BS EN ISO 19156:2023



BSI Standards Publication

Geographic information — Observations, measurements and samples

Documents
Document Sharing Hub

Full document details: BS EN ISO 19156:2023

National foreword

This British Standard is the UK implementation of EN ISO 19156:2023. It is identical to ISO 19156:2023. It supersedes BS EN ISO 19156:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee IST/36, Geographic information.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 16931 7

ICS 35.240.70

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2023.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS EN ISO 19156:2023

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 19156

May 2023

ICS 35.240.70

Supersedes EN ISO 19156:2013

English Version

Geographic information - Observations, measurements and samples (ISO 19156:2023)

Information géographique - Observations, mesures et échantillons (ISO 19156:2023)

Geoinformation - Erdbeobachtung und Erdmessung (ISO 19156:2023)

This European Standard was approved by CEN on 22 August 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2023 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN ISO 19156:2023 E

Documents
Document Sharing Hub

Full document details: BS EN ISO 19156:2023

European foreword

This document (EN ISO 19156:2023) has been prepared by Technical Committee ISO/TC 211 "Geographic information/Geomatics" in collaboration with Technical Committee CEN/TC 287 “Geographic Information” the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2023, and conflicting national standards shall be withdrawn at the latest by November 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 19156:2013.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Endorsement notice

The text of ISO 19156:2023 has been approved by CEN as EN ISO 19156:2023 without any modification.

Documents
Document Sharing Hub

Full document details: BS EN ISO 19156:2023

Contents

Page

Foreword ix
Introduction x
1 Scope 1
2 Normative references 1
3 Terms and definitions 1
4 Document conventions 5
4.1 Abbreviated terms and acronyms 5
4.2 Schema language 5
4.3 Model element names 6
4.4 Requirements and recommendations 6
4.5 Requirements classes 7
4.6 Conformance classes 7
4.7 Identifiers 8
4.8 Associations in UML context diagrams 8
5 Conformance 8
5.1 Overview 8
5.2 Conformance classes 9
6 Packaging, requirements and dependencies 11
6.1 Requirements 11
6.2 UML 12
6.2.1 UML package structure 12
6.2.2 UML package dependencies 12
6.3 Note on the use of "Any" 14
7 Fundamental characteristics of observations and samples (informative) 14
7.1 Observation schema 14
7.1.1 Property evaluation 14
7.1.2 Observation 15
7.1.3 Properties of an Observation 15
7.1.4 Observation location 16
7.1.5 Result types 16
7.1.6 Use of the observation model 16
7.2 Sample schema 17
7.2.1 Role of sample features 17
7.2.2 Proximate vs. ultimate feature-of-interest 17
7.2.3 Role of samples 18
7.2.4 Sampling process 18
7.2.5 Classification of samples 19
7.3 Alignment between Observation, Sample and domain models 19
7.3.1 Model consistency 19
7.3.2 Relationship between Sample and domain features 22
8 Conceptual Observation schema 25
8.1 General 25
8.1.1 Conceptual Observation model 25
8.1.2 Conceptual Observation schema package Requirements Class 26
8.1.3 Association relatedObservation 26
8.2 Observation 27
8.2.1 Observation Requirements Class 27
8.2.2 Interface Observation 27
8.2.3 Attribute phenomenonTime 28
8.2.4 Attribute resultTime 28
8.2.5 Attribute validTime 28

Documents
Document Sharing Hub

© ISO 2023 – All rights reserved

Full document details: BS EN ISO 19156:2023

8.2.6 Association featureOfInterest 29
8.2.7 Association observedProperty 29
8.2.8 Association result 29
8.2.9 Association observingProcedure 30
8.2.10 Association observer 30
8.2.11 Association host 30
8.2.12 Constraint Observer or Host 30
8.2.13 Constraint ObservableProperty characteristic associated with featureOfInterest 30
8.2.14 Constraint suitable ObservableProperty 30
8.2.15 Constraint suitable result type 30
8.2.16 Constraint unit of measure 31
8.3 ObservableProperty 31
8.3.1 ObservableProperty Requirements Class 31
8.3.2 Interface ObservableProperty 31
8.3.3 Association observer 32
8.4 Procedure 32
8.4.1 Procedure Requirements Class 32
8.4.2 Interface Procedure 32
8.5 ObservingProcedure 32
8.5.1 ObservingProcedure Requirements Class 32
8.5.2 Interface ObservingProcedure 32
8.5.3 Association observer 33
8.6 Observer 33
8.6.1 Observer Requirements Class 33
8.6.2 Interface Observer 33
8.6.3 Association observableProperty 34
8.6.4 Association observingProcedure 34
8.6.5 Association deployment 34
8.7 Host 34
8.7.1 Host Requirements Class 34
8.7.2 Interface Host 34
8.7.3 Association deployment 35
8.7.4 Association relatedHost 35
8.8 Deployment 35
8.8.1 Deployment Requirements Class 35
8.8.2 Interface Deployment 35
8.8.3 Association observer 35
8.8.4 Association host 35

9 Abstract Observation Core 36
9.1 General 36
9.1.1 Abstract Observation Core Package Requirements Class 36
9.1.2 Association metadata 36
9.2 AbstractObservationCharacteristics 36
9.2.1 AbstractObservationCharacteristics Requirements Class 36
9.2.2 Feature type AbstractObservationCharacteristics 38
9.2.3 Attribute observationType 39
9.2.4 Attribute parameter 39
9.2.5 Attribute resultQuality 39
9.2.6 Association proximateFeatureOfInterest 40
9.2.7 Association ultimateFeatureOfInterest 40
9.2.8 Association collection 41
9.3 AbstractObservation 41
9.3.1 AbstractObservation Requirements Class 41
9.3.2 Constraint observationType 42
9.3.3 Constraint resultTime instant 42
9.3.4 Constraint parameter unique name 42
9.3.5 Constraint proximate or ultimate featureOfInterest. 42

© ISO 2023 – All rights reserved
AVA Documents Document Sharing Hub
Full document details: BS EN ISO 19156:2023

9.3.6 Constraint Observer or Host ... 42
9.3.7 Constraint ObservableProperty characteristic associated with featureOfInterest ... 42
9.3.8 Constraint suitable ObservableProperty ... 42
9.3.9 Constraint suitable result type ... 42
9.4 AbstractObservableProperty ... 42
9.4.1 AbstractObservableProperty Requirements Class ... 42
9.5 AbstractObservingProcedure ... 43
9.5.1 AbstractObservingProcedure Requirements Class ... 43
9.6 AbstractObserver ... 45
9.6.1 AbstractObserver Requirements Class ... 45
9.7 AbstractHost ... 46
9.7.1 AbstractHost Requirements Class ... 46
9.8 AbstractDeployment ... 47
9.8.1 AbstractDeployment Requirements Class ... 47
9.8.2 Attribute deploymentReason ... 48
9.8.3 Attribute deploymentTime ... 49
9.9 AbstractObservationCollection ... 49
9.9.1 AbstractObservationCollection Requirements Class ... 49
9.9.2 Feature type AbstractObservationCollection ... 50
9.9.3 Attribute collectionType ... 50
9.9.4 Association member ... 51
9.9.5 Association memberCharacteristics ... 51
9.9.6 Association relatedCollection ... 51
9.10 NamedValue ... 51
9.10.1 NamedValue Requirements Class ... 51
9.10.2 Data type NamedValue ... 51
9.10.3 Attribute name ... 51
9.10.4 Attribute value ... 52
9.11 Codelists ... 52
9.11.1 AbstractObservationType ... 52
9.11.2 AbstractObservationCollectionType ... 52

10 Basic Observations ... 52
10.1 General ... 52
10.1.1 Basic Observations Package Requirements Class ... 52
10.1.2 Attribute link ... 53
10.1.3 Attribute location ... 53
10.2 Observation ... 53
10.2.1 Observation Requirements Class ... 53
10.3 ObservationCharacteristics ... 55
10.3.1 ObservationCharacteristics Requirements Class ... 55
10.4 ObservationCollection ... 55
10.4.1 ObservationCollection Requirements Class ... 55
10.5 ObservingCapability ... 55
10.5.1 ObservingCapability Requirements Class ... 55
10.5.2 Feature type ObservingCapability ... 57
10.6 ObservableProperty ... 58
10.6.1 ObservableProperty Requirements Class ... 58
10.7 ObservingProcedure ... 59
10.7.1 ObservingProcedure Requirements Class ... 59
10.8 Observer ... 61
10.8.1 Observer Requirements Class ... 61
10.9 Host ... 62
10.9.1 Host Requirements Class ... 62
10.10 Deployment ... 65
10.10.1 Deployment Requirements Class ... 65
10.11 GenericDomainFeature ... 66
10.11.1 GenericDomainFeature Requirements Class ... 66

Documents
Document Sharing Hub

© ISO 2023 – All rights reserved

Full document details: BS EN ISO 19156:2023

10.11.2 Feature type GenericDomainFeature ... 69
10.12 Codelists ... 69
10.12.1 ObservationCollectionType ... 69
10.12.2 ObservationTypeByResultType ... 71

11 Conceptual Sample schema ... 72
11.1 General ... 72
11.1.1 Conceptual Sample schema model ... 72
11.1.2 Conceptual Sample Schema package Requirements Class ... 73
11.2 Sample ... 74
11.2.1 Sample Requirements Class ... 74
11.2.2 Interface Sample ... 74
11.2.3 Association sampling ... 74
11.2.4 Association preparationStep ... 75
11.2.5 Association sampledFeature ... 75
11.2.6 Association relatedSample ... 75
11.3 Sampling ... 75
11.3.1 Sampling Requirements Class ... 75
11.3.2 Interface Sampling ... 76
11.3.3 Association sample ... 76
11.3.4 Association featureOfInterest ... 76
11.3.5 Association sampler ... 76
11.3.6 Association samplingProcedure ... 77
11.3.7 Association relatedSampling ... 77
11.4 Sampler ... 77
11.4.1 Sampler Requirements Class ... 77
11.4.2 Interface Sampler ... 77
11.4.3 Association sampling ... 77
11.4.4 Association implementedProcedure ... 78
11.5 PreparationStep ... 78
11.5.1 PreparationStep Requirements Class ... 78
11.5.2 Interface PreparationStep ... 78
11.5.3 Association processingDetails ... 78
11.5.4 Association preparedSample ... 78
11.6 PreparationProcedure ... 78
11.6.1 PreparationProcedure Requirements Class ... 78
11.6.2 Interface PreparationProcedure ... 79
11.6.3 Association samplePreparationStep ... 79
11.7 SamplingProcedure ... 79
11.7.1 SamplingProcedure Requirements Class ... 79
11.7.2 Interface SamplingProcedure ... 79
11.7.3 Association sampling ... 79
11.7.4 Association sampler ... 80

12 Abstract Sample Core ... 80
12.1 General ... 80
12.1.1 Abstract Sample Core Package Requirements ... 80
12.2 AbstractSample ... 80
12.2.1 AbstractSample Requirements Class ... 80
12.2.2 Attribute sampleType ... 82
12.2.3 Attribute parameter ... 82
12.3 AbstractSampling ... 82
12.3.1 AbstractSampling Requirements Class ... 82
12.3.2 Attribute samplingLocation ... 83
12.3.3 Attribute time ... 83
12.3.4 Attribute parameter ... 83
12.4 AbstractSampler ... 84
12.4.1 AbstractSampler Requirements Class ... 84
12.4.2 Attribute samplerType ... 85

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

12.5 AbstractSamplingProcedure 86
12.5.1 AbstractSamplingProcedure Requirements Class 86
12.6 AbstractPreparationProcedure 87
12.6.1 AbstractPreparationProcedure Requirements Class 87
12.7 AbstractPreparationStep 88
12.7.1 AbstractPreparationStep Requirements Class 88
12.7.2 Attribute description 89
12.7.3 Attribute time 89
12.8 Codelists 89
12.8.1 AbstractSampleType 89
12.8.2 AbstractSamplerType 89

13 Basic Samples 90
13.1 General 90
13.1.1 Basic Samples Package Requirements Class 90
13.2 Sample 90
13.2.1 Sample Requirements Class 90
13.3 SpatialSample 92
13.3.1 SpatialSample Requirements Class 92
13.3.2 Feature type SpatialSample 92
13.3.3 Attribute shape 92
13.3.4 Attribute horizontalPositionalAccuracy 93
13.3.5 Attribute verticalPositionalAccuracy 93
13.4 MaterialSample 93
13.4.1 MaterialSample Requirements Class 93
13.4.2 Feature type MaterialSample 93
13.4.3 Attribute size 94
13.4.4 Attribute storageLocation 94
13.4.5 Attribute sourceLocation 94
13.5 StatisticalSample 94
13.5.1 StatisticalSample Requirements Class 94
13.5.2 Feature type StatisticalSample 95
13.5.3 Attribute classification 95
13.6 Sampling 95
13.6.1 Sampling Requirements Class 95
13.7 Sampler 96
13.7.1 Sampler Requirements Class 96
13.8 SamplingProcedure 97
13.8.1 SamplingProcedure Requirements Class 97
13.9 PreparationProcedure 99
13.9.1 PreparationProcedure Requirements Class 99
13.10 PreparationStep 100
13.10.1 PreparationStep Requirements Class 100
13.11 SampleCollection 102
13.11.1 SampleCollection Requirements Class 102
13.11.2 Feature type SampleCollection 102
13.11.3 Association member 103
13.11.4 Association relatedCollection 103
13.12 PhysicalDimension 103
13.12.1 PhysicalDimension Requirements Class 103
13.12.2 Data type PhysicalDimension 103
13.12.3 Attribute dimension 103
13.12.4 Attribute value 103
13.13 NamedLocation 104
13.13.1 NamedLocation Requirements Class 104
13.13.2 Data type NamedLocation 104
13.13.3 Attribute address 104
13.13.4 Attribute name 104
13.13.5 Attribute representativeGeometry 104

Documents
Document Sharing Hub

© ISO 2023 – All rights reserved

Full document details: BS EN ISO 19156:2023

13.14 StatisticalClassification 104
13.14.1 StatisticalClassification Requirements Class 104
13.14.2 Data type StatisticalClassification 105
13.14.3 Attribute concept 105
13.14.4 Attribute classification 105
13.15 Codelists 105
13.15.1 SampleTypeByGeometryType 105

Annex A (normative) **Abstract test suite** **107**

Annex B (informative) **Common usage of OMS concepts** **117**

Annex C (informative) **Changes in the Observation and Sample modelsbetween ISO 19156:2011 and ISO 19156:2023 (this document)** **121**

Annex D (informative) **Best practices in use of the Observation and Sampling models** **139**

Annex E (informative) **Detailed package overview diagrams** **147**

Bibliography **150**

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Geographic Information,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement), and in collaboration with the Open Geospatial Consortium (OGC).

