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Information Technology - Conformance Testing Methodology Standard for Biometric Data Interchange Format Standards, Part 3 – Conformance Testing Methodology for INCITS 377-2004 Finger Pattern Data Interchange Format

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Introduction

The Finger Pattern Data Interchange Format, INCITS 377-2004, provides an industry standard to allow for fingerprint pattern data extracted with one vendor's algorithm to be useful to another vendor's matching algorithm.

Currently, there are no standardized methods for conducting conformance tests of commercial products that claim to support the Finger Pattern Data Interchange Format INCITS 377-2004. Application and Biometric Service Provider (BSP) developers may interpret INCITS 377-2004 specification differently from one another; therefore, their implementations of INCITS 377-2004 may differ and not interoperate. There is a need for a standardized, generally accepted, Finger Pattern Data Interchange Format conformance testing methodology that would allow implementation of a set of test tools realizing this methodology.

A particular fingerprint pattern template can be considered in conformance to the INCITS 377-2004 standard. In this case, a template can be parsed and examined to assure that the data layout is consistent with INCITS 377-2004. A process that transforms fingerprint images into fingerprint pattern templates can conform to INCITS 377-2004 by producing conformant templates. A process that assesses the similarity of fingerprints can conform to INCITS 377-2004 by accepting a conformant pattern template as input.

The INCITS 423.1 standard defines a testing methodology to assure conformance of a vendor's application or service to the Finger Pattern Data Record requirements as set forth in INCITS 377-2004. It intends to:

a) establish elements of the Conformance Testing Methodology framework that are specific to the Finger Pattern Data Record requirements of INCITS 377-2004

b) define requirements and guidelines for specifying conformance test suites and related test methods for measuring conformity of products and services to the Finger Pattern Data Record requirements of INCITS 377-2004, and

c) define test procedures to be followed before, during, and after conformance testing.

This part of the INCITS 423.1 standard is applicable to the development and use of conformity test method specifications, conformity test suites for Finger Pattern Data Record requirements as specified in INCITS 377-2004, and conformance testing programs for INCITS 377-2004-conformant products. It is intended primarily for use by testing organizations, but may be applied by developers and users of test method specifications and test method implementations.

1 Scope

This standard is concerned with conformance testing of implementations claiming conformance to the Finger Pattern Data Interchange Format specification defined in INCITS 377-2004. More specifically, it is concerned with testing only of the Biometric Data Interchange Records (BDIR) requirements as defined in INCITS 423.1.

Conformance testing of the CBEFF requirements as set forth in INCITS 377-2004 is not within the scope of this standard. Furthermore, this standard is not concerned with testing of other characteristics of biometric products or other types of testing of biometric products (i.e., acceptance, performance, robustness, security). Any organization contemplating the use of test methods defined in this part, should carefully consider the constraints on their applicability.

Two types (A and B) and three levels (1, 2, and 3) of conformance testing have been defined in INCITS 423.1. However, only Type A, and Levels 1 and 2 are within the scope of this standard.

2 Conformance

Conformance testing methodology implementations (conformance test suites or CTS) that claim conformance to this part of the standard shall satisfy the normative requirements of the methodology for those levels of test they are claiming to perform. Additionally, implementations of Level 1 or Level 2 tests shall use the assertions defined in Clause 7. Implementations of INCITS 377-2004 tested shall be able to claim conformance only to those Biometric Data Record requirements specified in INCITS 377-2004 that are tested by the test methods in this part of INCITS 423.

3 Normative References

The following normative references are critical to the proper understanding and application of this standard:

- INCITS 377-2004 Information Technology - Finger Pattern Data Interchange Format
- INCITS 423.1 Information Technology - Conformance Testing Methodology Standard for Biometric Data Interchange Format Standards - Part 1: Generalized Conformance Testing Methodology

4 Terms and Definitions

4.1 For the purposes of this standard, the following terms defined in INCITS 423.1 apply:

- **Assertion**
- **Base Standard**
- **Biometric Data Interchange Record (BDIR)**
- **Conformance**
- **Conformance Testing**
- **Conformance Test Suite (CTS)**
- **Implementation Under Test (IUT)**
- **Input Biometric Data Record (IBDR)**
- **Level 1 Testing**
- **Level 2 Testing**
- **Level 3 Testing**
- **Type A – Produce Conformant BDIR (type A or PCB)**
- **Type B – Use Conformant BDIR (type B or UCB**)

4.2 The following additional terms and definitions are also used in this standard. Some of these definitions are taken from ISO/IEC Guide 2, ISO/IEC 13210, and ISO/IEC 9646-1.

