

IDTA 02065-1

Submodel Digital Quality Documents

Part 1: Core elements

Version 1.0
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SPECIFICATION

Submodel Template of the
Asset Administration Shell



Submodel Template

IDTA approved

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

Imprint

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Contents

1	General	6
1.1	About this document	6
1.2	Scope of the Submodel	6
1.2.1	Relation of this Submodel to other IDTA Submodels	6
1.3	Relevant standards for the Submodel template	7
1.4	Use cases, requirements and design decisions	7
1.5	Structure of the specification	8
2	Submodel Digital Quality Documents	10
2.1	Approach.....	10
2.2	Properties of the Submodel DQD	10
2.3	Properties of SMC DocumentId	11
2.4	Properties of SMC DocumentClassification.....	12
2.5	Properties of SMC “DocumentInstance”	13
2.6	Properties of the SMC “AdministrativeData”	15
2.6.1	Properties of SMC “CoreData”	16
2.6.2	Properties of Submodel element collection “Items”	18
2.6.3	Properties of the Submodel element list “Statements”	19
2.7	Properties of the SMC “DocumentSignature”	20
Annex A.	Explanations on used table formats	23
3.	General	23
4.	Tables on Submodels and SubmodelElements.....	23
Annex B.	Use case-based definition of granularity	24
	Bibliography	26

Figures

Figure 1: Schematic for semantic mapping of the ISO/IEC 170xx semantic system to the CORE Model for digital quality documents and the AAS semantics for the DQD submodel.....	9
Figure 2: UML diagram of the SMT DigitalQualityDocument	10
Figure 3: UML diagram of Submodel element collection AdministrativeData	15
Figure 4 Illustration of DCC XML document, highlighted with colours indicating levels of detail.	25

Tables

Table 1: List of exemplary use cases for Digital Quality Document Submodel	7
Table 2: Properties of the Submodel DQD	11
Table 3: Properties of the Submodel Element Collection DocumentId	11
Table 4: Properties of the Submodel Element Collection DocumentClassification	12
Table 5: Properties of the Submodel Element Collection "DocumentInstance"	13
Table 6: Properties of the Submodel element collection "AdministrativeData"	15
Table 7: Properties of the Submodel element collection "CoreData"	16
Table 8: Properties of the Submodel element list "Identifications"	17
Table 9: Properties of SMC "Identification"	17
Table 10: Properties of the SMC "Items"	18
Table 11: Properties of the Submodel element collection "Item"	19
Table 12: Properties of SML "Statements"	19
Table 13: Properties of Submodel element collection "Statement"	19
Table 14: Properties of the Submodel Element Collection "DocumentSignature"	20
Table 15: Properties of the Submodel Element Collection "SignedInfo"	21
Table 16: Properties of the Submodel Element Collection "SignatureReference"	22

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 this 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 Submodel

This Submodel template addresses the need to handle documentation, certificates and reports about the conformity of an asset to relevant requirements. These kinds of requirements are usually related to the quality infrastructure (metrology, accreditation, conformity assessment, standards, market surveillance) and the corresponding documents are for the purpose of simplicity called "quality documents" here.

The Submodel aims to provide a Digital Quality Documents (DQD) model that can be transferred across an asset lifecycle. A quality document in the sense of this specification is a (usually machine-readable) document that contains information about quality properties about an asset, with this specification focusing on conformity statements. In general, one asset may have several conformity statements related to different domains and application purposes. For instance, for a measuring instrument there can be statements about calibration (based on ISO/IEC 17025) and about the compliance with explosion protection (ATEX/IECEx). Each instance of the DQD Submodel is then related to one document for each such statement. That is, several instances of the DQD Submodel may exist for one asset at the same time. Moreover, some conformity statements may relate to the product type rather than the individual asset. This is the case, for instance, for type approval in a conformity assessment based on ISO/IEC 17065.

The information contained in the Submodel is inspired by the already developed XML schema for Digital Calibration Certificates (DCC) [7]. This XML schema meets the requirements of ISO/IEC 17025 and can be signed electronically and secured cryptographically. There is an ongoing international harmonization of DCCs, and an increasing number of certificates and reports in other domains than calibration is being developed in a similar way.

Information described in this DQD Submodel regarding the assets of the respective Asset Administration Shell is semantically identified by means of the DCC namespace and dictionaries such as ECLASS and IEC CDD (Common Data Dictionary).

Part 1 of this Submodel focuses on general information expected to be relevant for all types of quality documents, especially with documents related to the ISO/IEC 170xx series in mind. Subsequent versions of this Submodel will extend the general specifications to more specific ones for various domains, such as conformity assessment, reference material, testing, and verification.

