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Geographic information — Conformance and testing

Information géographique — Conformité et essais

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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).

This second edition cancels and replaces the first edition (ISO 19105:2000), which has been technically revised.

The main changes are as follows:

— the document has been reformatted to have a modular structure;

— conformance testing requirements have been added for modular specification;

— dependency relationships have been introduced among conformance classes;

— three-valued logic is supported on the overall result evaluation;

— the statements on process are omitted, leaving freedom for implementers.

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.

Introduction

The scope of ISO/TC 211 is standardization in the field of digital geographic information. This work aims at establishing a structured set of International Standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These International Standards can specify, for geographic information, methods, tools and services for data management (including definition and description). They can also specify the acquisition, processing, analysing, accessing, presentation and transferring of such data in digital/electronic form between different users, systems and locations. The work will be linked to appropriate International Standards for information technology and data, where possible, and provide a framework for the development of sector-specific applications using geographic data.

This document is based on concepts defined in ISO International Standards which describe conformance and testing. Certain components of the Open Geospatial Consortium (OGC) modular specification,[2] including requirements, requirements classes, abstract test cases and conformance classes, are also used in this document. While the framework of conformance testing described in these documents is also used in this document, some concepts have been modified for use in this particular domain.

Conformance testing does not include robustness testing, acceptance testing and performance testing, because the family of documents on geographic information does not establish requirements for these areas.

Conformance testing tests a candidate product according to normative requirements which are required to be satisfied by passing the tests of the abstract test suite. These abstract test cases are organized into conformance classes in a modular structure, each of which represents a mechanism for partial satisfaction of the International Standard in terms of the corresponding requirements class.

In the practical sense, it is very important to be able to ensure good quality in testing and conformance with the relevant requirement(s). This can be achieved via traceability and perhaps even with a traceability matrix where the requirement and the test result are correlated.

It is recommended that all applicable International Standards regarding geographic information and the relevant application domains follow the formatting for requirements used in this document.

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

Geographic information — Conformance and testing

1 Scope

This document specifies the framework, concepts and methodology for conformance testing and criteria to be achieved to claim conformance to the family of applicable standardization documents regarding geographic information and relevant application domains. This document provides a framework for specifying abstract test suites composed of abstract test cases grouped in conformance classes and for defining the procedures to be followed during conformance testing.

Conformance can be claimed for data or software products or services or by specifications including any profile or functional standard. The structure of, and relationships between, conformance classes as defined in this document underly a systematic approach to configuration management involving managing dependencies within and between modules.

2 Normative references

There are no normative references in this document.

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
abstract
<as a modifier> implementation-independent

3.2
abstract test case
conformance test case
test for a particular requirement or a set of related requirements

Note 1 to entry: An abstract or conformance test case is a formal basis for deriving executable test cases. It should be complete in the sense that it is sufficient to enable a test verdict to be assigned unambiguously to each potentially observable test outcome.

Note 2 to entry: The definition for "test case" can be found in ISO/IEC/IEEE 24765:2017, 3.4210.

3.3
abstract test suite
ATS
set of conformance classes that define tests for all requirements of a specification

Note 1 to entry: Evidence of conformance to all or part of a standard, awarded for passing one or more of the conformance test classes specified in that standard

[SOURCE: OGC 08-131r3, 4.2][2]

3.4
conformance
conformity
fulfilment of a requirement

Note 1 to entry: When there is no ambiguity, the modifier “conformance” may be omitted. For example, "test report" is the same as "conformance test report".

3.5
conformance clause
conformity clause
clause containing all the requirements that need to be fulfilled for an International Standard or specification

Note 1 to entry: In this document, specification represents technical specification.

3.6
conformance class
conformance test class
set of abstract test cases that when applied receive a single certificate of conformance

Note 1 to entry: OGC 08-131r3 defines certificate of conformance as “evidence of conformance to all or part of a standard, awarded for passing one or more of the conformance test classes specified in that standard”.

3.7
conformance testing
testing of a product to determine the extent to which the product is a conforming implementation

3.8
conformance test report
test report
document that presents verdicts of each conformance class and abstract test case in an organized format

3.9
conformance test result
test result
all information recorded during the execution of an executable test case against an implementation under test

3.10
executable test case
specific test of an implementation to meet the specific requirements as stated in the specification containing the requirements

Note 1 to entry: Instantiation of an abstract test case with executable expressions.

3.11
executable test module
set of related executable test cases to test a single certificate of conformance

3.12
executable test suite
set of executable test modules

3.13
identifier
linguistically independent sequence of characters capable of uniquely and permanently identifying that with which it is associated

[SOURCE: ISO 19135-1:2015, 4.1.5]

3.14
implementation
realization of a specification

Note 1 to entry: In the context of the applicable geographic information standards documents, this includes relevant specifications of geographic information services and datasets.

3.15
implementation conformance statement
statement of conformance classes that have been implemented

3.16
implementation under test
implementation that is being evaluated for conformance

[SOURCE: ISO/IEC 18477-4:2017, 3.1.40]

3.17
inconclusive verdict
test verdict when neither a pass verdict nor a fail verdict applies

3.18
modular
consisting of separate parts that, when combined, form a complete whole

3.19
modular specification
specification which organizes its requirements and conformance classes in a modular structure

3.20
modular standard
standard which organizes its requirements and conformance classes in a modular structure

3.21
requirements class
aggregate of all requirements that have the same specification target to satisfy a conformance test class

Note 1 to entry: OGC 08-131r3 defines a similar concept under the name "requirement class" as follows: "aggregate of all requirement modules that must all be satisfied to satisfy a conformance test class."

