IEC 62714-3

Edition 1.0 2017-01

INTERNATIONAL STANDARD

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Engineering data exchange format for use in industrial automation systems engineering – Automation markup language – Part 3: Geometry and kinematics

Format d'échange de données techniques pour une utilisation dans l'ingénierie des systèmes d'automatisation industrielle – Automation markup language – Partie 3: Géométrie et cinématique

IEC 62714-3:2017-01(en-fr)

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

CDV	Report on voting
65E/497/CDV	65E/508/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

A list of all parts in the IEC 62714 series, published under the general title *Engineering data exchange format for use in industrial automation systems engineering – Automation markup language*, can be found on the IEC website.

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

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- withdrawn,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

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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 “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.

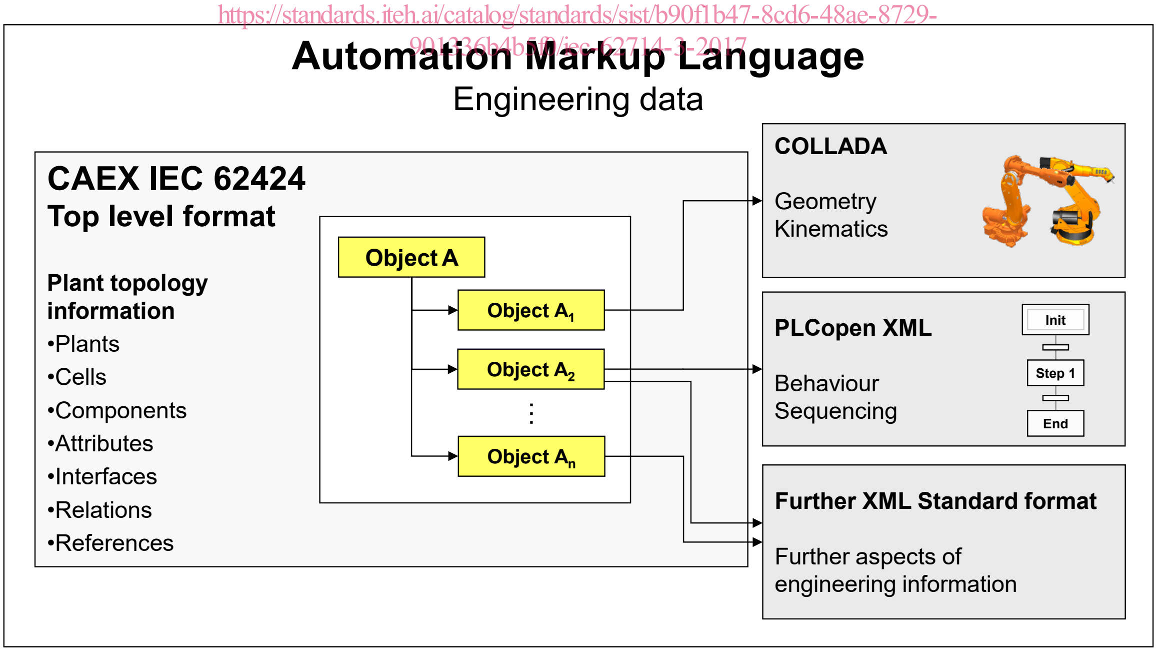

Figure 1 – Overview of the engineering data exchange format AML

Due to the different aspects of AML, IEC 62714 consists of different parts focussing 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: Role class libraries

  This part specifies additional AML libraries.

- IEC 62714-3: Geometry and kinematics

  This part specifies the modelling of geometry and kinematics information.

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

Clause 5 describes the geometry related extensions of the role class libraries.

Clause 6 describes the frame attribute which can be used to represent the geometric position of an InternalElement, InstanceHierarchy, SystemUnitClass, or SystemUnitClassLibrary with respect to another CAEX Object.

Clause 7 gives a normative description regarding referencing COLLADA documents.

Clause 8 specifies the normative provisions for the attachment of two geometric AML objects.

Clause 9 defines how to store meta informations about the source tool directly into the COLLADA document.

Annex A describes the referencing methods for geometric and kinematic models.

Annex B provides an example for modelling of kinematic systems and their combination in AML.