1.2.1 Relation of this Submodel to other IDTA Submodels

A quality statement for an asset is considered here as information, e.g., about conformity, that is meant to assess whether the asset is qualified to be used for the intended purpose. The consideration of such quality statements, reference to or use of measurement values and integration of measuring instrument properties are not exclusive to quality documents. For interoperability and consistency with other IDTA Submodel

templates, the series of SMTs for digital quality documents will thus reuse and adopt other Submodel templates.

This SMT inherits elements and semantic structure from the SMT “Handover documentation” (IDTA 02004 version 2.0), which contains all relevant documentation about a product that needs to be provided by the manufacturer or seller to the buyer after or with the product’s purchase. The SMT “Handover documentation” explicitly refers to conformity documentations such as the European CE. The SMT “Digital Quality Documents” extends the SMT “Handover documentation” by means of additional properties and attributes related to specific kinds of quality documents, such as those provided in accordance with the ISO/IEC 170xx series. Therefore, the SMT inherits the structural elements of IDTA 02004 for document identification and classification and augments them with additional properties required for machine-interpretable quality assessment and conformity statements. Subsequent parts of the SMT “Digital Quality Documents” will provide more domain-specific properties, such as specific elements of calibration certificates, reference materials or certificates of conformity. The scope of this SMT is to provide machine access to the actual content of a quality document. The underlying document file itself (e.g., the PDF or XML-based digital file) can be provided via the SMT.

The DocumentDomainId in IDTA 02004-2-0 is defined as the identification of the domain in which the given DocumentId is unique. The domain ID can be, e.g., the name or acronym of the organization that issued the document. For quality documents, in the sense of this specification, there is usually one unique identifier for the document, which may contain parts referring to the issuer of the document, e.g., the testing or calibration laboratory or a notified body. Thus, this SMT uses the property DocumentID from IDTA 02004-2-0 to uniquely identify the quality document.

The DocumentClassification of IDTA 02004-2-0 defines with ClassID 02-04 “Certificates, declarations” a document class that relates to quality documents in the sense considered here. IDTA 02004-2-0 also defines DocumentClassID according to IEC 61355 in section 7 (Annex E). The following ClassIDs are considered of clear relevance to quality documents:

- Q – Quality management documents; safety-describing documents
 - QA – Quality management documents
 - QB – Safety-describing documents
 - QC – Quality verifying documents
- In addition, the following ClassIDs are considered of further potential relevance for quality documents:
 - BB – Reports
 - CB – Approval documents
 - CH – Expertises
 - DD – Technical reports
 - EC – Technical specifications

1.3 Relevant standards for the Submodel template

- ISO/IEC 17000 “Conformity assessment — Vocabulary and general principles”
- ISO/IEC 17025 “General requirements for the competence of testing and calibration laboratories”
- ISO 9001 “Quality management systems — Requirements”
- VDI 2623 “Format für den Austausch von Daten im Prüfmittelmanagement; Definition des Calibration-Data-Exchange-Datenformats (CDE-Datenformat)”

1.4 Use cases, requirements and design decisions

Table 1: List of exemplary use cases for Digital Quality Document Submodel

Use Case	Explanation
Device Onboarding	Integrating a new device into a measurement setup requires accessing the status about the

	conformity with the intended use case for quality management and compliance reasons.
Transfer of device conformity information between machine manufacturers and machine users	With this Submodel, information about the conformity of the device (e.g., with regard to measurement traceability) can be transmitted electronically across different organizations (laboratories and companies) through a standardized API provided for AAS.
Automated preventive maintenance applications	Quality information of a device could serve as base data for a preventive maintenance application. The machine-readable document, such as the XML-based DCC, contains such data and can be accessed via this Submodel.

The following design decisions were taken for this Submodel:

- The design of this Submodel template started from a one-to-one mapping of the DCC elements from the XML version 3.3.x [7] to the elements of the related AAS Submodel. Those elements were selected that are commonly used not only for calibration certificates, but for other types of documents related to the ISO/IEC 170xx series.
- It is assumed that the native XML or PDF file can be attached to the DQD Submodel to create different usage options for the consumer of the Submodel, and to access more detailed information than provided by the Submodel itself.
- When a cryptographically or digitally signed quality document, e.g. a native XML or PDF file, is attached to the DQD, the digital seal to prove originality and authenticity of the document issuer has to be maintained. The attached signed document can serve as primary source of truth, e.g. in auditing use cases, when the full information content of the respective quality document is needed.

1.5 Structure of the specification

Digital Quality Documents are very detailed and complex as they contain a large set of information and data. Alone for the area of calibrations, the corresponding XML schema for a Digital Calibration Certificate (DCC) is a comprehensive structure of detailed and granular elements. Therefore, a single specification covering all kinds of Digital Quality Documents is too complex to handle. To this end, the DQD specification is separated into a set of parts:

- Part 1: Core elements
- Part 2: Digital Quality Documents following the ISO/IEC 17025

Further parts will cover domain specific aspects of other ISO/IEC standards from the 170xx series as sketched in Figure 1 for Certificates of Conformity and Certificates for Reference Material.

