

INTERNATIONAL IEEE Std 1636.2™ STANDARD

**Software Interface for Maintenance Information Collection and Analysis
(SIMICA) –
Part 2: Exchanging Maintenance Action Information via the Extensible Markup
Language (XML)**

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SOFTWARE INTERFACE FOR MAINTENANCE INFORMATION COLLECTION AND ANALYSIS (SIMICA) –

Part 2: Exchanging Maintenance Action Information via the Extensible Markup Language (XML)

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IEEE Std	FDIS	Report on voting
1636.2 (2018)	91/1815/FDIS	91/1826/RVD

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IEEE Standard for Software Interface for Maintenance Information Collection and Analysis (SIMICA): Exchanging Maintenance Action Information via the Extensible Markup Language (XML)

Sponsor

**IEEE Standards Coordinating Committee 20 on
Test and Diagnosis for Electronic Systems**

Approved 27 September 2018

IEEE-SA Standards Board

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Abstract: Promoting and facilitating interoperability components of automatic test systems where actions taken during maintenance need to be shared is addressed in this standard. The standard thus facilitates the capture of maintenance action information data in storage devices and databases, facilitating online and offline analysis. The maintenance action information schema becomes a class of information that can be used within the SIMICA family of standards. The exchange format is expressed in both the OWL and XML formats.

Keywords: automated test system (ATS), extensible markup language (XML), IEEE 1636.2™, maintenance action information (MAI), OWL ontology, Software Interface for Maintenance Information Collection and Analysis (SIMICA), XML schema

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Introduction

This introduction is not part of IEEE Std 1636.2-2018, IEEE Standard for Software Interface for Maintenance Information Collection and Analysis (SIMICA): Exchanging Maintenance Action Information via the Extensible Markup Language (XML).

Maintainers of complex systems require the ability to capture and share maintenance action information in a way that supports such activities as performance analysis, post production product improvement, maintenance process improvement, and diagnostic maturation. Principal stakeholders of this project include but are not limited to maintenance organizations within various Departments/Ministries of Defense, the commercial airlines, the automotive industry, and the telecommunications industry. This standard is being developed as a component of the IEEE Std 1636™ Software Interface for Maintenance Information Collection and Analysis (SIMICA) project. SIMICA's purpose is to specify a software interface for access, exchange, and analysis of product diagnostic and maintenance information. Maintenance action information provides a subset of the data needed to satisfy SIMICIA requirements.

This document provides the description of the maintenance action information elements.

IEEE Standards downloads and executable files

Files are available in the IEEE Std 1636.2-2018 directory located at: <https://standards.ieee.org/downloads>.

IEEE Standard for Software Interface for Maintenance Information Collection and Analysis (SIMICA): Exchanging Maintenance Action Information via the Extensible Markup Language (XML)

1. Overview

1.1 General

Software Interface for Maintenance Information Collection and Analysis (SIMICA) is a family of IEEE standards, associated web ontologies (OWL), and extensible markup language (XML) schemas which allow automatic test system (ATS), test result and session information, and maintenance action information to be exchanged in a common format adhering to the OWL and XML standards.

The SIMICA family of standards has been developed and is being maintained under the guidance of IEEE Standards Coordinating Committee 20 (SCC20) to serve as a comprehensive environment for integrating test results, test session information, and maintenance action information, while allowing this unit under test (UUT) related data to be interchanged between heterogeneous systems.

The SIMICA family of standards is organized as a base Standard (IEEE Std 1636™) and two (2) ‘dot’ standards:

- Test Results and Session Information (IEEE Std 1636.1™)
- Maintenance Action Information (IEEE Std 1636.2™)

The SIMICA base document and its relationship to this document is depicted in [Figure 1](#).

