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Industrial automation systems and integration — Manufacturing software capability profiling for interoperability —

Part 4: Conformance test methods, criteria and reports

Systèmes d'automatisation industrielle et intégration — Profil d'aptitude du logiciel de fabrication pour interopérabilité —

Partie 4: Méthodes d'essai, critères et rapports de conformité

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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 electro-technical standardization.

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

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 part of ISO 16100 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16100 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 5, *Architecture, communications and integration frameworks.*

ISO 16100 consists of the following parts, under the general title *Industrial automation systems and integration — Manufacturing software capability profiling for interoperability*

Part 1: Framework

Part 2: Profiling methodology

Part 3: Interface services, protocols and capability templates

Part 4: Conformance test methods, criteria and reports

The following part is under preparation

Part 5: Methodology for profile matching using multiple capability classes

Introduction

The motivation for ISO 16100 stems from the industrial and economic environment noted in the ISO/TC 184/SC5 strategic plan, in particular:

a) a growing base of vendor-specific solutions;

b) user difficulties in applying standards;

c) a need to move to modular sets of system integration tools; and

d) a recognition that application software and the expertise to apply that software are assets of the enterprise.

ISO 16100 is an International Standard for the computer-interpretable and human readable representation of a software capability profile. Its goal is to provide a method to represent the capability of manufacturing software relative to its role throughout the life cycle of a manufacturing application, independent of a particular system architecture or implementation platform.

Certain diagrams in this part of ISO 16100 are constructed following UML conventions. Because not all concepts embodied in these diagrams are explained in the text, some familiarity with UML on the part of the reader is assumed.

Industrial automation systems and integration — Manufacturing software capability profiling for interoperability —

Part 4: Conformance test methods, criteria and reports

1 Scope

This part of ISO 16100 specifies the test method, the associated test criteria and the statement format used to evaluate and declare the degree of conformance of an implementation, i.e. a unit under test (UUT), to the requirements specified in other parts of ISO 16100.

This part of ISO 16100 includes definitions intended to assist a manufacturer or supplier (first party), a user or purchaser (second party), or an independent body (third party) to perform the assessment for type evaluation.

This part of ISO 16100 contains the following:

— an enumeration of those conformance aspects that can be used to determine whether an implementation conforms to ISO 16100;

— a definition of the conformance tests and statements used in declaring which aspects are met by an implementation;

— a description of the aspects to be included in a conformance statement;

— a set of rules to select valid or invalid combinations of aspects when they are combined.

The following topics are not addressed in this part of ISO 16100:

— matters relating to marks or labels of conformance, certificates of conformance or manufacturers' or suppliers' declarations of conformance;

— dates of implementation or allocation of responsibilities to various parties making use of ISO 16100;

— requirements for production, execution or delivery procedures, unless it is impossible to specify adequately the conforming product, process or service, respectively, without doing so;

— requirements for quality control during production, execution or delivery of the product, process or service, respectively.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 16100-1:2002 *Industrial automation systems and integration — Manufacturing software capability profiling for interoperability — Part 1: Framework*

ISO 16100-2:2003 *Industrial automation systems and integration — Manufacturing software capability profiling for interoperability — Part 2: Profiling methodology*

ISO 16100-3:2005	*Industrial automation systems and integration — Manufacturing software capability profiling for interoperability — Part 3: Interface services, protocols and capability templates*
REC-xml-20000814	*Extensible Markup Language (XML) 1.0 Ed. 2 W3C Recommendation*
REC-xmlschema-1-20010502	*XML Schema Part 1: Structures*
REC-xmlschema-2-20010502	*XML Schema Part 2: Datatypes*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Some of these terms and definitions have been taken verbatim or were adapted from other standards. In such cases this is indicated in brackets with the specific part and subclause of the standard given.

3.1
abstract test case
specification, encapsulating at least one test purpose, that is independent of implementation platform, parameter values, and method

[adapted from ISO 10303-31:1994, 3.2.1]

3.2
abstract test suite
set of abstract test cases

3.3
capability
<software> set of functions and services with a set of criteria for evaluating the performance of a capability provider

[ISO 16100-1:2002, 3.3]

NOTE This definition differs from that given in ISO 15531-1 and ISO/DIS 19439, where capability is defined as the quality of being able to perform a given activity. See IEC 62264-1 for a general definition of capability.

3.4
capability class
element within the capability profiling method that represents software unit functionality and behaviour with regard to the software unit's role in a manufacturing activity

[ISO 16100-2:2003, 3.3]

3.5
capability profiling
selection of a set of offered services defined by a particular interface within a software interoperability framework

[ISO 16100-1:2002, 3.4]

3.6
conformance
conformity
relation between a specification and a real implementation that is realized when any proposition that is true in the specification is also true in the implementation

EXAMPLE A profile implementation is in conformance with the template specification that is created according to the rules in ISO 16100.