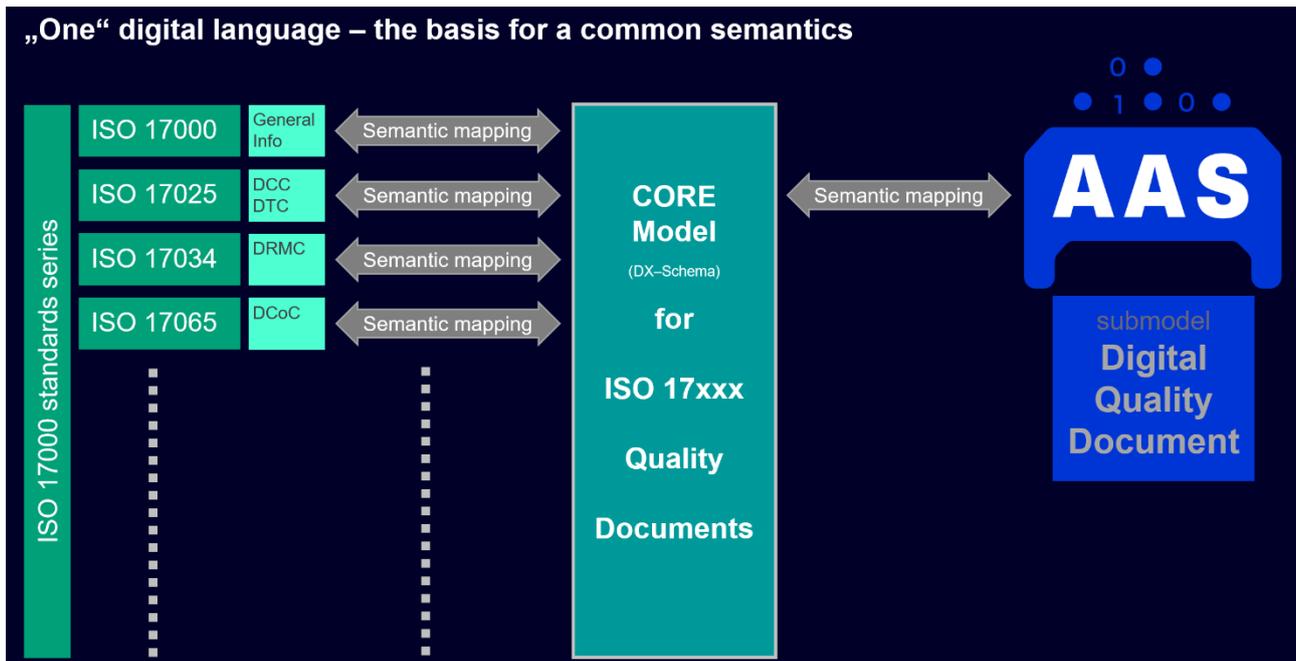


Figure 1: Schematic for semantic mapping of the ISO/IEC 170xx semantic system to the CORE Model for digital quality documents and the AAS semantics for the DQD submodel

2 Submodel Digital Quality Documents

2.1 Approach

The guiding example of the Submodel “Digital Quality Documents” is the calibration of measuring instruments, such as sensors and measurement systems. As a standard, the Asset Administration Shell and the Digital Quality Documents Submodel can help to store the calibration results and their metrological information as well as the calibration certificates in digital form. This enables uniform and faster traceability or re-traceability of calibrations, which increases the transparency of the processes and improves the quality of the application. Therefore, the general approach for the original design of this Submodel is oriented at the XML-based DCC and its use case scenarios, considering different levels of applications for the utilization of calibration certificates in practice. Appendix B contains further description of the development approach and potential evolution of the DQD series to fully represent the current DCC schema content, including such information as measurement values and tolerances.

As described in sections 1.2 and 1.4, Part 1 of the DQD Submodel is intended to be the first and core element in a series that may be extended to other types of quality document and use cases. Part 1 therefore contains only the most essential and widely applicable elements for the intended range of quality assessment scenarios, focusing on asset identification and conformity status (pass / fail). That is, part 1 of the DQD SMT addresses the most basic use case scenario that an operator must be able to ensure that the assets relevant to the process (e.g., of production) comply with the relevant requirements.

Part 2 of the DQD SMT will extend the Submodel with more properties specific for calibration to address further use cases, see Appendix B. In a similar way, further parts of the DQD SMT will extend for use cases in other domains, such as material characterization, explosion protection, and conformity assessment.

2.2 Properties of the Submodel DQD

Figure 2 outlines the structure of the DQD SMT. The figures in the following sections focus on the elements separately to allow closer inspection.