4.2.1 **Assertion Identifier -** The identifier assigned to an assertion

4.2.2 **Assertion Test -** The software or procedural methods that generate the test result codes used for assessment of conformance to an assertion

4.2.3 **Conformance Requirement** [ISO/IEC 13210] - A requirement stated in a base standard that identifies a specific requirement in a finite, measurable, and unambiguous manner. A conformance requirement by itself or in conjunction with other conformance requirements corresponds to an assertion

4.2.4 **Conformity Assessment** [ISO/IEC Guide 2 1996] - Activity concerned with determining directly or indirectly that relevant requirements are fulfilled

4.2.5 **Compressed Image Data** - image data after performing a compression algorithm

4.2.6 Conformance Test Procedure - The process of assessing conformance

4.2.7 **Final Test Result Code** - A test result code obtained from an assertion test that requires no further processing

4.2.8 **Format Conformity Statement** - A statement of the capabilities that have been implemented in conformance with the BDIR requirements specified in INCITS 381-2004

4.2.9 **Test** - technical operation that consists of the determination of one or more characteristics of a given product, process, or service according to a specified procedure

4.2.10 **Test Assertion (Assertion)** - The specification for testing a conformance requirement in an implementation under test in the form of software or procedural methods that generate the test results (also named test outcomes or test verdicts) used for assessment of the conformance requirement.

4.2.11 **Test Case** [ISO/IEC 9646-1]: [ISO/IEC 13210] - A specification of the actions required to achieve a specific test purpose or combination of test purposes

4.2.12 **Test Method Implementation** - The software, procedures, or other means used to measure conformance

4.2.13 **Test Method Specification** [ISO/IEC 13210] - A document that expresses the required functionality and behavior of a base standard as assertions and provides the complete set of conforming test result codes

4.2.14 **Test Purpose** [ISO/IEC 13210] - A prose description of a narrowly defined objective of testing, focusing on a single conformance requirement, as specified in the appropriate product specification

4.2.15 **Test Result Code** (**Test Verdict**) [ISO/IEC Guide 25] - A value that describes the result of a test

4.2.16 **Test Report** - A document that presents test results and other information relevant to the execution of the test methods against an implementation under test

4.2.17 **Test Suite** - See conformance test suite

4.2.18 **Validation** - The process of testing software for conformance to a specific specification

5 Symbols (and abbreviated terms)

BDIR – Biometric Data Interchange Record

BSP – Biometric Service Provider

CTP – Conformance Testing Procedure

CTS - Conformance Test Suite

FCS - Format Conformity Statement

IBDR – Input Biometric Data Records

IUT – Implementation Under Test

PCB - Produce Conformant BDIRs

UCB - Use Conformant BDIRs

6 Conformance Testing Methodology

6.1 General

6.1.1 Implementation Under Test

Implementation under test (IUT) is an object that is being tested for conformity. For complete implementation of INCITS 377-2004 specifications, it should be a collection of BDIRs containing information from one or more finger patterns, as well as a system or application that implements the INCITS 377-2004 specification according to its conformance clause.

6.1.2 Claimed Conformance

IUT claiming conformance to INCITS 377-2004 are expected to conform to all the applicable requirements in its conformity Clause 2, as well as other requirements set forth in the INCITS 377-2004 subsequent clauses . These requirements can be:

a) mandatory requirements – such requirements are to be observed in all cases;

b) conditional requirements – such requirements are to be observed if the conditions set out in the specification apply;

c) optional requirements – such requirements can be selected to suit the implementation, and are to be observed if selected.

6.1.3 Evaluation of Conformance

To evaluate the conformity of a biometric product, it is necessary to have a statement of the capabilities that have been implemented in conformance with the INCITS 377-2004 specification so that the implementation can be tested for conformity against relevant requirements and against those requirements only. Such a statement is called an INCITS 377-2004 Finger Pattern Data Record Conformity Statement (FCS), and shall be prepared by the IUT supplier prior to the beginning of the Conformance Testing. The FCS shall contain the minimum requirements of the INCITS 377-2004 standard that are included in the IUT.

6.2 Level I and Level II Assertions

As described in INCITS 423.1, the IUT shall be tested for conformity specified in INCITS 377-2004 using two levels of testing. These Conformance Testing Levels are:

Level 1: Data Format Conformance – such requirements are to be observed for all fields;

Level 2: Internal Consistency Checking – such requirements are to be observed for several fields, as detailed in Clause 7.

The specific test assertions required for Level 1 and Level 2 conformance testing of INCITS 377-2004 Finger Pattern Data Interchange Format are listed in the table below. Certain computations mentioned in this table are further explained in the notes that follow it.

