

IDTA 02013-1-0

Reliability

18. November 2022

SPECIFICATION

Submodel Template of the
Asset Administration Shell



Submodel Template

IDTA approved

- 100% AAS compliant
- Consistent & interoperable
- Released by the AAS experts

Imprint

Publisher

Industrial Digital Twin Association
Lyoner Strasse 18
60528 Frankfurt am Main
Germany
<https://www.industrialdigitaltwin.org/>

Version history

Date	Version	Comment
18.11.2022	1.0	Release of the official Submodel template published by IDTA.

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1 General

1.1 About this document

This document is a part of a specification series. Each part specifies the contents of a Submodel template for the Asset Administration Shell (AAS). The AAS is described in [1], [2], [3] and [6]. First exemplary Submodel contents were described in [4], while the actual format of this document was derived by the "Administration Shell in Practice" [5]. The format aims to be very concise, giving only minimal necessary information for applying a Submodel template, while leaving deeper descriptions and specification of concepts, structures and mapping to the respective documents [1] to [6].

The target group of the specification are developers and editors of technical documentation and manufacturer information, which are describing assets in smart manufacturing by means of the Asset Administration Shell (AAS) and therefore need to create a Submodel instance with a hierarchy of SubmodelElements. This document especially details on the question, which SubmodelElements with which semantic identification shall be used for this purpose.

1.2 Scope of the Submodels

Engineering tools used for the design of safety control system of machinery and similar control systems need functional safety and reliability data.

The purpose of this Submodel is to define the structure and relevant reliability properties for devices suitable for customer demands.

The intended benefits of this Submodel are to:

- reduce the costs, time and efforts of mapping data for each customer request;
- optimize the workflow of information exchange with engineering tools;
- facilitate the selection of a product, especially regarding reliability;
- give access to product data everywhere regardless of country, language and culture;

1.3 Relevant standards for the Submodel template

IEC 60947-1:2020, Low-voltage switchgear and controlgear - Part 1: General rules

IEC 61360-1:2017, Standard data element types with associated classification scheme – Part 1: Definitions – Principles and methods

IEC 62683-1 DB, Low-voltage switchgear and controlgear - Product data and properties for information exchange - Part 1: Catalogue data

IEC 61987 DB, Industrial-process measurement and control - Data structures and elements in process equipment catalogues

IEC 62061:2021, Safety of machinery - Functional safety of safety-related control systems

ISO 13849-1:2015, Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design

VDMA 66413:2012, Functional Safety - Universal data format for safety-related values of components or parts of control system

1.4 Use cases, requirements, and design decisions

Application of the relevant standards (1.3) requires the exchange of relevant data between all concerned: machine manufacturers, device manufacturers and calculation tools.

Device manufacturers create characteristic value libraries for their devices in "universal data format". The device manufacturer is the person who manufactures devices and/or components and makes them available to the machine manufacturer or user in the spirit of the free movement of goods. As a result, the creator of a characteristic value library can and indeed may only be the device manufacturer.

Calculation tool (suppliers) provide a mechanism for importing characteristic value libraries in database format. The characteristic values are prepared for display and selection within the tool.

Machine manufacturers use the characteristic values library (file) provided by the device manufacturer to read and update the characteristic values (device data) within the calculation tool.

[source: VDMA 66413]

2 Submodel Reliability

2.1 Approach

Figure 1 shows the UML-diagram defining the relevant properties which need to be set.