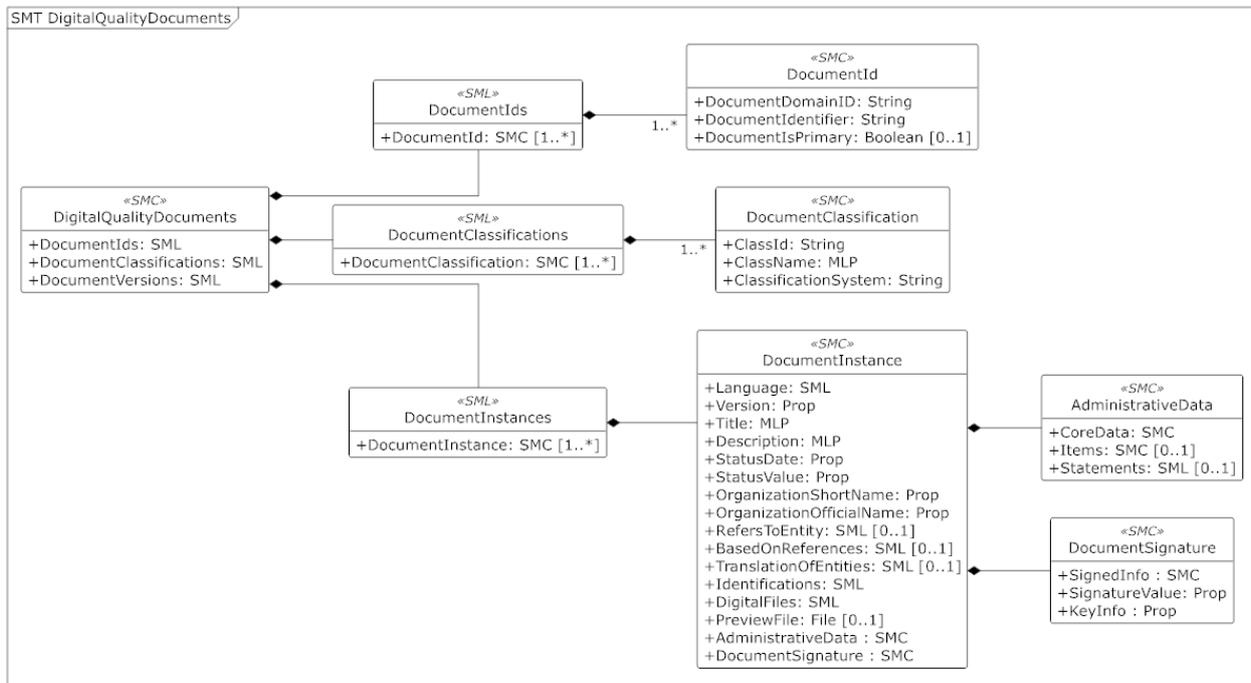


Figure 2: UML diagram of the SMT DigitalQualityDocument

Table 2: Properties of the Submodel DQD

idShort:	DigitalQualityDocuments		
Class:	Submodel (SM)		
semanticId:	https://admin-shell.io/idta/SubmodelTemplate/DigitalQualityDocument/1/0		
Parent:	None		
Explanation:	The Submodel DQD is the collection for various product-related quality information provided by an issuing organization		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[SML] DocumentIds	0173-1#02-ABI501#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABI501-003 Set of document identifiers for the document. One ID in this collection should be used as a preferred ID	[] 1 element	1
[SML] DocumentClassifications	0173-1#02-ABI502#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABI502-003 Set of information for describing the classification of the Document according to ClassificationSystems	[] 1 element	1
[SML] DocumentInstances	0173-1#02-ABI503#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABI503-003 Information elements of individual document instances, which can be different versions of each other	[] 1 element	1

2.3 Properties of SMC DocumentId

The SubmodelElementCollection (SMC) DocumentId identifies the Document in a given Domain. The table convention is explained in Annex A.2 of IDTA-02004-2-0.

Table 3: Properties of the Submodel Element Collection DocumentId

idShort:	DocumentId		
Class:	SubmodelElementCollection (SMC)		
semanticId:	0173-1#02-ABI501#003/0173-1#01-AHF580#003		
Parent:	DocumentIds		
Explanation:	Information about a document identification entity		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	

[Prop] DocumentDomainId	0173-1#02-ABH994#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABH994-003 Identification of the domain in which the given DocumentId is unique. The domain ID can, e.g., be the name or acronym of the providing organisation	[String] D-K-15xxx-01-00	1
[Prop] DocumentIdentifier	0173-1#02-AAO099#004 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-AAO099-004 Alphanumeric character sequence uniquely identifying a document. This can be the UniqueIdentifier from CoreData	[String] 1200-T123456-20241206-102606	1
[Prop] DocumentIsPrimary	0173-1#02-ABH995#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABH995-003 Flag indicating whether a DocumentId within a collection of at least two DocumentIds is the 'primary' identifier for the document. This is the preferred ID of the document (commonly from the point of view of the owner of the asset)	[Boolean] True	0..1

2.4 Properties of SMC DocumentClassification

The SubmodelElementCollection (SMC) "DocumentClassification" contains the information for a classification of a document according to a classification system. A Document might have multiple classifications in multiple systems. The table convention is explained in Annex A.2 of IDTA-02004-2-0.