Test #	Field	Operator	Operands	Reference clause in INCITS 377	Level
1	Format Identifier	EQ	0x46505200	6.2.1	1
2	Version Number	EQ	0x20313000	6.2.2	1
3	Length of Record	IN	44 to (2^{32} -1)	6.1, 6.2.3	1
3.1	Length of Record	EQ	Total bytes present in the record	6.1, 6.2.3	2
3.2	Length of Record	EQ	Total Bytes Expected (See Note 1)	6.1, 6.2.3	2
4	Number of Finger Patterns	IN	1 to 255	6.2.5	1
4.1	Number of Finger Patterns	EQ	Patterns present in the record	6.2.5	2
5	X Size of Finger Pattern	IN	1 to 255	6.2.6	1
6	Y Size of Finger Pattern	IN	1 to 255	6.2.7	1
7	X Resolution of Finger Pattern	IN	1 to 788	6.2.8	1
8	Y Resolution of Finger Pattern	IN	1 to 788	6.2.9	1
9	X Number of Cells	C	(See Note 2)	6.2.10	2
10	Y Number of Cells	C	(See Note 3)	6.2.11	2
11	X Number of Pixels in Cells	IN	1 to ({X Size of Finger Pattern} - {X Cellular Offset})	6.2.12	2
12	Y Number of Pixels in Cells	IN	1 to ({Y Size of Finger Pattern} - {Y Cellular Offset})	6.2.13	2
13	X Cellular Offset	IN	0 to {X Size of Finger Pattern}	6.2.14	2
14	Y Cellular Offset	IN	0 to {Y Size of Finger Pattern}	6.2.15	2
15	Bit-depth of Cell Structure Angle	IN	1 to 8	6.2.16	1
16	Bit-depth of Cell Structure Wavelength	IN	1 to 8	6.2.17	1
17	Bit-depth of Cell Structure Phase Offset	IN	1 to 8	6.2.18	1
18	Bit-depth of Cell Structure Quality	IN	1 to 8	6.2.19	1
19	Cell Quality Granularity	IN	1 to 8	6.2.20	1
20	Reserved Bytes	EQ	0	6.2.21	1
21	Finger Location	IN	0 to10	6.3.1.1	1
22	Impression Type	IN	0 to 3, 8, 9	6.3.1.2	1
23	Number of Views in Finger Pattern	IN	1 to 255	6.3.1.3	1
24	Finger Pattern Quality	IN	-2, -1, 0 to 100	6.3.1.4	1
25	Length of Data Block	EQ	Bytes present in the record	6.3.1.5	2
25.1	Length of Data Block	EQ	Bytes Expected (See Note 4)	6.3.1.5	2
26	View Number	INC	0 to {Number of Views -1}	6.3.2.1.1	2

Note 1: (Test #3.2) – {Total Bytes Expected}

Total Bytes Expected is calculated using the following algorithm:

SUMBYTES = 36

FOR I = 1 TO {Number of Finger Patterns}

SUMBYTES = SUMBYTES + 6 + {Length of Data Block}

END

{Total Bytes Expected} = SUMBYTES

Note 2: (Test #9) – Range of {X Number of Cells}

We assume that any pixels on the right side of the image which are less than {X Number of Pixels in Cells} will be ignored and that there will not be a smaller cell created at the edge of the image. Therefore, the value in this field must be non-zero and consistent with the value calculated by the following formula

```
{X number of Cells}= FLOOR(({X Size of Finger Pattern} - {X Cellular Offset}) / {X Number of Pixels in Cells})
```

Note 3: (Test #10) – Range of {Y Number of Cells}

We assume that any pixels on the bottom of the image which are less than {Y Number of Pixels in Cells} will be ignored and that there will not be a smaller cell created at the edge of the image. Therefore, the value in this field should be nonzero and consistent with the value given by the following formula

```
{Y number of Cells}= FLOOR(({Y Size of Finger Pattern} - {Y Cellular Offset}) / {Y Number of Pixels in Cells})
```

Note 4: (Test #25.1) – {Length of Data Block Bytes Expected}

If there is no extended data then {Length of Data Block} = “Bytes Expected” for every finger pattern in the BIR. If, however, there is extended data then some finger patterns may have extended data. Since the length of the extended data may vary from one pattern to the next within the same BIR, the only possible test is {Length of Data Block} GTE {Length of Data Block Bytes Expected}.

The following method of calculating {Length of Data Block Bytes Expected} assumes that the Finger Pattern Cell Data, Cell Quality Data and Finger Pattern Extended Data all begin at the start of a new byte, so there may be wasted bits within a byte at the end of each of these data sets. It also assumes that the cell quality groups are always square arrays of cells and that if there are insufficient pattern cells at the right edge or bottom edge of the pattern cell data to fit a complete cell quality group, then those cells don’t have any cell quality assigned to them. For example, if the image is divided into 9 by 11 cells and {Cell Quality Granularity} = 3, then there will be 3 by 3 = 9 cell structure quality values.

```
NUMCELLS = {X Number of Cells} * {Y Number of Cells}
```

PATTERNBYTES = CEILING (NUMCELLS * ({Bit-depth of Cell Structure Angle} + {Bit-depth of Cell Structure Wavelength} + {Bit-depth of Cell Structure Phase Offset}) / 8)

6.3 Test Method

6.3.1 Overview

For conformance testing to be meaningful, all implementations of the INCITS 377-2004 specification shall be tested in the same manner. Conformance testing reflects the essence of technical requirements of the INCITS 377-2004 specification and measures whether a biometric product faithfully implements the specification.