3.7
conformance point
specific requirement contained in a set of subclauses in ISO 16100 that are used as a basis to generate and perform a test to determine if an implementation is conformant

3.8
conformance statement
statement that identifies conformance points of a specification and the behaviour that must be satisfied at these points

[adapted from ISO/IEC 10746-2:1996, 15.1]

3.9
conformance testing
conformity assessment
testing of a candidate product for the existence of specific characteristics required by a standard in order to determine the extent to which that product is a conforming implementation

[ISO 10303-31:1994, 3.2.22]

3.10
conformance test report

document written at the end of the conformance assessment process, that provides the overall summary of the conformance of the UUT to the standard for which conformance testing was carried out, and that gives the details of the testing

[ISO 10303-31:1994, 3.2.23]

3.11
conforming implementation
implementation which satisfies the conformance requirements, consistent with the capabilities stated in the CSI

[adapted from ISO 10303-31:1994, 3.2 24]

3.12
executable test case
implementation of an abstract test case that is platform-dependent and is associated with parameter values and a specific test method

3.13
executable test suite
set of executable test cases

3.14
falsification testing
test method developed to find errors in the implementation

[adapted from ISO 10303-31:1994, 3.2.32]

3.15
interface
abstraction of the behaviour of an object that consists of a subset of the interactions of that object together with a set of constraints on when they may occur

[ISO 16100-3:2005, 3.3.3]

3.16
manufacturing software unit
class of software resource, consisting of one or more manufacturing software components, performing a definite function or role within a manufacturing activity while supporting a common information exchange mechanism with other units

[ISO 16100-1:2002, 3.12]

NOTE A manufacturing software unit can be modeled as a software object using a UML convention.

3.17
matcher
mechanism to compare an offered capability profile with a required capability profile.

[ISO 16100-3:2005, 3.1.6]

3.18
matching level
<profile> qualitative measure of how closely a capability profile of an MSU meets the software functional requirements of a manufacturing activity

[ISO 16100-3:2005, 3.1.7]

3.19
MSU interoperability
capability of a MSU to support a particular usage of an interface specification in exchanging a set of application information with another MSU

[ISO 16100-3:2005, 3.1.8]

3.20
profile
set of one or more base specifications or sub-profiles or both, and, where applicable, the identification of chosen classes, conforming subsets, options and parameters of those base specifications, or sub-profiles necessary to accomplish a particular function, activity, or relationship

[ISO 16100-2:2003, 3.10]

3.21
reference capability class structure
schema representing a hierarchy of capability classes to be used for capability profiling

[ISO 16100-3:2005, 3.1.11]

3.22
template
schema for a manufacturing software capability profile

[ISO 16100-3:2005, 3.1.14]

3.23
unit under test
capability profile, capability template, capability class structure or profile matcher being evaluated to determine if it meets or provides specific characteristics described in ISO 16100

4 Abbreviated terms

ATC	Abstract test case
ATG	Abstract test group
ATS	Abstract test suite
CITI	Conformance information for testing the implementation
CSI	Conformance statement for the implementation
ETC	Executable test case
ETG	Executable test group
ETS	Executable test suite
MSU	Manufacturing software unit
UML	Unified Modeling Language
UUT	Unit under test
XIPI	eXtra information for platform implementation
XITI	eXtra information for testing the implementation
XML	eXtensible Markup Language

5 Conformance framework

5.1 Conformance testing

A UUT, such as capability profile, template, reference capability class structure, or profile matcher shall be called conforming if its externally visible behaviour fulfils specific conformance requirements in this part of ISO 16100.

Conformance testing shall be used to verify if an implementation meets the requirements of a standard or specification. Conformance testing is a necessary step toward achieving interoperability, but is not a guarantee for interoperability. Conformance testing provides developers and users the assurance and confidence that the conforming UUT behaves as expected, performs functions in a known manner, or possesses a prescribed interface or format.

The basic conformance testing strategy for ISO 16100 shall be falsification testing. Falsification testing subjects an implementation to various combinations of valid and invalid inputs, and compares the test outputs to the corresponding expected outputs as defined in the test criteria in order to determine the degree of conformance. When a test output does not match the expected output, the deduction that the implementation does not conform to the specification can be made. When the conformance testing output is true, it does not mean absolute conformance. Falsification testing shall only demonstrate non-conformance. The use of a greater variety of test inputs can increase the likelihood of conformance.

5.2 Types of UUTs

The interoperability for manufacturing software can be realized through the capability profiling method described in ISO16100-2. The key phases of this capability profiling method both for MSU capability profiling and required activity capability profiling are as follows:

a) create a capability class structure and register it in the database;

b) search for a capability class structure in the database according to the manufacturing application requirements;

c) select capability class from the reference capability class structure in the database;

d) create a capability template and register it in the database;

e) search for a capability template in the database corresponding to a capability class;

f) create a capability profile by filling in each field of the template and register it in the database;

g) match a MSU capability profile with a requirement profile using a profile matcher.

Before registering the UUTs in steps (a), (d) and (f), a conformance test associated with the UUT type shall be performed on the UUT.