This second edition cancels and replaces the first edition (ISO 19156:2011), which has been technically revised.

The main changes are as follows:

— the UML model and the requirements/conformance class structure has been completely redesigned to address the contemporary modelling and observation data provision use cases;

— the fundamental Observation model has remained largely the same as in ISO 19156:2011, but certain carefully designed improvements and clarifications for the intended use have been included;

— the Sample model has been refined: given the integral nature of the Sample model, is has been decided to include that term in the name of the document;

— Annex C has been added listing the changes between ISO 19156:2011 and this document.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

Introduction

This document arises from work originally undertaken through the Open Geospatial Consortium's Sensor Web Enablement (SWE) activity. A set of interfaces and protocols was standardized through which applications and services are able to access sensors of all types, and observations generated by them, over the Web.

A new generation of geospatial standards is now emerging, based on general Web standards, architecture and current practice, as described in W3C Spatial Data on the Web Best Practices.[31] This includes several new standards for describing and publishing sensors and observations, such as the OGC SensorThings API[22] and the W3C/OGC Semantic Sensor Network Ontology.[28] This second edition of ISO 19156 (now named "Observations, Measurements and Samples", or abbreviated to "OMS") is informed by these recent developments. The focus of revising ISO 19156:2011 is aimed at enabling the publication of observation data as part of the Web of data, while also supporting other means of data exchange.

The content presented in this document is derived from the previous edition published by Open Geospatial Consortium as OGC 10-004r3, and also ISO 19156:2011. A technical note describing the changes in comparison to ISO 19156:2011 is provided in Annex C.

The name and contact information of the maintenance agency for this document can be found at www.iso.org/maintenance_agencies.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

Geographic information — Observations, measurements and samples

1 Scope

This document defines a conceptual schema for observations, for features involved in the observation process, and for features involved in sampling when making observations. These provide models for the exchange of information describing observation acts and their results, both within and between different scientific and technical communities.

Observations commonly involve sampling of an ultimate feature-of-interest. This document defines a common set of sample types according to their spatial, material (for ex situ observations) or statistical nature. The schema includes relationships between sample features (sub-sampling, derived samples).

This document concerns only externally visible interfaces and places no restriction on the underlying implementations other than what is needed to satisfy the interface specifications in the actual situation.

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.

ISO 19103, *Geographic information — Conceptual schema language*

ISO 19107, *Geographic information — Spatial schema*

ISO 19108, *Geographic information — Temporal schema*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
application schema
conceptual schema for data required by one or more applications

[SOURCE: ISO 19101-1:2014, 4.1.2]

3.2
coverage
feature that acts as a function to return values from its range for any direct position within its domain

[SOURCE: ISO 19123-1:—,[1)] 3.1.8]

1) Under preparation. Stage at the time of publication: ISO/FDIS 19123-1:2023.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

3.3
data type
specification of a value domain with operations allowed on values in this domain

EXAMPLE Integer, Real, Boolean, String and Date.

Note 1 to entry: Data types include primitive predefined types and user-definable types.

[SOURCE: ISO 19103:2015, 4.14]

3.4
domain
well-defined set

Note 1 to entry: All elements within a domain (set) are of a given type.

[SOURCE: ISO 19109:2015, 4.8, modified — Original Note 1 to entry has been replaced with a new Note 1 to entry.]

3.5
domain feature
feature of a type defined within a particular application domain

Note 1 to entry: This can be contrasted with observations and sampling features, which are features of types defined for cross-domain purposes.

3.6
ex situ
off-site
referring to the study, maintenance or conservation of a specimen or population away from its natural surroundings

Note 1 to entry: Opposite of in situ (on-site).

Note 2 to entry: An example of ex situ and direct is measuring a patient's temperature with a mercury thermometer in a blood sample.

Note 3 to entry: An example of ex situ and remote is measuring a patient's temperature with an infra-red thermometer pointed at the blood sample.

3.7
feature
abstraction of real-world phenomena

Note 1 to entry: A feature can occur as a type or an instance. In this document, feature instance is meant unless otherwise specified.

[SOURCE: ISO 19101-1:2014, 4.1.11, modified — Note 1 to entry has been modified.]

3.8
feature-of-interest
subject of the observation

3.9
feature type
class of features having common characteristics

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

3.10
in situ
on-site
referring to the study, maintenance or conservation of a specimen or population without removing it from its natural surroundings

Note 1 to entry: Opposite of ex situ (off-site).

Note 2 to entry: An example of in situ and direct is measuring a patient's temperature with a mercury thermometer in the patient's rectum.

Note 3 to entry: An example of in situ and remote is measuring a patient's temperature with an infra-red thermometer at a distance.

3.11
measure
<GML> value described using a numeric amount with a scale or using a scalar reference system

Note 1 to entry: When used as a noun, measure is a synonym for physical quantity.

[SOURCE: ISO 19136-1:2020, 3.1.41]

3.12
measurement
set of operations having the object of determining the value of a quantity

[SOURCE: ISO 19101-2:2018, 3.21]

3.13
observation
act carried out by an observer to determine the value of an observable property of an object (feature-of-interest) by using a procedure, with the value provided as the result

3.14
observation result
estimate of the value of a property determined through a known observation procedure

3.15
observer
identifiable entity that can generate observations pertaining to an observable property by implementing a procedure

Note 1 to entry: An observer is an instance of a sensor, instrument, implementation of an algorithm or a being such as a person.

3.16
procedure
specified way to carry out an activity or a process

[SOURCE: ISO 9000:2015, 3.4.5, modified — Note 1 to entry has been deleted.]

3.17
process
set of interrelated or interacting activities that use inputs to deliver an intended result

[SOURCE: ISO 9000:2015, 3.4.1, modified — Notes 1-6 have been deleted.]

3.18
property
facet or attribute of an object referenced by a name

EXAMPLE Abby's car has the colour red, where "colour red" is a property of the car.

Documents
Document Sharing Hub

© ISO 2023 – All rights reserved

Full document details: BS EN ISO 19156:2023

Note 1 to entry: In some communities, the observed property is referred to as the measurand.

[SOURCE: ISO 19143:2010, 4.21, modified — Example and note have been added to the entry.]

3.19
property type
characteristic of a feature type

EXAMPLE Cars (a feature type) all have a characteristic colour, where “colour” is a property type.

Note 1 to entry: The value for an instance of an observable property type can be estimated through an act of observation.

Note 2 to entry: In chemistry-related applications, the term “determinand” or “analyte” is often used.

3.20
proximate feature-of-interest
entity that is directly of interest in the act of observing

Note 1 to entry: This is a specialized form of the feature-of-interest.

3.21
range
<coverage> set of feature attribute values associated by a function, the coverage, with the elements of the domain of a coverage

Note 1 to entry: This is consistent with the more generic definition of "range" in ISO 19107.

[SOURCE: ISO 19123-1:—, 3.1.47]

3.22
sample
object that is representative of a concept, real-world object or phenomenon

3.23
sampler
device or entity (including humans) that is used by, or implements, a sampling procedure to create or transform one or more sample(s)

3.24
sensor
element of a measuring system that is directly affected by a phenomenon, body, or substance carrying a quantity to be measured

[SOURCE: JCGM 200:2012, 3.8, modified — EXAMPLES and NOTE deleted.]

3.25
ultimate feature-of-interest
entity that is ultimately of interest in the act of observing

Note 1 to entry: This is a specialized form of the feature-of-interest.

3.26
unit of measure
reference quantity chosen from a unit equivalence group

Note 1 to entry: In positioning services, the usual units of measurement are either angular units or linear units. Implementations of positioning services shall clearly distinguish between SI units and non-SI units. When non-SI units are employed, it is required that their relation to SI units be specified.

[SOURCE: ISO 19116:2019, 3.29]

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

3.27
value
element of a type domain

Note 1 to entry: A value considers a possible state of an object within a class or type (domain).

Note 2 to entry: A data value is an instance of a datatype, a value without identity.

Note 3 to entry: A value can use one of a variety of scales including nominal, ordinal, ratio and interval, spatial and temporal. Primitive datatypes can be combined to form aggregate datatypes with aggregate values, including vectors, tensors and images.

[SOURCE: ISO/IEC 19501:2005, 0000_5, modified — Notes 1- 3 to entry have been added.]

4 Document conventions

4.1 Abbreviated terms and acronyms

CIS	Coverage Implementation Schema
EO	Earth observation
GFM	General Feature Model
GML	Geography Markup Language
INSPIRE	Infrastructure for Spatial Information in Europe
O&M	Observations and measurements
OMS	Observations, measurements and samples (this document)
OGC	Open Geospatial Consortium
RDA	Research Data Alliance
SensorML	OGC Sensor Model Language
SOS	OGC Sensor Observation Service
STA	OGC SensorThings API
SWE	OGC Sensor Web Enablement
UML	Unified Modeling Language
UoM	unit of measure
URI	Uniform Resource Identifier
XML	Extensible Markup Language
2-D	two-dimensional
3-D	three-dimensional

4.2 Schema language

The conceptual schema specified in this document is in accordance with the Unified Modelling Language (UML, ISO/IEC 19501), following the guidance of ISO 19103.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

The UML in Abstract Core and Basic packages is conformant with the profile described in ISO 19136-1:2020, Annex E. Use of this restricted idiom supports direct transformation into a GML Application Schema. The stereotype «FeatureType» states that a class is an instance of the «metaclass» FeatureType (ISO 19109) and therefore represents a feature type.

The prose explanation of the model uses the term "property" to refer to both class attributes and association roles. This is consistent with the General Feature Model described in ISO 19109. In the context of properties, the term "value" refers to either a literal (for attributes whose type is simple), or to an instance of the class providing the type of the attribute or target of the association. Within the explanation, the property names (property types) are sometimes used as natural language words where this assists in constructing a readable text.

4.3 Model element names

This document specifies a model for observations using terminology that is based on current practice in a variety of scientific and technical disciplines. It is designed to be applied across disciplines, so the best or "most neutral" term has been used in naming the classes, attributes and associations provided. The terminology does not, however, correspond precisely with any single discipline. As an aid to implementers, a mapping from the element names specified in this document to common terminology in related application domains is provided in Annex B.

4.4 Requirements and recommendations

All requirements are normative and each is presented with the following template:

Requirement /req/{pkg}/{classM}/{reqN}	[Normative statement]

where **/req/{pkg}/{classM}/{reqN}** identifies the requirement. The use of this layout convention allows the normative provisions of this document to be easily located by implementers.

All defined classes, attributes and associations mentioned within requirements or recommendations are shown in **bold**. These correspond to references to the definition of the referenced element.

The following base (/req/{pkg}/) has been used per package:

a) **/req/obs-cpt**: Conceptual Observation schema;

b) **/req/obs-core**: Abstract Observation Core;

c) **/req/obs-basic**: Basic Observations;

d) **/req/sam-cpt**: Conceptual Sample schema;

e) **/req/sam-core**: Abstract Sample core;

f) **/req/sam-basic**: Basic Samples.

In the lines below, the base (/req/{pkg}/) has been left out for better readability.

For naming of individual requirements pertaining to classes, the following syntax is used.

— **{Class Name}-sem**: The semantic definition of the concept, together with the naming of the Class.

For naming of individual requirements pertaining to attributes or associations, the following syntax is used.

— **{Attribute/Association Name}-sem**: The semantic definition of the concept, together with the naming of the attribute or association role. Except for cases where concepts are mandatory within all packages, these statements are phrased to be cardinality-neutral, e.g. they apply to cardinality 0..*.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

— **{Attribute/Association Name}-type**: Type information pertaining to the attribute or association when the type is constrained within one model package.

— **{Attribute/Association Name}-card**: Cardinality information pertaining to the attribute or association, when the cardinality is constrained within one model package.

— **{Attribute/Association Name}-con**: Additional constraints. As these sometimes pertain to multiple attributes or associations, this part of the name can become more complex.

Individual requirements are case-sensitive, following UML naming conventions. Requirements pertaining to classes contain the class name in UpperCamelCase. Requirements pertaining to attributes or associations utilize the attribute name or association role name in lowerCamelCase.

All recommendations are informative and each is presented with the following template:

Recommendation /rec/{pkg}/{classM}/{recO}	[Informative statement]

where **/rec/{pkg}/{classM}/{recO}** identifies the recommendation. The use of this layout convention allows the informative provisions of this document to be easily located by implementers.

4.5 Requirements classes

Each statement (requirement or recommendation) in this document is a member of a requirements class.

All requirement classes are normative.

Each requirements class is described in a discrete clause and summarized using the following template:

Requirements class	**/req/{pkg}/{classM}**
Target type	[artefact or technology type]
Name	Name of the requirements class
Imports	/req/{pkg}/{classZ}
Requirement	/req/{pkg}/{classM}/{reqN}
Recommendation	/rec/{pkg}/{classM}/{recO}
Requirement	/req/{pkg}/{classM}/{reqP}
Requirement/Recommendation	[repeat as necessary]

All requirements in a class shall be satisfied. Hence, the requirements class is the unit of re-use and dependency.

Dependency to another requirements class (and the requirements and recommendations defined in it) is done using the “Imports” keyword. All requirements in a dependency shall also be satisfied by a conforming implementation.

A requirements class may consist only of dependencies and introduce no new requirements.

4.6 Conformance classes

Conformance to this document is possible at a number of levels, specified by conformance classes in accordance with Annex A. Each conformance class is summarized using the following template:

Conformance class	**/conf/{pkg}/{classM}**
Requirements	[Identifier for the requirements class]
Test purpose	[Reason for test]
Test method	[Method to determine if test fulfilled]
Test type	[Type of test]

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

All tests in a class shall be passed. Each conformance class tests conformance to a set of requirements packaged in a requirements class.

4.7 Identifiers

Each requirements class, requirement and recommendation is identified by a unique identifier. This allows cross-referencing of class membership, dependencies and links from each conformance test to the requirements tested. Appended to a base Uniform Resource Identifier (URI) that identifies the specification as a whole, it enables the construction of a complete URI for identification in an external context.