In this standard, conformance testing methodology consists of:

a) Preparation of the format as referenced in INCITS 377-2004. This record will be either extracted from the CBEFF-conformant structure by the testing laboratory, or presented to the testing laboratory by the data record owner (vendor, user, etc.) Description of the IUT supplier and the testing organization responsibilities are usually within the scope of a specific conformance testing or a conformity assessment program that utilizes the methodology described in this standard.

b) inspection of the internal structure of resulting data record or data file(s), including size and values of each field of the file;

c) validation of data fields and the associated parameter data used in the data fields of the internal structure claiming conformance to Level 1 and 2 as described in INCITS 243.1.

Considering the complexity of the INCITS 377-2004 specification, and many possible ways of generating finger pattern records, the testing methodology consists of several steps:

1) For each finger pattern record, Level 1 conformance testing shall parse and verify the pattern data field by field and byte by byte conformance against the requirements of INCITS 377-2004 both in terms of fields included and ranges of the values in those fields.

2) For each finger pattern record, Level 2 conformance testing shall determine whether the values of the specified fields are internally consistent, wherever such testing is applicable

Figure 1 shows the flow of testing of a single finger pattern record; this flow shall be repeated for every finger pattern record in the data file.

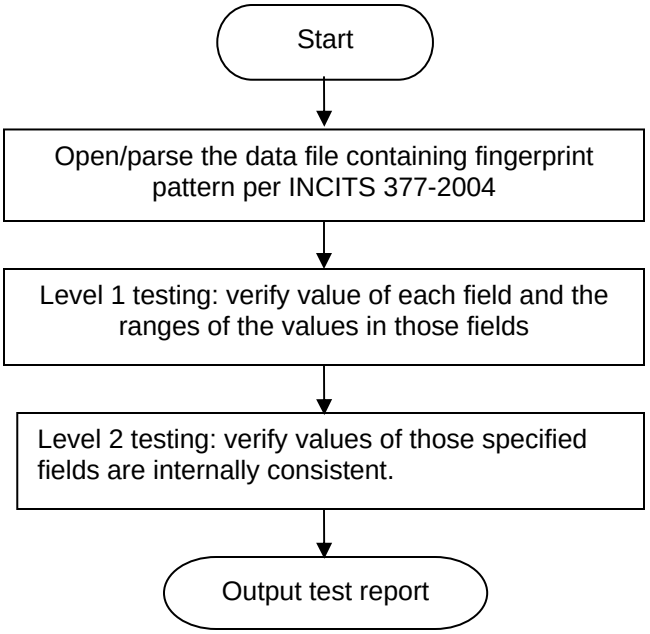

Figure 1: INCITS 377-2004 BDR File Format Level 1 and Level 2 Conformance Test Flow

This testing methodology can only demonstrate non-conformity (i.e., if errors are found, non-conformance of the IUT shall be proven), but the absence of errors does not necessarily imply the converse. This test method is intended to provide a reasonable level of confidence and practical assurance that the IUT conforms to the base standard. To guarantee such conformity, a very exhaustive testing would be required, which is impractical for both technical and economic reasons.

6.3.2 Test Method Implementation Requirements

A test method implementation shall document that it conforms to this standard by include the following:

a) a CTS conformant to INCITS 377-2004 that includes documentation of the test suite, describing test categories, test objectives for each individual test, instructions on how to execute the test suite, and the expected results of executing the individual tests. The CTS shall be capable of executing the test script sets, capturing the returned results, evaluating the results, and reporting them in a human-readable form;

b) documented test cases that shall sufficiently assure conformity to the requirements as specified in the base standard. The test cases shall be formally represented in the form of test assertions, preferably using a test assertion language, which can be submitted to the CTS for subsequent execution; and

c) a Conformance Testing Procedure, which shall identify and define all the activities necessary to prepare for conformance testing, perform the conformance testing and report the test results. The procedure shall be detailed enough so that testing of a given IUT can be repeated with no significant changes in test results. The procedure shall also identify necessary administrative processes that may include record keeping, personnel, security, and other requirements.

A test method implementation shall use the required assertion definitions, types, syntax, and constructs specified in this standard as applicable. Also, it shall use test result codes specified in this standard.