3.22
specification
document containing requirements and abstract test cases for those requirements

3.23
specification target
entity to which some requirements of a specification apply

Note 1 to entry: OGC 08-131r3 defines a similar concept under the name "standardization target" as follows: "an entity that may receive a proof of conformance for a requirements class."

3.24
standard
document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context

Note 1 to entry: Standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits.

[SOURCE: ISO/IEC Guide 2:2004, 3.2]

3.25
test tool
application that executes an executable test suite

4 Symbols and abbreviated terms

ATC	abstract test case
ATS	abstract test suite
CWA	closed world assumption
ETC	executable test case
ETM	executable test module
ETS	executable test suite
ICS	implementation conformance statement
IUT	implementation under test
OWA	open world assumption
SA	stub assumption
TEAM	test, evaluation, and measurement
UML	unified modeling language
URI	uniform resource identifier

5 Conformance

This document defines four conformance classes:

— “Modular specification” (specification target: specifications);

— “Modular standard” (specification target: standards);

— “Executable test suites” (specification target: executable test suites);

— “Conformance test report” (specification target: test tools).

A specification, standard, test suite or test tool claiming conformance to this document shall implement the conformance class relevant to that specification target.

Conformance with this standard shall be assessed using all the relevant conformance test cases specified in Annex A of this standard. Table 1 provides the uniform resource identifiers (URIs) of conformance classes.

Table 1 — Conformance class URIs

Conformance class	URI
Modular specification	https://standards.isotc211.org/19105/-/2/conf/ModularSpecification
Modular standard	https://standards.isotc211.org/19105/-/2/conf/ModularStandard
Executable test suites	https://standards.isotc211.org/iso19105/-/2/conf/TestSuite
Conformance test report	https://standards.isotc211.org/iso19105/-/2/conf/report

6 Notation

6.1 UML notation

In this document, conceptual schemas are presented in the Unified Modeling Language (UML). ISO 19103 presents the specific profile of UML used in this document.

6.2 Identifiers

The normative provisions in this document are identified by the URI

https://standards.isotc211.org/iso19105/-/2

All requirements and abstract test cases that appear in this document are denoted by partial URIs which are relative to this base.

7 Framework

In an applicable conformance testing framework, a specification contains requirements classes which are used to derive an abstract test suite (ATS). An implementation under test (IUT) is developed according to the specification and an executable test suite (ETS) is implemented according to the ATS. The ETS tests the IUT to determine if it meets the well-defined set of requirements classes as stated in the normative clauses of the specification. See Figure 1.

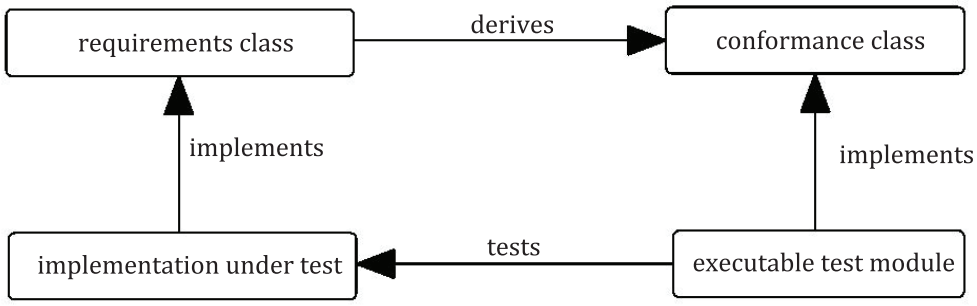

Figure 1 — General approach of the conformance testing

8 Modular specification

8.1 General

In summary, the structure of the requirements and requirements classes of the model should be reflected in the organization of the conformance tests and classes and also in the structure of the normative clauses in the specification document.

NOTE This makes it more difficult to write a specification, but is expected to make the specification easier to read and understand. This trade-off is usually worthwhile, since the readers of a specification are always orders of magnitude more numerous than its contributing authors. Facilitating the implementation of a specification is an important goal of this document.

8.2 Conformance clause

For a specification to be effective and useful, it is essential to be able to determine conformance to the specification clearly. For this reason, all applicable documents regarding geographic information and relevant application domains provide a conformance clause.

Requirement 1 /req/specification/ConformanceClause

A specification shall contain a conformance clause.

A conformance clause is an entry point for testing conformance. To check if an implementation conforms to a specification, the conformance clause is first examined to determine what has to be checked. Thus, conformance clauses shall clearly state which requirements shall be fulfilled to claim conformance to a specification.

Requirement 2 /req/specification/ConformanceClauseStatement

A conformance clause shall start with the statement of conformance classes to be satisfied in order for an implementation to claim conformance to that specification.

Requirement 3 /req/specification/ConformanceTarget

The conformance clause shall specify the specification target of each conformance class in the specification.

Conformance classes modularize abstract test cases (see Annex A). A sample conformance clause template is provided in Clause B.1.

Requirement 4 /req/specification/ConformanceClauseReference

The conformance clause shall reference the ATS in an annex.

8.3 Conformance classes

Requirement 5 /req/specification/CorrespondenceRequirementsClasses

The requirements classes shall segment the requirements in the specification in a manner consistent with the conformance classes.

Each requirements class will be in a 1 to 1 correspondence to a similarly named conformance class that tests all of the requirements class' requirements.

A sample requirement is provided in Clause B.2

Requirement 6 /req/specification/SpecificationTarget

All requirements in a requirements class shall have the same specification target.