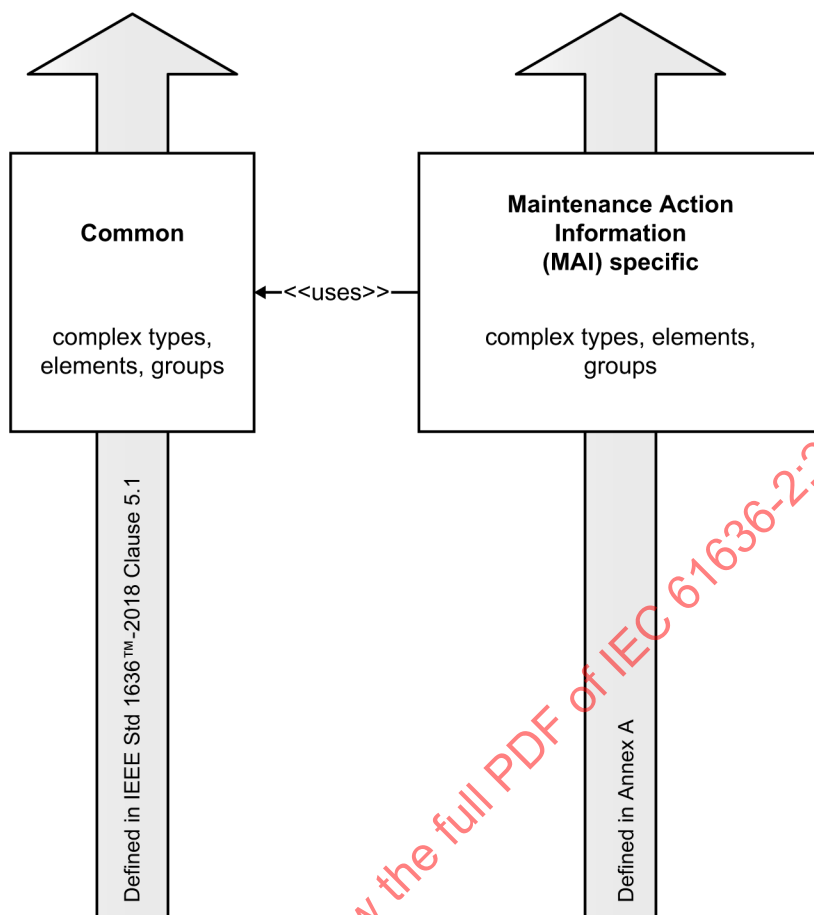


Figure 1—Relationship between this document and the SIMICA base document

1.2 Scope

The scope of this standard is the definition of an exchange format, utilizing XML, for exchanging maintenance action information (MAI) associated with the removal, repair, and replacement of system components to maintain/support an operational system.

1.3 Purpose

The purpose of this standard is to promote and facilitate interoperability between components of a test system and applications in a maintenance environment where MAI needs to be shared. The standard will facilitate the capture and exchange of unit under test (UUT) specific maintenance information, facilitating online and offline analysis of the maintenance process. The maintenance action schema defines a class of information to be used within the SIMICA family of standards.

1.4 Application

1.4.1 Of this document

This document provides formal specifications of the information required for the development of shared maintenance action data. Anticipated users of this standard include the following:

- a) System developers
- b) System maintainers
- c) Test program set (TPS) developers
- d) TPS maintainers
- e) Automatic test equipment (ATE) system developers
- f) ATE systems maintainers
- g) Test instrument developers
- h) Reliability, maintainability, and diagnostic analytical applications

1.4.2 Of this document's annexes

This document includes two annexes. Of these two, one is normative ([Annex A](#)).

[Annex A](#) contains descriptive information about each of the XML schema and OWL ontology elements and types.

[Annex B](#) contains the bibliography. This is informative, and thus is provided strictly as information, for both users and maintainers of this document.

1.5 Precedence

In the event of conflict between this document and a normatively referenced standard (see [Clause 2](#)), the normatively referenced standard, as it applies to the information being produced, shall take precedence.

In the event of conflict between this document and the SIMICA family base document (IEEE Std 1636-2018), the SIMICA family base document shall take precedence.

In the event of conflict between this document and another SIMICA family component standard, this document shall take precedence.

1.6 Conventions used in this document

1.6.1 General

All groups, complex types, simple types, and attribute groups are listed in [Annex A](#); Descriptive information for each is provided.

Where there are references to a groups, complex types, simple types, and attribute groups within the associated XML schema or OWL ontology (MaintenanceActionInformation.xsd and MAI.owl), the convention of [name] at [element] is used to indicate where the user can locate the data within either the MaintenanceActionInformation.xsd or MAI.owl files.