The entire Requirements and Conformance Structure, consisting of the individual requirements and definitions together with the information on how these are linked together for the creation of Requirements and Conformance classes, will be exposed in a machine-actionable format (such as the one provided by the OGC Definitions Server).

The URI for each requirements class has the form:

http://www.opengis.net/spec/om/3.0/req/pkg/classM

The URI for each requirement has the form:

http://www.opengis.net/spec/om/3.0/req/pkg/classM/reqN

The URI for each recommendation has the form:

http://www.opengis.net/spec/om/3.0/rec/pkg/classM/recO

The URI for each conformance class has the form:

http://www.opengis.net/spec/om/3.0/conf/pkg/classM

4.8 Associations in UML context diagrams

The UML model described in this document is rather complex. To keep the text size readable in the UML, context diagrams of this document only display certain associations of each class. Please refer to the context diagram of a particular class to see all associations of that class. All associations of the classes in each package are also shown in the detailed package overview diagrams in Annex E.

5 Conformance

5.1 Overview

Clauses 8 to 13 of this document use UML to present conceptual schemas for describing Observations. These schemas define conceptual classes that:

a) may be considered to comprise a cross-domain application schema; or

b) may be used in application schemas, profiles and implementation specifications.

This flexibility is controlled by a set of UML types that can be implemented in a variety of manners. Use of alternative names that are more familiar in a particular application is acceptable, provided that there is a one-to-one mapping to classes and properties in this document.

The UML model in this document defines conceptual classes. Various software systems define implementation classes or data structures. All of these reference the same information content. The same name may be used in implementations as in the model, so that types defined in the UML model may be used directly in application schemas.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

Annex A defines a set of conformance tests that will support applications whose requirements range from the minimum necessary to define data structures to full object implementation.

5.2 Conformance classes

The conformance rules for Models in general are described in ISO 19109. Application Schemas also claiming conformance to this document shall also conform to the rules specified in Clauses 8 to 13 and pass all relevant test cases of the Abstract Test Suite in Annex A.

Depending on the characteristics of the implementing model application, schema or profile, one or more of the declared conformance classes can be chosen for fine-grained Observations, measurements and samples (OMS) conformance. Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6 list all of these classes by package, including their relative identifiers and the corresponding subclauses of the Abstract Test Suite. The full URIs of the conformance classes are formed by prefixing the relative URI path as described in 4.7.

Table 1 — Conceptual Observation schema conformance classes

Conformance class	Identifier	Subclause
Conceptual Observation schema package	/conf/obs-cpt	A.1.1
Conceptual Observation – Deployment	/conf/obs-cpt/Deployment	A.1.2
Conceptual Observation – Host	/conf/obs-cpt/Host	A.1.3
Conceptual Observation – ObservableProperty	/conf/obs-cpt/ObservableProperty	A.1.4
Conceptual Observation – Observation	/conf/obs-cpt/Observation	A.1.5
Conceptual Observation – Observer	/conf/obs-cpt/Observer	A.1.6
Conceptual Observation – ObservingProcedure	/conf/obs-cpt/ObservingProcedure	A.1.7
Conceptual Observation – Procedure	/conf/obs-cpt/Procedure	A.1.8

Table 2 — Abstract Observation Core conformance classes

Conformance class	Identifier	Subclause
Abstract Observation Core package	/conf/obs-core	A.2.1
Abstract Observation Core – AbstractDeployment	/conf/obs-core/AbstractDeployment	A.2.2
Abstract Observation Core – AbstractHost	/conf/obs-core/AbstractHost	A.2.3
Abstract Observation Core – AbstractObservableProperty	/conf/obs-core/AbstractObservableProperty	A.2.4
Abstract Observation Core – AbstractObservation	/conf/obs-core/AbstractObservation	A.2.5
Abstract Observation Core – AbstractObservationCharacteristics	/conf/obs-core/AbstractObservationCharacteristics	A.2.6
Abstract Observation Core – AbstractObserver	/conf/obs-core/AbstractObserver	A.2.7
Abstract Observation Core – AbstractObservingProcedure	/conf/obs-core/AbstractObservingProcedure	A.2.8
Abstract Observation Core – NamedValue	/conf/obs-core/NamedValue	A.2.9
Abstract Observation Core – AbstractObservationCollection	/conf/obs-core/AbstractObservationCollection	A.2.10

Table 3 — Basic Observations conformance classes

Conformance class	Identifier	Subclause
Basic Observations package	/conf/obs-basic	A.3.1
Basic Observations – Deployment	/conf/obs-basic/Deployment	A.3.2

AVA Documents Document Sharing Hub

© ISO 2023 – All rights reserved

Full document details: BS EN ISO 19156:2023

Table 3 *(continued)*

Conformance class	Identifier	Subclause
Basic Observations – GenericDomainFeature	/conf/obs-basic/GenericDomainFeature	A.3.3
Basic Observations – Host	/conf/obs-basic/Host	A.3.4
Basic Observations – ObservableProperty	/conf/obs-basic/ObservableProperty	A.3.5
Basic Observations – Observation	/conf/obs-basic/Observation	A.3.6
Basic Observations – ObservationCharacteristics	/conf/obs-basic/ObservationCharacteristics	A.3.7
Basic Observations – ObservationCollection	/conf/obs-basic/ObservationCollection	A.3.8
Basic Observations – Observer	/conf/obs-basic/Observer	A.3.9
Basic Observations – ObservingCapability	/conf/obs-basic/ObservingCapability	A.3.10
Basic Observations – ObservingProcedure	/conf/obs-basic/ObservingProcedure	A.3.11

Table 4 — Conceptual Sample schema conformance classes

Conformance class	Identifier	Subclause
Conceptual Sample schema package	/conf/sam-cpt	A.4.1
Conceptual Sample – PreparationProcedure	/conf/sam-cpt/PreparationProcedure	A.4.2
Conceptual Sample – PreparationStep	/conf/sam-cpt/PreparationStep	A.4.3
Conceptual Sample – Sample	/conf/sam-cpt/Sample	A.4.4
Conceptual Sample – Sampler	/conf/sam-cpt/Sampler	A.4.5
Conceptual Sample – Sampling	/conf/sam-cpt/Sampling	A.4.6
Conceptual Sample – SamplingProcedure	/conf/sam-cpt/SamplingProcedure	A.4.7

Table 5 — Abstract Sample Core conformance classes

Conformance class	Identifier	Subclause
Abstract Sample Core package	/conf/sam-core	A.5.1
Abstract Sample Core – AbstractPreparation-Procedure	/conf/sam-core/AbstractPreparationProce-dure	A.5.2
Abstract Sample Core – AbstractPreparation-Step	/conf/sam-core/AbstractPreparationStep	A.5.3
Abstract Sample Core – AbstractSample	/conf/sam-core/AbstractSample	A.5.4
Abstract Sample Core – AbstractSampler	/conf/sam-core/AbstractSampler	A.5.5
Abstract Sample Core – AbstractSampling	/conf/sam-core/AbstractSampling	A.5.6
Abstract Sample Core – AbstractSamplingPro-cedure	/conf/sam-core/AbstractSamplingProcedure	A.5.7

Table 6 — Basic Samples conformance classes

Conformance class	Identifier	Subclause
Basic Samples package	/conf/sam-basic	A.6.1
Basic Samples – MaterialSample	/conf/sam-basic/MaterialSample	A.6.2
Basic Samples – NamedLocation	/conf/sam-basic/NamedLocation	A.6.3
Basic Samples – PhysicalDimension	/conf/sam-basic/PhysicalDimension	A.6.4
Basic Samples – Sample	/conf/sam-basic/Sample	A.6.5
Basic Samples – SampleCollection	/conf/sam-basic/SampleCollection	A.6.6
Basic Samples – Sampler	/conf/sam-basic/Sampler	A.6.7
Basic Samples – Sampling	/conf/sam-basic/Sampling	A.6.8
Basic Samples – SpatialSample	/conf/sam-basic/SpatialSample	A.6.9

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

Table 6 *(continued)*

Conformance class	Identifier	Subclause
Basic Samples – StatisticalClassification	/conf/sam-basic/StatisticalClassification	A.6.10
Basic Samples – StatisticalSample	/conf/sam-basic/StatisticalSample	A.6.11

6 Packaging, requirements and dependencies

6.1 Requirements

As OMS implementations often seamlessly integrate with existing data ecosystems, a very flexible requirements and conformance structure is defined. This structure enables users to selectively mix and match elements as required for their purposes from the OMS data model without the necessity of achieving compliance with the entire data model.

Such flexibility is becoming increasingly relevant with the shift to Linked Data practices, where different organizations maintain and expose only certain aspects of a larger distributed dataset.

EXAMPLE Some providers only serve information on Observable Properties or Monitoring Facilities, while relying on other partners to provide information on measurement procedures. These can claim compliance to those parts falling under their responsibility, while letting other data providers link to these resources.

For this purpose, a fine-grained structure for requirements and recommendations, requirements classes and conformance classes has been defined. As far as possible, patterns from the OGC Modular Specification[25] have been taken into account. However, pertaining to the alignment between UML Packages and Conformance Classes, a relaxation of the requirement on one-to-one alignment between UML Package and Conformance class has been proposed as follows.

a) For each UML Package, both a Requirements Class as well as a conformance class have been defined.

b) Additional Requirements Classes have been created for each Class appearing in the data model. Conformance Classes are added accordingly to enable grouping of the former and support references to either a group or an individual Requirement Class depending on the need.

c) Thematic domains can create additional Requirements and Conformance classes reflecting their domain profiles by reference to existing Requirements and Requirements Classes.

As mentioned, as data provision paradigms increasingly shift towards distributed and linked approaches, stipulating that all aspects of an information system conform explicitly to the same underlying standards becomes increasingly difficult. Simultaneously, as distributed data provision becomes increasingly ubiquitous, ever more communities are emerging dedicated to individual aspects of the wider data provision landscape.

One example of such external definition and hosting pertains to the provision of observable properties. In previous versions of the Observations and Measurements (O&M) Model, the observable properties concept was only included as a metaclass, with the assumption that a reference to an existing code list will be provided. Within the current OMS Model, the observable property has been upgraded to a featureType. This is because emerging requirements show the need for a more detailed model for this concept. Simultaneously, other communities, such as the Research Data Alliance (RDA), are also working on observable property models (I-ADOPT). The same rationale can be applied to most concepts from the OMS Model.

In order to expose this flexibility beyond the package structure described above, a fine-grained hierarchical requirements class structure was created. A modular requirements class is provided for each concept at all three levels of the model. In addition, a further requirements class that imports all the modular classes provided for the individual concepts has been provided for each package.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

6.2 UML

6.2.1 UML package structure

OMS provides the relevant concepts for the structured description of observations, including the sampling structure often essential for true understanding of the nature of the observations being provided. As data provision mechanisms are transitioning towards highly distributed linked approaches, the model structure and packaging has been significantly abstracted. This approach allows implementers to explicitly select the concepts to be supported based on their requirements, while clearly stating to which requirements and Conformance Classes their implementation complies. Both the Observation and Sample sections of this model have been structured using the following layering of packages.

a) **Conceptual**: Within the Conceptual Model Packages, only Interfaces are provided. These models provide a very abstract view of the individual concepts they contain without reference to specific implementations. This approach allows for the inclusion of semantically aligned objects from external sources, which, although they have not been created under the OMS model, do provide concepts sharing the same semantic meaning as the concepts from the Conceptual models.

b) **Abstract Core**: Within the Abstract Core Model Packages, only abstract featureTypes are provided following the semantic structure of the Conceptual model (i.e. realizing the interfaces provided by the Conceptual Model Packages). A consistent approach to metadata provision is introduced. All associations from the abstract featureTypes reference the conceptual interfaces for greater implementation flexibility. The Abstract Core Model Packages are foreseen for the creation of domain models providing an Abstract Core ready for Extension.

c) **Basic**: Within the Basic Packages, simple concrete featureTypes (specializing the abstract ones from the Abstract Core model) have been defined with some basic utility attributes added for rapid out-of-the-box deployment. A few additional concepts pertaining to collections and potential observations are introduced at this level.

6.2.2 UML package dependencies

Some model elements used in the schema are defined in other International Standards. Table 7 lists the dependencies between the UML packages defined in this document and other International Standards, and Figure 1 shows the dependencies of the entire OMS UML model package to the other International Standards in a graphical form.

Table 7 — UML package level dependencies

OMS Package	Package	International Standard	Classes
Conceptual Observation schema	Any type	ISO 19103:2015	Any
Conceptual Observation schema	Temporal Objects	ISO 19108:2002	TM_Object
Conceptual Observation schema	Name types	ISO 19103:2015	GenericName
Abstract Observation Core	Conceptual Observation schema	ISO 19156:2023 (this document)	TM_Instant, TM_Period via the Temporal Objects dependency
Abstract Observation Core	General Feature Model	ISO 19109:2015	Feature concepts
Abstract Observation Core	Text	ISO 19103:2015	CharacterString
Basic Observations	Abstract Observation Core	ISO 19156:2023 (this document)	
Basic Observations	Web environment	ISO 19103:2015	URI
Basic Observations	Geometry	ISO 19107:2019	Geometry

© ISO 2023 – All rights reserved
AVA Documents Document Sharing Hub
Full document details: BS EN ISO 19156:2023

Table 7 *(continued)*

OMS Package	Package	International Standard	Classes
Conceptual Sample schema	Any type	ISO 19103:2015	Any
Conceptual Sample schema	Temporal Objects	ISO 19108:2002	TM_Object
Conceptual Sample schema	Name types	ISO 19103:2015	GenericName
Conceptual Sample schema	Conceptual Observation schema	ISO 19156:2023 (this document)	Observation, Procedure
Abstract Sample Core	Conceptual Sample schema	ISO 19156:2023 (this document)	
Abstract Sample Core	General Feature Model	ISO 19109:2015	Feature concepts
Abstract Sample Core	Geometry	ISO 19107:2019	Geometry
Abstract Sample Core	Text	ISO 19103:2015	CharacterString
Abstract Sample Core	Abstract Observation Core	ISO 19156:2023 (this document)	NamedValue
Basic Samples	Abstract Sample core	ISO 19156:2023 (this document)	
Basic Samples	Web environment	ISO 19103:2015	URI
Basic Samples	Measure types	ISO 19103:2015	Measure