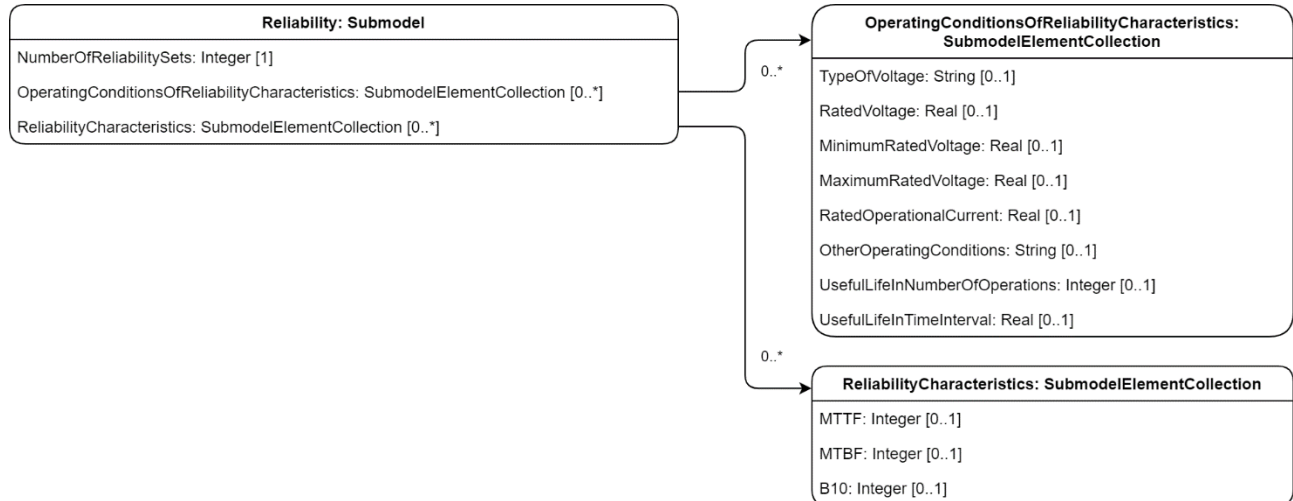


Figure 1: UML-Diagram for Submodel "Reliability"

2.2 Attributes of the Submodel reliability

Table 1: Attributes of the Submodel Reliability

idShort:	Reliability		
Class:	Submodel (SM)		
semanticId:	[IRDI] 0112/2///62683#ACC008#001		
Parent:	Asset Administration Shell, to which the documents shall be associated to		
Explanation:	The Submodel defines a reliability data model for devices to be used by engineering tools for the design of safety related control systems according to IEC 62061, IEC 61508-2 or ISO 13849-1 or for dependability analysis of electrotechnical systems. This Submodel is used to facilitate the exchange between computers of data characterizing safety relevant devices in particular. The data models described in this document is based on the definition in the IEC/CDD 62683-1 DB.		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Property]	[IRDI] 0112/2///62683#ACE006#001	[integer]	1
NumberOfReliabilitySets	cardinality property for the number of sets of characteristics of a product for use in reliability assessment	1	
[SMC]	[IRDI] 0112/2///62683#ACG071#001	n/a	0..*
OperatingConditionsOfReliabilityCharacteristics	operating condition limits for which the reliability characteristics are valid		
[SMC]	[IRDI] 0112/2///62683#ACG080#001	n/a	0..*
ReliabilityCharacteristics	characteristics of a subsystem or a subsystem element intended for evaluating its ability to perform as required, without failure, for a given time interval, under given conditions		

2.3 SubmodelElements of OperatingConditionsOfReliabilityCharacteristics

Table 2: SubmodelElements of OperatingConditionsOfReliabilityCharacteristics

idShort:	OperatingConditionsOfReliabilityCharacteristics		
Class:	SubmodelElementCollection (SMC)		
semanticId:	[[IRDI] 0112/2///62683#ACG071#001		
Parent:	Submodel Reliability		
Explanation:	This SubmodelElementCollection contains information on operating condition limits for which the reliability characteristics are valid.		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Property]	[[IRDI] 0112/2///61987#ABA969#007		
TypeOfVoltage	classification of a power supply according to the time behaviour of the voltage enumeration: AC (AC, 0112/2///61987#ABL837#001), DC (DC, 0112/2///61987#ABL838#001), others (others, 0112/2///61987#ABI407#004)	[string] DC	0..1
[Property]	[[IRDI] 0112/2///61987#ABA588#004		
RatedVoltage	operating voltage of the device as defined by the manufacturer and to which certain device properties are referenced	[real] 24 [V]	0..1
[Property]	[[IRDI] 0112/2///61987#ABD461#004		
MinimumRatedVoltage	lowest operating voltage of the device as defined by the manufacturer	[real] 15 [V]	0..1
[Property]	[[IRDI] 0112/2///61987#ABD462#004		
MaximumRatedVoltage	highest operating voltage of the device as defined by the manufacturer	[real] 30 [V]	0..1
[Property]	[[IRI] https://admin-shell.io/idta/Reliability/RatedOperationalCurrent/1/0		
RatedOperationalCurrent	current combined with a rated operational voltage intended to be switched by the device under specified conditions	[real] 300 [mA]	0..1
[Property]	[[IRDI] 0112/2///62683#ACE070#001		
OtherOperatingConditions	other limits of operation related to functional safety characteristics	[string] Duty in number of operations per hour, 50% of normal current	0..1
[Property]	[[IRDI] 0112/2///62683#ACE055#001		
UsefulLifeInNumberOfOperations	under given conditions, the number of operations for which the failure rate becomes unacceptable	[integer] 50,000	0..1