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

ENGINEERING DATA EXCHANGE FORMAT FOR USE IN INDUSTRIAL AUTOMATION SYSTEMS ENGINEERING – AUTOMATION MARKUP LANGUAGE –

Part 3: Geometry and kinematics

1 Scope

This part of IEC 62714 specifies the integration of geometry and kinematics information for the exchange between engineering tools in the plant automation area by means of AML.

It does not define details of the data exchange procedure or implementation requirements for the import/export tools.

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 62714-1:2014, *Engineering data exchange format for use in industrial automation systems engineering – Automation markup language – Part 1: Architecture and general requirements*

IEC 62714-2:2015, *Engineering data exchange format for use in industrial automation systems engineering – Automation markup language – Part 2: Role class libraries*

ISO/PAS 17506, *Industrial automation systems and integration – COLLADA digital asset schema specification for 3D visualization of industrial data*

COLLADA 1.4.1: March 2008 COLLADA – Digital Asset Schema Release 1.4.1 (available at <http://www.khronos.org/files/collada_spec_1_4.pdf>)

Extensible Markup Language (XML) 1.0:2004, W3C Recommendation (available at <http://www.w3.org/TR/2004/REC-xml-20040204/>)

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62714-1:2014 and of IEC 62714-2:2015 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/ [access on 26th September 2016]
- ISO Online browsing platform: available at http://www.iso.org/obp [access on 26th September 2016]

3.1.1
SID path
reference of type sidref_type to an arbitrary element within a COLLADA document according to ISO/PAS 17506 or COLLADA 1.4.1

3.2 Abbreviations

For the purposes of this document, the abbreviations of IEC 62714-1:2014 and of IEC 62714-2:2015 apply as well as the abbreviations listed in Table 1.

Table 1 – Abbreviations

SCARA	Selective Compliance Assembly Robot Arm
SID	Scoped Identifier

4 Conformity

To claim conformity to the present document with respect to the support of AML, the requirements of Clauses 5, 6, 7, 8 and 9 shall be fulfilled. In the scope of AML, a COLLADA document shall conform to the specification of ISO/PAS 17506 or COLLADA 1.4.1.

5 Extensions of AML libraries for geometry and kinematics

5.1 General

Clause 5 defines extensions of the standard AML RoleClasses and standard AML InterfaceClasses. These classes are part of the AML standard libraries and a specific extension of IEC 62714-1 for this part of IEC 62714. All described attributes are part of the standard libraries and may be removed in the InstanceHierarchy if not needed.

5.2 AutomationMLBaseRoleClassLib – RoleClass Frame

The RoleClass “Frame” shall be used as specified in Table 2.

Table 2 – RoleClass Frame

Class name	Frame
Description	This role denotes a Cartesian right handed coordinate system.
Parent class	AutomationMLBaseRoleClassLib/AutomationMLBaseRole
Path for element reference	AutomationMLBaseRoleClassLib/AutomationMLBaseRole/Frame

NOTE 1 An AML object referencing the RoleClass “Frame” is useable to define reference coordinate systems like attachment points.

NOTE 2 To define reference coordinate systems like attachment points an AML object referencing the RoleClass “Frame” is useable.

5.3 AutomationMLInterfaceClassLib

5.3.1 InterfaceClass COLLADAInterface

The InterfaceClass “COLLADAInterface” shall be used as specified in Table 3.

Table 3 – InterfaceClass COLLADAInterface

Class name	COLLADAInterface	
Description	The InterfaceClass "COLLADAInterface" shall be used in order to reference external COLLADA documents and to publish interfaces that are defined inside an external COLLADA document.	
Parent class	AutomationMLInterfaceClassLib/AutomationMLBaseInterface/ExternalDataConnector	
Path for element reference	AutomationMLInterfaceClassLib/AutomationMLBaseInterface/ExternalDataConnector/ COLLADAInterface	
Attributes	refType (AttributeDataType="xs:string")	The attribute "refType" specifies whether the referenced COLLADA document has an explicit or implicit character. The allowed values are "explicit" or "implicit". The attribute is mandatory.
	target (AttributeDataType="xs:token")	The attribute "target" specifies the SID path of a COLLADA element within the referenced document. The attribute is optional.

NOTE The InterfaceClass "COLLADAInterface" additionally inherits the attribute "refURI" from the parent InterfaceClass "ExternalDataConnector".