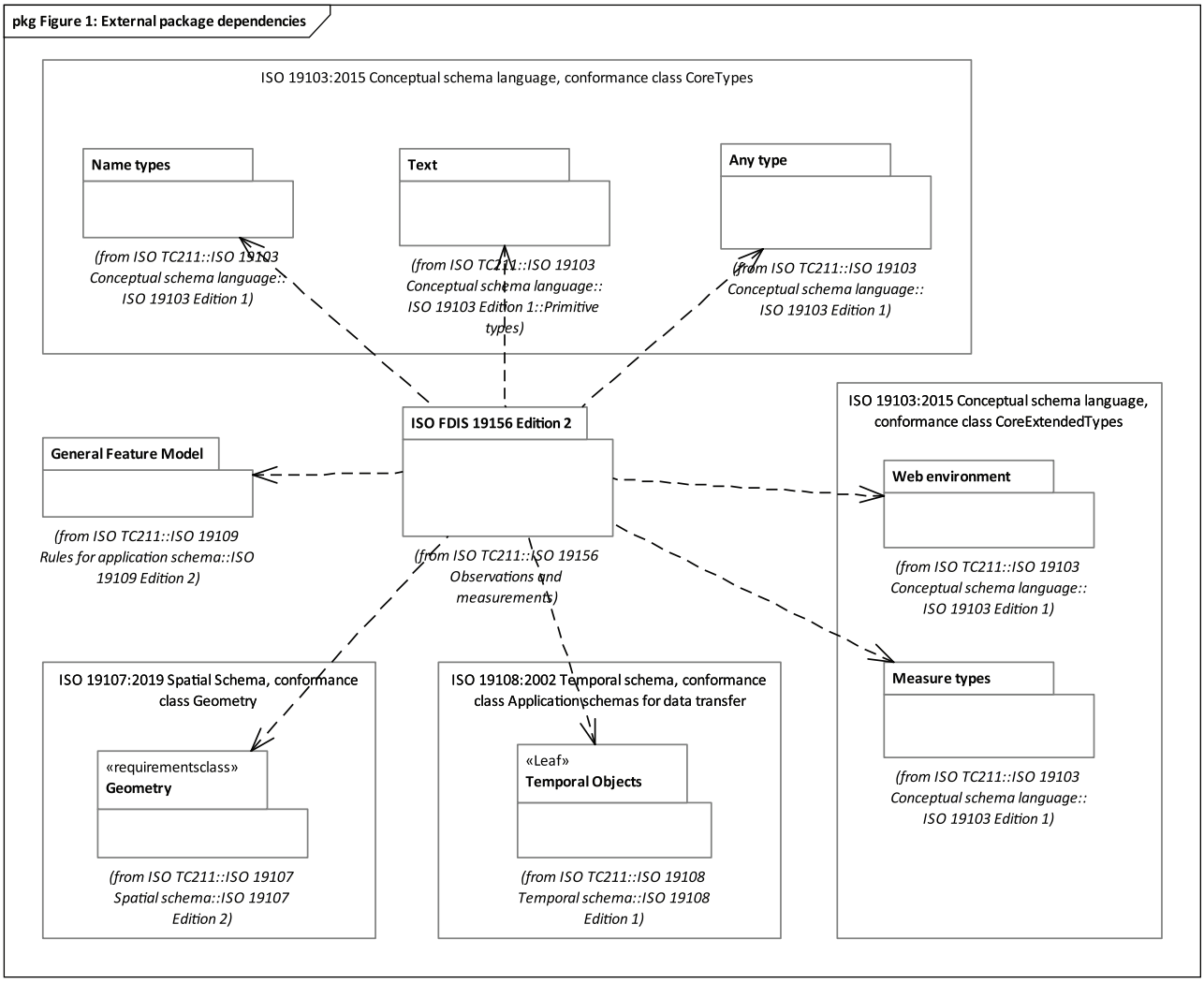


Figure 1 — External UML package dependencies

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

6.3 Note on the use of "Any"

The UML models defined in this document make extensive use of the Any interface defined in the ISO 19103:2015 Any type package. The realized Any values of the associations with role names **proximateFeatureOfInterest**, **ultimateFeatureOfInterest**, **result**, **metadata**, **featureOfInterest** and **sampledFeature** may be of any type or a reference to a digital representation of an appropriate concept. If they are of feature type, the values are not owned by the instances of referring classes, they may have an independent life span from the referring classes, and they may be associated with more than one instance of referring classes.

NOTE Any type can be owl:Thing, featureType, dataType

EXAMPLE 1 Reference to SWEET Ontology: http://sweetontology.net/realmAtmoBoundaryLayer#planetaryboundarylayer

EXAMPLE 2 Reference to SensorThings deployment: https://lubw-frost.docker01.ilt-dmz.iosb.fraunhofer.de/v1.1/Locations(269)

EXAMPLE 3 Reference to the ISO 19115 series Metadata: https://inspire-geoportal.ec.europa.eu/resources/INSPIRE-61494ff5-6fad-11e8-b649-52540023a883_20210415-080302/services/1/PullResults/701-750/43.iso19139.xml

EXAMPLE 4 Reference to an instance of borehole: https://data.geoscience.fr/id/borehole/BSS001REWW

EXAMPLE 5 Reference to a hydrostation: https://iddata.eaufrance.fr/id/HydroStation/Y251002001

EXAMPLE 6 Reference to a river segment: https://iddata.eaufrance.fr/id/WatercourseLinkSequence/A0080300

EXAMPLE 7 An (embedded) Boolean value as Result.

EXAMPLE 8 An (embedded) SWE DataRecord.

EXAMPLE 9 Elevation Coverage from an external WCS as an Observation Result: https://inspire.rasdaman.org/rasdaman/ows?service=WCS&version=2.0.1&request=GetCoverage&coverageId=INSPIRE_EL&subset=E(494500,496000)&subset=N(4654300,4655000)&format=image/jpeg

EXAMPLE 10 OMS MaterialSample -> Reference to a rock sample: https://www.geodata.rocks/Samples/SD-5054_1_A_564_7WR_20-40

7 Fundamental characteristics of observations and samples (informative)

7.1 Observation schema

7.1.1 Property evaluation

Properties of a feature fall into two basic categories.

1) Value (e.g. name, price, legal boundary) assigned by some authority. These are exact.

2) Value (e.g. height, classification, colour) determined by application of an observation procedure. These are estimates, with a finite error associated with the value.

The observation error typically has a systematic component, which is similar for all estimates made using the same procedure, and a random component, associated with the particular application instance of the observation procedure. If potential errors in a property value are important in the context of a data analysis or processing application, then the details of the act of observation which provided the estimate of the value are required.

© ISO 2023 – All rights reserved
Documents Document Sharing Hub
Full document details: BS EN ISO 19156:2023

7.1.2 Observation

An observation is an act associated with a discrete time instant or period through which a number, term or other symbol is assigned to a characteristic. This act involves application of a specified procedure, such as a sensor, instrument, algorithm or process chain. The procedure may be applied in situ, remotely, or ex situ with respect to the sampling location. The result of an observation is an estimate of the value of a property of a given feature; an observation is a property-value-provider for a feature-of-interest. Use of a common model allows observation data using different procedures to be combined unambiguously.

In conventional measurement theory (e.g. References [11], [14], [15], [16], [18], [23]) the term "measurement" is used. However, a distinction between measurement and category-observation has been adopted in more recent work[12],[17],[24] so the term "observation" is used here for the general concept. "Measurement" may be reserved for cases where the result is a numerical quantity.

The observation itself is also a feature, since it has properties and identity.

Observation details are important for data discovery and for data quality estimation.

The observation could be considered to carry "property-level" instance metadata, which complements the dataset-level and feature-level metadata commonly provided via catalogue services (e.g. the ISO 19115 series or another community agreed one).

7.1.3 Properties of an Observation

An observation results in a value being assigned to a characteristic. The characteristic is a property of a feature, the latter being the feature-of-interest of the observation. The observation uses a specified procedure performed by an observer, which is often an instrument or sensor[11],[12] but may be a process chain, human observer, an algorithm, a computation or a simulator. The key idea is that the observation result is an estimate of the value of some quality (property, characteristic) of the feature-of-interest, and the other properties of the observation provide context or metadata to support evaluation, interpretation and use of the result. Figure 2 (based on representation work done under INSPIRE[29]) provides a visual overview of this.

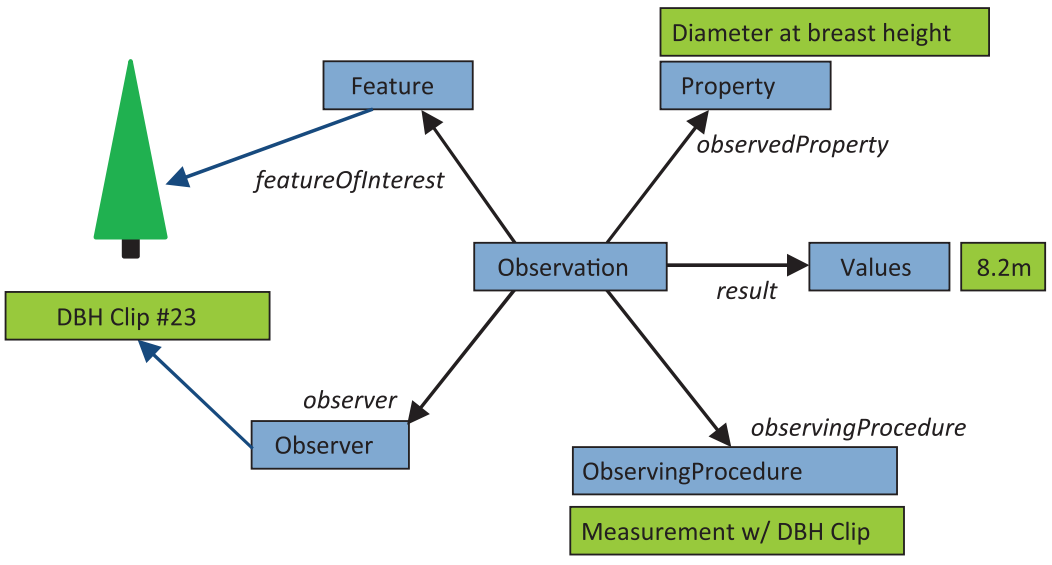


Figure 2 — Properties of an Observation

The relationship between the properties of an observation and those of its feature-of-interest is key to the semantics of the data model elaborated in this document. This is further elaborated in Clause D.3.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

7.1.4 Observation location

The principal location of interest of an observation is usually associated with the ultimate feature-of-interest.

However, the location of the feature-of-interest can potentially not be readily available. For example, in remote sensing applications, a complex processing chain is required to geolocate the scene or swath. In feature-detection applications, the initial observation can be made on a scene, but the entity to be detected, which is the ultimate feature-of-interest, occupies some location within it. The distinction between the proximate and ultimate feature-of-interest is a key consideration in these cases. The proximate feature-of-interest is the object upon which the measurement is directly performed, whereas the ultimate feature-of-interest is the object for which this measurement is ultimately seen as representative of.

Other locations may be relevant in various scenarios. Sub-sampling at locations within the feature-of-interest may occur. The procedure may involve a sensor located remotely from the ultimate feature-of-interest such as in remote sensing, or where specimens are removed from their sampling location and observations made ex-situ (the sampling schema description below elaborates on this). Furthermore, the location of the feature-of-interest may be time-dependent.

The model is generic. The geospatial location of the feature-of-interest may be of little or no interest for some observations (e.g. live specimens, observations made on non-located things like chemical species).

For these reasons, a generic Observation class does not have an inherent location property. Relevant location information should be provided by the feature-of-interest, by the sampling procedure, or by the observation procedure, according to the specific scenario.

NOTE In contrast to spatial properties, some temporal properties are associated directly with an observation (8.2.3; 8.2.4). This is due to the fact that an observation is a kind of event so its temporal characteristics are fundamental, rather than incidental.

7.1.5 Result types

Observation results may have many datatypes, including primitive types like category or measure, but may also have more complex types such as time, location and geometry. Complex results are obtained when the observed property requires multiple components for its encoding. Furthermore, if the property varies on the feature-of-interest, then the result is a coverage, whose domain extent is the extent of the feature. In reality, the result will typically be sampled discretely on the domain and may be represented as a discrete coverage.

Building on this, specialized observation types can be defined by communities to describe the type of result provided, expressed using a terminology common to that community.

7.1.6 Use of the observation model

The observation model takes a data-user-centric viewpoint, emphasizing the semantics of the feature-of-interest and its properties. This contrasts with sensor-oriented models, which take a process- and thus a provider-centric viewpoint.

The digital representation of an observation is a property-value-provider for a feature-of-interest. Aside from the result, the details of the observation event are primarily of interest in applications where an evaluation of errors in the estimate of the value of a property is of concern. The observation could be considered to carry “property-level” instance metadata, complementing the dataset-level and feature-level metadata that have been conventionally considered (e.g. ISO 19115-1).

Additional discussion of the application of the observation and sample models, and nuances within these, is provided in Annex D.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

7.2 Sample schema

7.2.1 Role of sample features

A sample may act as a proxy for the ultimate feature-of-interest of an observation, and be associated with this observation by the role feature-of-interest. In this case the sampled-feature association of the sample would point upwards in the chain of sampled features leading to the ultimate feature-of-interest of the observation. The sample may also be associated with observations, both those being made directly on the sample as well as observations on other samples.

7.2.2 Proximate vs. ultimate feature-of-interest

7.2.2.1 Introduction

The observation model maps the result of the application of a procedure to a subject, which plays the role of feature-of-interest of the observation. However, the proximate feature-of-interest of an observation is not always the ultimate domain-specific feature whose properties are of interest in the investigation of which the observation is a part. There are three circumstances that can lead to this:

a) the observation does not obtain values for the whole of a domain feature;

b) the observation is performed on a proxy that is not part of the domain feature;

c) the observation procedure obtains values for properties that are not characteristic of the type of the ultimate feature.

Furthermore, in some practical situations, multiple differences apply.

7.2.2.2 Proximate feature-of-interest embodies a sample design

In some cases, for various reasons, the domain feature is not fully accessible. In such circumstances, the procedure for estimating the value of a property of the domain feature involves sampling in representative locations. Then the procedure for transforming a property value observed on the sample to an estimate of the property on the ultimate feature-of-interest depends on the sample design.

EXAMPLE 1 The chemistry of water in an underground aquifer is sampled at one or more positions in a well or bore.

EXAMPLE 2 The magnetic field of the earth is sampled at positions along a flight-line. In contrast to the well in the EXAMPLE 1, the flight-line does not represent a real-world object.

