ประกาศกระทรวงอุตสาหกรรม

ฉบับที่ ๔๙๔๒ (พ.ศ. ๒๕๕๙)

ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พ.ศ. ๒๕๑๑

เรื่อง กำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม

สารสนเทศภูมิศาสตร์ - การเป็นไปตามมาตรฐานและการทดสอบ

อาศัยอำนาจตามความในมาตรา ๑๕ แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. ๒๕๑๑ ซึ่งแก้ไขเพิ่มเติมโดยพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม (ฉบับที่ ๗) พ.ศ. ๒๕๕๘ รัฐมนตรีว่าการกระทรวงอุตสาหกรรมออกประกาศกำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม สารสนเทศภูมิศาสตร์ - การเป็นไปตามมาตรฐานและการทดสอบ มาตรฐานเลขที่ มอก. 19105 - 2559 ไว้ ดังมีรายละเอียดต่อท้ายประกาศนี้

ทั้งนี้ ให้มีผลตั้งแต่วันที่ประกาศในราชกิจจานุเบกษาเป็นต้นไป

ประกาศ ณ วันที่ ๒๕ พฤศจิกายน พ.ศ. ๒๕๕๙

อรรชกา สีบุญเรือง

รัฐมนตรีว่าการกระทรวงอุตสาหกรรม

มาตรฐานผลิตภัณฑ์อุตสาหกรรม
สารสนเทศภูมิศาสตร์–การเป็นไปตามมาตรฐานและการทดสอบ

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้กำหนดขึ้น โดยรับ ISO 19105: 2000 Geographic Information – Conformance and testing มาใช้โดยวิธีพิมพ์ซ้ำ (reprint) ในระดับเหมือนกันทุกประการ (identical) โดยใช้ ISO ฉบับภาษาอังกฤษเป็นหลัก

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้กำหนดโครงร่าง แนวความคิด และวิธีการสำหรับการทดสอบและเกณฑ์ตัดสินการเป็นไปตามมาตรฐานด้านสารสนเทศภูมิศาสตร์ โดยกำหนดโครงร่างสำหรับการระบุรายละเอียดของชุดทดสอบแบบนามธรรม (Abstract Test Suite: ATS) และโครงร่างสำหรับการกำหนดกระบวนการที่ต้องปฏิบัติระหว่างการทดสอบการเป็นไปตามมาตรฐาน การเป็นไปตามมาตรฐานนี้อาจใช้กล่าวอ้างได้สำหรับข้อมูล หรือผลิตภัณฑ์ซอฟต์แวร์ หรือการบริการ หรือข้อกำหนดคุณลักษณะที่รวมถึง มาตรฐานโปรไฟล์ หรือมาตรฐานการใช้งานใด ๆ

การมาตรฐานสำหรับการทดสอบและเกณฑ์ตัดสินการเป็นไปตามมาตรฐานด้านสารสนเทศภูมิศาสตร์จะทำให้การตรวจสอบย้อนกลับการเป็นไปตามมาตรฐานเหล่านั้น เป็นสิ่งสำคัญสำหรับผู้ใช้งานสารสนเทศภูมิศาสตร์ สามารถแลกเปลี่ยนหรือใช้งานข้อมูลร่วมกันได้

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ สามารถใช้ได้กับทุกระยะของการเป็นไปตามมาตรฐานและการทดสอบ ระยะต่าง ๆ เหล่านั้นสามารถแสดงโดยกิจกรรมหลัก ดังต่อไปนี้

ก) การกำหนดชุดทดสอบแบบนามธรรม สำหรับการเป็นไปตามมาตรฐานด้านสารสนเทศภูมิศาสตร์
ข) การกำหนดวิธีการทดสอบสำหรับการเป็นไปตามมาตรฐานด้านสารสนเทศภูมิศาสตร์
ค) กระบวนการประเมินการเป็นไปตามมาตรฐานที่ดำเนินการโดยห้องปฏิบัติการทดสอบ สำหรับลูกค้าผู้รับบริการให้ได้ตามมาตรฐาน

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ ระบุข้อกำหนดรายการและให้แนวทาง สำหรับขั้นตอนที่ต้องปฏิบัติตามในการทดสอบการเป็นไปตามมาตรฐานสารสนเทศภูมิศาสตร์ โดยรวมเฉพาะสารสนเทศที่จำเป็นเพื่อบรรลุวัตถุประสงค์ดังต่อไปนี้

1) ให้ได้มาซึ่งความเชื่อมั่นในการทดสอบว่าเป็นมาตรการสำหรับวัดการเป็นไปตามมาตรฐาน
2) ให้เกิดการเปรียบเทียบระหว่างผลของการทดสอบที่เกี่ยวข้องที่ใช้ในสถานที่และเวลาที่ต่างกัน
3) ส่งเสริมการติดต่อสื่อสารระหว่างผู้รับผิดชอบต่อกิจกรรมที่ระบุใน 1) และ 2)

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้กำหนดกรอบงานสำหรับการรับรอง (กระบวนการด้านการบริหารซึ่งอาจเป็นไปตามการทดสอบการเป็นไปตามมาตรฐาน) ใน Annex B

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ ไม่ครอบคลุมถึง หัวข้อดังต่อไปนี้

