquipment"
/>
      <RoleClass Name="Gate" RefBaseClassPath="DiscManufacturingEquipment" />
      <RoleClass Name="Robot" RefBaseClassPath="DiscManufacturingEquipment" />
      <RoleClass Name="Tool" RefBaseClassPath="DiscManufacturingEquipment" />
      <RoleClass Name="Carrier" RefBaseClassPath="DiscManufacturingEquipment"
/>
      <RoleClass Name="Machine" RefBaseClassPath="DiscManufacturingEquipment"
/>
      <RoleClass Name="StaticObject"
RefBaseClassPath="DiscManufacturingEquipment" />
    </RoleClass>
  </RoleClassLib>
```

D.2 AutomationMLCMIRoleClassLib

```
<CAEXFile xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://www.dke.de/CAEX" SchemaVersion="3.0"
FileName="AutomationMLCMIRoleClassLib.aml"
xsi:schemaLocation="http://www.dke.de/CAEX CAEX_ClassModel_V.3.0.xsd">
  <AdditionalInformation AutomationMLVersion="2.0" />
  <SuperiorStandardVersion>AutomationML 2.10</SuperiorStandardVersion>
  <SourceDocumentInformation OriginName="IEC SC65E WG 9" OriginID="IEC SC65E
WG 9" OriginVersion="1.0" LastWritingDateTime="2013-03-01T00:00:00+01:00"
OriginVendor="IEC" OriginVendorURL="www.iec.ch" OriginRelease="1.0.0"
OriginProjectTitle="Automation Markup Language Standard Libraries"
OriginProjectID="Automation Markup Language Standard Libraries" />
  <SourceDocumentInformation OriginName="AutomationML Editor"
OriginID="916578CA-FE0D-474E-A4FC-9E1719892369" OriginVersion="5.2.8.0"
```

```
LastWritingDateTime="2020-01-20T22:40:16.4276593+01:00"
OriginProjectID="unspecified" OriginProjectTitle="unspecified"
OriginRelease="5.2.8.0" OriginVendor="AutomationML e.V."
OriginVendorURL="www.AutomationML.org" />
  <ExternalReference Path="AutomationMLBaseRoleClassLib.aml"
Alias="AutomationMLBaseRoleClassLib" />
  <RoleClassLib Name="AutomationMLCMIRoleClassLib">
    <Description>Automation Markup Language Continuous Manufacturing Industry
Role Class Library</Description>
    <Version>1.1.0</Version>
    <RoleClass Name="ContManufacturingEquipment"
RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/Au
tomationMLBaseRole/Resource" />
  </RoleClassLib>
</CAEXFile>
```

D.3 AutomationMLBMIRoleClassLib

```
<CAEXFile xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns="http://www.dke.de/CAEX" SchemaVersion="3.0"
      FileName="AutomationMLBMIRoleClassLib.aml"
      xsi:schemaLocation="http://www.dke.de/CAEX CAEX_ClassModel_V.3.0.xsd">
  <AdditionalInformation AutomationMLVersion="2.0" />
  <SuperiorStandardVersion>AutomationML 2.10</SuperiorStandardVersion>
  <SourceDocumentInformation OriginName="IEC SC65E WG 9" OriginID="IEC SC65E
WG 9" OriginVersion="1.0" LastWritingDateTime="2013-03-01T00:00:00+01:00"
OriginVendor="IEC" OriginVendorURL="www.iec.ch" OriginRelease="1.0.0"
OriginProjectTitle="Automation Markup Language Standard Libraries"
OriginProjectID="Automation Markup Language Standard Libraries" />
  <SourceDocumentInformation OriginName="AutomationML Editor"
OriginID="916578CA-FE0D-474E-A4FC-9E1719892369" OriginVersion="5.2.8.0"
LastWritingDateTime="2020-01-20T22:39:41.5949754+01:00"
OriginProjectID="unspecified" OriginProjectTitle="unspecified"
OriginRelease="5.2.8.0" OriginVendor="AutomationML e.V."
OriginVendorURL="www.AutomationML.org" />
  <ExternalReference Path="AutomationMLBaseRoleClassLib.aml"
Alias="AutomationMLBaseRoleClassLib" />
  <RoleClassLib Name="AutomationMLBMIRoleClassLib">
    <Description>Automation Markup Language Batch Manufacturing Industry Role
Class Library</Description>
    <Version>1.1.0</Version>
    <RoleClass Name="BatchManufacturingEquipment"
RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/Au
tomationMLBaseRole/Resource" />
  </RoleClassLib>
</CAEXFile>
```

D.4 AutomationMLCSRoleClassLib