6.3.3 Conformance Testing Process

The conformance testing process is the complete process of accomplishing of all conformance testing activities necessary to assess the conformity of an IUT to the requirements as specified in INCITS 377-2004. The conformance testing process involves three phases:

1) preparation for testing, which includes the collection of the necessary information that is related to the submitted finger pattern records that needs to be included in the test report;

2) test execution, which includes execution of the CTS and recording the observed test results in conformity test log(s). The results of conformance testing shall apply only to the IUT and the test environment for which the tests are run;

3) test report production, which includes the recording of all events that occur during the execution of each test case, including all test outcomes and test verdicts.

To achieve the objective of credible conformance testing, the result of executing a test case on an IUT should be the same whenever it is performed.

It may be necessary to review the observed test outcomes in order to make sure that all procedures have been correctly followed. It is essential that all inputs, outputs, and other test events be logged for each test case being executed with sufficient information to produce a conformity log for each test execution for future reference.

6.4 Test Procedures

6.4.1 General

A software product can claim conformance to requirements as specified in INCITS 377-2004 and document this claim in the FCS as described in clause 6.1.1.3.

Conformance of a software product with respect to the ability to produce finger pattern data records shall be verified by testing the conformance of a reasonable number of data records created by the product. Please refer to INCITS 423.1 Clause 6.1. The product shall be determined to be conformant to the requirements as specified in INCITS 377-2004 if and only if all those data records (tested using the assertions specified in Clause 7) have passed the tests.

Most software products that process finger pattern data records will emit some form of error message when they detect an invalid input (for example, an error message may be directed to a user through the user interface or may be written to a log file). Conformance testing of software products that process data records can only be performed if the product emits error messages that are observable by a testing operator.

Every conformant INCITS 377-2004 file must be able to be fully parsed or partially parsed by the CTS. Failure to meet the INCITS 377-2004 specification for a single test input file results in the test case failing to be conformant for the test. The test procedures are based on the three-levels testing specification described in INCITS 423.1.

6.4.2 INCITS 377-2004 Level 1 and 2 Conformant Testing Procedure Flow Chart

Figure 3 (next page) shows the detailed flow of the BDIR data file conformance testing implementation procedure. The flow chart in Figure 2 starts with parsing of the finger image-based BDIRs and then proceeds to evaluate the values in each data field. In this figure, finger image-based BDIR indicates the dataset file containing data records under test.

6.4.3 Test Execution

The execution of the conformance test shall include execution of a Conformance Test Suite (CTS) capable of processing the test cases (test assertions) specified in Clause 7. A description of possible CTS implementation is given in Annex C. The test execution shall include automated and/or manual testing procedures implementing individual test cases, and recording the observed test results in conformity test log(s). The results of conformance testing shall apply only to IUT and the test environment for which the tests are run.

6.5 Test Report

The results of the execution of one or more test assertions against an implementation under test shall contain the following information at a minimum:

a) title of the report;

b) name and address of the testing organization;

c) name and contact information of provider of IUT;

d) unique identifier of the conformance test report issued by that particular testing organization;

e) date of performance of the conformance testing;

f) an unambiguous identification of the IUT under test;

g) any abnormalities or departures from standard conditions;

h) identification of the conformance test suite;

i) case numbers of executed assertions;