ก) รายละเอียดของข้อกำหนดสำหรับการจัดซื้อและสัญญา

ข) การทดสอบโดยวิธีทดสอบซึ่งกำหนดนั้น สำหรับการใช้งานเฉพาะหรือระบบเฉพาะ

ค) การทดสอบการยอมรับ การทดสอบประสิทธิภาพ และการทดสอบความคงทน

กรอบงานที่จัดทำโดยมาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ รวมถึงแนวคิดของชุดทดสอบที่ดำเนินการได้ (executable test suites; ETS) เหล่านี้ โดยธรรมชาติแล้วไม่สามารถกำหนดมาตรฐานได้ ดังนั้นการมาตรฐานสำหรับ ETS จึงอยู่นอกขอบข่ายของมาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้

รายละเอียดให้เป็นไปตาม ISO 19105: 2000

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เอกสารนี้เป็นลิขสิทธิ์ของ ISO หากมิได้กำหนดไว้เป็นอย่างอื่น ห้ามนำมาตรฐานฉบับนี้หรือส่วนหนึ่งส่วนใดไปทำซ้ำหรือใช้ประโยชน์ในรูปแบบหรือโดยวิธีใด ๆ ไม่ว่าจะเป็นรูปแบบอิเล็กทรอนิกส์หรือทางกล รวมถึงการถ่ายสำเนา การถ่ายไมโครฟิล์ม โดยไม่ได้รับอนุญาตเป็นลายลักษณ์อักษรจาก ISO ตามที่อยู่ข้างล่างหรือจากสมาชิก ISO ในประเทศของผู้ร้องขอ

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 19105 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Annex A forms a normative part of this International Standard. Annex B is for information only.

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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 may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analysing, accessing, presenting and transferring 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 International Standard provides the framework, concepts, and methodology for testing and the criteria to be achieved to claim conformance to this family of International Standards. This International Standard is based in part on ISO 9646-1 which describes conformance and testing in Open Systems Interconnection (OSI), ISO 10303-31 which describes conformance and testing in industrial automation systems and integration, and ISO 10641 which describes conformance and testing for computer graphics and image processing. While the framework of conformance testing described in these three International Standards is used in this International Standard, some concepts have been modified for use in this particular domain.

The objective of standardization in the field of digital geographic information cannot be completely achieved unless data and systems can be tested to determine whether they conform to the relevant geographic information standards. Conformance testing is the testing of a candidate product for the existence of specific characteristics required by an International Standard in order to determine the extent to which that product is a conforming implementation. It involves testing the capabilities of an implementation against both the conformance requirements in the relevant International Standard(s) and the statement of the implementation's capabilities.

A framework of an abstract test suite (ATS) is standardized for relevant standards in ISO/TC 211. The standardization of ATS requires international definition and acceptance of a common test methodology, together with appropriate test methods and procedures. The purpose of this International Standard is to define this methodology, to provide a framework for specifying ATS, and to define the procedures to be followed during conformance testing.

Test methods are also addressed in this International Standard; however, any organization contemplating the use of test methods defined in this International Standard should carefully consider the constraints on their applicability. Conformance testing does not include robustness testing, acceptance testing and performance testing, because the geographic information family of standards does not establish requirements for these areas.

The main body of this International Standard is structured as follows. The general framework of conformance including the definition of a conforming implementation appears in clause 5. Conformance testing methodology is described in clause 6. The possible test methods for testing conformance to the ISO geographic information standards are discussed in clause 7. The relationship between ATS and ETS is presented in clause 8. The bibliography on conformance testing is given at the end. Guidelines for writing conformance clauses and associated templates are provided in annex A.

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INTERNATIONAL STANDARD ISO 19105:2000(E)

Geographic information — Conformance and testing

1 Scope

This International Standard specifies the framework, concepts and methodology for testing and criteria to be achieved to claim conformance to the family of ISO geographic information standards. It provides a framework for specifying abstract test suites (ATS) and for defining the procedures to be followed during conformance testing. Conformance may be claimed for data or software products or services or by specifications including any profile or functional standard.

Standardization of test methods and criteria for conformance to geographic information standards will allow verification of conformance to those standards. Verifiable conformance is important to geographic information users, in order to achieve data transfer and sharing.

This International Standard is applicable to all the phases of conformance and testing. These phases are characterized by the following major activities:

a) the definition of ATS for conformance to the ISO geographic information standards;

b) the definition of test methods for conformance to the ISO geographic information standards;

c) the conformance assessment process carried out by a testing laboratory for a client, culminating in the production of a conformance test report.

This International Standard specifies the requirements for, and gives guidance on, the procedures to be followed in conformance testing for the ISO geographic information standards. It includes only such information as is necessary to meet the following objectives:

1) to achieve confidence in the tests as a measure of conformance;

2) to achieve comparability between the results of corresponding tests applied in different places at different times;

3) to facilitate communication between the parties responsible for the activities described in 1) and 2).

This International Standard provides a framework for certification (an administrative procedure which may follow conformance testing) in informative annex B.

The following topics are outside the scope of this International Standard.

a) The description of requirements for procurement and contracts.

b) Testing by means of test methods which are specific to particular applications or systems.

c) Acceptance testing, performance testing and robustness testing.

The framework established by this International Standard includes the concept of executable test suites (ETS). These, by their very nature, cannot be standardized; consequently, standardization of ETS is outside the scope of this International Standard.

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2 Conformance

2.1 Conformance requirements

This International Standard defines two classes of conformance: class A and class B. Class A concerns conformance of specifications, including any profile or functional standard, with the series of ISO geographic information standards as a whole. Class B concerns conformance of conformance clauses as defined by this International Standard. Further requirements for conformance of profiles in addition to class A are given in ISO 19106.

NOTE Conformance is defined in annex A.