EXAMPLE 3 The structure of a rock mass is observed on a cross-section exposed in a river bank.

EXAMPLE 4 The bubble of air around the intake of an air quality monitoring station is taken as representative for the wider air around the station. Again, a virtual feature serves as proximate feature-of-interest.

In other cases, where direct observation of the domain feature is not possible, the observation may be performed on a proxy.

EXAMPLE 5 In order to measure the intensity of the sun's light, the reflectance on a white sheet of paper can be utilized as a proxy for the sun's intensity.

In some cases, the observation procedure obtains values for properties that are not characteristic of the type of the ultimate feature.

EXAMPLE 6 The salinity of water in a well is measured, the feature-of-interest of this well is an aquifer. However, the final target of the observation is the fluid body contained within the aquifer (see Figure 8).

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

7.2.2.3 Observed property is a proxy

The procedure for obtaining values of the property of interest may be indirect, relying on direct observation of a more convenient parameter which is a proxy for the property of interest. Application of an algorithm or processing chain obtains an estimate of the ultimate property of interest.

The observation model requires that the feature-of-interest of the initial observation be of a type that carries the observed property within its properties. Thus, if the proxy property is not a member of the ultimate feature-of-interest, a proxy feature with a suitable model shall be involved.

EXAMPLE 1 A remote sensing observation can potentially obtain the reflectance colour, when the investigation is actually interested in vegetation type and quality. The feature which contains reflectance colour is a scene or swath, while the feature carrying vegetation properties is a parcel or tract.

EXAMPLE 2 The direct value coming from a sensor can be quantified as a voltage, whereas the observed property represented by this voltage is the physiochemical value being observed by the sensor (e.g. pH).

7.2.2.4 Combination

These variations may be combined if exhaustive observation of the domain feature is impractical, and direct measurement is of a proxy property.

EXAMPLE For certain styles of mineralization, the gold concentration of rocks in a region can be estimated through measurement of a related element (e.g. copper) in a specimen of gravel collected from a stream that drains part of the region. The gravel samples the rocks in the catchment of the stream, i.e. in the stream bed and upslope.

7.2.3 Role of samples

Samples are artefacts of an observational strategy and have no significant function outside of their role in the observation process. The physical characteristics of the samples themselves are of little interest, except perhaps to the manager of a sampling campaign.

EXAMPLE 1 In various countries/domains, terms like “site” and station” are encountered. These usually correspond to an identifiable locality where a monitoring facility (host, platform, etc.) has been established, or sensors or other measurement devices (observers) have been deployed to acquire observations on a given observable property applying a specific procedure. In the context of the observation model, the spatial sample (both proximate and ultimate) connotes the world in the vicinity of the observer/sampler, so the observed properties relate to the physical medium at the observer/sampler described by the sample, and not to any physical artefact such as a mooring, buoy, benchmark, monument, well, and so forth that are potentially described by the Host.

EXAMPLE 2 In some domains, elements are taken from their natural environment (ex situ), curated and preserved for the purpose of keeping a trace of their existence. Examples include biodiversity studies, crop seed preservation, etc. In those cases, the material samples considered are called specimen. It is for this reason that the class named "SF_Specimen" in the previous edition of this document has been renamed "MaterialSample" in this edition.

EXAMPLE 3 Statistical samples usually apply to populations or other sets, of which a certain subset can be of specific interest.

NOTE A transient spatial sample, such as a ship-track or flight-line, can be identified and described, but is unlikely to be revisited exactly.

A sample is intended to sample some object in an application domain. However, in some cases the identity, and even the exact type, of the sampled object is not known when observations are made using the sample.

7.2.4 Sampling process

Understanding the process by which samples are obtained is often essential to understanding the context of subsequent measurements on this object (feature-of-interest). Different sampling strategies

© ISO 2023 – All rights reserved
AVA Documents Document Sharing Hub
Full document details: BS EN ISO 19156:2023

can provide vastly different samples, in turn leading to different result values in observations pertaining to these samples.

A sample is created through the act of sampling, whereby a sampler follows a defined procedure in order to identify and/or extract representative samples from the ultimate feature-of-interest.

The nature of the sampler varies by sampling strategy; at one end of the spectrum the sampler can be a sensor or other automated measurement device; at the other end of the spectrum the sampler can be a human being providing observations or taking part in a biodiversity survey campaign.

As a dependence on the sampling strategy, a sampling procedure appropriate to the sampling act to be performed needs to be selected and defined. For the provision of fine-grained information pertaining to the sampling process, multiple sampling procedures can be applied to one sampling act. Multiple sampling procedures can also be required for the case where one sampling process classifies samples in accordance with multiple criteria.

EXAMPLE 1 When performing observations on populations, these can potentially first be sampled by gender and age. Sampling procedures describing the criteria utilized for gender and age classification can be provided individually.

A sampling event can involve very different samples, whereby some of these samples can serve purely to provide contextual information pertaining to the sampling event.

EXAMPLE 2 When sampling water from a river, information on the meteorology at the time of sampling can be relevant for the interpretation of measurements obtained on the water sample.

7.2.5 Classification of samples

A small number of common sampling patterns, similar across domains, provide a basis for processing and portrayal tools, and depend particularly on the geometry of the sample design. These provide a basis for processing and portrayal tools which are similar across domains, and depend particularly on the geometry of the sample design. Common names for sampling features include specimen, sample, site, profile, transect, path, swath and scene.

Spatial sampling is classified primarily by the topological dimension. Material samples can provide information on their original source location, but are more often characterized by their size and storage location.

In addition, various preparation steps may be performed on samples both before and after observations are performed on the sample.

Additional information on provenance, curation and methods of archiving a sample has been delegated to external standards that may be referenced via the ‘metadata’ association that can be provided for all types contained within the Sampling model.

7.3 Alignment between Observation, Sample and domain models

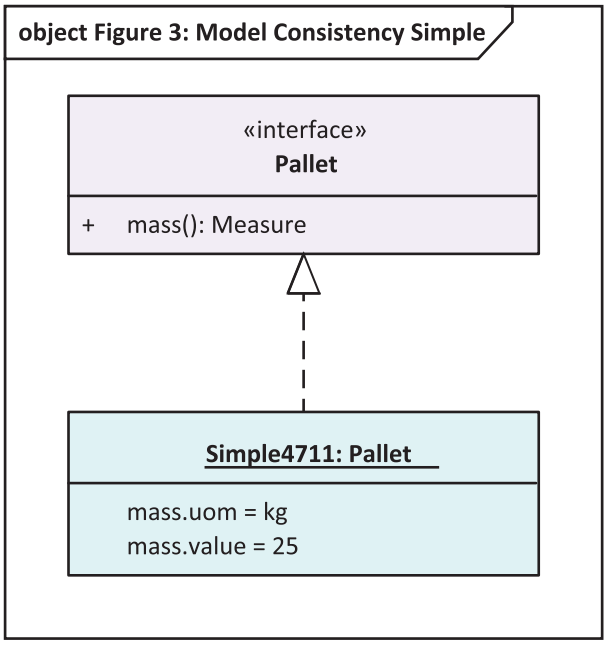
7.3.1 Model consistency

The type of the feature-of-interest is defined in an application schema (ISO 19109). This may be part of a domain model, or may be from a cross-domain model, such as Sample (Clause 11). The feature type defines its set of characteristics as properties. For consistency, the feature-of-interest shall carry the observed property as part of the definition of its type (e.g. Figure 3).

EXAMPLE A pallet with the characteristic mass is to be described via a feature model. In the simplest form, an interface “Pallet” can be defined as having the attribute “mass” of type “Measure” describing the mass characteristic of the pallet being described (Figure 3). However, when using this direct approach, no further measurement metadata is available; only the numeric mass is provided together with the unit of measurement.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023



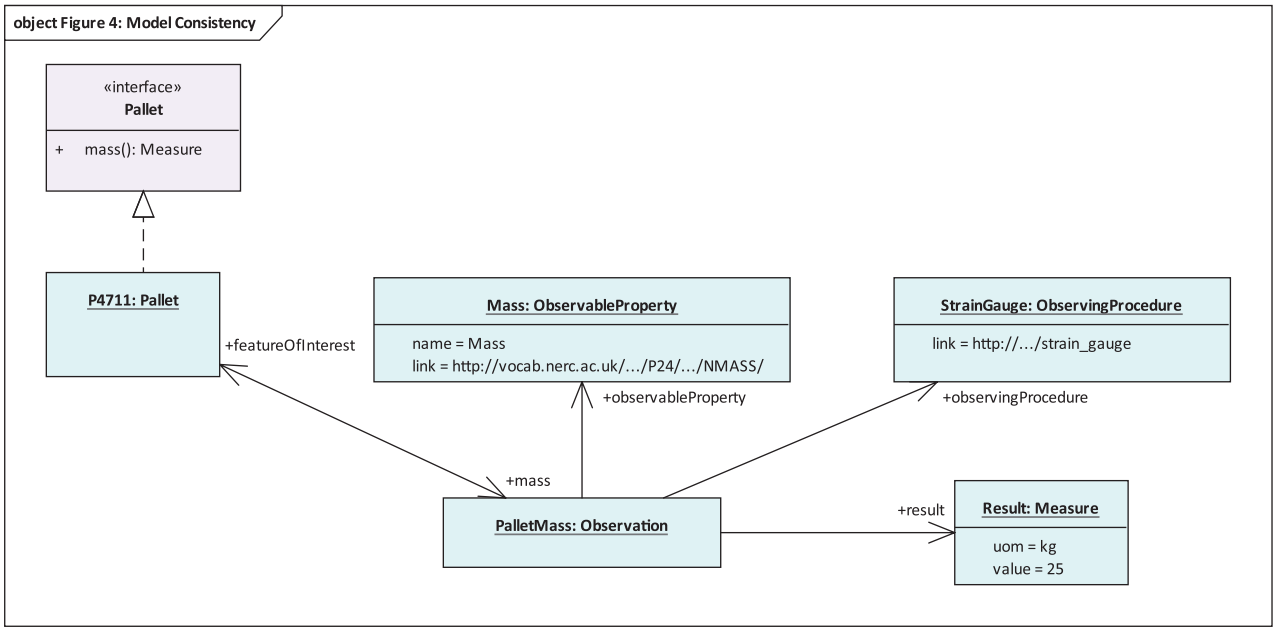
NOTE Simple example for model consistency.

Figure 3 — (Example) Pallet interface

Alternatively, through utilization of the OMS model, an observation providing the value of this property for the feature being investigated may be utilized to fulfil the data requirements ensuing from the Pallet Interface. This approach makes it possible for the information system to 'describe' how the result (here mass value) was obtained together with the relevant value.

For this purpose, the observation shall have observedProperty "mass", the result shall be of the type "Measure" and the scale (unit of measure) shall be suitable for mass measurements. Thus, the requirements ensuing from the Pallet Interface are fulfilled, while additional relevant measurement meta-information is also provided; model consistency has been ensured. This approach is illustrated in Figure 4.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023



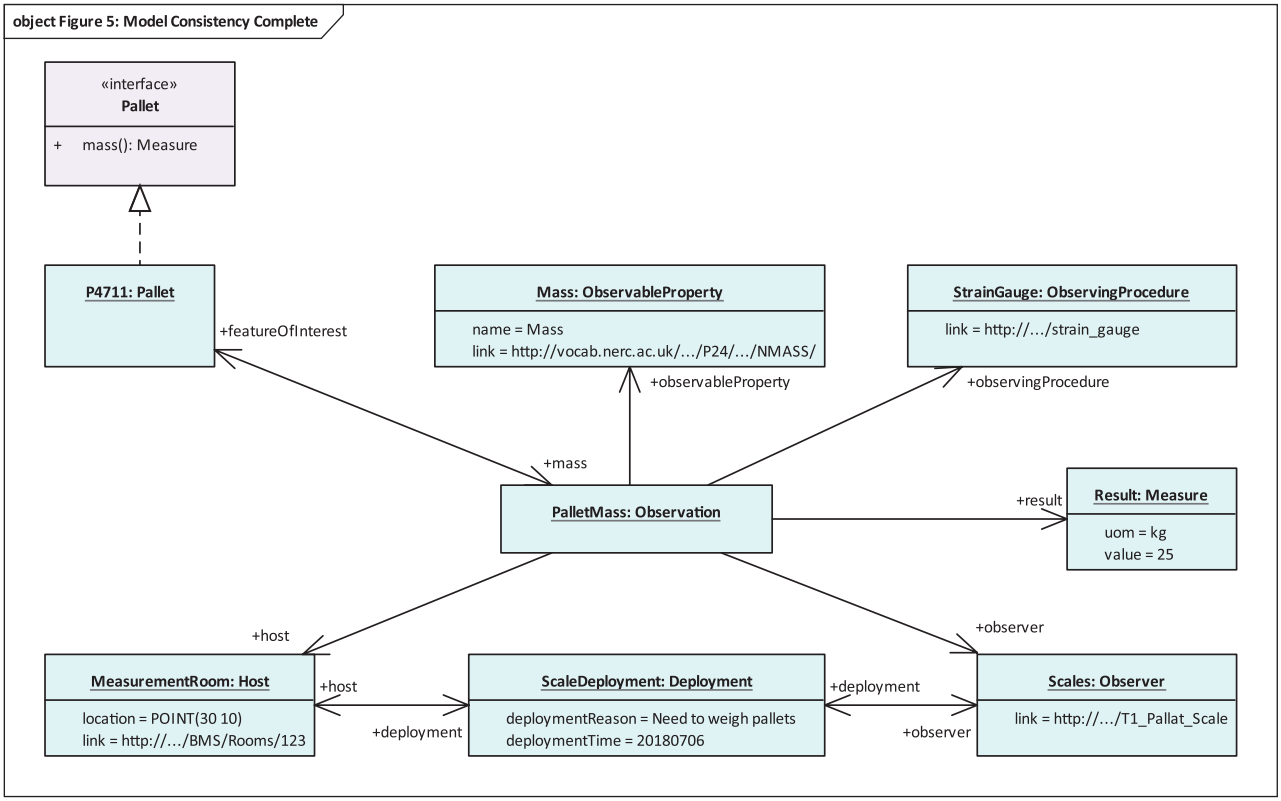
NOTE The observed property (mass) is a characteristic associated with the type of the feature-of-interest (Pallet) and the procedure and result type are also suitable.