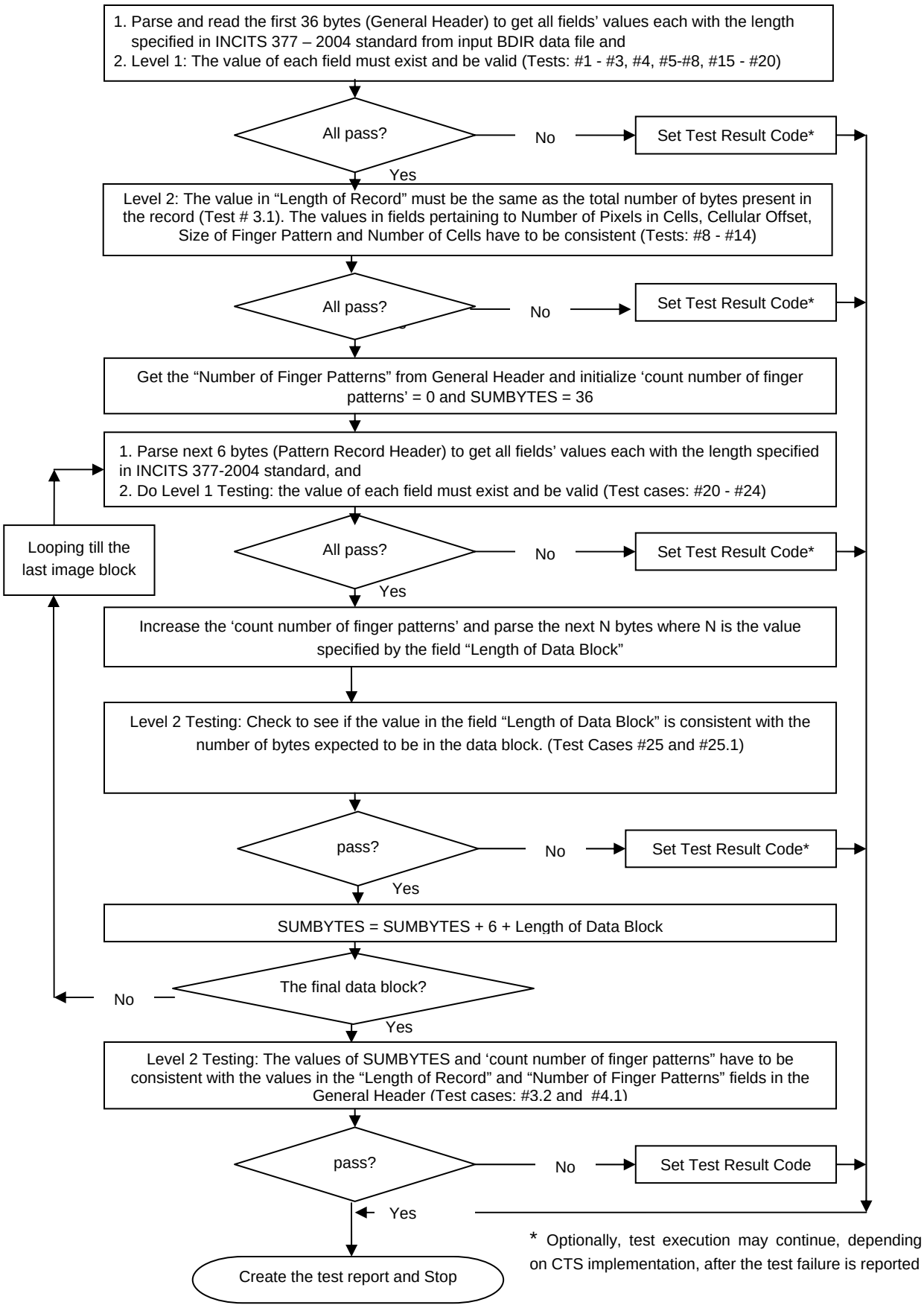

Figure 2: INCITS 377 BDIR Data File Level 1 and 2 Conformance Testing Implementation Procedure

j) conformance testing log or a reference to the log;

k) conformance testing results / test verdicts;

7 Test Assertions for Type A Conformance Testing

7.1 General Consideration

The test assertions specified in this clause are based on the conformance testing methodology specified in Clause 6 of this part of INCITS 423, and can only be used in the context of that methodology. The following assertions shall be used to determine whether the IUT satisfies the requirements specified in INCITS 377-2004 standard. All the assertions specified in this clause shall be executed (in order) to determine conformance of an IUT. Each test assertion consists of description test purpose, excerpts, references, expected test results, and the test result code.

7.2 Level 1 and Level 2 Testing of the General Record Header

7.2.1 Test Case #1: Format Identifier Assertion

7.2.1.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.1.

7.2.1.2 Description of test purpose

This assertion checks if the byte locations within the data record which correspond to the field “Format Identifier” have a valid content according to the statement quoted below.

7.2.1.3 Expected results

Type-A Level 1 testing: Those four byte locations contain 'F', 'P', "R', and 0x0, in this order. The valid value shall equal to “0x46505200”.

7.2.1.4 Test result code

This assertion shall return a “Pass-001” code for passing the conformance testing or a “Fail-001” code for failing to pass the test.

7.2.2 Test Case #2: Version Number Assertion

7.2.2.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.2.

7.2.2.2 Description of test purpose

This assertion checks if the byte locations within the data record which correspond to the field “Version Number” have a valid content according to the statement quoted below.

7.2.2.3 Expected results

Type-A Level 1 testing: Those four byte locations contain '0', '1', "0', and 0x0, in this order. The valid value shall equal to “0x20313000”.

7.2.2.4 Test result code

This assertion shall return a “Pass-002” code for passing the conformance testing or a “Fail-002” code for failing to pass the test.

7.2.3 Test Cases #3, #3.1 and #3.2: Length of Record Assertion

7.2.3.1 INCITS 377 target

This assertion concerns INCITS 381-2004, sub-clauses 6.1 and 6.2.3

7.2.3.2 Description of test purpose

This assertion checks if the byte locations within the data record which correspond to the field “Record Length” have a valid content according to the statement quoted below.

7.2.3.3 Expected results

The content of those four byte locations, interpreted as a four-byte unsigned integer value in big-endian order, equals the length of the data record.