```
<CAEXFile xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns="http://www.dke.de/CAEX" SchemaVersion="3.0"
      FileName="AutomationMLCSRoleClassLib.aml"
      xsi:schemaLocation="http://www.dke.de/CAEX CAEX_ClassModel_V.3.0.xsd">
  <AdditionalInformation AutomationMLVersion="2.0" />
  <SuperiorStandardVersion>AutomationML 2.10</SuperiorStandardVersion>
  <SourceDocumentInformation OriginName="IEC SC65E WG 9" OriginID="IEC SC65E
WG 9" OriginVersion="1.0" LastWritingDateTime="2013-03-01T00:00:00+01:00"
OriginVendor="IEC" OriginVendorURL="www.iec.ch" OriginRelease="1.0.0"
OriginProjectTitle="Automation Markup Language Standard Libraries"
OriginProjectID="Automation Markup Language Standard Libraries" />
  <SourceDocumentInformation OriginName="AutomationML Editor"
OriginID="916578CA-FE0D-474E-A4FC-9E1719892369" OriginVersion="5.2.8.0"
LastWritingDateTime="2021-06-21T13:44:51.8053203+02:00"
OriginProjectID="unspecified" OriginProjectTitle="unspecified"
```

```
OriginRelease="5.2.8.0" OriginVendor="AutomationML e.V."
OriginVendorURL="www.AutomationML.org" />
  <ExternalReference Path="AutomationMLBaseRoleClassLib.aml"
Alias="AutomationMLBaseRoleClassLib" />
  <RoleClassLib Name="AutomationMLCSRoleClassLib">
    <Description>Automation Markup Language Control Industry Role Class
Library</Description>
    <Version>2.3.1</Version>
    <RoleClass Name="ControlEquipment"
RefBaseClassPath="AutomationMLBaseRoleClassLib@AutomationMLBaseRoleClassLib/Au
tomationMLBaseRole/Resource">
      <RoleClass Name="Communication" RefBaseClassPath="ControlEquipment" />
      <RoleClass Name="ControlHardware" RefBaseClassPath="ControlEquipment">
        <RoleClass Name="PC" RefBaseClassPath="ControlHardware" />
        <RoleClass Name="IPC" RefBaseClassPath="ControlHardware" />
        <RoleClass Name="EmbeddedDevice" RefBaseClassPath="ControlHardware" />
        <RoleClass Name="Handheld" RefBaseClassPath="ControlHardware" />
      </RoleClass>
      <RoleClass Name="Sensor" RefBaseClassPath="ControlEquipment" />
      <RoleClass Name="Actuator" RefBaseClassPath="ControlEquipment" />
      <RoleClass Name="Controller" RefBaseClassPath="ControlEquipment">
        <RoleClass Name="PLC" RefBaseClassPath="Controller" />
        <RoleClass Name="NC" RefBaseClassPath="Controller" />
        <RoleClass Name="RC" RefBaseClassPath="Controller" />
      </RoleClass>
    </RoleClass>
  </RoleClassLib>
</CAEXFile>
```

D.5 AutomationMLExtendedRoleClassLib

```
<CAEXFile xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns="http://www.dke.de/CAEX" SchemaVersion="3.0"
      FileName="AutomationMLExtendedRoleClassLib.aml"
      xsi:schemaLocation="http://www.dke.de/CAEX CAEX_ClassModel_V.3.0.xsd">
  <AdditionalInformation AutomationMLVersion="2.0" />
  <SuperiorStandardVersion>AutomationML 2.10</SuperiorStandardVersion>
  <SourceDocumentInformation OriginName="IEC SC65E WG 9" OriginID="IEC SC65E
WG 9" OriginVersion="1.0" LastWritingDateTime="2013-03-01T00:00:00+01:00"
OriginVendor="IEC" OriginVendorURL="www.iec.ch" OriginRelease="1.0.0"
OriginProjectTitle="Automation Markup Language Standard Libraries"
OriginProjectID="Automation Markup Language Standard Libraries" />
  <SourceDocumentInformation OriginName="AutomationML Editor"
OriginID="916578CA-FE0D-474E-A4FC-9E1719892369" OriginVersion="5.2.8.0"
LastWritingDateTime="2020-01-20T22:46:00.5235622+01:00"
OriginProjectID="unspecified" OriginProjectTitle="unspecified"
OriginRelease="5.2.8.0" OriginVendor="AutomationML e.V."
OriginVendorURL="www.AutomationML.org" />

