

**CWG – 019rev7: Conformance testing methodology for ANSI/NIST ITL-1
2011 - Final Draft**

Report of ANSI/NIST-ITL 1-2011 Conformance Testing Working Group

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1 Overview

This document establishes tests for checking the conformance of an implementation, i.e., system or transaction(s), to the requirements specified in the ANSI/NIST-ITL 1-2011 standard.

ANSI/NIST-ITL 1-2011 specifies a data record interchange format for storing, recording, and transmitting records pertaining to a single subject, hereafter referred to as an ANSI/NIST transaction. The objective of the ANSI/NIST-ITL 1-2011 cannot be completely achieved until implementations can be tested to determine whether they conform to those specifications. Conforming implementations are a necessary prerequisite for achieving interoperability between implementations; therefore there is a need for a standardized conformance testing methodology, test assertions, and test procedures as applicable to specific requirements of ANSI/NIST-ITL 1-2011. The test assertions shall cover normative, conditional, and optional requirements to assure the conformity assessment reflects the real degree of conformity of the implementations to ANSI/NIST-ITL 1-2011 standard.

This document specifies elements of the conformance testing methodology, test assertions, and test procedures.

2 Conformance testing framework

2.1 Limitations

A thorough and perfect conformance assessment is not practical. In fact, it is only possible to prove that an implementation or a transaction is non-conformant. Thus the goal of conformance testing is to test as many requirements as possible or practical, and under enough conditions, so that any implementation or transaction that passes the conformance test is likely to be conformant to ANSI/NIST-ITL 2011.

Additionally, there are may be some requirements that cannot be quantitatively tested.

2.2 Conformance testing levels

2.2.1 Hierarchy of Conformance Tests

Three levels of conformance testing are defined here:

- Level 1 – Morphological and Lexical conformance deals with the form and structure of the internal content and verifies data structures exist and have correct values,
- Level 2 – Syntactical conformance deals with explicit requirements that checks for internal consistency and ensures values are within a specified range,
- Level 3 – Semantical conformance checks if the biometric transaction is a faithful representation of the parent biometric data and ensures requirements are satisfied that are not merely syntactical or morphological.

This conformance testing hierarchy progresses from least complex and expensive to test to most complex and expensive to test. They also progress from less useful in predicting the performance of real world systems using conformant products, to more useful.

It ultimately will be up to application profiles or to individual end users of this Conformance Testing Methodology to determine which level of conformance testing will be required for a specific application, as well as any requirements on performance or interoperability. This will be dependent on time, cost, and importance of biometric performance, and implications of non-interoperability. Conformance testing will be required, at a minimum, for all mandatory requirements.

The conformance hierarchy is described below.

2.2.2 Level 1 – Checking internal content

In Level 1 testing, an ANSI/NIST transactions shall be checked for field-by-field, subfield-by-subfield and information item–by information item conformance with the specification of the standard, both in terms of ranges, character types, and cardinality. Level 1 testing involves a direct comparison between a data value and requirements stated in the ANSI/NIST-ITL 1-2011 standard, therefore, it can be performed by a simple field-by-field, subfield-by-subfield and information item–by information item reading of the standard and comparison to known values, and their encoding.

EXAMPLE Valid values for Field 4.004 (FRICTION RIDGE GENERALIZED POSITION - FGP) are 0 to 17,19, 40 to 50, and 255.

Level 1 testing of Field 4.004 checks if its value is a positive integer less than 18, or equal to 19, or between 40 and 50 (including 40 and 50), or equal to 255.

A value of 10 is Level 1 conformant, however a value of 250 is not Level 1 conformant.

NOTE that performing Level 1 conformance testing only requires a set of ANSI/NIST transaction (as opposed to a computer algorithm or a set of hardware and software). Therefore, any hardware or software components of the implementation being tested do not have to come into the possession of the testing lab, only ANSI/NIST transactions created with those components.

2.2.3 Level 2 – Internal consistency checking

In Level 2 testing, an ANSI/NIST transaction shall be checked to determine if it is internally consistent. This is achieved by relating values from one or more fields, subfields, or information items within a transaction to other values within the same transaction.