2.2 Abstract test suite

2.2.1 Test case for conformance class A

a) Test purpose: verify conformance with the ISO geographic information standards.

b) Test method: manually check that all specifications, including profiles and functional standards, claiming conformance to the ISO geographic information standards have a conformance clause. This conformance clause shall not exclude conformance with any of the ISO geographic information standards. Conformance testing shall be performed in accordance with clause 6. The test method used shall be in accordance with clause 7.

c) Reference: ISO 19105

d) test type: capability test

2.2.2 Test case for conformance class B

a) Test purpose: verify that the conformance clause is written in a correct format.

b) Test method: manually check if the conformance clause is written according to normative annex A.

c) Reference: ISO 19105:2000, annex A.

d) Test type: capability test.

3 Terms and definitions

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

3.1
abstract test case
generalized test for a particular requirement

NOTE An abstract test case is a formal basis for deriving executable test cases. One or more test purposes are encapsulated in the abstract test case. An abstract test case is independent of both the implementation and the values. 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 (i.e. sequence of test events).

3.2
abstract test method
method for testing implementation independent of any particular test procedure

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3.3
abstract test module
set of related abstract test cases

NOTE Abstract test modules may be nested in a hierarchical way.

3.4
ATS
abstract test suite
abstract test module specifying all the requirements to be satisfied for conformance

NOTE Abstract test suites are described in a conformance clause.

3.5
acceptance testing
〈user〉 process of determining whether an implementation satisfies acceptance criteria and enables the user to determine whether to accept the implementation

NOTE 1 This includes the planning and execution of several kinds of tests (e.g. functional, volume, performance tests) that demonstrate that the implementation satisfies the user requirements.

NOTE 2 This is not a part of conformance testing.

3.6
basic test
initial capability test intended to identify clear cases of non-conformance

3.7
capability test
test designed to determine whether an IUT conforms to a particular characteristic of an International Standard as described in the test purpose

3.8
conformance
fulfilment of specified requirements

3.9
conformance assessment process
process for assessing the conformance of an implementation to an International Standard

3.10
conformance clause
clause defining what is necessary in order to meet the requirements of the International Standard

3.11
conformance testing
testing of a product to determine the extent to which the product is a conforming implementation

3.12
conformance test report
summary of the conformance to the International Standard as well as all the details of the testing that supports the given overall summary

3.13
conforming implementation
implementation which satisfies the requirements

3.14
executable test case
specific test of an implementation to meet particular requirements

NOTE Instantiation of an abstract test case with values.

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3.15
ETS
executable test suite
set of executable test cases

3.16
fail verdict
test verdict of non-conformance

NOTE Non-conformance may be with respect to either the test purpose or at least one of the conformance requirements of the relevant standard(s).

3.17
falsification test
test to find errors in the implementation

NOTE If errors are found, one can correctly deduce that the implementation does not conform to the International Standard; however, the absence of errors does not necessarily imply the converse. The falsification test can only demonstrate non-conformance. Compare with the verification test. Due to technical and economic problems, in most cases, the falsification test is adopted as a test method for conformance testing.

3.18
implementation
realization of a specification

NOTE In the context of the ISO geographic information standards, this includes specifications of geographic information services and datasets.

3.19
ICS
Implementation Conformance Statement
statement of specification options that have been implemented

3.20
IXIT
Implementation eXtra Information for Testing
statement containing all of the information related to the IUT and its corresponding SUT which will enable the testing laboratory to run an appropriate test suite against that IUT

NOTE IXIT typically provides the details on the organization and storage of concepts in the SUT as well as on the means of access to and modification of the SUT.

3.21
inconclusive verdict
test verdict when neither a pass verdict nor a fail verdict apply

3.22
non-conformance
failure to fulfil one or more specified requirements

3.23
pass verdict
test verdict of conformance

3.24
performance testing
measurement of the performance characteristics of an Implementation Under Test (IUT), such as its throughput, responsiveness, etc., under various conditions

NOTE This is not a part of conformance testing.

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3.25
robustness testing
process of determining how well an IUT processes data which contains errors

NOTE This is not a part of conformance testing.

3.26
SUT
System Under Test
computer hardware, software and communication network required to support IUT

3.27
testing laboratory
organization that carries out the conformance assessment process

3.28
verification test
test developed to prove rigorously whether an IUT is correct

4 Abbreviated terms

For the purposes of this International Standard, the following abbreviations apply.

ATS: Abstract Test Suite

ETS: Executable Test Suite

ICS: Implementation Conformance Statement

IUT: Implementation Under Test

IXIT: Implementation eXtra Information for Testing

SUT: System Under Test

5 General framework of conformance

5.1 Introduction

In the context of the ISO geographic information standards, an implementation exhibits conformance if it complies with the conformance requirements of the applicable ISO geographic information standards. The conformance requirements are stated in the conformance clause of each International Standard.

5.2 Conformance clause

All testable ISO geographic information standards contain a conformance clause. This clause specifies all the requirements that shall be satisfied to claim conformance to that International Standard. The conformance clause serves as an entry point for conformance testing.

The requirements for conformance clauses are given in annex A.

5.3 Conformance requirements

Conformance requirements may be classified as

a) **mandatory requirements**: these shall be observed in all cases;

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b) **conditional requirements**: these shall be observed if the conditions set out in the specification apply;

c) **optional requirements**: these may be selected to suit the implementation, provided that any requirements applicable to the option are observed.

Furthermore, conformance requirements may be stated

a) **positively**: they state what is required to be done;

b) **negatively**: they state what is required not to be done.

To manage a set of options specific to a subset of International Standards, such as profiles, conformance classes may be provided (see normative annex A).