  <SourceDocumentInformation OriginName="IEC SC65E WG 9" OriginID="IEC SC65E WG 9"
OriginVersion="2.0"                 LastWritingDateTime="2021-04-22T00:00:00+01:00"
OriginVendor="IEC"        OriginVendorURL="www.iec.ch"        OriginRelease="2.0.0"
OriginProjectTitle="Automation     Markup     Language     Standard     Libraries"
OriginProjectID="Automation Markup Language Standard Libraries" />
  <ExternalReference Path="AutomationMLBaseRoleClassLib.aml"
Alias="AutomationMLBaseRoleClassLib" />
  <ExternalReference Path="AutomationMLDMIRoleClassLib.aml"
Alias="AutomationMLDMIRoleClassLib" />
  <ExternalReference Path="AutomationMLCSRoleClassLib.aml"
Alias="AutomationMLCSRoleClassLib" />
  <RoleClassLib Name="AutomationMLExtendedRoleClassLib">
    <Version>2.7.0</Version>
    <RoleClass Name="PLCFacet"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Facet" />
    <RoleClass Name="HMIFacet"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Facet" />
```

```
    <RoleClass Name="Enterprise"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="Site"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="Area"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="ProductionLine"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="WorkCell"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="ProcessCell"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="Unit"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="ProductionUnit"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="StorageZone"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="StorageUnit"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="ConnectedWorld"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="WorkCenter"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="WorkUnit"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="Equipment"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="Station"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="EquipmentModule"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="ControlModule"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="ControlDevice"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="FieldDevice"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Structure/
ResourceStructure" />
    <RoleClass Name="Turntable"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port" />
    <RoleClass Name="Conveyor"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port">
      <RoleClass Name="BeltConveyor"
RefBaseClassPath="AutomationMLExtendedRoleClassLib/Conveyor" />
```

```
      <RoleClass Name="RollConveyor"
RefBaseClassPath="AutomationMLExtendedRoleClassLib/Conveyor" />
      <RoleClass Name="ChainConveyor"
RefBaseClassPath="AutomationMLExtendedRoleClassLib/Conveyor" />
      <RoleClass Name="PalletConveyor"
RefBaseClassPath="AutomationMLExtendedRoleClassLib/Conveyor" />
      <RoleClass Name="OverheadConveyor"
RefBaseClassPath="AutomationMLExtendedRoleClassLib/Conveyor" />
    </RoleClass>
    <RoleClass Name="LiftingTable"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port" />
    <RoleClass Name="AGV"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port" />
    <RoleClass Name="Transposer"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port" />
    <RoleClass Name="CarrierHandlingSystem"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port" />
    <RoleClass Name="BodyStore"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Stora
ge" />
    <RoleClass Name="Lift"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port" />
    <RoleClass Name="Rollerbed"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Trans
port" />
    <RoleClass Name="StationaryTool"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Tool"
/>
    <RoleClass Name="MovableTool"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Tool"
/>
    <RoleClass Name="ControlCabinet"
RefBaseClassPath="AutomationMLCSRoleClassLib/ControlEquipment" />
    <RoleClass Name="IODevice"
RefBaseClassPath="AutomationMLCSRoleClassLib/ControlEquipment" />
    <RoleClass Name="HMI"
RefBaseClassPath="AutomationMLCSRoleClassLib/ControlEquipment">
      <RoleClass Name="WarningEquipment"
RefBaseClassPath="AutomationMLExtendedRoleClassLib/HMI" />
    </RoleClass>
    <RoleClass Name="ActuatingDrive"
RefBaseClassPath="AutomationMLCSRoleClassLib/ControlEquipment/Actuator" />
    <RoleClass Name="MotionController"
RefBaseClassPath="AutomationMLCSRoleClassLib/ControlEquipment/Controller" />
    <RoleClass Name="HMIPanel"
RefBaseClassPath="AutomationMLCSRoleClassLib/ControlEquipment/ControlHardware"
/>
    <RoleClass Name="MeasuringEquipment"
RefBaseClassPath="AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Resource"
/>
    <RoleClass Name="Clamp"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Fixtu
re" />
    <RoleClass Name="ProcessController"
RefBaseClassPath="AutomationMLCSRoleClassLib/ControlEquipment/Controller" />
    <RoleClass Name="Loader"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Stora
ge" />
```

```
    <RoleClass Name="Unloader"
RefBaseClassPath="AutomationMLDMIRoleClassLib/DiscManufacturingEquipment/Stora
ge" />
  </RoleClassLib>
</CAEXFile>
```

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