Table 4: Properties of the Submodel Element Collection DocumentClassification

idShort:	DocumentClassification		
Class:	SubmodelElementCollection (SMC)		
semanticId:	0173-1#02-ABI502#003/0173-1#01-AHF581#003		
Parent:	DocumentClassifications		
Explanation:	Set of information for describing the classification of the Document according to a ClassificationSystem		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Prop] ClassId	0173-1#02-ABH996#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABH996-003 Unique ID of the document class within a classification system	[String] Q	1
[MLP] ClassName	0173-1#02-ABJ219#002 supplementalSemanticId:	[] Quality management documents; safety-	1

	https://api.eclass-cdp.com/0173-1-02-ABJ219-002 Name of the class in the classification system	describing documents	
[Prop] ClassificationSystem	0173-1#02-ABH997#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABH997-003 Identification of the classification system	[String] IEC 61355-1:2008	1

2.5 Properties of SMC “DocumentInstance”

Table 5: Properties of the Submodel Element Collection “DocumentInstance”

idShort:	DocumentInstance		
Class:	SubmodelElementCollection		
semanticId:	0173-1#02-ABI503#003/0173-1#01-AHF582#003		
Parent:	DocumentInstances		
Explanation:	Information about a document instance. This SMC inherits from “DocumentVersion” of IDTA 02004-2-0 “Handover Documentation”		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[SML] Language	0173-1#02-AAN468#008 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-AAN468-008 Language of the document	[] 1 element	1
[Prop] Version	0173-1#02-AAP003#005 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-AAP003-005	[String]	1
[MLP] Title	0173-1#02-ABG940#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABG940-003 Name of the document	[] dcc_template_temperature_30_v0_2	1
[MLP] Description	0173-1#02-AAN466#004 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-AAN466-004 Plain text characterizing the content of the document, e.g., the context of the quality document and its conformity statement.	[] Calibration certificate for RTD thermometer with transmitter and display	1
[Prop] StatusSetDate	0173-1#02-ABI000#003 supplementalSemanticId:	[Date] 2024-12-06	1

	https://api.eclass-cdp.com/0173-1-02-ABI000-003		
	Date when the document status was set. Usually, the date when the quality document was issued		
[Prop] StatusValue	0173-1#02-ABI001#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABI001-003 Each document instance represents a point in time in the asset life cycle. This status value refers to the milestones in the asset life cycle.	[String] Re-calibration	1
[Prop] OrganizationShort Name	https://api.eclass-cdp.com/0173-1-02-ABI002-003 Short name of the organization that issued the quality document instance	[String] D-K-15xxx-01-00	1
[Prop] OrganizationOfficialName	0173-1#02-ABI004#003 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABI004-003 Official name of the organization that issued the document	[String] Professional Calibrations GmbH	1
[SML] RefersToEntities	0173-1#02-ABK288#002 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABK288-002 Forms a generic refers to-relationship to another document or document instance.	[]	0..1
[SML] BasedOnReferences	0173-1#02-ABK289#002 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABK289-002 Forms a based on-relationship to another document or document instance.	[]	0..1
[SML] DigitalFiles	0173-1#02-ABK126#002 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABK126-002 MIME-Type, file name and file contents given by the file SubmodelElement. This holds the actual quality document, e.g., the DCC XML file.	[]	1
[File] PreviewFile	0173-1#02-ABK127#002 supplementalSemanticId: https://api.eclass-cdp.com/0173-1-02-ABK127-002 Provides a preview of the Document Instance, e.g., the human-readable PDF version of the XML file	[] 202506_DCC_v330_TemperaturSensor.pdf	0..1
[SMC] AdministrativeData	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData This Submodel element collection contains all essential administrative information of the quality document	[]	1

<p>[SMC] DocumentSignature</p>	<p>[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature</p> <p>supplementalSemanticId: http://www.w3.org/TR/xmlsig-core1/</p> <p>Information about the electronic signature of the quality document. The semantic structure is based on the W3C schema xmlsig</p>	<p>See Table 14</p>	<p>0..*</p>
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2.6 Properties of the SMC “AdministrativeData”