5.4 Implementation conformance statement

To evaluate the conformance of a particular implementation, there shall be a statement of the options which have been implemented. This will allow the implementation to be tested for conformance against the relevant requirements, and against those requirements only. Such a statement is called an Implementation Conformance Statement (ICS). This statement shall contain only options within the framework of requirements specified in the relevant ISO geographic information standards. The statement shall not include options outside this framework.

This statement provides the testing laboratory with a better understanding of the System Under Test (SUT) for use in the conformance assessment process and helps identify the boundaries of the domain of testing.

This statement may be generated by using an ICS proforma. An ICS proforma may be provided by the testing laboratory. It is a questionnaire used as a framework to document those SUT capabilities necessary to undertake conformance testing.

For further information on ICS, see ISO 9646 [2, 3, 4] and ISO 10303-31 [5].

5.5 A conforming implementation

A conforming implementation shall satisfy the conformance requirements of the applicable ISO geographic information standards and shall be consistent with the ICS. Such an implementation shall have passed all tests constituting the domain of testing, including any optional requirements stated as supported in it. A conforming implementation may support additional capabilities not described in the appropriate International Standard, providing those capabilities are not explicitly prohibited in the standard.

6 Conformance testing methodology

6.1 Introduction

This clause describes the conformance testing methodology, the different types of conformance tests that are used, and additional information that must be provided by the client to the testing laboratory.

6.2 Types of conformance tests

6.2.1 Overview

The objective of conformance testing is to determine whether the implementation being tested conforms to the requirements stated in the relevant ISO geographic information standard. Two types of tests are identified, according to the extent to which they provide an indication of conformance.

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a) Basic tests, which provide preliminary evidence that an IUT conforms. If the ATS identifies tests to be used as basic tests, they shall be used at the start of the conformance assessment process. Such tests are standardized.[1)]

b) Capability tests, which check that the observable capabilities of the IUT are in accordance with the capabilities claimed in the ICS. They endeavour to provide testing which is as comprehensive as possible over the full range of conformance requirements specified in the appropriate International Standard. Such tests are standardized.

An ATS given in a conformance clause indicates which capability tests, if any, shall be used as basic tests. An ATS does not include any basic tests that are additional to the set of capability tests. In simple cases, basic tests may not be necessary.

6.2.2 Basic tests

Basic tests provide limited testing of an IUT in order to establish whether or not it is appropriate to perform more thorough testing. Basic tests may be in abstract or executable form. They may be used to determine the degree of conformance prior to deciding whether or not to proceed with thorough capability testing. Basic tests are simple capability tests. Conformance clauses should identify those test cases that may be used as basic tests.

Basic tests shall be used

a) for detecting obvious cases of non-conformance, and

b) as a preliminary step in order to decide whether or not to run capability tests.

Basic tests shall not be used alone to

a) determine whether an implementation conforms, or

b) guarantee the determination of causes for failure.

6.2.3 Capability tests

Capability tests, which may be in abstract or executable form, should exercise an implementation as thoroughly as is practical over the full range of conformance requirements specified in an International Standard. Capability tests should be provided to check mandatory capabilities and those optional capabilities that are identified in the ICS as being supported by the IUT.

Capability tests shall be used to

a) check that the capabilities of the IUT are consistent with the conformance requirements, that is, determine whether or not an implementation conforms, and

b) investigate causes for failure.

Capability tests shall not be used to

a) test in detail the behaviour associated with each capability which has been implemented, or

b) guarantee completeness.

Abstract capability tests are standardized within an ATS.

---

1) An executable test case may be obtained for these basic tests, the system may be tested before application for the basic and capability tests to the testing laboratory (the in-house testing). This may also be done for capability tests, but it is more appropriate for basic tests.

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6.3 Implementation eXtra Information for Testing

In order to test an implementation, the testing laboratory requires information relating to the IUT and the environment in which it will be tested. The client submitting the implementation for testing shall provide this information as an Implementation eXtra Information for Testing (IXIT). The IXIT may be completed using the question/answer process initiated by the IXIT proforma.

The IXIT shall contain the following:

a) information about the IUT which is needed by the testing laboratory in order to be able to run the appropriate ETS against that IUT and analyse the results;

b) reference to the related ICS and any other administrative information.

The IXIT shall not conflict with the related ICS; a consistency check shall be performed during preparation for testing to remove any inconsistencies. While the ICS gives information to the testing laboratory for the definition of the domain of testing, the IXIT gives information on how to perform the testing. In particular, it provides the details on the organization and storage of concepts in the SUT and on the means for accessing and modifying the SUT. It also contains conversion algorithms between the concepts of the IUT and the International Standard. There shall be one IXIT for each conformance assessment process.

For further information on IXIT, see ISO 9646 [2, 3, 4] and ISO 10303-31 [5].

6.4 Conformance assessment

6.4.1 Process overview

The conformance assessment process encompasses all conformance testing activities necessary to determine the conformance of an implementation to the relevant ISO geographic information standards.

The conformance assessment process involves four phases:

a) preparation for testing;

b) test campaign;

c) analysis of results;

d) conformance test report.

The conformance assessment process is shown in Figure 1.

6.4.2 Preparation for testing

The preparation for the testing phase should involve the following steps:

a) production of administrative information;

b) production of ICS and IXIT for testing;

c) identification of test method and ATS;

d) an ICS review, conducted by analysing the conformance statement with respect to the relevant conformance requirements;

e) an IXIT review which includes a consistency check against the corresponding ICS;

f) selection of initial abstract test cases and assignment of parameter values based on the ICS and the IXIT;

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g) preparation of the SUT;

NOTE This enables a client to run executable test cases on the IUT before presenting the IUT for the test campaign.

h) final abstract test-case selection.