Example: 1636.2-2018 download at: <http://standards.ieee.org/downloads> indicates that the user is to open the MaintenanceActionInformation.xsd at the location provided and find for the schema definition.

The namespace prefix “mai:” identifies that the type or attribute group associated with this document.

All specifications for OWL and XML within this document are given in the Courier type font and italicized.

1.6.2 Word usage

In this document, the word *shall* is used to indicate a mandatory requirement. The word *should* is used to indicate a recommendation. The word *may* is used to indicate a permissible action. The word *can* is used for statements of possibility and capability.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 1636™-2018, IEEE Standard for Software Interface for Maintenance Information Collection and Analysis (SIMICA).^{1,2}

World Wide Web Consortium, (W3C) extensible Markup Language (XML), 1.0 (Fifth Edition) Proposed Edited Recommendation.³

World Wide Web Consortium, (W3C) OWL Web Ontology Language (OWL 2), W3C Recommendation.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.⁴

component [in an extensible Markup Language (XML) schema]: The generic term for the building blocks that comprise the abstract data model of the schema.

extensible Markup Language (XML) attribute: Name-value pair associated with an XML element.

extensible Markup Language (XML) document: A (text) data object that conforms to the XML requirements for being well-formed (as defined by W3C).

extensible Markup Language (XML) namespace: A method for distinguishing XML elements and attributes that may have the same name but different meanings. A URL is used as a prefix to a “local name.” This combination ensures the uniqueness of the element or attribute name. The URL is used only as a way to create a unique prefix and does not have to resolve to a real page on the Internet.

NOTE—See Namespaces in XML 1.0 [B4].⁵

extensible Markup Language (XML) schema: The structure or framework used to define a data record. This includes each field’s name, type, shape, dimension, and mapping.

framework: A framework is a real or conceptual structure expressed as a set of abstract classes. The framework provides a context for the components to be used.

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⁵Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

instance document: A textual information set grouped for some purpose that is governed by a single XML schema.

maintenance: Activity intended to keep equipment (hardware) or programs (software) in satisfactory working condition, including replacements, adjustments, repairs, software/firmware updates, and program improvements. Maintenance can be preventative or corrective. (Adapted from MIL-STD-1309D [B8].)

ontologies: A formal way to define the structure of knowledge.

web ontology language: A knowledge representation language for authoring ontologies.

3.2 Acronyms and abbreviations

ATE	automatic test equipment
ATS	automatic test system
MAI	maintenance action information
OWL	Web Ontology Language
SCC20	Standards Coordinating Committee 20
SIMICA	Software Interface for Maintenance Information Collection and Analysis
TPS	test program set
UUT	unit under test
W3C	World Wide Web Consortium
XML	eXtensible Markup Language

4. Maintenance action information

4.1 Background

Current automatic test system architectures are implemented with tight coupling between components. This tight coupling inhibits interoperability by requiring components of the automatic test system to be developed specific to that particular architecture. In many cases, this coupling can be reduced by developing the components that operate relative to standard interfaces.

This document will facilitate accomplishing several objectives. First, the document will serve as a single source for specifying essential test data with data elements related to the unit under test (UUT), the test station, and the test program. Second, the document will assist the automatic test equipment (ATE) industry to design and create compatible, interoperable tool sets such as data parsers and writers. Third, the standard will assist ATE users of such data (e.g., automotive, semiconductor, aerospace, and military) to process and display maintenance action information across a variety of systems.

This document has been developed as a “component standard” or “dot standard” under the SIMICA family base document (IEEE Std 1636). The SIMICA family of standards purpose is to specify software interfaces for access, exchange, and analysis of product diagnostic and maintenance information. Maintenance Action Information provides a subset of the data needed to satisfy SIMICA’s requirements.

4.2 General introduction

This documents XML schema and OWL ontology provides a standard format for the transport of qualitative maintenance actions that have been taken. This information is intended to permit use of an instance document for a variety of purposes, including statistical analysis and diagnostics. This document establishes a hierarchical structure for maintenance action data to permit the grouping of a series of related maintenance actions in a single instance document.

4.3 Applicability

This document will permit maintenance action data to be shared for a variety of purposes, including statistical analysis, diagnostics, and improvement of the unit under test (UUT) repair process.