Requirement 7 /req/specification/ConformanceTest

A requirement shall be tested in at least one abstract test case.

Requirement 8 /req/specification/ConformanceClassIdentification

A conformance class shall be identified by a URI.

Requirement 9 /req/specification/ConformanceClassDependency

A conformance class shall specify any other conformance class upon which it is dependent. That other conformance class shall also be used to test the conformance.

8.4 Abstract test suite

Without considering dependency relationships among conformance classes, the ATS has a hierarchical structure. Conformance classes may be used to aid planning, development or understanding of the ATS. [9] A conformance class is composed of one or many abstract test cases (see Annex C).

An abstract test case is used as the basis for generating an executable test case and is independent of the IUT.

Concerning modularization and dependencies, the structure of abstract test cases and classes may correspond to a directed acyclic-graph of conformance classes (see Annex C).

Requirement 10 /req/specification/ATSStructure

The structure of abstract test cases (ATCs) shall follow the structure of conformance classes.

A sample template is provided in Clause B.3.

Requirement 11 /req/specification/ATCTemplate

An abstract test case shall contain:

a) the test case identifier;

b) the test purpose (optional);

c) the test method (including test verdict criteria);

d) a reference to a specific requirement (optional).

A sample template is provided in Clause B.4.

Requirement 12 /req/specification/ATCIdentifier

An identifier for an abstract test case shall be a URI.

Recommendation 1 /rec/specification/ATSTestPurpose

An abstract test case should include one test purpose in order to provide a precise description of the objective which it is intended to achieve.

The test purpose of a conformance test case is to test the requirements referenced from the test case. As this is the case for every conformance test case, explicitly specifying a test purpose is optional.

Requirement 13 /req/specification/ATCTestMethod

A test method for an abstract test case shall contain test verdict criteria of its test purpose.

Requirement 14 /req/specification/ATCTestReference

A reference for an abstract test case shall identify the requirements that are tested.

Permission 1 /per/specification/ATSElements

An ATS may contain other elements than identifier, test method and references to requirements.

NOTE To provide backward compatibility, it is permitted to include a test type[2] in an ATC. The test type can be either a basic test or a capability test. Generally, a basic test provides preliminary evidence that an IUT conforms. Capability tests check that the observable capabilities of the IUT are in accordance with the claimed capabilities.

9 Modular standard

For an International Standard to be effective and useful, it is essential to be able to determine conformance to the International Standard clearly. For this reason, all applicable standardization documents regarding geographic information and relevant application domains provide a conformance clause.

Requirement 15 /req/standard/Dependency

A modular ISO/TC 211 International Standard shall follow the modular structure specified in Clause 8 of this standard.

Dependency: https://standards.isotc211.org/19105/-1/2/req/ModularSpecification

The implementation of ISO/TC 211 standards as XML Schemas and ontologies requires access to official URIs for both the schemas and individual resources within the schemas. For conformance testing and documentation, conformance classes, conformance tests, requirements and recommendations from standards also need to be uniquely identified.

Requirement 16 /req/standard/Identification

All identifiable requirements classes, requirements, conformance classes and abstract test cases shall be identified by URIs in accordance with Annex D.

10 Executable test suite

An ETS is an instantiation of an ATS, in which all implementation-dependent parameters are assigned specific values.

Requirement 17 /req/test-suites/ExecutableTestSuite

An executable test suite shall cover all conformance classes specified in the abstract test suite.

Requirement 18 /req/test-suites/ExecutableTestModule

The executable test suite shall segment the executable test cases in executable test modules in a manner consistent with the conformance classes.

Each executable test modules shall be in a 1 to 1 correspondence to a similarly-named conformance class that tests all of the requirements class' requirements.

Requirement 19 /req/test-suites/ETC

An executable test case shall be derived from one or more abstract test cases.

Requirement 20 /req/test-suites/ETCTemplate

An executable test case shall contain:

a) the test case identifier;

b) the test description;

c) the test expression;

d) a reference to the corresponding ATCs.

Requirement 21 /req/test-suites/ETCTestIdentifier

An identifier for an executable test case shall be a URI.

Requirement 22 /req/test-suites/ETCTestDescription

A test description for an executable test case shall include a test description which is consistent with the ATCs that the ETC implements.

Requirement 23 /req/test-suites/ETCTestExpression

A test expression for an executable test case shall implement verdict criteria consistent with the test methods of the ATCs that the ETS implements.

Requirement 24 /req/test-suites/ETCTestReference

A reference for an executable test case shall identify the ATCs that are implemented.

NOTE The ATC identifier is an URI. For applicable ISO/TC 211 documents, this refers to the URI structure provided in Annex D.

11 Conformance test report

The results of conformance testing are documented in a conformance test report.

Requirement 25 /req/report/TestReport

The conformance test report shall contain the test verdicts according to the implemented requirements classes of the IUT.

Recommendation 2 /rec/report/ICS

An IUT should provide an implementation conformance statement (ICS) which provides a statement of the conformance classes that have been implemented to allow the implementation to be tested against the relevant requirements.

NOTE 1 An ICS indicates the requirements classes against which the IUT is to be tested, e.g. an ICS can be the URIs of the implemented requirements classes in a Web service capability description document.

NOTE 2 Normally, a conformance test report consists of two parts: a summary and a detailed information section. See examples in Annex E.

EXAMPLE 1 FAILED, WARNING, INFO, PASSED, PASSED_MANUAL, SKIPPED, NOT_APPLICABLE, UNDEFINED; see Ares(2016)6685626.[12]

EXAMPLE 2 Pass, fail, inconclusive, none, error; see ES 201 873-1.[15]

Requirement 26 /req/report/TestVerdict

A test verdict shall be a statement of result value.