An ETS is produced as a result of selecting abstract test cases and assigning parameter values [steps f) and h) above]. At this point, the IUT and the scope of the conformance assessment process are fixed and cannot be changed subsequently. This is achieved by agreement between the client and the testing laboratory.

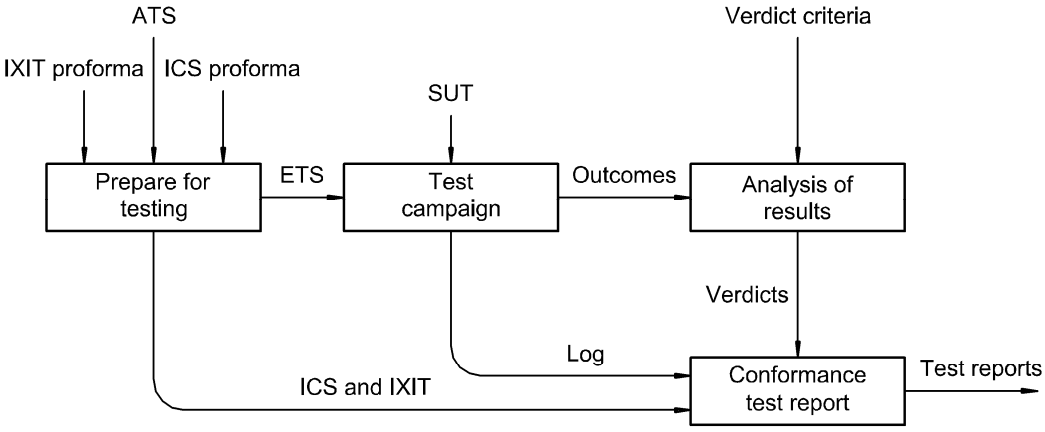

Figure 1 — Conformance assessment process overview

6.4.3 Test campaign

A test campaign is the process of executing the ETS and recording the observed test outcome and any other relevant information in a conformance log. The input to the IUT and the observed test outcome resulting from the execution of a test case shall be recorded in the conformance log. The recording and retention of all information provided by the IUT during the test campaign is necessary for the analysis phase and for auditing purposes.

6.4.4 Analysis of results

The analysis of results shall be performed by evaluating the observed test outcome against the verdict criteria which are prescribed by the abstract test case. Although there is a clear distinction between the test campaign and the analysis phase, the two may overlap in time.

A test verdict is a statement of pass, fail or inconclusive. Pass and fail are the two major verdicts but, in rare cases, a verdict of inconclusive may have to be assigned. A justification shall be given with each fail or inconclusive verdict; informative messages may also be provided.

a) “Pass verdict” means that the observed test outcome gives evidence of conformance to the conformance requirement on which the test purpose is focused, and is valid with respect to the relevant International Standard and with respect to the ICS.

b) “Fail verdict” means that the observed test outcome demonstrates non-conformance with respect to either a test purpose or at least one conformance requirement in the relevant standard(s).

EXAMPLE Abnormal termination — if the execution of the executable test case is terminated prematurely, for whatever reason.

c) “Inconclusive verdict” means that the observed test outcome produces neither a pass nor a fail verdict. This should occur only in very rare circumstances.

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EXAMPLE Test-case error.

The test verdict shall be assigned to a particular test outcome using the verdict criteria relevant to that particular abstract test case.

The test verdicts assigned shall then be synthesized into an overall summary for the IUT.

6.4.5 Conformance test report

The results of conformance testing shall be documented in a conformance test report. This report shall be in two parts: a summary and detailed information. A proforma shall be used to produce each conformance test report. The first part shall be an overall summary of the conformance status of the IUT. This overall summary shall provide an overview of the verdicts that are assigned to the test cases executed in the conformance assessment process. The second part shall document all the results of the executable test cases, with reference to the conformance log which contains the observed test outcomes. It shall make reference to all necessary documents relating to the conduct of the conformance assessment process for that International Standard.

6.5 Intrinsic properties of the conformance assessment process

6.5.1 Repeatability of results

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

6.5.2 Comparability of results

In order to achieve the objectives of conformance testing, the overall summary concerning conformance of an IUT should be independent of the testing laboratory in which the testing takes place. The standardization of all the procedures concerned with conformance testing should 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.

There are important factors to be considered to achieve this, including:

a) careful design and unambiguous specification of the abstract test cases to show which conformance requirements have to be met and how the verdicts are to be assigned while allowing flexibility where appropriate;

b) careful specification of the procedures to be followed by testing laboratories when it is necessary to repeat the execution of a test case;

c) a proforma for a conformance test report;

d) careful specification of the procedures for writing a conformance test report.

6.5.3 Auditability of results

It may be necessary to review the observed test outcomes from the execution of an ETS in order to make sure that all procedures have been correctly followed. 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. It is the responsibility of the testing laboratory to produce the conformance log for each test campaign.

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7 Test methods

7.1 Introduction

Geographic information is complex and has many aspects, most of which are covered in the ISO geographic information standards. Implementation of these International Standards may be expected to reflect these different aspects. This means that there will be variation in the ways in which such implementations can be tested.

7.2 Approaches to conformance testing

7.2.1 Introduction

Two general approaches to conformance testing exist:

a) verification testing, the use of methods involving rigorous proofs of correctness in which the conformance of an implementation can be conclusively and exhaustively demonstrated;

b) the use of methods involving falsification testing.