4.4 Usage

This document presumes some knowledge of XML and the use of XML schemas. A variety of XML software tools are available in a number of computer programming languages. This document makes no presumption regarding the tool(s) being used or the specific test system(s) generating the maintenance action information being captured in an XML instance document.

This document describes the MaintenanceActionInformation.xsd schemas as well as specifies the OWL ontology that conformant instance documents must follow. In general, this document serves as an enhancement to the annotations provided within the XML schema and OWL ontology files.

4.4.1 XML schemas associated with this document

There are two (2) XML schemas associated with this document, both titled MaintenanceActionInformation.xsd.

For new applications of Maintenance Action Information that do not require adherence to IEEE Std 1671™, the MaintenanceActionInformations.xsd schema that includes Simica.xsd shall be utilized. (This schema is contained in the download site folder 1636.1-2018, see [Clause 7.](#))

For new or legacy applications of Maintenance Action Information that require adherence to IEEE Std 1671, the MaintenanceActionInformations.xsd schema that includes Common.xsd shall be utilized. (This schema is contained in the download site folder 1636.1-2018/1671-Compatible, see [Clause 7.](#))

4.4.2 XML schema representation

Within the body of this document, unless otherwise indicated, all syntax references relate to XML. Refer to XML eXtensible Markup Language (XML) 1.0 (Fifth Edition). W3C Proposed Edited Recommendation [\[B1\]](#) for detailed descriptions of XML data formats.

4.4.3 OWL ontology representation

This document also provides an OWL ontology that further defines the semantics of the elements contained in the XML schema. The OWL ontology is presented in a lexical form to facilitate understanding. Refer to the OWL Web Ontology Language (OWL 2), W3C Recommendation [\[B6\]](#) for detailed descriptions of OWL data formats.

5. Conformance

The minimal expectation for XML instance documents conformant with this standard shall be that the XML instance document is considered valid if the instance document complies with the constraints expressed in:

- a) The MaintenanceActionInformation.xsd schema (defined in [Annex A](#) of this document, and available as described in [Clause 7](#)).
- b) The Simica.xsd or Common.xsd schema (defined in 5.1 of IEEE Std 1636™-2018 and available as described in [Clause 7](#)).
- c) The MAI.owl ontology (defined in [Annex A](#) of this document, and available as described in [Clause 7](#)).
- d) The Simica.owl ontology (defined in IEEE Std 1636™-2018 and available as described in [Clause 7](#)).

Validity shall only occur when the XML instance document is populated.

6. XML schema extensibility

A provision in the XML schema of an extension mechanism is necessary to ensure the viability of the specification and allow producers and consumers of SIMICA XML instance documents to interoperate in those cases where there is a requirement to exchange relevant data that is not included in the MaintenanceActionInformation.xsd schema. The use of the extensions shall be done in a way that ensures that a conformant consumer can utilize the extended file without error, discard or otherwise sidestep the extended data and use the non-extended portions of the data as it is intended, without error or loss of functionality.

Extensions shall be additional information added to the content model of the element being extended.

Extensions shall not repackage existing information entities that are already supported by this standard.

An extended instance document shall be accompanied by the extension XML schema and documentation sufficient to explain the need for the extension as well as the underlying semantics and relationship(s) to the base schema.

MaintenanceActionInformation.xsd supports two forms of extension:

- a) Wildcard-based extensions allow for the extension of SIMICA schemas with additional elements.
- b) Type derivation allows for extending the set of data types by deriving a new type from an existing type.

XML schemas control the location and type of extension allowed.

An element has an extensible content model if in instance documents that element can contain elements and data beyond that specified by the schema. SIMICA schemas should explicitly identify where they can be extended. Only elements from a namespace different from the document namespace should be allowed in an extension. The schema shall use the MaintenanceActionInformation <Extension> type to identify where extension is allowed.

Allowing the extension of a schema using type substitution should be avoided. Schemas should mark elements defined via a simple or complex type with the block attribute set to #all if type substitution is to be avoided. Elements that use type substitution as their means of definition should set the abstract attribute to true.

7. OWL ontology XML schema names and locations

The IEEE provides a download site for material published in association with IEEE Standards, presented in machine friendly format. This material is digital rights management restricted use material. The SIMICA family of standards utilizes this download site to allow easy accessibility to all of the SIMICA family EXPRESS

models, OWL ontologies and XML schemas (and in some cases, example XML instance documents and EXPRESS Information Models).