Pass and fail are the two major verdicts but, in rare cases, a verdict of inconclusive may have to be assigned. In practical test tools, there will be more result values[11] which can be mapped to the three verdicts (see Clause E.1). These result values include, but are not limited to, the values given in Table E.1.

Requirement 27 /req/report/OverallResult

The test verdicts assigned shall be synthesized into an overall conformance verdict evaluation for the IUT.

NOTE 1 The overall result is a synthesis of the conformance class results.

NOTE 2 IUTs are required to undergo some specific verification and validation procedures. However, the complexity of geo-services establishes additional synthesis problems; one of them, which is addressed in this document, is related to dependency issues. Such dependencies often exist already within one specification against which an IUT is to be assessed. Moreover, specifications themselves often refer to other specifications – either because some pre-existing specifications are used, as in the case of relying on standards, or because the specification on hand is itself modularized into different documents between which, consequently, logical relationships exist.

In practical test tools, there will be different result synthesis methods to evaluate the overall result. These result synthesis methods include, but are not limited to, the method provided in Annex F.

The recording and retention of all information provided by the IUT during the test process is necessary for the analysis phase and for auditing purposes.

Requirement 28 /req/report/RecordAuditability

The results of conformance testing shall be auditable.

NOTE Whether or not the analysis of results is carried out manually or automatically, all inputs and outputs shall be recorded for each test case being executed.

Requirement 29 /req/report/ResultRepeatability

The results of conformance testing shall be repeatable.

NOTE To achieve the objective of credible conformance testing, the result of executing an executable test case on a given IUT needs to be the same whenever it is performed. It needs to be possible to execute a complete ETS and observe test outcomes which are identical to those obtained on another occasion.

Requirement 30 /req/report/ResultComparability

The results of conformance testing shall be comparable.

NOTE In order to achieve the objectives of conformance testing, the overall summary concerning conformance of an IUT needs to be independent of the testing laboratory[10][11] in which the testing takes place. The standardization of all the procedures concerned with conformance testing needs to result in a comparable overall summary being accorded to the IUT, whether the testing is done by a supplier (first party), a user (second party) or by any (third party) testing laboratory.

Annex A
(informative)

Abstract test suite

A.1 Overview

This annex specifies an ATS which shall be passed by any implementation claiming conformance with this document.

The requirements identifiers below are relative to https://standards.isotc211.org/iso19105/-/2

A.2 Conformance test class: modular specification

A.2.1 General

The URI identifier of this conformance class is:
https://standards.isotc211.org/19105/-1/2/conf/ModularSpecification

The URI identifier of this requirements class is:
https://standards.isotc211.org/19105/-1/2/req/ModularSpecification

The tests identifiers below are relative to https://standards.isotc211.org/19105/-1/2

A.2.2 Specification contains a conformance clause

Test ID: **/conf/specification/ConformanceClause**

Test method: `For an applicable specification, check that a conformance clause exists.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ConformanceClause**

A.2.3 Conformance clause starts with the statement of conformance classes

Test ID: **/conf/specification/ConformanceClauseStatement**

Test method: `For a conformance clause, check that the conformance classes are specified in the ATS in the conformance clause, otherwise check that the conformance clause references an ATS annex.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ConformanceClauseStatement**

A.2.4 Specification target of each conformance class is specified in the conformance clause

Test ID: **/conf/specification/ConformanceTarget**

Test method: `For a conformance clause, check that the specification target of each conformance class is specified.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ConformanceTarget**

A.2.5 Actual conformance classes are stated in the ATS

Test ID: **/conf/specification/ConformanceClauseReference**

Test method: `For a conformance clause, check that it references the ATS in an annex.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ConformanceClauseReference**

A.2.6 Correspondence between requirements and conformance classes

Test ID: **/conf/specification/CorrespondenceRequirementsClasses**

Test method: `For all requirements in a requirements class, check that these requirements are consistent with the conformance classes.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/CorrespondenceRequirementsClasses**

A.2.7 All requirements in a requirements class have the same specification target

Test ID: **/conf/specification/SpecificationTarget**

Test method: `For all the requirements in a requirements class, check that these requirements have the same specification target.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/SpecificationTarget**

A.2.8 A requirement is tested in at least one abstract test case

Test ID: **/conf/specification/ConformanceTest**

Test method: `For a requirement, check that there is at least one abstract test case that tests this requirement.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ConformanceTest**

A.2.9 A conformance class is identified by a URI

Test ID: **/conf/specification/ConformanceClassIdentification**

Test method: `For a conformance class, check that it is identified by a URI.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ConformanceClassIdentification**

A.2.10 The dependency is specified for testing

Test ID: **/conf/specification/ConformanceClassDependency**

Test method: `For a dependent conformance class, check that it is identified by a URI.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ConformanceClassDependency**

A.2.11 ATS is consistent with the requirements classes

Test ID: **/conf/specification/ATSStructure**

Test method: `For an ATS, check that its hierarchical structure is consistent with the conformance classes.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ATSStructure**

A.2.12 ATC follows the template

Test ID: **/conf/specification/ATCTemplate**

Test method: `For an ATC, check that it is specified according to the given template.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ATCTemplate**

A.2.13 An ATS is identified by a URI

Test ID: **/conf/specification/ATCIdentifier**

Test method: `For an ATC, check that it is identified by a valid URI.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ATCIdentifier**