Figure 4 — (Example) An observation with consistent properties

Figure 5 shows a complete representation of a mass observation. In addition to the basic information provided with the observation in Figure 4, information on the specific measurement device used is provided together with information on where this device was deployed as the observation was performed.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023



NOTE For additional context, the Observer, Host and Deployment have been added.

Figure 5 — (Example) An observation with complete properties

An attribute from within the conceptual model can be instantiated as an Observation in the concrete realization. The attributes that have been defined for the domain feature within the interface, in the example “mass” and “uom”, can be realized through the association of an Observation carrying this information. Formally, these two representations both realize the defined interface.

Based on the use case, when modelling, it is necessary to decide whether solely providing information of type "Measure" with UoM is sufficient for the domain considered. In some cases, the full OMS model is required to actually discover, exchange and reuse data properly. For example, a single attribute "lake surface" will be sufficient for most mapping agency needs, whereas a more thorough observation description of how that surface was measured and when (e.g. dam empty/full, rainfall observation, etc.) is important for water management needs.

7.3.2 Relationship between Sample and domain features

A Sample feature is established in order to make observations concerning some domain feature. The association “sampledFeature” links the Sample feature to the feature which this Sample feature was designed to sample. The target of this association is usually a real-world feature from an application domain (see Figure 6).

EXAMPLE A profile typically samples a water- or atmospheric-column; a well samples the water in an aquifer; a tissue specimen samples a part of an organism.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

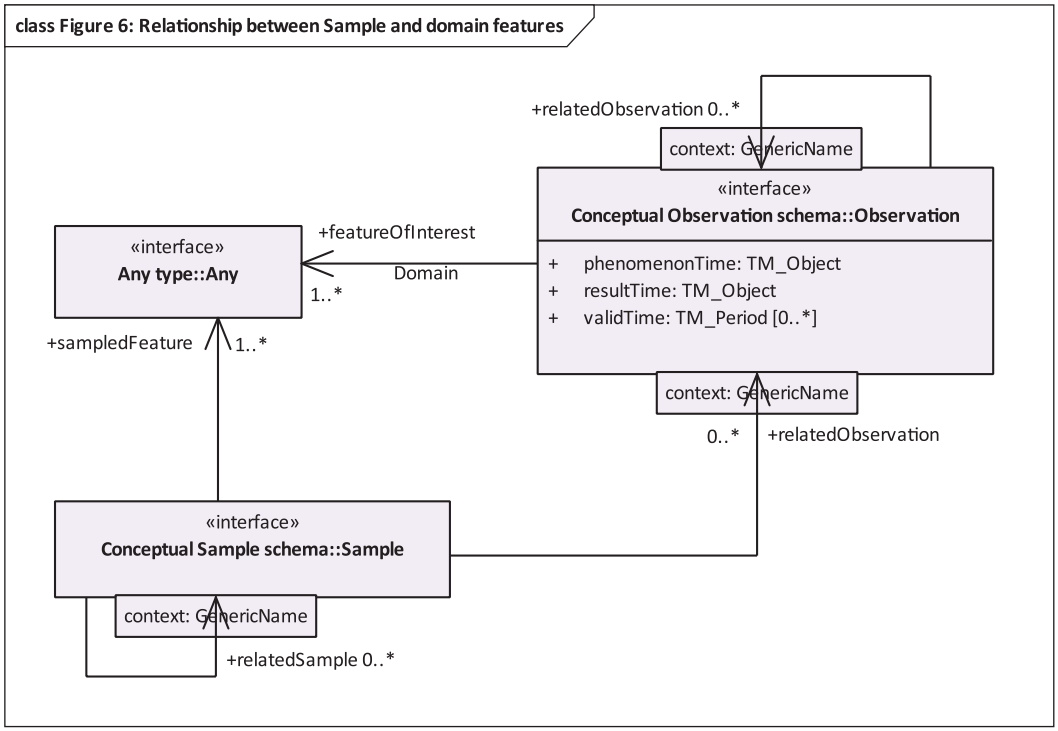


Figure 6 — (Informative) Relationship between Sample and domain features

Both the Sample feature and the domain feature can potentially appear as the feature-of-interest. If a Sample feature is involved, it samples a feature of a type defined in a domain model.

Any domain object can be a featureOfInterest of an Observation.

The more refined example described in Figure 7 further explains how both Sample and Observation from the OMS model can interact with a domain model.

In this example, Well, Aquifer and FluidBody are modelled outside the OMS model (in OGC:GWML2 respectively under GW_Well, GW_Aquifer and GW_FluidBody) but:

a) the Well also conforms to the Sample requirements;

b) instances from the domain model are the proximate and ultimate features of interest of the WaterSalinity observation.

The Well that samples the Aquifer acts as a proxy to the Aquifer in the observation act. The Well is thus considered as the proximateFeatureOfInterest of the Observation. The sampledFeature (the aquifer) of the Well is the ultimateFeatureOfInterest.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

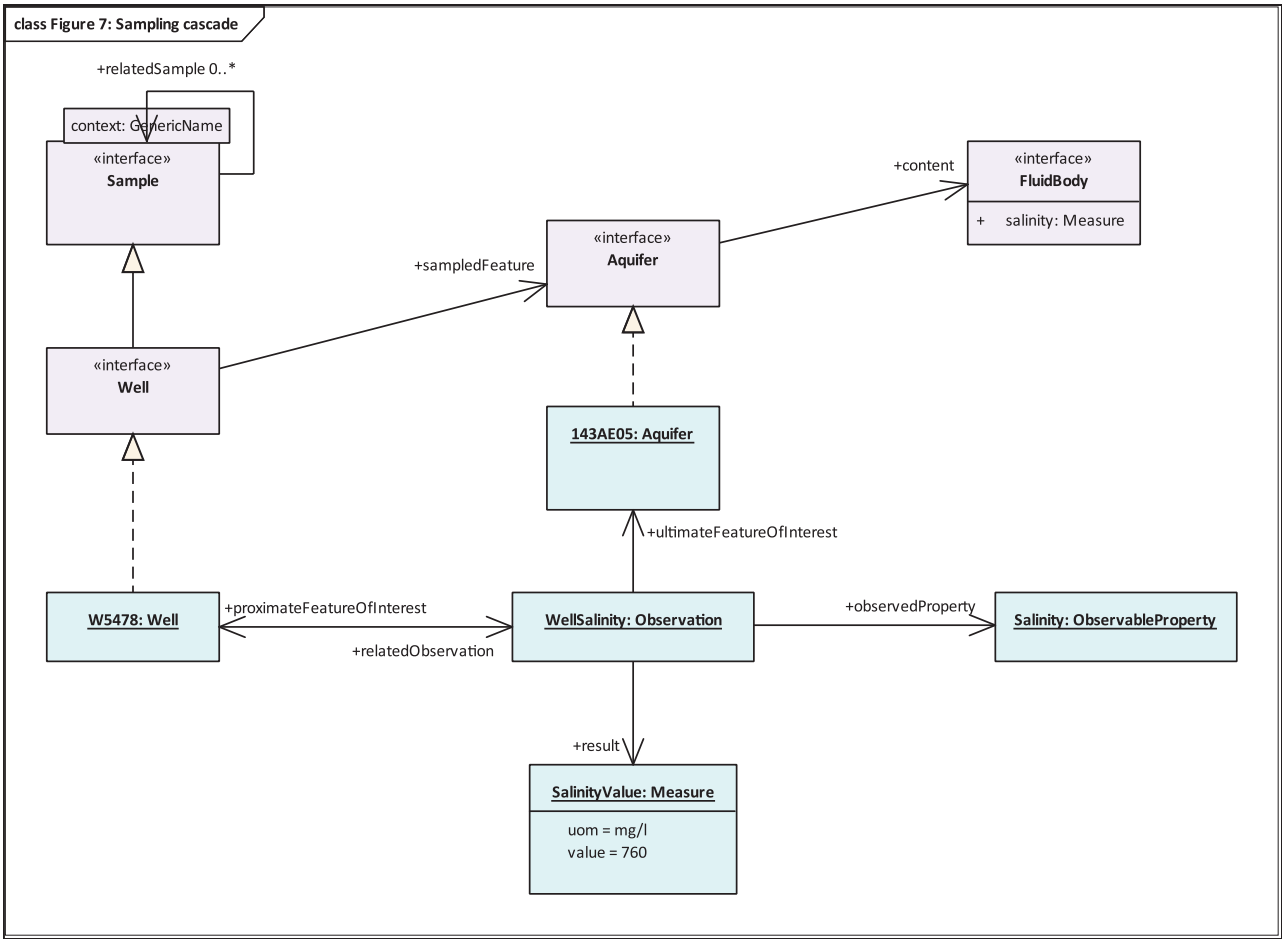


Figure 7 — (Example) Sampling Cascade example including domain features

Depending on the use case, it is advisable to push the modelling choice a step further and instantiate a FluidBody in the system according to the semantics of the domain model (Well, Aquifer, FluidBody). The example is further refined accordingly in Figure 8. Then, depending on the viewpoint considered, either the instance of the Aquifer and/or the instance of the fluidBody can be considered as the ultimateFeatureOfInterest of the Observation. The Well remains the proximateFeatureOfInterest.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

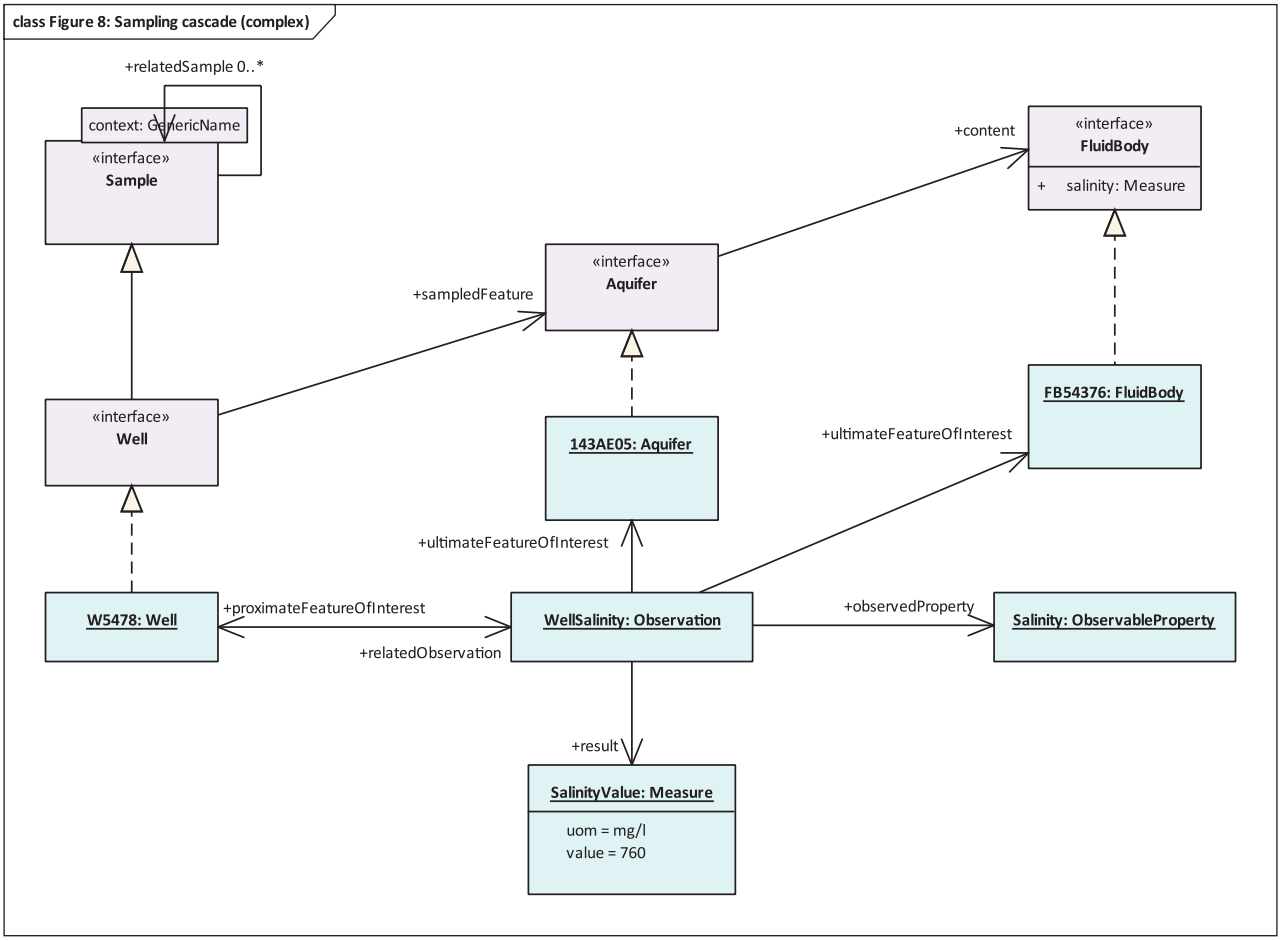


Figure 8 — (Example) Complex Sampling Cascade example referencing external domain feature

8 Conceptual Observation schema

8.1 General

8.1.1 Conceptual Observation model

The Conceptual Observation schema is described as a class diagram in Figure 9. The schema is fully described in 8.1.2.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