Type-A Level 1 testing: Those four byte locations contain the value that is greater than 42 (36 general header bytes plus 6 pattern record data header bytes).

Type-A Level 2 testing I: Those four byte locations contain the value that is the same as the byte count of the full record.

Type-A Level 2 testing II: Those four byte locations contain the value which is the same as the total number of bytes expected as calculated by the following formula:

Total Bytes Expected = 36 + {Number of Finger Patterns} x (6 + {Length of Data Block}).

7.2.3.4 Test result code

This assertion shall return a “Pass-003” code for passing the conformance testing or a “Fail-003”, “Fail-003-1” or “Fail-003-2” code for failing to pass the specific tests described in clause 7.2.3.3 above.

7.2.4 Test Cases #4 and #4.1: Number of Finger Patterns Assertion

7.2.4.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.5.

7.2.4.2 Description of test purpose

This assertion checks the value in to the 1-byte field “Number of Finger Patterns in Record” and determines if it is consistent with the total bytes expected to be in the record.

7.2.4.3 Expected results

Type-A Level 1 testing: This byte should not be zero.

Type-A Level 2 testing II: This byte should contain a value which is consistent with the actual number of finger patterns present in the record obtained by the final value of “count number of finger patterns” variable in the flow chart in Fig. 3

7.2.4.4 Test result code

This assertion shall return a “Pass-004” code for passing the conformance testing or a “Fail-004” or “Fail-004-1” code for failing to pass the Level 1 and Level 2 tests, respectively.

7.2.5 Test Case #5: X Size of Finger Pattern Assertion

7.2.5.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.6.

7.2.5.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Size of Finger Pattern in X Direction” has a valid content according to the statement quoted below.

7.2.5.3 Expected results

Type-A Level 1 testing: This byte should not be zero.

7.2.5.4 Test result code

This assertion shall return a “Pass-005” code for passing the conformance testing or a “Fail-005” code for failing to pass the test.

7.2.6 Test Case #6: Y Size of Finger Pattern Assertion

7.2.6.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.7.

7.2.6.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Size of Finger Pattern in Y Direction” has a valid content according to the statement quoted below.

7.2.6.3 Expected results

Type-A Level 1 testing: This byte should not be zero.

7.2.6.4 Test result code

This assertion shall return a “Pass-006” code for passing the conformance testing or a “Fail-006” code for failing to pass the test.

7.2.7 Test Case #7: X Resolution of Finger Pattern Assertion

7.2.7.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.8.

7.2.7.2 Description of test purpose

This assertion checks if the two-byte location within the data record which corresponds to the field “Resolution of Finger Pattern in X Direction” has a valid content according to the statement quoted below.

7.2.7.3 Expected results

Type-A Level 1 testing: The value of this two-byte binary number should be grater than zero and less than 789.

7.2.7.4 Test result code

This assertion shall return a “Pass-007” code for passing the conformance testing or a “Fail-007” code for failing to pass the test.

7.2.8 Test Case #8: Y Resolution of Finger Pattern Assertion

7.2.8.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.9.

7.2.8.2 Description of test purpose

This assertion checks if the two-byte location within the data record which corresponds to the field “Resolution of Finger Pattern in Y Direction” has a valid content according to the statement quoted below.

7.2.8.3 Expected results

Type-A Level 1 testing: The value of this two-byte binary number should be grater than zero and less than 789.

7.2.8.4 Test result code

This assertion shall return a “Pass-008” code for passing the conformance testing or a “Fail-008” code for failing to pass the test.

7.2.9 Test Case #9: X Number of Cells Assertion

7.2.9.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.10.

7.2.9.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Number of Cells in X Direction” has a valid content according to the statement quoted below.

7.2.9.3 Expected results

Type-A Level 2 testing: The value of this one-byte binary number should be grater than one AND consistent with the value calculated by the following formula:

```
{X Number of Cells} = FLOOR(({X Size of Finger Pattern} - {X Cellular Offset}) / {X Number of Pixels in Cells})
```

7.2.9.4 Test result code

This assertion shall return a “Pass-009” code for passing the conformance testing or a “Fail-009” code for failing to pass the test.

7.2.10 Test Case #10: Y Number of Cells Assertion

7.2.10.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.11.

7.2.10.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Number of Cells in Y Direction” has a valid content according to the statement quoted below.

7.2.10.3 Expected results

Type-A Level 2 testing: The value of this one-byte binary number should be grater than one AND consistent with the value calculated by the following formula:

```
{Y Number of Cells} = FLOOR(({Y Size of Finger Pattern} - {Y Cellular Offset}) / {Y Number of Pixels in Cells})
```

7.2.10.4 Test result code

This assertion shall return a “Pass-010” code for passing the conformance testing or a “Fail-010” code for failing to pass the test.