A.2.14 ATC Test method contains test-verdict

Test ID: **/conf/specification/ATCTestMethod**

Test method: `For a test method of an ATC, check that it contains test verdict criteria of its test purpose.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ATCTestMethod**

A.2.15 ATC references the requirement

Test ID: **/conf/specification/ATCTestReference**

Test method: `For an abstract test case, check that it identifies the requirements that are tested.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/specification/ATCTestReference**

A.3 Conformance test class: modular standard

A.3.1 General

The URI identifier of this conformance class is:
https://standards.isotc211.org/19105/-1/2/conf/ModularStandard

The URI identifier of this requirements class is:
https://standards.isotc211.org/19105/-1/2/req/ModularStandard

The tests identifiers below are relative to https://standards.isotc211.org/19105/-1/2

A.3.2 A modular standard follows the modular structure

Test ID: **/conf/standard/Dependency**

Test method: `For a modular ISO/TC 211 International Standard, check that it follows all requirements specified in Clause 7 of this document.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/standard/Dependency**

A.3.3 All identification follows Annex D

Test ID: **/conf/standard/Identification**

Test method: `For an applicable ISO/TC 211 International Standard, check that all identifiable requirements classes, requirements, conformance classes, ATCs, and corresponding resources are identified by referenceable URIs, as given in Annex D.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/standard/Identification:**

A.4 Conformance Test Class: Executable test suite

A.4.1 General

The URI identifier of this conformance class is:
https://standards.isotc211.org/iso19105/-/2/conf/TestSuite

The URI identifier of this requirements class is:
https://standards.isotc211.org/19105/-1/2/req/TestSuite

The tests identifiers below are relative to https://standards.isotc211.org/iso19105/-1/2/

A.4.2 Executable test suite shall cover all executable test modules (ETMs)

Test ID: **/conf/test-suites/ExecutableTestSuite**

Test method: `For an ETS, check that it covers all ETMs specified in the ATS.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ExecutableTestSuite**

A.4.3 Executable test modules shall be consistent with the conformance classes

Test ID: **/conf/test-suites/ExecutableTestModule**

Test method: `For an ETS, check that the ETCs are segmented in executable test modules in a manner consistent with the conformance classes.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ExecutableTestModule:**

A.4.4 Executable test is derived from corresponding ATC/ATCs

Test ID: **/conf/test-suites/ETC**

Test method: `For an ETC, check that it refers to the corresponding ATC/ATCs.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ETC**

A.4.5 ETC follows the specified template

Test ID: **/conf/test-suites/ETCTemplate**

Test method: `For an ETC, check that it follows the specified template.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ETCTemplate**

A.4.6 ETC is identified by a URI

Test ID: **/conf/test-suites/ETCTestIdentifier**

Test method: `For an ETC, check that it is identified by a URI.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ETCTestIdentifier**

A.4.7 An ETC includes one test description

Test ID: **/conf/test-suites/ETCTestDescription**

Test method: `For an ETC, check that it contains a test description which is consistent with the ATCs that the ETC implements.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ETCTestDescription**

A.4.8 An ETC includes one test expression

Test ID: **/conf/test-suites/ETCTestExpression**

Test method: `For an ETC, check that it contains a test expression which implements verdict criteria consistent with the test methods of the ATCs that the ETS implements.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ETCTestExpression**

A.4.9 An ETC shall include a reference to the requirement

Test ID: **/conf/test-suites/ETCTestReference**

Test method: `For an executable test case, check that it contains a reference to the ATCs that it implements.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/test-suites/ETCTestReference**

A.5 Conformance test class: Conformance test report

A.5.1 General

The URI identifier of this conformance class is:
https://standards.isotc211.org/iso19105/-/2/conf/report

The URI identifier of this requirements class is:
https://standards.isotc211.org/iso19105/-/2/req/report

The tests identifiers below are relative to https://standards.isotc211.org/iso19105/-1/2/

A.5.2 Conformance test report is provided according to ICS

Test ID: **/conf/report/TestReport**

Test method: `For a conformance test report, check that the test verdicts are provided according to the ICS.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/report/TestReport**

A.5.3 A test verdict is a statement of result value

Test ID: **/conf/report/TestVerdict**

Test method: `For test verdict, check that it is a statement of result value.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/report/TestVerdict**

A.5.4 Test verdicts are synthesized into an overall conformance verdict evaluation

Test ID: **/conf/report/OverallResult**

Test method: `For an IUT, check that there is an overall conformance verdict evaluation.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/report/OverallResult**

A.5.5 The conformance testing is auditable

Test ID: **/conf/report/ResultAuditability**

Test method: `Run the ETS against the IUT, check that all inputs and outputs are recorded for each test case being executed.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/report/RecordAuditability**

A.5.6 The conformance testing is repeatable

Test ID: **/conf/report/ResultRepeatability**

Test method: `Run the ETS against the same IUT twice, check that both results are identical.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/report/ResultRepeatability**

A.5.7 The conformance testing is comparable

Test ID: **/conf/report/ResultComparability**

Test method: `Run the ETS against the same IUT in different test laboratories, check that both results are identical.`

Test passes if constraint evaluates to be 'true'.

Reference: **/req/report/ResultComparability**

Annex B
(informative)

Sample template of styling constructs

B.1 Conformance clause template

A sample conformance clause template can be as follows:

This document defines *n* conformance classes:

— "C_1"(specification target: target T_1);

— "C_2" (specification target: target T_2);

— …

— "C_n" (specification target: target T_n).

A specification, standard, test suite or test tool claiming conformance to this document shall implement the conformance class relevant to that specification target.