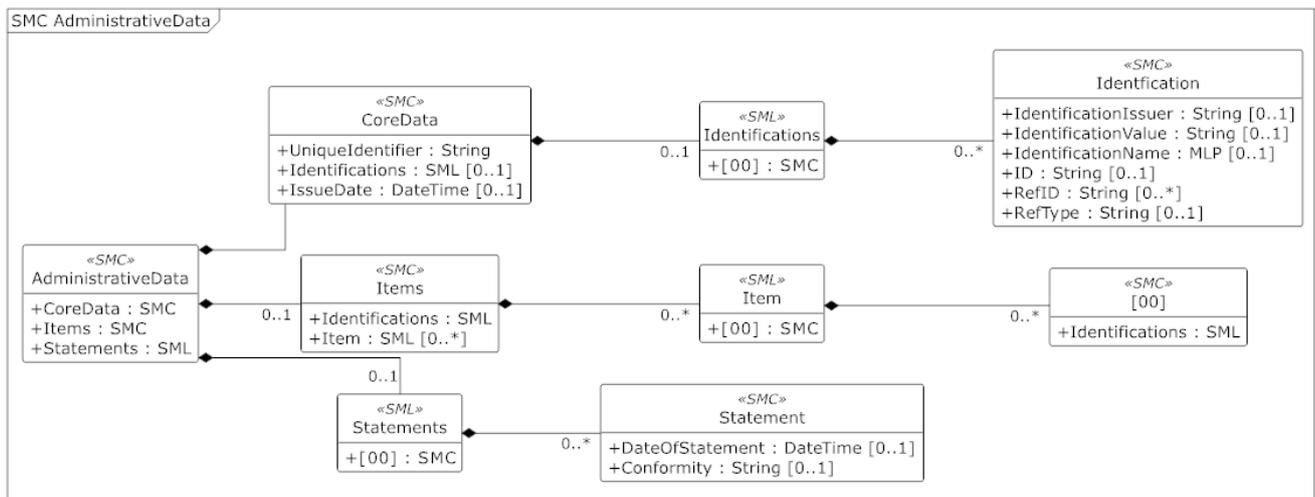


Figure 3: UML diagram of Submodel element collection AdministrativeData

The SMC “AdministrativeData” contains core information about the quality-related properties of the item (asset) in the sense of this SMT. More detailed information is provided in the (optional) attached quality document. Note that the SMC “AdministrativeData” is not related to the AAS common attribute “AdministrativeInformation”, which contains administrative information about an element. Instead, the SMC “AdministrativeData” contains data from a quality document other than the actual measurement, test results and other data.

Table 6: Properties of the Submodel element collection “AdministrativeData”

idShort:	AdministrativeData		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData		
Parent:	DocumentInstance		
Explanation:	This Submodel element collection contains all essential administrative information.		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	

[SMC] CoreData	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData Contains essential administrative information for the quality document	n/a see Table 7	1
[SML] Items	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Items Contains unique identification and description of the asset	n/a see Table 10	[0..1]
[SML] Statements	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statements Contains list of statement records regarding the conformity assessment	n/a see Table 12	[0..1]

2.6.1 Properties of SMC “CoreData”

Table 7: Properties of the Submodel element collection "CoreData"

idShort:	CoreData		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData		
Parent:	AdministrativeData		
Explanation:	Contains essential information for the administrative part of the quality document		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Property] UniqueIdentifier	[IRDI PATH] 0173-1#02-ABI501#001/0173-1#01-AHF580#001 https://admin-shell.io/DataSpecificationTemplates/DataSpecificationlec6/1360/3/0 An identifier for the DQD (e.g., calibration certificate number). The identifier shall be globally unique. Recommended: UUID or issuer-qualified certificate number.	[String] 1200-T123456-20241206-102606	[1]
[SML] Identifications	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications Contains list of identification object(s) to further describe the quality document. Identifications contains identifiers which exactly describe the content of the parent element	[string] N/A See Table 8	[0..1]
[Property] IssueDate	[IRDI] 0173-1#02-ABI000#001 Date when the document has been officially issued	[date] 2023-08-17	[0..1]

Table 8: Properties of the Submodel element list "Identifications"

idShort:	Identifications		
Class:	SubmodelElementList		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications		
Parent:	CoreData		
Explanation:	Contains list of objects that provide exact description of the item(s) or the document itself. Examples are serial number defined by manufacturer or batch number defined by owner.		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[SMC] Identification	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identification It is an object that provides exact identification of the quality document or an item	n/a see Table 9	[0..*]

Table 9: Properties of SMC "Identification"

idShort:	Identification		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identification		
Parent:	Identifications		
Explanation:	It is an object that provides exact description of the quality document.		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Property] IdentificationIssuer	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications/IdentificationIssuer Note: For a Digital Calibration Certificate (DCC), the following values are recommended: manufacturer, calibrationLaboratory, customer, owner, other See also: https://wiki.dcc.ptb.de/en/dccidentificationType	[string] manufacturer	[0..1]
[Property] IdentificationValue	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications/IdentificationValue Placeholder for the actual identification (e.g., serial number)	[string] A3/2024	[0..1]