The likelihood of interoperability of MSUs will be ensured when their respective capability profiles have been validated using a capability class structure, a capability class, and a capability profile template that have also been validated.

The four types of UUTs that shall undergo conformance testing to ensure the likelihood of interoperability are:

— reference capability class structure;

— capability template;

— capability profile;

— capability profile matcher.

5.3 Conformance test methodology

As shown in Figure 1, the following set of activities shall form a conformance testing process:

a) create CSI;

b) create ATC;

c) create ETC;

d) test UUT.

The process shall begin with the creation of a CSI based on analyzing the conformance points and conformance test criteria contained in ISO 16100.

Adding XITI and a CSI shall result in the creation of an ATC. XITI shall be UUT type-specific and shall include those items listed in Table 2 for each UUT type.

Each ATC shall be traceable back to a CSI and shall be implemented as a set of ETCs. For a particular test platform, extra information as listed in Table 3 shall be combined with the set of ETCs corresponding to an ATS to form an ETS.

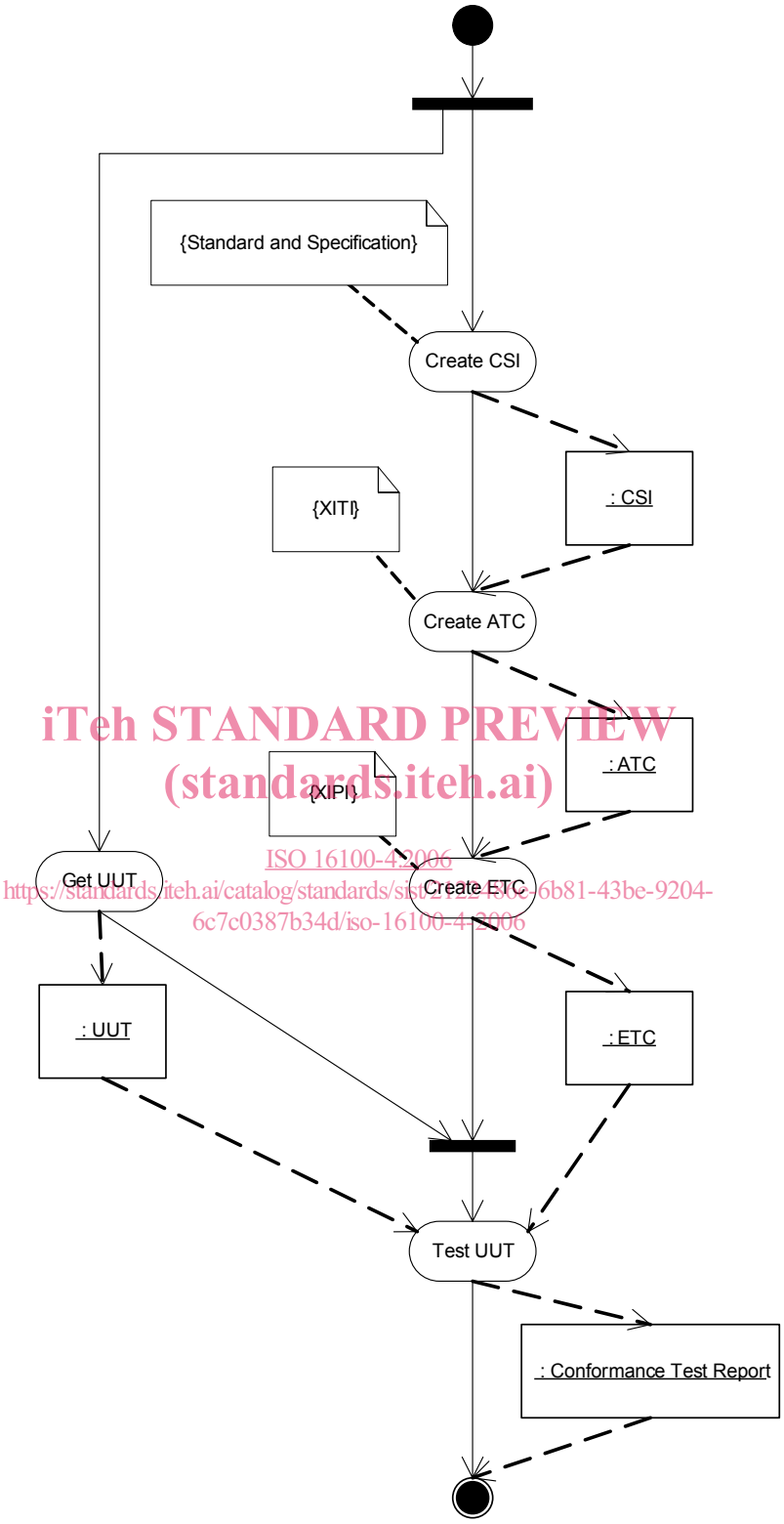

Figure 1 — Methodology for developing the conformance testing process