Conformance with this document shall be assessed using all the relevant conformance test cases specified in Annex *X* of this document. Table *j* provides conformance class URIs.

Where C_i is conformance class, T_i is specification target, and *X* is Annex order, and *j* is table order.

An example conformance clause, with descriptive text and formatted table, is shown in Clause 5.

B.2 Requirement template

A sample requirement template can be as follows:

Requirement *i* /req/*reqcls*/*req*

Requirement statement

Dependency: {*URIs}*

Where *i* is requirement order, *reqcls* is requirement class name, *req* is requirement name, *Requirement statement* is the normative requirement statement, {*URI*} is the dependent requirement classes.

Numbered requirements 1 through 30 in Clause 8, 9 and 10 are examples of formatted requirement statements.

B.3 Abstract test suite template

A sample ATS template can be as follows:

This annex specifies an abstract test suite (ATS) which shall be passed by any implementation claiming conformance with this document.

Requirements identifiers below are relative to <*URI*>

Where *URI* is the URI of the standard/specification.

An example can be found in Annex A of this document.

B.4 Abstract test case template

A sample abstract test case template can be as follows:

Test ID: **/conf/*confcls*/*test***

Test purpose: *test purpose*

Test method: *test method*

Reference: **/req/*reqcls*/*req***

Where *confcls* is conformance class name, *test* is conformance test name, *Test purpose* is test purpose description, *test method* is test method description, *reqcls* is requirement class name, *req* is requirement name.

An example can be found in Annex A of this document.

Annex C
(informative)

UML model

The OGC08-131r3 conceptual model has been modified for use in this annex for a better understanding of the modular specification. An applicable specification contains requirements classes and the corresponding ATS which consists of conformance classes that test corresponding requirements classes. Requirements in a requirements class all share the same specification target. A requirement is tested according to at least one abstract test case. An ETS is derived from the corresponding ATS and executes against an IUT to check if the declared capability provided in URIs of an ICS is developed properly. The conformance test result is used to derive the conformance test report for the IUT. See the UML model in Figure C.1.

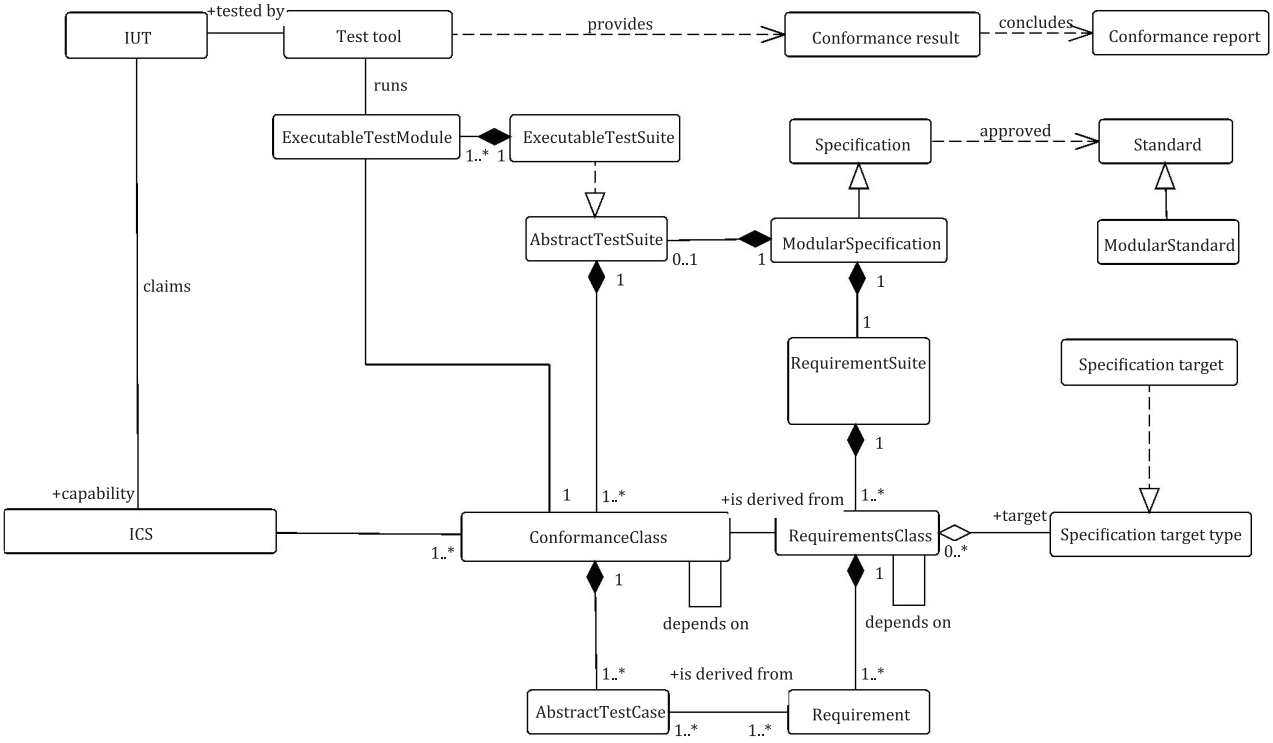

Figure C.1 — UML model

Annex D
(informative)

URI structure

D.1 The Normative statements

Template:

https://standards.isotc211.org/standardNumber/-[partNumber]/editionNumber/statementType/nsClassId/nsId

where:

— Standard number: The main number of the document, e.g. “19115”

— Part number: For a series with several parts, e.g. “-1”. If the series has no parts: “-”

— Edition number: Official ISO edition number, e.g. “1”

— statementType: req (requirement), rec (recommendation) or per (permission)

— nsClassId: The class ID for the normative statement

— nsID: Internal ID for the normative statement

Example:

— URI for requirement “extent” in the requirement class “content” in ISO 19131, edition 2:

  — https://standards.isotc211.org/19131/-/2/req/content/extent

Notes:

— The *edition number* of the document is placed before the *statement type* to enable one main URI for all statements in one edition. The statements are expected to require inspection for each edition.