Level 2 tests involve interactions between multiple values from different parts of the ANSI/NIST-ITL 1-2011 standard and sometimes from implicit assumptions that are not explicitly stated in the base standard. Thus, Level 2 tests require more complex validation than Level 1, usually after the entire transaction has been parsed.

EXAMPLE If Field 17.031 (Subject acquisition profile – SAP) is 40, then Field 17.026 (iris diameter - IRD) shall be equal or larger than 210. If SAP level is 40 (Field 17.031 has a value of 40), a value of 220 for Iris diameter is Level 2 conformant. A value of 200 is not Level 2 conformant.

Similar to Level 1 testing, Level 2 conformance testing only requires an ANSI/NIST transaction. To ensure that all (or almost all) possible internal consistency checks are tested, it is vital to test a large number of transactions that represent as many as possible different structural variants.

2.2.4 Level 3 – Content checking

A Level 3 test is intended to test whether an ANSI/NIST transaction under test, is faithful representations of the original biometric data and that it satisfies those requirements of the standard that are not simply a matter of syntax and format.

Level 3 conformance testing of some requirements might be significantly difficult or even impossible to test. Those requirements for which no Level 3 test is possible shall be marked as Level 3NT (Level 3 Not Testable) in the Table of requirements and test assertions (see Table 1, in section 3.1).

EXAMPLE Valid values for Field 4.004 (FRICTION RIDGE GENERALIZED POSITION - FGP) are 0 to 17,19, 40 to 50, and 255. A value of 10 indicates that the image data in Field 4.009 shall be an impression of left little finger. Level 3 testing of Field 4.004 checks if the image in Field 4.009 is actually a grayscale image of a left little finger. While this Level 3 requirement is currently not testable, a technology such as finger geometry detection may enable such a test to be performed in the future.

NOTE Level 3NT is equivalent to Level 3C defined in JTC 1 ISO/IEC SC 37 29109-1:2010 [isoConformance].

3 Conformance testing and reporting methodology

3.1 Conformance requirements and test assertions

Although the ANSI/NIST-ITL 1-2011 standard itself specifies the normative requirements, the Conformance Testing Methodology shall provide a simple but precise summary of the requirements as a checklist for the supplier of the implementation under test (IUT). Furthermore, the testing laboratory needs to have a clear statement of which requirements of the standard are mandatory and which are optional, as well as a clear methodology for testing them. The testing laboratory also needs a statement from the supplier of the IUT that lists which mandatory and optional requirements of the standard are supported by the IUT. To simplify and harmonize the communication of the requirements of the standard and of those claimed conformance by IUT, the Table of requirements and test assertions shall be developed. The Table of requirements and test assertions details the general requirements of the ANSI/NIST-ITL 1-2011 standard, references corresponding section of the standard, indicates what level of conformance testing is applicable to each requirement, and gives specific test assertions to be tested for Level 1, Level 2 and Level 3 testing. The table also has space for the supplier of the IUT to provide information about the IUT and its support of the ANSI/NIST-ITL 1-2011 standard as well as for the testing laboratory to record the results of the test. This table and its accompanying notes, as described below, shall be included in each test report produced by a testing laboratory that follows this Conformance Testing Methodology.

Table 1. Table of requirements and test assertion

Explanation of columns of Table of requirements and test assertions follows:

- **Requirement ID** – is a unique identifier. In the case where the requirement pertains to a specific Record Type and Field, it indicates the Record Type and the Field Number followed by an abbreviation of the field name/requirement. A Record Type of “xx” indicates that the requirement is common to all or several record types.
- **Section** is the clause or table reference in the standard that specifies the requirement on the current row.
- **Mnemonic** – values defined in the standard.