The first approach is recommended for conformance testing whenever possible. However, the size and complexity of most standards often makes using the proof-of-correctness approach impractical for both technical and economic reasons. Therefore as a practical matter, falsification testing has become an accepted way of doing conformance testing. Falsification testing is a method for detecting errors in an implementation by developing a set, or suite, of specific tests for testing an implementation against an International Standard. By focusing on tests in critical areas of an International Standard, falsification testing is intended to provide confidence that an implementation has the required capabilities. Using this approach, an implementation that fails a particular test, or set of tests, can be judged to not conform to an International Standard. However, even if an implementation produces correct results for an entire suite of tests, there is no absolute assurance that the implementation conforms to the International Standard. This is because, unlike the proof of correctness approach, the use of falsification testing does not guarantee that a particular suite of tests provides complete coverage of the content of an International Standard.

For the purposes of the ISO geographic information standards, either approach, or combination of approaches, to conformance testing may be used. Regardless of which approach is taken, conformance testing is usually performed automatically by executing software that implements the test. However, in the case of International Standards for geographic information, non-automated, manual testing may also be used to carry out falsification testing. This is explained in 7.2.3.

7.2.2 Automated test

Automated testing may implement the required tests as a software system using either verification testing or falsification testing. Besides tests that are specific to information technology (such as testing the format of data), some tests are specific to geographic information. The testing of geometric structures is of such a type.

EXAMPLE A software system can check whether a set of vector data forms a closed polygon.

Since there may be many test methods, the method that is used shall be reported.

7.2.3 Manual test

Manual testing may be required when automated testing is too complex and/or human judgement is required. In manual testing, the client and the conformance testing personnel may jointly examine the output and compare it against input to perform the tests.

Manual testing should be used only for those standards where automatic testing is not viable. In manual testing, clear criteria for determining test verdicts are required.

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7.3 Areas of geographic information for conformance testing

In the framework of the ISO geographic information standards, geographic information datasets and services fall into the following major areas:

a) geographic data models and operators, including spatial schema, temporal schema, rules for application schema, spatial operators;

b) geographic data administration, including cataloguing, spatial referencing by coordinates, spatial referencing by geographic identifiers, quality principles, quality evaluation procedures, metadata;

c) positioning services, portrayal services, encoding services and other services;

d) profiles and functional standards.

Application schemas and services based on the four areas listed above may be tested for conformance using the approaches described in 7.2.

8 Abstract test suites and executable test suites

8.1 Introduction

An abstract test suite (ATS) in a conformance clause has a hierarchical structure consisting of abstract test modules and abstract test cases. Abstract test cases form the lowest level in a hierarchy. Abstract test modules are used to classify abstract test cases and other abstract test modules. An example of this hierarchical structure is shown in Figure 2.

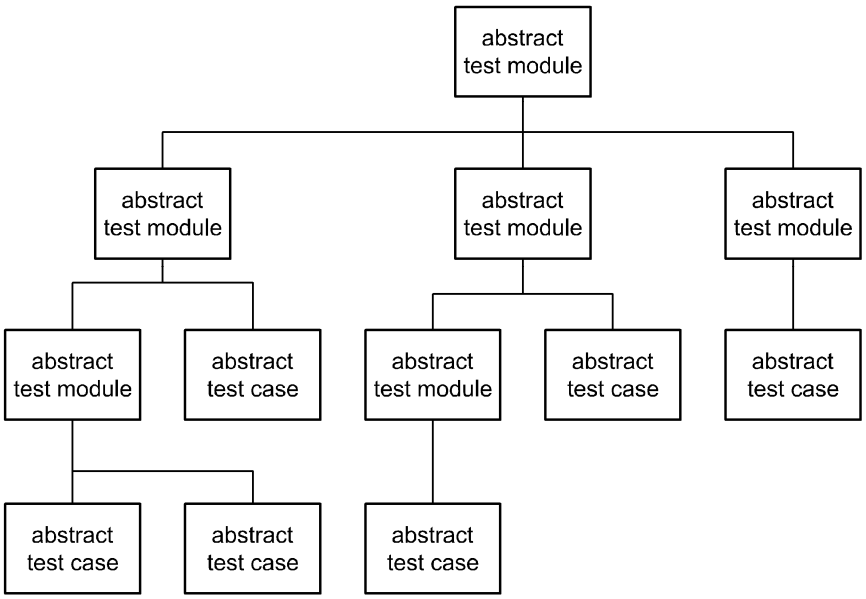

Figure 2 — Example of hierarchical structure of an abstract test suite (ATS)

Each abstract test case shall exercise at least one test purpose from the appropriate International Standard. Within a hierarchical structure of an ATS, nested abstract test modules may be used to provide a logical ordering of the abstract test cases. Abstract test modules may be nested to any depth. They may be used to aid planning, development or understanding of the ATS. Each abstract test module is composed of zero, one or many abstract

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test cases. An executable test suite (ETS) is an instantiation of an ATS, in which all implementation-dependent parameters are assigned specific values.

The conformance clause of each ISO geographic information standard describes an ATS which has the hierarchical structure described in this subclause.

8.2 Test purposes

Each abstract test module or abstract test case shall include a test purpose in order to provide a precise description of the objective which it is intended to achieve.

EXAMPLE "Test the generation of a polygonal line as a sequence of line segments without self intersection".

A test purpose of the root module of ATS becomes the test purpose of this ATS.

8.3 Abstract test cases

An abstract test case shall satisfy the requirement(s) of one or more test purpose(s). An abstract test case is used as the basis for generating an executable test case and is independent of the IUT.