As depicted by Figure 1, the IEEE Download site (<http://standards.ieee.org/downloads/>) contains several folders, each folder labeled by an associated IEEE standards number (e.g., IEEE Std 1636 standards are in the 1636 folder). Each folder under the ‘base’ IEEE standards number contains the material (XML schemas, etc.) for that family member.

Family members are identified by their ‘dot’ standard number (if it is a ‘dot’ standard) and the year in which that standard was published by the IEEE.

A description of the use of the OWL ontologies, XML schemas, and EXPRESS models associated with the SIMICA family of standards and their publication revisions is available in the SIMICA base document, IEEE Std 1636-2018 Clause 9.

NOTE 1—Standards that are revised will contain a folder for the year in which the standard is reissued. Both folders (for each year the standard was published) will be present on the IEEE download Web site.

NOTE 2—Providing a particular standard has associated material that is to be made available via the download Web site, folders for that standard are not available until the standard is published by the IEEE.

Figure 2 depicts a portion of the IEEE download site, as it pertains to the SIMICA family of standards.

IECNORM.COM : Click to view the full PDF of IEC 61636-2:2023

<http://standards.ieee.org/downloads/>

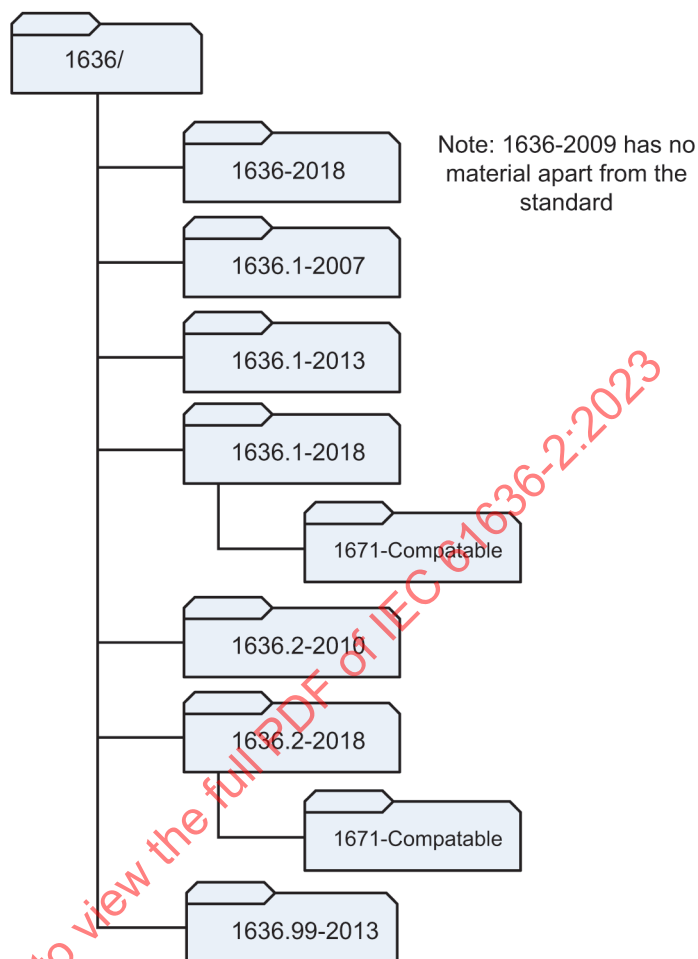


Figure 2—SIMICA related IEEE download site structure

The material available on the IEEE download Web site in association with this document is described in [Table 1](#).

Table 1—IEEE Std 1636.2-2018 folder contents

Component	Defined In:	XML Schema Name	IEEE Download Site Folder (See Figure 2)
XML schema	Annex A	MaintenanceActionInformation.xsd (NOTE 1)	1636/1636.2-2018
XML schema	Annex A	MaintenanceActionInformation.xsd (NOTE 2)	1636/1636.1-2018/1671-Compatible
OWL ontology	Annex A	MAI.owl	1636/1636.2-2018
NOTE 1—Requires the inclusion of the Simica.xsd schema, see IEEE Std 1636-2018.			
NOTE 2—Requires the inclusion of the Common.xsd schema, see IEEE Std 1671-2010.			