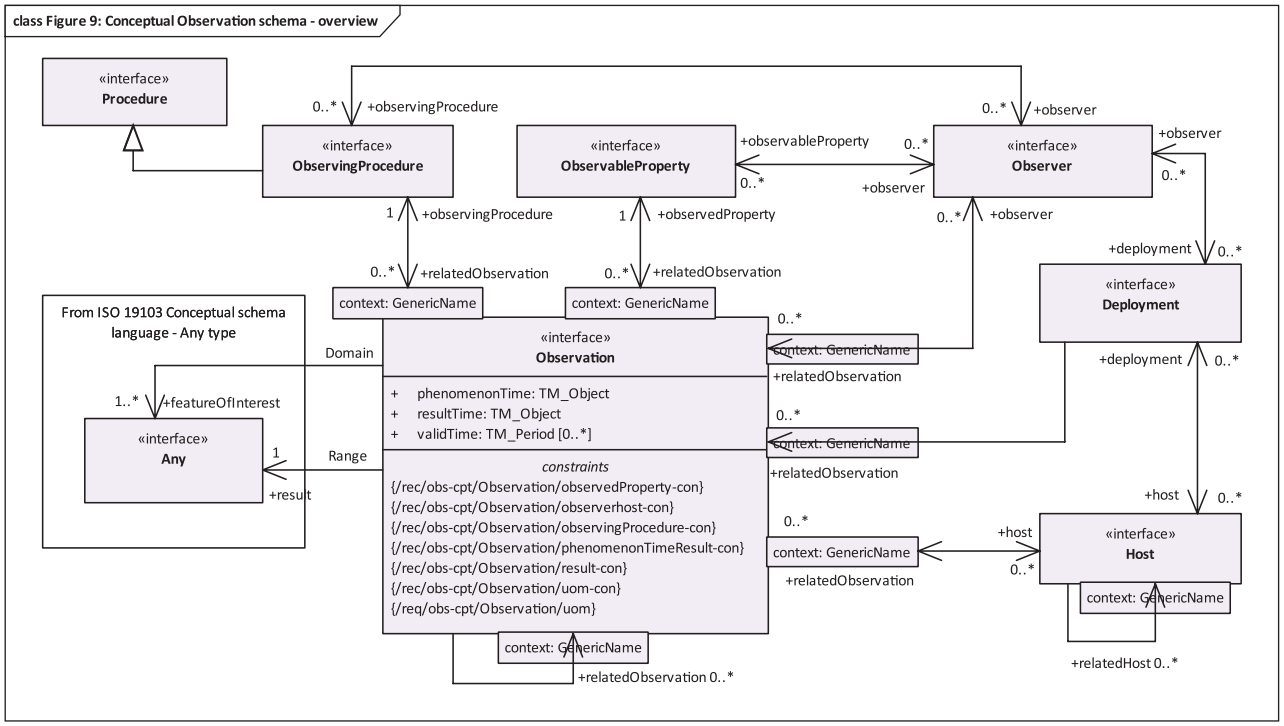


Figure 9 — Conceptual Observation schema overview

8.1.2 Conceptual Observation schema package Requirements Class

Requirements Class	/req/obs-cpt
Target type	Conceptual model
Name	Conceptual Observation schema package
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Imports	/req/obs-cpt/Observation
Imports	/req/obs-cpt/ObservableProperty
Imports	/req/obs-cpt/Procedure
Imports	/req/obs-cpt/ObservingProcedure
Imports	/req/obs-cpt/Observer
Imports	/req/obs-cpt/Host
Imports	/req/obs-cpt/Deployment

8.1.3 Association relatedObservation

Requirement /req/obs-cpt/gen/relatedObservation-sem	An **Observation** the object is related to. If a reference to a related **Observation** is provided, the association with role **relatedObservation** shall be used. The **context:GenericName** qualifier of this association may be used to provide further information as to the nature of the relation.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

8.2 Observation

8.2.1 Observation Requirements Class

Requirements Class	/req/obs-cpt/Observation
Target type	Conceptual model
Name	Conceptual Observation – Observation
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, Core-Types conformance class
Dependency	ISO 19108:2002, Geographic information — Temporal schema, Application schemas for data transfer conformance class
Requirement	/req/obs-cpt/Observation/Observation-sem
Requirement	/req/obs-cpt/Observation/phenomenonTime-sem
Requirement	/req/obs-cpt/Observation/phenomenonTime-card
Requirement	/req/obs-cpt/Observation/resultTime-sem
Requirement	/req/obs-cpt/Observation/resultTime-card
Requirement	/req/obs-cpt/Observation/validTime-sem
Requirement	/req/obs-cpt/Observation/featureOfInterest-sem
Requirement	/req/obs-cpt/Observation/featureOfInterest-card
Requirement	/req/obs-cpt/Observation/observedProperty-sem
Requirement	/req/obs-cpt/Observation/observedProperty-card
Requirement	/req/obs-cpt/Observation/result-sem
Requirement	/req/obs-cpt/Observation/result-card
Requirement	/req/obs-cpt/Observation/observingProcedure-sem
Requirement	/req/obs-cpt/Observation/observingProcedure-card
Requirement	/req/obs-cpt/Observation/observer-sem
Requirement	/req/obs-cpt/Observation/host-sem
Recommendation	/rec/obs-cpt/Observation/observerhost-con
Recommendation	/rec/obs-cpt/Observation/observedProperty-con
Recommendation	/rec/obs-cpt/Observation/observingProcedure-con
Recommendation	/rec/obs-cpt/Observation/result-con
Recommendation	/rec/obs-cpt/Observation/phenomenonTimeResult-con
Requirement	/req/obs-cpt/gen/relatedObservation-sem
Requirement	/req/obs-cpt/Observation/uom
Recommendation	/rec/obs-cpt/Observation/uom-con

8.2.2 Interface Observation

Requirement /req/obs-cpt/Observation/Observation-sem	An **Observation** shall be defined as an act carried out by an **Observer** to determine the value of an **ObservableProperty** of an object (**featureOfInterest)** by using an **ObservingProcedure**; the value is provided as the **result**.

NOTE It is important to note that the terms 'observation', 'interpretation', 'forecast' and 'simulation' do correspond to this definition. This aspect is further clarified in Clause 7.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

8.2.3 Attribute phenomenonTime

Requirement /req/obs-cpt/Observation/phenomenonTime-sem	The time for which the **result** applies to the characteristic of the **FeatureOfInterest** being observed. If the **phenomenonTime** is described, this shall be provided by the attribute **phenomenonTime:TM_Object**

NOTE 1 The phenomenonTime is often the time of interaction with a real-world feature either by a SamplingProcedure (time at which a Sample has been taken) or by an ObservingProcedure.

NOTE 2 If the result is the average of multiple samples taken at different times, then the phenomenonTime is the time interval over which these measurements were taken.

Requirement /req/obs-cpt/Observation/phenomenonTime-card	An **Observation** shall have exactly 1 **phenomenonTime.**

Recommendation /rec/obs-cpt/Observation/phenomenonTimeResult-con	If the **observedProperty** of an **Observation** is 'occurrence time' then the **result** should be the same as the **phenomenonTime.**

8.2.4 Attribute resultTime

Requirement /req/obs-cpt/Observation/resultTime-sem	The instant of time when the **result** of the **Observation** became available. If the **resultTime** is described, this shall be provided by the attribute **resultTime:TM_Object**

EXAMPLE 1 The resultTime typically corresponds to when the Procedure associated with the Observation was completed. For some observations this is identical to the phenomenonTime. However, there are important cases where they differ.

EXAMPLE 2 Where a measurement is made on a specimen in a laboratory, the phenomenonTime is the time the specimen was retrieved from its host, while the resultTime is the time the laboratory procedure was applied.

EXAMPLE 3 The resultTime also supports disambiguation of repeat measurements made of the same property of a feature using the same procedure.

EXAMPLE 4 Where sensor observation results are post-processed, the resultTime is the post-processing time, while the phenomenonTime is the time of initial interaction with the world.

EXAMPLE 5 Simulations can be used to estimate the values for phenomena in the future or past. The phenomenonTime is the time to which the result applies, while the resultTime is the time at which the simulation was executed.

Requirement /req/obs-cpt/Observation/resultTime-card	An **Observation** shall have exactly 1 **resultTime**.

8.2.5 Attribute validTime

Requirement /req/obs-cpt/Observation/validTime-sem	The time interval during which the **result** is assumed to be applicable for use. If **validTime(s)** are described, they shall be provided by the attribute **validTime:TM_Period**

NOTE This attribute is commonly required in forecasting applications.

© ISO 2023 – All rights reserved
Documents Document Sharing Hub
Full document details: BS EN ISO 19156:2023

8.2.6 Association featureOfInterest

Requirement /req/obs-cpt/Observation/featureOfInterest-sem	The subject of the **Observation**. The reference(s) to **featureOfInterest(s)** shall be provided using the association **Domain** with the role **featureOfInterest**.

EXAMPLE 1 An instance of a feature modelled in a specific domain model (Borehole according to OGC GeoSciML).

EXAMPLE 2 The bubble of air around the intake of an air quality monitoring station.

EXAMPLE 3 An existing well being used for water quality measurements.

NOTE 1 The featureOfInterest can be of Any type.

NOTE 2 This object is either the real-world object whose properties are under observation, or it is an object used as a proxy for a real-world object that is not directly observable, as described in 7.2. An observation instance serves as a propertyValueProvider for its feature-of-interest.

Requirement /req/obs-cpt/Observation/featureOfInterest-card	An **Observation** shall have at least 1 **featureOfInterest** and may have more than 1 in cases where objects are created with the intention to sample the real-world object The cardinality of the **featureOfInterest** association shall be 1 at minimum.

8.2.7 Association observedProperty

Requirement /req/obs-cpt/Observation/observedProperty-sem	The **ObservableProperty** that is the subject of the **Observation**. If a reference to an **ObservableProperty** is provided, the association with the role **observedProperty** shall be used.

Requirement /req/obs-cpt/Observation/observedProperty-card	An **Observation** shall have exactly 1 **observedProperty**.

8.2.8 Association result

Requirement /req/obs-cpt/Observation/result-sem	The **result** of the **Observation**. If a reference to a **result** is provided, the association **Range** with the role **result** shall be used.

NOTE 1 The result can be of Any type as it can represent the value of any feature property.

NOTE 2 If the observed property is a spatial operation or function, the type of the result can be a coverage.

NOTE 3 In some contexts, particularly in earth and environmental sciences, the term “observation” is used to refer to the result itself.

Requirement /req/obs-cpt/Observation/result-card	An **Observation** shall have exactly 1 **result**.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

8.2.9 Association observingProcedure

Requirement /req/obs-cpt/Observation/observingProcedure-sem	The **ObservingProcedure** is used by the **Observation** to determine the value of the **ObservableProperty** provided by the **result.** If a reference to an **ObservingProcedure** is provided, the association with the role **procedure** shall be used.

EXAMPLE Observed radiance wavelength is determined by the response characteristics of the sensor.

A description of the observation procedure provides or implies an indication of the reliability or quality of the observation result.

Requirement /req/obs-cpt/Observation/observingProcedure-card	An **Observation** shall have exactly 1 **observingProcedure**.

8.2.10 Association observer

Requirement /req/obs-cpt/Observation/observer-sem	An **Observer** that is involved in the creation of this **Observation**. If a reference to an **Observer** is provided, the association with the role **observer** shall be used.

8.2.11 Association host

Requirement /req/obs-cpt/Observation/host-sem	A **Host** that is involved in the creation of this **Observation.** If a reference to a **Host** is provided, the association with the role **host** shall be used.

8.2.12 Constraint Observer or Host

Recommendation /rec/obs-cpt/Observation/observerhost-con	At least one **Observer** or **Host** should be provided.

8.2.13 Constraint ObservableProperty characteristic associated with featureOfInterest

Recommendation /rec/obs-cpt/Observation/observedProperty-con	The **ObservableProperty** referenced by **observedProperty** should correspond to a characteristic associated with the **featureOfInterest.**

8.2.14 Constraint suitable ObservableProperty

Recommendation /rec/obs-cpt/Observation/observingProcedure-con	The **ObservingProcedure** referenced by **procedure** should be suitable for the associated **ObservableProperty.**

8.2.15 Constraint suitable result type

Recommendation /rec/obs-cpt/Observation/result-con	The type of the result provided by the **result** association should be suitable for the associated **ObservableProperty**.

© ISO 2023 – All rights reserved
Documents Document Sharing Hub
Full document details: BS EN ISO 19156:2023

8.2.16 Constraint unit of measure

Requirement /req/obs-cpt/Observation/uom	The **Observation** shall provide a unit of measure (UoM) if the result is measurable. If the UoM is not contained in the result, it shall be provided in the context of the **Observation**; the provision modality is to be defined by communities.

Recommendation /rec/obs-cpt/Observation/uom-con	The unit of measure should be suitable for the associated **ObservableProperty** and **ObservingProcedure**.

NOTE 1 In the case where the result of the Observation is a classification, for which no unit exists, the UoM can be declared as unitless (e.g. referencing the QUDT[27] https://qudt.org/vocab/unit/UNITLESS or UCUM[19] entry for "no units").

8.3 ObservableProperty

8.3.1 ObservableProperty Requirements Class

Requirements Class	/req/obs-cpt/ObservableProperty
Target type	Conceptual model
Name	Conceptual Observation – ObservableProperty
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Requirement	/req/obs-cpt/ObservableProperty/ObservableProperty-sem
Requirement	/req/obs-cpt/ObservableProperty/observer-sem
Requirement	/req/obs-cpt/gen/relatedObservation-sem

8.3.2 Interface ObservableProperty

Requirement /req/obs-cpt/ObservableProperty/ObservableProperty-sem	An **ObservableProperty** shall be defined as a quality (property, characteristic) of the **feature-of-interest** that can be observed.

EXAMPLE 1 The height of a tree, the depth of a water body, or the temperature of a surface are examples of observable properties, while the value of a classic car is not (directly) observable but asserted.

EXAMPLE 2 Groundwater Level.

On a groundwater well, the:

a) Groundwater Level (1 observable property)

is monitored

b) with an automated probe (that remains in the ground all year, constituting 1 procedure).

In addition, the groundwater well is revisited in the context of physical campaigns, where the:

c) Groundwater Level (still the same observable property as above)

is measured, but

d) with a manual probe (this is a different procedure than used above).

This allows for checking whether the probe needs recalibration.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

8.3.3 Association observer

Requirement /req/obs-cpt/ObservableProperty/observer-sem	An **Observer** capable of observing this **ObservableProperty**. If a reference to the **Observer** is provided, the association with the role **observer** shall be used.

8.4 Procedure

8.4.1 Procedure Requirements Class

Requirements class	/req/obs-cpt/Procedure
Target type	Conceptual model
Name	Conceptual Observation – Procedure
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Requirement	/req/obs-cpt/Procedure/Procedure-sem

8.4.2 Interface Procedure

Requirement /req/obs-cpt/Procedure/Procedure-sem	A **Procedure** shall be defined as a description of steps performed.

NOTE 1 Procedure is an abstract concept that is then further specialized in the various procedure types defined in this document. All share the commonality of describing a defined series of steps to a specific purpose.

NOTE 2 The term "process" that was used in ISO 19156:2011 was purposely dropped in this document to avoid unnecessary confusion between the terms “procedure” and “process”.