- **Requirement Summary** is a simple text summary of the requirement. It may be a verbatim quote from the base standard or a synopsis of a more complex requirement. It carries the essentials of the requirement but may not provide all the text necessary to understand it. That text is to be found in the referenced section of the base standard.
- **Level** indicates the level of conformance testing required for the requirement summarized on the current row of the table. In cases when test assertions of different levels (e.g. Level 2 and Level 3) are associated with a single requirement, it is recommended to split (replicate) such rows to reflect different levels of testing. Each row in the table addresses one requirement at either conformance testing Level 1 or 2, or Level 3. Those Level 3 requirements that cannot be tested shall be marked as Level 3NT. Thus the permitted values are 1, 2, 3, or 3NT.
- **Status** indicates whether the requirement is mandatory (M), or mandatory if the field/repeating subfield is used (M↑), optional (O) or optional if the field/repeating subfield is used (O↑), or conditional on other information items (C-xxx where xxx is the mnemonic). If a dash and then a number follows the letter indicating mandatory or optional (e.g. M-1 or O-3) then the number refers to a numbered note in the **Status Notes** section that immediately follows the table. If a series of optional requirements must all be satisfied together or not at all (e.g. an extended data section consisting of multiple elements) then all the optional requirements should reference the same **Status Note**. In the case of Level 3 conformance requirements that are difficult to test or Level 3NT conformance requirements that are impossible to test, these may have status listed as O-x, where x is the number of a **Status Note** that explains why this normative requirement in the base standard is considered too difficult (or impossible) to test and should therefore be treated as optional for purposes of a declaration of conformance.
- **Assertion ID** is a unique identifier for each requirement in the standard and its corresponding test assertion(s) listed.
- **Test Assertion** is either a plain English statement, or a mathematical equation, or a procedure detailing calculations needed to test the requirement. The complex calculations can be expressed in a pseudo code (or an appropriate programming language e.g. C programming language).
- **Test Note** is a numerical reference to one of the **Test Notes** that follows the table. These are used when an assertion involves a complex calculation or when it requires further explanation than is provided by the simple test assertion in the table. The complex calculations can be expressed in a simple pseudo code.
- **Implementation Support** is to be filled in by the supplier of the IUT. It should contain either a “Y” to indicate that a particular requirement is supported or an “N” to indicate that it is not. A conformant ANSI/NIST implementation shall, at the minimum, support all mandatory requirements at Level 1 and 2. If the supplier wishes to provide a note providing more information about the support of a particular requirement then they should add a dash followed by a number (e.g. Y-2) where the number corresponds to one of the implementation

Support Notes following the table.

- **Supported Range** is to be filled in by the supplier of the ANSI/NIST implementation. It indicates what range of values is supported when a particular requirement allows only a subset of values to be supported. When there is only a single value possible or there is no specific requirement, then this column is pre-filled in with N/A.
- **Test Result** is to be filled in by the testing laboratory once the test has been completed. Permitted values are
 - “P” to indicate that the IUT passed all tests related to this assertion,
 - “F” to indicate that it failed at least one test related to this assertion,
 - “W” to indicate warnings,
 - “N/A” to indicate that the test was not applicable, or
 - “N/T” to indicate that the requirement was not tested.

The test may not be applicable because it is beyond the scope of the conformance testing methodology standard, or it is related to an optional requirement that was not supported by the IUT, or the requirement is impossible to test (i.e. Level 3NT).

The requirement may not be tested because the testing laboratory was unable or unwilling to perform the test.

If the testing laboratory wishes to include short notes about particular test results then they may append a dash followed by a number (e.g. F-2, N/A-4, N/T-6) where the number refers to one of the Test Result Notes following the table.

An Example of very few requirements and related test assertions follows. Note that the table below is only an example to demonstrate how Table of Requirements and Test assertions will be filled, and obviously, it is by no way complete.