An abstract test case shall contain:

a) test-case identifier;

b) test purpose(s);

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

d) reference to specific standard(s);

e) test types (either a basic test or a capability test).

8.4 Executable test cases

An executable test case shall contain:

a) test-case identifier;

b) test purpose(s);

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

d) reference to specific parts of ATS;

e) parameter values.

8.5 Relationship between abstract and executable test cases

An executable test case is derived from an abstract test case and shall be in a form that allows it to be run on the IUT. Executable test cases result from the instantiation of specific values for parameters in abstract test cases. Executable test cases may be unique to each IUT.

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Annex A
(normative)

Conformance clauses

A.1 Introduction

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 testable ISO geographic information standards provide a conformance clause in clause 2.

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

This annex provides guidelines for writing conformance clauses for implementing ISO geographic information standards.

A.2 Simple conformance clauses

A conformance clause starts with the statement of requirements to be satisfied in order for an implementation to claim conformance to an International Standard. A conformance clause should be written as follows:

> 2 Conformance
>
> 2.1 Conformance requirement(s)
>
> Any product claiming conformance with this International Standard shall pass all the requirements described in the following abstract test suite. (The definition of an abstract test suite appears in ISO 19105.)
>
> 2.2 Abstract test suite
>
> (The ATS follows here.)

The actual requirements shall be stated in the Abstract Test Suite (ATS). If the ATS becomes too large, it may be placed in a normative annex. In this case, the conformance clause (clause 2) shall explicitly indicate where it appears. The explanation on how to write an ATS is given in clause A.4.

A.3 Conformance clauses with classes and levels

Conformance classes may be used to define different kinds of conformance requirements. If some parts of the International Standard are essential for a particular class of application but not for other classes, it is preferable not to specify all parts of an International Standard as being mandatory. Doing so would require that all applications fulfil all requirements. Conformance classes are used to avoid this problem.

When conformance classes are used in a standard, they shall be defined in the conformance clause. For example, three conformance classes may be defined as follows:

> 2 Conformance
>
> 2.1 Conformance requirement(s)

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This International Standard defines three classes of conformance: class A, class B and class C. (The intended application of the conformance classes may be stated here.) Any product claiming conformance with one of these classes shall pass all the requirements described in the corresponding abstract test suite below. (The definition of the abstract test suite appears in ISO 19105.)

2.2 Abstract test suite for conformance class A

(The ATS for conformance class A follows here.)

2.3 Abstract test suite for conformance class B

(The ATS for conformance class B follows here.)

2.4 Abstract test suite for conformance class C

(The ATS for conformance class C follows here.)

Requirements of conformance classes may overlap, in which case, subparts of the ATS may be shared between different conformance classes.

A conformance level is a special kind of conformance class in which the requirements of a higher level contain all the requirements of the lower levels. The example below shows three conformance levels defined in a conformance clause:

2 Conformance

2.1 Conformance requirement(s)

This International Standard defines three levels of conformance. (The intended application of the conformance levels may be stated here.) Any product claiming conformance with one of these levels shall pass all the requirements described in the corresponding abstract test suite below. (The definition of the abstract test suite appears in ISO 19105.)

2.2 Abstract test suite for conformance level 1 (low level)

(The ATS for conformance level 1 follows here.)

2.3 Abstract test suite for conformance level 2 (medium level)

(The ATS for conformance level 2 follows here.)

2.4 Abstract test suite for conformance level 3 (high level)

(The ATS for conformance level 3 follows here.)

Since a higher conformance level includes all the requirements of a lower level, the ATS for the higher level typically has a pointer to the ATS for the lower level. It is recommended that this relationship be made explicit in the structure of the ATS.

When conformance classes or levels are defined, conformance testing shall be performed for each applicable conformance class or level.

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A.4 How to structure an abstract test suite

A.4.1 Introduction

An ATS is represented as a hierarchical structure of abstract test modules and test cases. Since the essential components of abstract test modules or test cases are their test purposes, the construction of an ATS starts with the identification of test purposes.

A.4.2 to A.4.9 illustrate how to structure an ATS using ISO 19113 as an example. Note that the example is not the actual conformance clause for ISO 19113.

A.4.2 Identifying test purpose

The first thing to do is to identify the main test purpose. This will become the test purpose of the root node of ATS. To be more specific, the following question has to be answered.

> "What does this standard specify?"

The answer to this question is usually obvious. For example, in the case of quality principles, it is "How to specify quality". Thus, the test purpose of the root node of the ATS for quality principles becomes: "check the conformance with the definition of quality principles".

A.4.3 Decomposing test purpose

Once the main test purpose is determined, continue by decomposing it. The decomposition identifies the child nodes of the ATS. To be more specific, the following question has to be answered:

> "For an implementation to be in conformance to the test purpose specified, what requirements have to be satisfied?"

In the quality principles example, the answer might be "It has to contain data quality elements and data quality overview elements." Thus, we now have two child nodes: "check the conformance of data quality elements" and "check the conformance of data quality overview elements".

A.4.4 Repeating identification and decomposition of test purposes

This process continues until all test purposes are decomposed into sufficiently small pieces, i.e. abstract test cases. In the quality principles example, data quality elements will be further decomposed into data quality sub-elements, and then into data quality measures, which are basic enough to be abstract test cases.

On the other hand, data quality overview elements would be decomposed into three components: purpose, lineage and usage, which would also be small enough to be abstract test cases.