[MLP] IdentificationName	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications/IdentificationName Other information about the identification	[langString] Calibration mark	[0..1]
[Property] ID	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications/ID Attribute for which the value is unique within the quality document. Is usually used for complex items under quality assessment	[string] Item_1	[0..1]
[Property] RefID	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications/refID Reference to an existing ID within the quality document. Is usually used for complex items under quality assessment	[string] Item_1	[0..*]
[Property] RefType	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications/RefType Specification of a context defining identification	[string] basic_calibrationMark	[0..1]

2.6.2 Properties of Submodel element collection “Items”

Table 10: Properties of the SMC "Items"

idShort:	Items		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Items		
Parent:	AdministrativeData		
Explanation:	Contains unique identification, description and if applicable, conditions of the items		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[SML] Identifications	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications Same as Table 8	n/a see Table 8	[0..1]
[SML] Item	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Item	n/a see Table 11	1

	The element item contains all necessary information about each individual item		
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Table 11: Properties of the Submodel element collection "Item"

idShort:	Item		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Item		
Parent:	Items		
Explanation:	The SMC Item contains all necessary information to identify and describe a system of assets or a single item. Elements defined below are collection of the Item SMC.		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[SML] Identifications	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/CoreData/Identifications Same as Table 8	n/a see Table 8	[0..1]

2.6.3 Properties of the Submodel element list "Statements"

Table 12: Properties of SML "Statements"

idShort:	Statements		
Class:	SubmodelElementList		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statements		
Parent:	AdministrativeData		
Explanation:	Contains list of statement records regarding the quality assessment		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[SMC] Statement	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statement Statement records regarding the quality assessment	See Table 13	[1..*] or [0..*]

Table 13: Properties of Submodel element collection "Statement"

idShort:	Statement
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Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statement		
Parent:	AdministrativeData		
Explanation:	Contains statement regarding the conformity of the item		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Prop] DateOfStatement	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statement/Date Date of statement	[DateTime] 2023-08-17	[0..1]
[Prop] StatementReference	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statement/StatementReference Normative or other reference in accordance which the statement is made.	[String] DKD-R 5-1:2018	[0..1]
[MLP] Declaration	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statement/Declaration Additional information providing context for the statement	[String] The conformity statement is made in accordance with the decision rule "Confidence level 50" with a conformity probability greater than 50%.	[0..1]
[Prop] Conformity	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/AdministrativeData/Statements/Conformity Statement of whether the asset complies with certain requirements according to the quality document. Values can be "pass" or "fail" Note: For some areas such as certification a dedicated statement of conformity is not required, because the existence of the certificate itself is the confirmation	[String] pass	[0..1]

2.7 Properties of the SMC “DocumentSignature”

Table 14: Properties of the Submodel Element Collection “DocumentSignature”

idShort:	DocumentSignature
Class:	SubmodelElementCollection
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature
Parent:	DocumentInstance
Explanation:	Contains information about the electronic signature used for the quality document

[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[SMC] SignedInfo	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo Information about the signature and the algorithms used	[] See Table 15	1
[Prop] SignatureValue	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignatureValue Contains the Base64 encoded result of the hash algorithm, i.e., the signature generated with the parameters specified in the SignatureMethod defined in SignedInfo after applying the algorithm specified by the CanonicalizationMethod.	[String]	1
[Prop] KeyInfo	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/KeyInfo Information to allow the signer to provide recipients with the key that validates the signature, usually in the form of one or more X.509 digital certificates	[String]	0..*

Table 15: Properties of the Submodel Element Collection “SignedInfo”

idShort:	SignedInfo		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo		
Parent:	DocumentSignature		
Explanation:	Information about the signature and the algorithms used		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Prop] CanonicalizationMethod	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo/CanonicalizationMethod Information about the signature and the algorithms used	[String] c14n	1
[Prop] SignatureMethod	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo/SignatureMethod	[String] RSA-SHA1	1

	Information about the method used for creating the signature		
[SMC] SignatureReference	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo/SignatureReference	[] See Table 16	1..*
	Additional information for processing the signature		

Table 16: Properties of the Submodel Element Collection “SignatureReference”

idShort:	SignatureReference		
Class:	SubmodelElementCollection		
semanticId:	https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo/SignatureReference		
Parent:	SignedInfo		
Explanation:	Information about the signature and the algorithms used for processing		
[SME type]	semanticId = [idType]value	[valueType]	card.
idShort	Description@en	example	
[Prop] Transforms	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo/SignatureReference/Transforms Contains the transformations applied to the resource prior to signing	[String] Enveloped Signature	1
[Prop] DigestMethod	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo/SignatureReference/DigestMethod Specifies the hash algorithm before applying the hash	[String] SHA1	1
[Prop] DigestValue	[IRI] https://admin-shell.io/idta/DigitalQualityDocument/1/0/DocumentSignature/SignedInfo/SignatureReference/DigestValue Contains the Base64 encoded result of applying the hash algorithm to the transformed resource	[String]	1

Annex A. Explanations on used table formats

3. General

The tables used in this document outline information as concisely 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.