Table 2. EXAMPLE of Table of requirements and test assertion

xx.001- RecHdr_FirstField	7.1	The record header appears as the first field (xx.001) in each record type.	2	M	1.001_FirstField	1.001 is the first field in record type 1					
			2	M	2.001_FirstField	2.001 is the first field in record type 2					
					...						
			2	M	99.001_FirstField	99.001 is the first field in					

							record type 99				
xx.002-IDC_Present	7.2	IDC	Each of the records present in a transaction, with the exception of the Type-1 record, shall include a field (xx.002) containing the Information designation character / IDC	2	M	1.002_IDCNotPresent	Type 1 record does not contain the IDC field.				
				2	M	2.002_IDCPresent	Type 2 records contain the IDC field.				
						...					
				2	M	99.002_IDCPresent	Type 99 records contain the IDC field.				
xx.002-IDC_0-255	7.2	IDC	The value of the IDC shall be a sequentially assigned positive integer starting from zero to a maximum of 255.	1	M	002-IDC_0-255	0 <= IDC <= 255				
1.002-VER_Rqd	8.1 Table 21	VER	The Version field is mandatory.	2	M	1.002-VER_Rqd	The Version field is present.				
1.002-VER_Num	8.1 Table 21	VER	The Version field is numeric.	1	M	1.002-VER_Num	The Version field is numeric (see Clauses 5.4, 5.5, and Annex C (Character set) in the standard).				
1.002-VER_Min4	8.1 Table 21	VER	The minimum length of the Version field is 4.	1	M	1.002-VER_Min4	Length _{min} (Version field) = 4				
1.002-VER_Max4	8.1 Table 21	VER	The maximum length of the Version field is 4.	1	M	1.002-VER_Max4	Length _{max} (Version field) = 4				
1.002-VER_Value	8.1 Table 21	VER	Version = 0500	1	M	1.002-VER_Value	Version = 0500				

4 Data for test

Conformance can be claimed and declared for a single ANSI/NIST transaction, a set of transactions, or an implementation that generated ANSI/NIST transactions. If a set of transactions is being tested for conformity, conformance is declared only if all the records pass the test successfully. If an implementation that generates ANSI/NIST records is tested for conformance, the test dataset should be large enough and diverse enough to ensure the natural variability in biometric characteristics has been accounted for in the conformance test.

Level 3 conformance testing may also require a specific data set along with its metadata or may involve the creation of special sets of biometric samples using a hardware and/or software solution. Therefore, it is necessary to identify each data set used in a particular conformance test, in the test report.

At a minimum the following information about test data set shall be included in the **Test Report**:

- dataset Identifier,
- supplier/owner of the dataset,
- whether it contains actual data (collected from human subjects), synthesized data or both,
- biometric characteristic included,
- total number of samples for each biometric characteristics in the test dataset,
- metadata associated with each biometric sample.

5 Declaration of Conformance

An ANSI/NIST transaction is declared conformant at a particular level (i.e. Level 1, Level 2 or 3) of conformance testing by a testing laboratory if it successfully passes all mandatory (and optional) conformance tests at the level at which conformance is being claimed and at all lower levels. That is the **Test Result** column of the table of requirements and test assertions shall be “P” for all mandatory requirements and those optional requirements that are claimed conformant by the ANSI/NIST IUT.

A **Test Result** of “N/A” or “N/T” for a mandatory requirement or for an optional requirement for which the supplier of the ANSI/NIST IUT has claimed conformance means the conformance test has failed (equivalent to a **Test Result** of “F”). The only exception is if the test has a status of “O” with a note, which explains that the requirement is mandatory in the base standard but has been declared optional because for example it is impossible to test. In that case, if the ANSI/NIST IUT claims conformance to the requirement, a result of “N/T” should be considered as equivalent to a result of “P”.

6 Test Report

6.1 Purpose

Each conformance test shall produce a **Test Report**. The main purpose is to document all aspects of the test procedure, the test results and the mechanisms used to evaluate each test assertion or conformance requirement so that a future test on the same implementation produce identical results and an identical declaration of conformance or non-conformance.

6.2 Format/Content

A conformance test report shall contain

- name of the test accreditation laboratory performing the test and any accreditation,
- date of initialization of the test,
- date of completion of the test,
- completed Table of requirements and test assertions, along with its accompanying notes,
- information on dataset as outlined in section 4, and
- an overall declaration of conformance or non-conformance of the IUT.

Optionally detailed test logs that were generated during the test could be included.

Bibliography

[isoConformance] JTC 1 ISO/IEC 29109 Conformance testing methodologies for biometric data record defined in ISO/IEC 19794 Part 1: Framework (2010 edition).