— The content of the resource should show the normative statement.

D.2 Conformance classes and tests

Template:

https://standards.isotc211.org/standardNumber/-[partNumber]/editionNumber/conf/classId/TestId

where:

— Standard number: The main number of the document. e.g. “19115”

— Part number: For a series with several parts. e.g. “-1”. If the series has no parts: “-”

— Edition number: Official ISO edition number. e.g. “1”

— ClassId: The class ID for the conformance class

— TestID: The class ID for the conformance test (only for conformance tests)

Example:

— URI identifier for the conformance test “allContent” in the conformance class “content” in ISO 19131, edition 2:

  — https://standards.isotc211.org/19131/-/2/conf/content/allContent

Notes:

— The *edition number* of the document is placed before *conf* to enable one main URI for all conformance classes in one edition. The tests are expected to require inspection for each edition.

— The content of the resource should describe the conformance class and test.

Annex E
(informative)

Conformance test report examples

E.1 Conformance test report of OGC TEAM engine

In OGC, an implementation specification document contains an annex with an ATS consisting of one test specification for a requirement. In sync with the requirements classes, these tests are grouped into conformance test classes. These tests are formulated abstractly in the sense that they only give a high-level description; a concrete ETS, which is developed in Compliance Test Language, represents the executable counterpart of the ATS. OGC's Test, Evaluation, And Measurement (TEAM) Engine[16] runs this ETS and tests corresponding implementations.[13] See the example in Figure E.1.

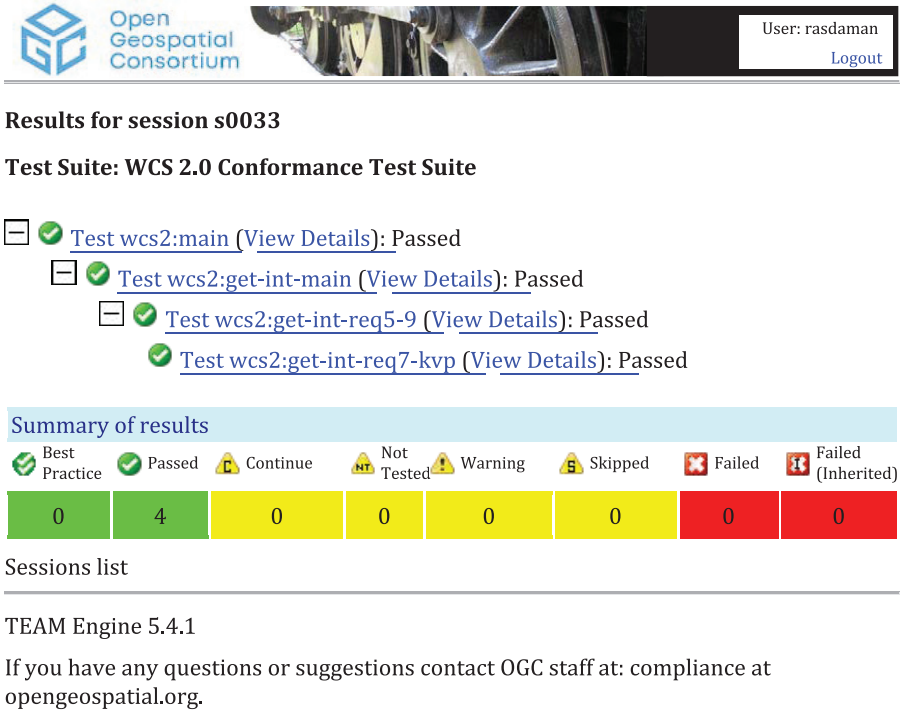

Figure E.1 — Sample test report of OGC TEAM engine

E.2 Conformance test report of the INSPIRE Reference Validator (ETF)

INSPIRE is a European Directive that aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which can have an impact on the environment.[17] INSPIRE defines specifications (Technical Guidelines) for data, metadata and web services to which components in the infrastructure ought to conform. Reference [18] shows the location at which the abstract test suite for a specification is documented and maintained. The executable test suites implementing the abstract test suites are available from Reference [19]. A test tool with the ETSs is available online at Reference [20]. Figure E.2 is an example of a test report created by the INSPIRE Reference Validator on a metadata record. The ETF software uses more fine-grained status values which are mapped to the three verdict values pass, fail, inconclusive as shown in Table E.1. The colours used in the test report represent the verdict. Green is "PASS", red is "FAILED" and ochre-yellow is "PASSED_MANUAL".

Test run on 18:33 - 15.06.2019 with test suite
Conformance class: INSPIRE Profile based on EN ISO 19115 and EN ISO 19119

Status Failed
Started 15/06/2019 18:34:17 GMT
Duration 10 s

	Total Count	Skipped	Failed	Warnings	Manual
Test suites	2	0	1	0	0
Test cases	9	0	1	0	1
Assertions	30	0	1	0	2

Show: All / Only failed / Only manual
Level of detail: All details / Less information / Simplified

Conformance class: XML encoding of ISO 19115/19119 metadata 1

Conformance class: INSPIRE Profile based on EN ISO 19115 and EN ISO 19119 Failed: 1 / 8

This test suite examines metadata records against the requirements for metadata in INSPIRE.