A.4.5 Making the hierarchical structure

When all test purposes are decomposed into abstract test cases, the test purposes are collected to form the ATS of the International Standard. The final ATS for the quality principles example is shown below. Please note that the hierarchical structure of the test purposes automatically constitutes the structure of the ATS. (For the template of abstract test modules/cases, see A.4.8.)

2.2 Abstract test suite

2.2.1 Test module for quality principles

2.2.1.1 Quality principles

a) Test purpose: check the conformance to the definition of quality principles

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b) Test method: check if it has two components, data quality elements (2.2.1.2) and data quality overview elements (2.2.1.3), and see that both satisfy their requirements

c) Reference: ISO 19113, subclause X.X

d) Test type: basic

2.2.1.2 Test case for data quality elements

a) Test purpose: check the conformance to the definition of data quality elements

b) Test method: check if it has data quality sub-elements. If it has, check their conformance to the definition of data quality elements. Otherwise, for each data quality measure, check if they are actually valid data quality measures as described in clause X

c) Reference: ISO 19113, subclause X.X

d) Test type: basic

2.2.1.3 Test case for data quality overview elements

a) Test purpose: check the conformance to the definition of data quality overview elements

b) Test method: check if it has three components, purpose, lineage and usage, and see if they are valid as described in clause X

c) Reference: ISO 19113, subclause X.X

d) Test type: basic

A.4.6 Notes on test methods

A description of a test method for an abstract test module typically contains references to other clauses. It may also include statements on whether it is mandatory, optional, or conditional. Specific test methods shall be stated in abstract test cases.

A.4.7 Reference to main clauses and test types

In addition to the test purpose and the test method, two other items of information shall be included in an ATS: reference and test type. Reference designates the clause in the main body of the International Standard where the requirements to be tested are specified. Test type shall be either a basic test or a capability test. Generally, a basic test is a simple test performed prior to full capability testing. Complex capability tests may require the services of testing laboratories, while basic tests generally do not. See 6.2 for further information.

A.4.8 Template for abstract test modules

The following template shall be used for abstract test modules:

2.2.X Test module for XXX

2.2.X.1 XXX (the same as above)

a) Test purpose: (test purpose)

b) Test method: (test method)

c) Reference: ISO 191XX, subclause X.X

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Annex B
(informative)

Supporting organizations

B.1 Purpose

The purpose of this annex is to promote the integrity of national conformance testing programmes for ISO geographic information standards and encourage international harmonization by describing supporting organizations. Because the framework of supporting organizations itself is not specific to this geographic standard, it is only described briefly. For more details, see ISO/IEC 17025 [1].

B.2 Background

This annex provides procedures to encourage cooperation by national and international certification and standardization bodies to set up a common strategy for certification; these institutions should enforce mutual recognition of test results and certificates of conformity for implementations of ISO geographic information standards. The scope of harmonization activities ranges from the bilateral recognition of the testing laboratories (e.g. memoranda of understanding) involved in the conformance testing services up to the approval of standardized test procedures by the standardization bodies.

B.3 Responsible authorities

There may be various authorities, both national and international, which are involved in conformance testing. Figure B.1 provides an overall framework of international and national infrastructure for conformance testing. Among these organizations, control board, accreditation body, testing laboratory and certification body are described in clauses B.4 to B.7.

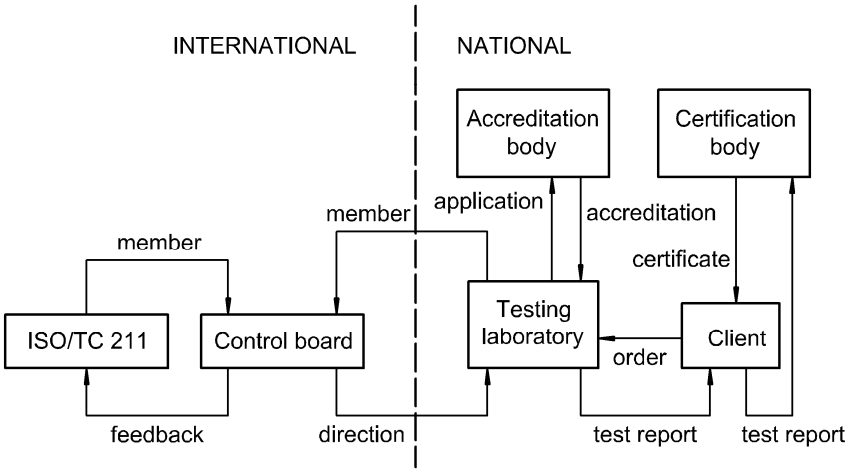

Figure B.1 — International and national infrastructure for conformance

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B.4 Control board

A control board is established for the purpose of resolving differences between interpretations which arise when the ATS is being used for the purpose of conformance testing. It is independent of ISO/TC 211 and assists testing laboratories in interpreting the required technical content of an ATS.

B.5 Accreditation body

An accreditation body performs a formal process which ensures that a testing laboratory is competent to carry out specific types of tests. It covers the recognition of both the technical competence and the impartiality of a testing laboratory. Only testing laboratories that are accredited are allowed to perform formal conformance testing.

B.6 Testing laboratory

A testing laboratory carries out conformance testing and provides test reports to the client. In addition, it provides test reports for the certification body upon the client's request.

B.7 Certification body

A certification body establishes well-defined criteria for issuing a certificate, and issues certificates based upon the test report produced by testing laboratories. A certification body should exist in each country which has a conformance testing service operating. Mutual recognition of test results is ensured by adoption of the same criteria by certification bodies worldwide. The function of the certification body may be performed by the accreditation body, in which case no separate certification body is necessary.

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