Annex A

(normative)

XML schema and OWL ontology

A.1 General

Should the reader not have a general understanding of XML schemas, there are several XML schema tutorials available for reference (see the XML Schema Part 0: Primer [B9], the XML Schema Tutorial [B10] and the XML Schema Tutorial, Part 1 [B11]). These tutorials will help with the understanding of the contents of the MaintenanceActionInformation.xsd schema which this annex is defining the elements.

Should the reader not have a general understanding of OWL ontologies, there are several OWL tutorials available for reference. (see the Tutorial on OWL [B7] and OWL Web Ontology Language Guide–W3C [B5]). These tutorials will help with the understanding of the contents of the MAI.owl ontology which this annex is defining the elements.

A.1 defines Maintenance Action Information with Simica.xsd included; A.2 defines Maintenance Action Information with Common.xsd included.

A.2 MaintenanceActionInformation

Name: *mai:MaintenanceActionInformation*

Type: Element

Description: Shall define the information associated with actions required for the maintenance of a product at a specific level of maintenance or at a repair facility.

XML Definition:

See MaintenanceActionInformation.xsd at: *MaintenanceActionInformation* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *MaintenanceActionInformation* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.2.1 SystemInstanceExtension

Name: *mai:SystemInstanceExtension*

Type: Group

Description: Shall define common system instances for all associated types.

XML Definition:

See MaintenanceActionInformation.xsd at: *SystemInstanceExtension* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *SystemInstanceExtension* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.2.2 ItemMaintained

Name: *mai:ItemMaintained*

Type: Complex

Description: Shall define the actual repair item.

XML Definition:

See MaintenanceActionInformation.xsd at: *ItemMaintained* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *ItemMaintained* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.2.3 Maintainer

Name: *mai:Maintainer*

Type: Complex

Description: Shall define a specific person performing the maintenance action on the system or item the actual repair item.

XML Definition:

See MaintenanceActionInformation.xsd at: *Maintainer* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *Maintainer* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.2.4 MaintenanceAction

Name: *mai:MaintenanceAction*

Type: Complex

Description: Shall be the base type for any element defining a specific action taken in the maintenance of some item or entity.

XML Definition:

See MaintenanceActionInformation.xsd at: *MaintenanceAction* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *MaintenanceAction* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.2.5 MaintenanceReason

Name: *mai:MaintenanceReason*

Type: Complex

Description: Shall define the cause(s) that led to a maintenance action.

XML Definition:

See MaintenanceActionInformation.xsd at: *MaintenanceReason* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *MaintenanceReason* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.2.6 RepairActionInformation

Name: *mai:RepairActionInformation*

Type: Complex

Description: Shall define the work required to restore the unit to an operational state.

XML Definition:

See MaintenanceActionInformation.xsd at: *RepairActionInformation* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *RepairActionInformation* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.2.7 SystemInstance

Name: *mai:SystemInstance*

Type: Complex

Description: Shall be the base type for any element describing a specific target of maintenance against which the maintenance action has been performed.

XML Definition:

See MaintenanceActionInformation.xsd at: *SystemInstance* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

OWL Definition:

See MAI.owl at: *SystemInstance* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.3 MaintenanceActionInformation

Name: *mai:MaintenanceActionInformation*

Type: Element

Description: Shall define the information associated with actions required for the maintenance of a product at a specific level of maintenance or at a repair facility.

XML Definition:

See 1671-Compatible/MaintenanceActionInformation.xsd at: *MaintenanceActionInformation* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.3.1 SystemInstanceExtension

Name: *mai:SystemInstanceExtension*

Type: Group

Description: Shall define common system instances for all associated types.

XML Definition:

See 1671-Compatible/MaintenanceActionInformation.xsd at: *SystemInstanceExtension* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.

A.3.2 ItemMaintained

Name: *mai:ItemMaintained*

Type: Complex

Description: Shall define the actual repair item.

XML Definition:

See 1671-Compatible/MaintenanceActionInformation.xsd at: *ItemMaintained* located in the 1636.2-2018 download at: <https://standards.ieee.org/downloads>.