This is a draft version. It has limitations and is expected to contain errors. Please report any issues or problems in GitHub.

Known limitations are documented in the description of the applicable test case or test assertion.

There is a general limitation in all assertions that polymorphism and containment by reference (see the Technical Guidance, sub-clauses A.3, A.4 and A.5) are not supported. However, the current Abstract Test Suite does not support polymorphism and references either (all XPath expressions do not support polymorhism or references; in addition, schema validation is only executed against the ISO/OGC schemas without extensions). It is therefore unclear if this is really a limitation or if the sections in the technical guidance are outdated.

Source: Conformance Class 'INSPIRE Profile based on EN ISO 19115 and EN ISO 19119'

Pre-requisite conformance classes:

- Conformance Class 'XML encoding of ISO 19115/19119 metadata'

Status Failed
Duration 7 s
Version 0.2.6

Common tests 11

Hierarchy level 1

Dataset (series) tests Failed: 1 / 7

Execute tests that apply for all dataset / dataset series metadata records.

Status Failed
Duration 6 s

md-iso.c.1: Dataset identification

md-iso.c.2: Dataset language

If the type of the resource is dataset or series, a resource language must be given.

This test case only applies to records with a hierarchyLevel value 'dataset' or 'series'.

The test first checks if a gmd:LanguageCode object is given (inside gmd:identificationInfo), containing a codeListValue attribute with a valid 3-letter language code (see the values of enumeration type languageISO6392B in http://inspire.ec.europa.eu/schemas/common/1.0/common.xsd).

Relevant requirements:

- TG MD Requirement 8: The resource language is mandated by ISO 19115.
- TG MD Requirement 9: The resource language has to be filled with a value from the codelist ISO/TS 19139 based on alpha-3 codes of ISO 639-2.

Source: Abstract Test Case 'Dataset language'

Status Passed
Duration 0.001 s

Figure E.2 — Test report created by the INSPIRE Reference Validator on a metadata record

Table E.1 — Verdict mapping rules

Result value	Meaning	Verdict
FAILED	If at least one status value is FAILED.	fail
WARNING	If at least one status value is WARNING.	pass
INFO	If at least one status value is INFO.	pass
PASSED	If all status values are PASSED.	pass

Table E.1 *(continued)*

Result value	Meaning	Verdict
PASSED_MANUAL	If at least one status value is PASSED_MANUAL and all other values are PASSED. A test case possesses the status PASSED_MANUAL if the test is not automated (no manual test steps) or not fully automated (at least one manual test step) and the user has to validate results manually based on instructions in the report.	pass
SKIPPED	If at least one status value is SKIPPED because a test case depends on another test case which has the status FAILED.	fail
NOT_APPLICABLE	If at least one status value is NOT_APPLICABLE, in the case the test object does not provide the capabilities for executing the test.	pass
UNDEFINED	In all other cases.	inconclusive

Annex F
(informative)

Overall result synthesis

F.1 Truth-bearer proposition

A truth-bearer proposition can be used to specify the overall result synthesis. The three possible truth values of a statement, namely T, F, and U, follow a three-valued logic having two or more statements connected by logical *conjunction* ("and") and *disjunction* ("or") operators. Such a logical expression is represented as given by the following grammar:

S:"T"|"F"|"U"

P:"∧"|"∨"

Exp:*S*|"("Exp")"|Exp*P*Exp

where *S* is a truth value and *Exp* is a logical expression.

F.2 Test result synthesis

The three possible truth values of a statement, namely "Pass", "Fail", and "Inconclusive", follow a three-valued logic. Three evaluation assumptions can be used to evaluate "Inconclusive verdicts": open world assumption (OWA), closed world assumption (CWA) and stub assumption (SA). The OWA states that the truth value of a verdict that is not included in or inferred from the knowledge explicitly recorded in the system shall be considered inconclusive. The CWA is the assumption that any statement that is not known to be true is false. In an SA, the dependent conformance classes are always assumed to be true when the results are not available.

According to Kleene's logic, a conjunction produces a value of T if both of its operands are T, an F if one of its operands is F, and otherwise U. Disjunction delivers a value of T if one of its operands is T, an F if both of its operands are F, and otherwise a U. Kleene's approach is an OWA. This approach is extended under the three assumptions; see the logic assumptions on unknown results in Table E.1 and extended truth table of the logic operations for Kleene's logic with CWA and SA in Table E.2.

Table F.1 — Logic assumptions on unknown results

Assumption	Operand	Result
CWA	U	F
OWA	U	U
SA	U	T

Table F.2 — Extended truth table of the logic operations for Kleene's logic with CWA and SA

P	Q	P and Q (CWA)	P and Q (Kleene's logic, OWA)	P and Q (SA)	P or Q (CWA)	P or Q (Kleene's logic, OWA)	P or Q (SA)
T	T	T	T	T	T	T	T
T	U	F	U	T	T	T	T

Table F.2 *(continued)*

P	Q	P and Q (CWA)	P and Q (Kleene's logic, OWA)	P and Q (SA)	P or Q (CWA)	P or Q (Kleene's logic, OWA)	P or Q (SA)
T	F	F	F	F	T	T	T
U	T	F	U	T	T	T	T
U	U	F	U	T	F	U	T
U	F	F	F	F	F	U	T
F	T	F	F	F	T	T	T
F	U	F	F	F	F	U	T
F	F	F	F	F	F	F	F

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