4. 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 "(no-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.

Annex B. Use case-based definition of granularity

The guiding example of the Submodel “Digital Quality Documents” is the calibration of measuring instruments, such as sensors and measurement systems. As a standard, the Asset Administration Shell and the Digital Quality Documents Submodel can help to store the certified calibration results and their metrological information as well as the calibration certificates in digital form. This enables uniform and faster traceability or retraceability of the calibrations, which increases the transparency of the processes and improves the quality of the application. Therefore, the general approach for the original design of the Submodel was oriented at the XML-based DCC and its use case scenarios. Part 1 of the Submodel considers elements of the XML-based DCC that are also relevant for other types of conformity assessments. The approach for identifying these elements was to consider different levels of applications for the utilization of calibration certificates in practice.

An important aspect of the calibration of sensors, measurement systems and calibration artifacts is the need to regularly check their functionality and accuracy. Sensors can change over time due to aging, environmental influences and other factors, which can lead to a reduction in measurement accuracy. Therefore, it is important to calibrate and check sensors according to the specific requirements (quality management, ISO 9001 ff.) of the application.

Industrial users and use cases have different interests and levels of application with respect to (digital) calibration certificates and calibration data in today’s practice. For our guiding example of a digital calibration certificate (DCC), we distinguished the following levels of applications:

- A Sensor has valid calibration: For basic operations according to a basic level of a production quality system, the operator must ensure that all sensors used for critical applications are calibrated according to process requirements. This can be approved by a valid calibration with a positive conformity statement for the respective sensor or measuring system.
- B Software-based adjustment of the sensor operation based on the calibration measurements at the setpoints defined: The difference between the value measured of the system under test and the reference system for calibration can be used to correct the actual values measured by the respective measurement system to the more precise values of the reference system.
- C Assessment of tolerances and conformity statement: When the allowed tolerances for each set point and the respective deviations as measured for the system under test are conveyed, the operator or user of the data can determine how accurate the system under test was in this calibration. If the deviation is always within the tolerance range, the conformity statement of the calibration certificate can be cross-checked and verified.
- D Full data access and auditing: When full data is conveyed through the Digital Quality Data sub-model, the full information about the calibration service provider, its accreditation details, the actual environmental and influence conditions, the methods of data evaluation as specified, and further details can be directly accessed. This will allow for intrinsic and immediate auditing of production lines, production systems and actual processes of the system owner.

For the development of the first version of the DQD Submodel functionality and scope, the working group focussed on the basic requirements for a DQD dataset according to level A. It focusses on the most important question, if the sensor is calibrated successfully, and the date of this calibration or next calibration due date. The minimum requirement is that the equipment used in production has always a valid calibration. Level A is typically the standard one for all manually operated measuring systems in daily practice.

To answer this question of a valid calibration properly, there needs to be a calibration certificate from a calibration service provider related to the sensor by a unique identification plus the information about the performance date of the calibration and the conformity assessment for the calibration as a pass/fail statement.

To identify the sensor unambiguously, one unique identifier is required. For all products, there is the supplier’s unique identifier as contained in the (digital) nameplate with supplier’s name or web domain, (optional) material number or product identification code plus serial number for the individual device. Depending on the manufacturer’s operational strategy, the serial number can be a unique number for all their

products or just for a material number or product group. In the latter case, only the combination of material number or product identification code plus serial number is unique and thus satisfies the unique identification requirement. Alternatively, a unique identifier from the system owner or operator can be used. In case of a first calibration of a new sensor in manufacturing, only the manufacturer's identification exists. This is the case in our generic DCC example as it is used for the digital quality document sub-model template development.

The digital quality document can support more advanced applications from level B, C and D by providing additional data contained in the respective quality document. Figure 4 shows a complete DCC in an overview for a newly fabricated temperature sensor, made agnostic to the respective calibration service provider. It is not intended to be read, but the four levels defined are colour coded to indicate the amount of data related to the respective level. The following colour coding is applied:

Level A: Sensor has valid calibration (basic))	Green (dark (very basic), brighter (basic))
Level B: Software based adjustment	Yellow
Level C: Assessment of Tolerances and conformity statement	Orange
Level D: Full Data Access and Auditing	Grey



Figure 4 Illustration of DCC XML document, highlighted with colours indicating levels of detail.

For the release of the first version of the DQD Submodel, which is somehow related to the digital calibration certificate (DCC) in the Version 3.3.x of the DCC schema, the team focussed on data for Level A applications. Data necessary for the more advanced levels can be added in an ongoing community effort without impacting the released status as long as the same DCC schema version is used.

A new release of the DQD Submodel template will be needed, when the DCC schema 3.x.y. will be advanced to the more generic schema to support a much broader variety of digital quality documents like Reference Material (DRMC), Test Certificates (DTC) or Test Reports (DTR) and others and also with the respective digital request documents to specify the expected service to the respective service provider.

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