5.3.2 InterfaceClass AttachmentInterface

The InterfaceClass "AttachmentInterface" shall be used as specified in Table 4.

Table 4 – InterfaceClass AttachmentInterface

Class name	AttachmentInterface
Description	The InterfaceClass "AttachmentInterface" specifies an interface for geometric or kinematic links between AML objects with RoleClass Frame.
Parent class	AutomationMLInterfaceClassLib/AutomationMLBaseInterface
Path for element reference	AutomationMLInterfaceClassLib/AutomationMLBaseInterface/AttachmentInterface

6 Frame attribute

An InternalElement or a SystemUnitClass may require a frame attribute that represents its geometric position in relation to other objects. For this, the following provisions apply:

- Each frame shall be based on a three dimensional, orthogonal, right-handed coordinate system.
- The elements InstanceHierarchy and SystemUnitClassLib specify a three dimensional, orthogonal, right-handed coordinate system with standard basis. The positive z axis is considered upward, the positive x direction defines the right axis and the negative y direction defines the forward axis.
- The relative translations x, y and z as well as the rotations rx, ry and rz shall be specified as sub-attributes in an AML attribute „Frame" defined in Table 5 and Table 6. The relative translations x, y and z shall be given in relation to the parent coordinate System specified in the previous point. The rotations rx, ry and rz shall be executed in the order rx, ry and rz with respect to the fixed axes of the parent coordinate System. The origin of the translated Frame shall retain its position (x, y, z) during the spatially-fixed rotation. The attribute "Frame" shall affect its containing AML object and all its children.

  NOTE This means, that the point of rotation rotates whereas the frame position remains unchanged. This avoids double changes.

- If the attribute "Frame" is not specified, the default values of x, y, z, rx, ry and rz shall be 0.

- If the attribute “Frame” is specified, all sub-attributes x, y, z, rx, ry and rz shall be listed. Any unused sub-attribute shall have the default value 0.

The attribute “Frame” shall be used as complex attribute specified in Table 5 and Table 6. An example is given in A.1.2.

Table 5 – Attribute “Frame”

Attribute	AttributeDataType	Description
Frame	This attribute has no AttributeDataType since attribute has no value.	The attribute “Frame” shall be used as structure element for the storage of the sub-attributes specified in Table 6.

Table 6 – Sub-attributes of the attribute “Frame”

Attribute	AttributeDataType	Description
x	xs:double	The attribute “x” shall be used to specify the relative position in meters along the x axis of the coordinate system specified by the parent element. The value of attribute “Unit” of the CAEX element “Attribute” shall be “m”.
y	xs:double	The attribute “y” shall be used to specify the relative position in meters along the y axis of the coordinate system specified by the parent element. The value of attribute “Unit” of the CAEX element “Attribute” shall be “m”.
z	xs:double	The attribute “z” shall be used to specify the relative position in meters along the z axis of the coordinate system specified by the parent element. The value of attribute “Unit” of the CAEX element “Attribute” shall be “m”.
rx	xs:double	The attribute “rx” shall be used to specify the relative rotation in degrees around the x axis of the coordinate system specified by the parent element. The value of attribute “Unit” of the CAEX element “Attribute” shall be “deg”.
ry	xs:double	The attribute “ry” shall be used to specify the relative rotation in degrees around the y axis of the coordinate system specified by the parent element. The value of attribute “Unit” of the CAEX element “Attribute” shall be “deg”.
rz	xs:double	The attribute “rz” shall be used to specify the relative rotation in degrees around the z axis of the coordinate system specified by the parent element. The value of attribute “Unit” of the CAEX element “Attribute” shall be “deg”.

7 Integration of COLLADA documents

Regarding referencing COLLADA documents, the following provisions apply:

- A reference from an AML object to a COLLADA document shall be modelled by means of a CAEX ExternalInterface derived from the AML InterfaceClass “COLLADAInterface” as defined in 5.3.1.
- The COLLADA document shall be referenced by its URI within the attribute “refURI” of this CAEX ExternalInterface.
- The value of the attribute “target” shall point at an element within the COLLADA document and shall follow the syntax of a SID path.
- If the attribute “target” is not present or its content is empty and the URI has no fragment, the element “scene” of the COLLADA document shall be considered.
- The COLLADA document and its entry point shall be resolved as specified in Table 7. A decision tree to resolve the different entries is shown in Figure A.1.