[Property] UsefulLifeInTime Interval	[IRDI] 0112/2///62683#ACE054#001 under given conditions, the time interval beginning at a given instant of time, and ending when the failure rate becomes unacceptable	[real] 10 [y]	0..1
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2.4 SubmodelElements of ReliabilityCharacteristics

Table 3: SubmodelElements of ReliabilityCharacteristics

idShort:	ReliabilityCharacteristics		
Class:	SubmodelElementCollection (SMC)		
semanticId:	[IRDI] 0112/2///62683#ACG080#001		
Parent:	Submodel Reliability		
Explanation:	This SubmodelElementCollection contains information on characteristics of a subsystem or a subsystem element intended for evaluating its ability to perform as required, without failure, for a given time interval, under given conditions		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Property]	[IRDI] 0112/2///62683#ACE061#001	[integer]	0..1
MTTF	mean operating time to failure: expectation of the operating time to failure Note: In the case of non-repairable items with an exponential distribution of operating times to failure (i.e. a constant failure rate) the MTTF is numerically equal to the reciprocal of the failure rate. This is also true for repairable items if after restoration they can be considered to be "as-good-as-new"	[y]	
[Property]	[IRDI] 0112/2///62683#ACE062#001	[integer]	0..1
MTBF	mean operating time between failure: expectation of the duration of the operating time between failures Note: Mean operating time between failures should only be applied to repairable items. For non-repairable items, see mean operating time to failure.	[y]	
[Property]	[IRI] https://admin-shell.io/idta/Reliability/B10/1/0	[integer]	0..1
B10	mean number of cycles until 10% of the components fail	500000	

Annex A. Explanations on used table formats

1. General

The used tables in this document try to outline information as concise as possible. They do not convey all information on Submodels and SubmodelElements. For this purpose, the definitive definitions are given by a separate file in form of an AASX file of the Submodel template and its elements.

2. Tables on Submodels and SubmodelElements

For clarity and brevity, a set of rules is used for the tables for describing Submodels and SubmodelElements.

- The tables follow in principle the same conventions as in [5].
- The table heads abbreviate 'cardinality' with 'card'.
- The tables often place two information in different rows of the same table cell. In this case, the first information is marked out by sharp brackets [] from the second information. A special case are the semanticIds, which are marked out by the format: (type)(local)[idType]value.
- The types of SubmodelElements are abbreviated:

SME type	SubmodelElement type
Property	Property
MLP	MultiLanguageProperty
Range	Range
File	File
Blob	Blob
Ref	ReferenceElement
Rel	RelationshipElement
SMC	SubmodelElementCollection

- If an idShort ends with '{00}', this indicates a suffix of the respective length (here: 2) of decimal digits, in order to make the idShort unique. A different idShort might be chosen, as long as it is unique in the parent's context.
- The Keys of semanticId in the main section feature only idType and value, such as: [IRI]https://admin-shell.io/vdi/2770/1/0/DocumentId/Id. The attributes "type" and "local" (typically "ConceptDescription" and "(local)" or "GlobalReference" and (non-local)) need to be set accordingly; see [6].
- If a table does not contain a column with "parent" heading, all represented attributes share the same parent. This parent is denoted in the head of the table.
- Multi-language strings are represented by the text value, followed by '@'-character and the ISO 639 language code: example@EN.
- The [valueType] is only given for Properties.

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