8.5 ObservingProcedure

8.5.1 ObservingProcedure Requirements Class

Requirements Class	/req/obs-cpt/ObservingProcedure
Target type	Conceptual model
Name	Conceptual Observation – ObservingProcedure
Dependency	ISO 19103:2015, Geographic information Conceptual schema language, UML2 conformance class
Imports	/req/obs-cpt/Procedure
Requirement	/req/obs-cpt/ObservingProcedure/ObservingProcedure-sem
Requirement	/req/obs-cpt/ObservingProcedure/observer-sem
Requirement	/req/obs-cpt/gen/relatedObservation-sem

8.5.2 Interface ObservingProcedure

Requirement /req/obs-cpt/ObservingProcedure/ObservingProcedure-sem	An **ObservingProcedure** shall be defined as the description of steps performed in order to determine the value of an **observableProperty** by an **Observer**.

NOTE 1 Depending on the complexity of the use case, the procedure will be more or less explicitly described. Especially pertaining to historical data, there can be very little or no information available. Information on the recipe that the observer (cook) follows to generate the Observation is ideally included.

NOTE 2 The procedure is often referred to as the method.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

NOTE 3 Different observers can follow the same (reusable) procedure for the creation of different observations.

NOTE 4 The procedure is a workflow, protocol, plan, algorithm, or computational method specifying how to make an observation.

NOTE 5 The observing procedure cannot describe a sensor instance, but it can describe the sensor type.

NOTE 6 The term "process" that was used in ISO 19156:2011 has been purposely dropped in this document to avoid unnecessary confusion between the terms “procedure” and “process”.

EXAMPLE An instance of Procedure is a description of the process utilized by an observer. This could be a chemical analysis method, a protocol for measuring an object, but could also be a checklist utilized by a human observer during a biodiversity campaign. Procedure could further describe the algorithms behind simulators or models used to generate a result from other inputs.

8.5.3 Association observer

Requirement /req/obs-cpt/ObservingProcedure/observer-sem	An **Observer** capable of performing this **ObservingProcedure**. If a reference to an **Observer** is provided, the association with the role **observer** shall be used.

8.6 Observer

8.6.1 Observer Requirements Class

Requirements Class	/req/obs-cpt/Observer
Target type	Conceptual model
Name	Conceptual Observation – Observer
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Requirement	/req/obs-cpt/Observer/Observer-sem
Requirement	/req/obs-cpt/Observer/observableProperty-sem
Requirement	/req/obs-cpt/Observer/observingProcedure-sem
Requirement	/req/obs-cpt/Observer/deployment-sem
Requirement	/req/obs-cpt/gen/relatedObservation-sem

8.6.2 Interface Observer

Requirement /req/obs-cpt/Observer/Observer-sem	An **Observer** shall be defined as an identifiable entity that can generate **Observations** pertaining to an **observableProperty** by implementing an **ObservingProcedure**.

NOTE 1 Different Observers can follow the same (reusable) observing Procedure for the creation of different Observations.

NOTE 2 The Observer is the entity instance, not the entity type. Pertaining to sensors, the Observer would reference the explicit sensor, while the Procedure would reference the methodology utilized by that sensor type.

NOTE 3 An Observer is closely linked with an observableProperty for which it generates results for.

NOTE 4 An Observer can be hosted by one or more Host.

NOTE 5 The Observer is an instance of a sensor, instrument, implementation of an algorithm, or a being such as a person.

Documents
Document Sharing Hub

© ISO 2023 – All rights reserved

Full document details: BS EN ISO 19156:2023

An Observer responds to a stimulus (e.g. a change in the environment or input data composed from the results of prior Observations) and generates a result.

EXAMPLE Accelerometers, gyroscopes, barometers, magnetometers, etc. are Observers that are typically mounted on a modern smartphone (which acts as Host). Other examples of sensors include the human eyes.

8.6.3 Association observableProperty

Requirement /req/obs-cpt/Observer/observableProperty-sem	An **ObservableProperty** that this **Observer** can observe. If a reference to **ObservableProperty**(s) is provided, the association with the role **observableProperty** shall be used.

8.6.4 Association observingProcedure

Requirement /req/obs-cpt/Observer/observingProcedure-sem	An **ObservingProcedure** that this **Observer** can perform. If a reference to **ObservingProcedure**(s) is provided, the association with the role **observingProcedure** shall be used.

8.6.5 Association deployment

Requirement /req/obs-cpt/Observer/deployment-sem	A **Deployment** to which this **Observer** is either physically or organizationally attached. If a reference to **Deployment**(s) is provided, the association with the role **deployment** shall be used.

8.7 Host

8.7.1 Host Requirements Class

Requirements Class	/req/obs-cpt/Host
Target type	Conceptual model
Name	Conceptual Observation – Host
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Requirement	/req/obs-cpt/Host/Host-sem
Requirement	/req/obs-cpt/Host/deployment-sem
Requirement	/req/obs-cpt/Host/relatedHost-sem
Requirement	/req/obs-cpt/gen/relatedObservation-sem

8.7.2 Interface Host

Requirement /req/obs-cpt/Host/Host-sem	A **Host** shall be defined as a grouping of **Observer**s for a specific reason.

NOTE 1 In many use cases, the Host is the environmental monitoring facility.

NOTE 2 The Host can be a platform that hosts a set of sensors.

NOTE 3 An alternative usage could pertain to a biodiversity survey campaign. In this scenario, the team performing the survey would be modelled as observers whereas the entire survey campaign can be represented as a Host.

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

8.7.3 Association deployment

Requirement /req/obs-cpt/Host/deployment-sem	A **Deployment** at this **Host**. If a reference to a **Deployment** is provided, the association with the role **host** shall be used.

8.7.4 Association relatedHost

Requirement /req/obs-cpt/Host/relatedHost-sem	A **Host** the **Host** is related to. If a reference to a related **Host** is provided, the association with role **relatedHost** shall be used. The **context: GenericName** qualifier of this association may be used to provide further information as to the nature of the relation.

8.8 Deployment

8.8.1 Deployment Requirements Class

Requirements Class	/req/obs-cpt/Deployment
Target type	Conceptual model
Name	Conceptual Observation – Deployment
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Requirement	/req/obs-cpt/Deployment/Deployment-sem
Requirement	/req/obs-cpt/Deployment/observer-sem
Requirement	/req/obs-cpt/Deployment/host-sem

8.8.2 Interface Deployment

Requirement /req/obs-cpt/Deployment/Deployment-sem	A **Deployment** shall be defined as information on the assignment of an **Observer** to a **Host.**

EXAMPLE 1 Information regarding a sensor being attached to a pole.

EXAMPLE 2 The monitoring facilities pertaining to an environmental monitoring network.

EXAMPLE 3 The description of a ship cruise linking a research vessel with a marine network.

EXAMPLE 4 The participation of a citizen in a citizen-science project involving crowd sensing.

8.8.3 Association observer

Requirement /req/obs-cpt/Deployment/observer-sem	The **Observer** associated with this **Deployment**. If a reference to an **Observer** is provided, the association with the role **observer** shall be used.

8.8.4 Association host

Requirement /req/obs-cpt/Deployment/host-sem	The **Host** to which this **Deployment** pertains. If a reference to a **Host** is provided, the association with the role **host** shall be used

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

9 Abstract Observation Core

9.1 General

9.1.1 Abstract Observation Core Package Requirements Class

Requirements Class	/req/obs-core
Target type	Logical model
Name	Abstract Observation Core package
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Imports	/req/obs-core/AbstractObservationCharacteristics
Imports	/req/obs-core/AbstractObservation
Imports	/req/obs-core/AbstractObservableProperty
Imports	/req/obs-core/AbstractObservingProcedure
Imports	/req/obs-core/AbstractObserver
Imports	/req/obs-core/AbstractHost
Imports	/req/obs-core/AbstractDeployment
Imports	/req/obs-core/AbstractObservationCollection

9.1.2 Association metadata

Requirement /req/obs-core/gen/metadata-sem	If descriptive metadata is provided, the association role **metadata** shall link to descriptive metadata as commonly understood by communities.

NOTE When providing metadata, using the classes, attributes and associations explicitly modelled in the OMS greatly improves the interoperability compared to using the generic metadata association to include the same information.

9.2 AbstractObservationCharacteristics

9.2.1 AbstractObservationCharacteristics Requirements Class

Requirements class	/req/obs-core/AbstractObservationCharacteristics
Target type	Logical model
Name	Abstract Observation Core – AbstractObservationCharacteristics
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, UML2 conformance class
Dependency	ISO 19103:2015, Geographic information — Conceptual schema language, Core-Types conformance class
Dependency	ISO 19108:2002, Geographic information — Temporal schema, Application schemas for data transfer conformance class
Requirement	/req/obs-core/AbstractObservationCharacteristics/AbstractObservationCharacter-istics-sem
Requirement	/req/obs-core/AbstractObservationCharacteristics/type-sem
Requirement	/req/obs-core/AbstractObservationCharacteristics/parameter-sem
Recommendation	/rec/obs-core/AbstractObservationCharacteristics/parameter-procedure
Recommendation	/rec/obs-core/AbstractObservationCharacteristics/parameter-redundant
Requirement	/req/obs-core/AbstractObservationCharacteristics/resultQuality-sem
Requirement	/req/obs-cpt/Observation/phenomenonTime-sem

© ISO 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

Requirements class	/req/obs-core/AbstractObservationCharacteristics
Requirement	/req/obs-cpt/Observation/resultTime-sem
Requirement	/req/obs-cpt/Observation/validTime-sem
Requirement	/req/obs-cpt/Observation/featureOfInterest-sem
Requirement	/req/obs-core/AbstractObservationCharacteristics/pFoI-sem
Requirement	/req/obs-core/AbstractObservationCharacteristics/uFoI-sem
Requirement	/req/obs-basic/ObservationCharacteristics/collection-sem
Requirement	/req/obs-cpt/Observation/observedProperty-sem
Requirement	/req/obs-cpt/Observation/result-sem
Requirement	/req/obs-cpt/Observation/observingProcedure-sem
Requirement	/req/obs-cpt/Observation/observer-sem
Requirement	/req/obs-cpt/Observation/host-sem
Requirement	/req/obs-cpt/gen/relatedObservation-sem
Requirement	/req/obs-core/gen/metadata-sem
Recommendation	/rec/obs-core/AbstractObservationCharacteristics/uFoI
Imports	/req/obs-core/NamedValue

AbstractObservationCharacteristics and AbstractObservation from the Abstract Observation Core are described as a class diagram in Figure 10. The schema is fully described in 9.2 and 9.3.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023

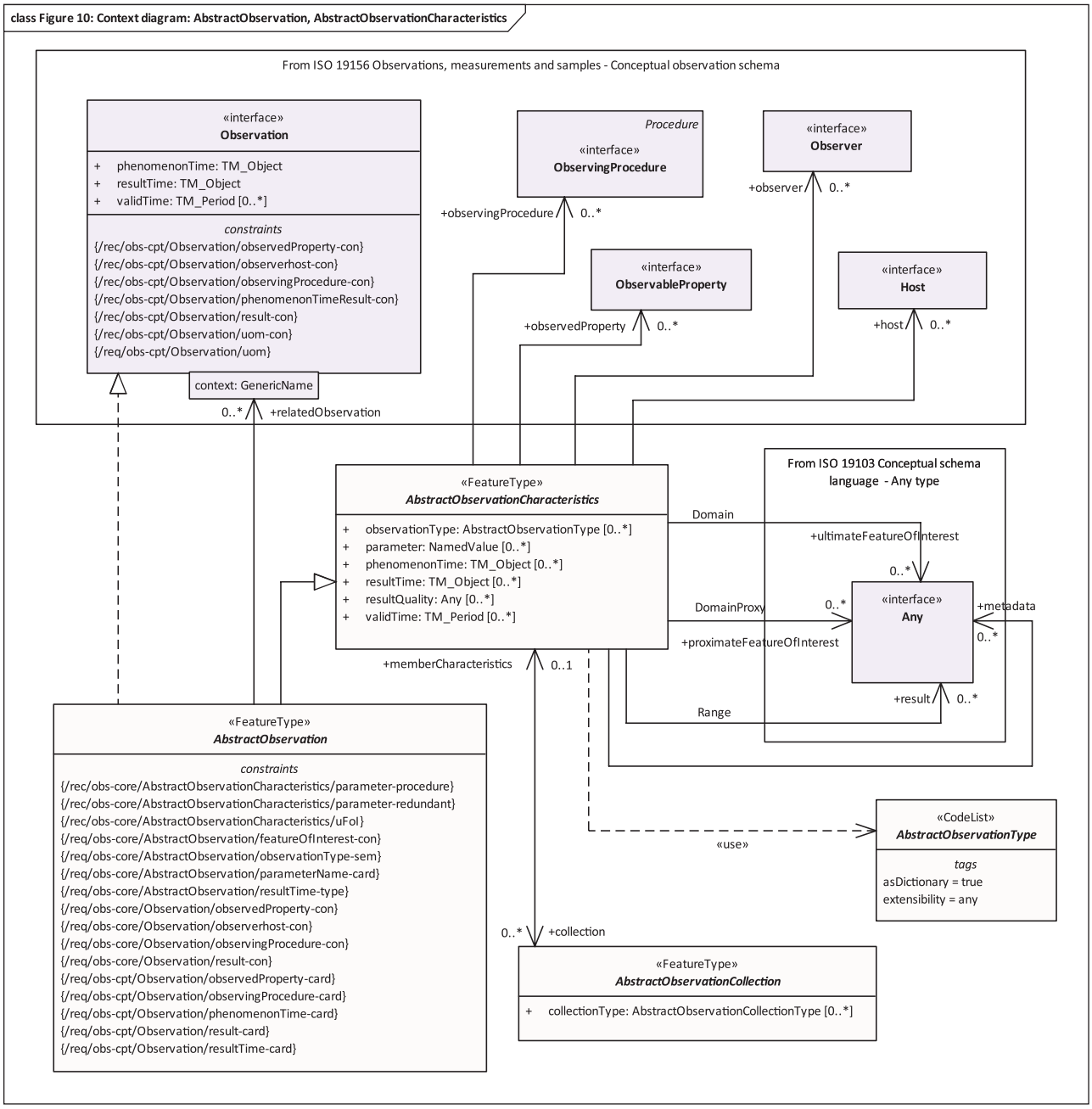


Figure 10 — Context diagram for Abstract Observation Core — AbstractObservationCharacteristics and AbstractObservation

9.2.2 Feature type AbstractObservationCharacteristics

Requirement /req/obs-core/AbstractObservationCharacteristics/AbstractObservationCharacteristics-sem	An **AbstractObservationCharacteristics** shall be defined as a set of common characteristics used for describing an **Observation** or a collection of Observations.

© ISO 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS EN ISO 19156:2023