7.2.11 Test Case #11: X Number of Pixels in Cells Assertion

7.2.11.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.12.

7.2.11.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Number of Pixels in Cells in X Direction” has a valid content according to the statement quoted below.

7.2.11.3 Expected results

Type-A Level 2 testing: The value of this one-byte binary number should be grater than one but less than `{X Size of Finger Pattern} - {X Cellular Offset}.`

7.2.11.4 Test result code

This assertion shall return a “Pass-011” code for passing the conformance testing or a “Fail-011” code for failing to pass the test.

7.2.12 Test Case #12: Y Number of Pixels in Cells Assertion

7.2.12.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.13.

7.2.12.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Number of Pixels in Cells in Y Direction” has a valid content according to the statement quoted below.

7.2.12.3 Expected results

Type-A Level 2 testing: The value of this one-byte binary number should be grater than one but less than {Y Size of Finger Pattern} - {Y Cellular Offset}.

7.2.12.4 Test result code

This assertion shall return a “Pass-012” code for passing the conformance testing or a “Fail-012” code for failing to pass the test.

7.2.13 Test Case #13: X Cellular Offset Assertion

7.2.13.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.14.

7.2.13.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Cellular X Offset” has a valid content according to the statement quoted below.

7.2.13.3 Expected results

Type-A Level 2 testing: The value of this one-byte binary number should be grater than zero but less than {X Size of Finger Pattern}.

7.2.13.4 Test result code

This assertion shall return a “Pass-013” code for passing the conformance testing or a “Fail-013” code for failing to pass the test.

7.2.14 Test Case #14: Y Cellular Offset Assertion

7.2.14.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.15.

7.2.14.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Cellular Y Offset” has a valid content according to the statement quoted below.

7.2.14.3 Expected results

Type-A Level 2 testing: The value of this one-byte binary number should be grater than zero but less than {Y Size of Finger Pattern}.

7.2.14.4 Test result code

This assertion shall return a “Pass-014” code for passing the conformance testing or a “Fail-014” code for failing to pass the test.

7.2.15 Test Case #15: Bit Depth of Cell Structure Angle Assertion

7.2.15.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.16.

7.2.15.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Bit Depth of Cell Structure Angle” has a valid content according to the statement quoted below.

7.2.15.3 Expected results

Type-A Level 1 testing: The value of this one-byte binary number should be grater than zero but less than nine.

7.2.15.4 Test result code

This assertion shall return a “Pass-015” code for passing the conformance testing or a “Fail-015” code for failing to pass the test.

7.2.16 Test Case #16: Bit Depth of Cell Structure Wavelength Assertion

7.2.16.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.17.

7.2.16.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Bit Depth of Cell Structure Wavelength” has a valid content according to the statement quoted below.

7.2.16.3 Expected results

Type-A Level 1 testing: The value of this one-byte binary number should be grater than zero but less than nine.

7.2.16.4 Test result code

This assertion shall return a “Pass-016” code for passing the conformance testing or a “Fail-016” code for failing to pass the test.

7.2.17 Test Case #17: Bit Depth of Cell Structure Phase Offset Assertion

7.2.17.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.18.

7.2.17.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Bit Depth of Cell Structure Phase Offset” has a valid content according to the statement quoted below.

7.2.17.3 Expected results

Type-A Level 1 testing: The value of this one-byte binary number should be grater than zero but less than nine.

7.2.17.4 Test result code

This assertion shall return a “Pass-018” code for passing the conformance testing or a “Fail-018” code for failing to pass the test.

7.2.18 Test Case #15: Bit Depth of Cell Structure Quality Assertion

7.2.18.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.19.

7.2.18.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Bit Depth of Cell Structure Quality” has a valid content according to the statement quoted below.

7.2.18.3 Expected results

Type-A Level 1 testing: The value of this one-byte binary number should be grater than zero but less than nine.

7.2.18.4 Test result code

This assertion shall return a “Pass-018” code for passing the conformance testing or a “Fail-018” code for failing to pass the test.

7.2.19 Test Case #19: Cell Quality Granularity Assertion

7.2.19.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.20.

7.2.19.2 Description of test purpose

This assertion checks if the one-byte location within the data record which corresponds to the field “Cell Quality Granularity” has a valid content according to the statement quoted below.

7.2.19.3 Expected results

Type-A Level 1 testing: The value of this one-byte binary number should be grater than zero but less than nine.

7.2.19.4 Test result code

This assertion shall return a “Pass-019” code for passing the conformance testing or a “Fail-019” code for failing to pass the test.

7.2.20 Test Case #20: Reserved Bytes Assertion

7.2.20.1 INCITS 381 target

This assertion concerns INCITS 377-2004, sub-clause 6.2.21.

7.2.20.2 Description of test purpose

This assertion checks if the two-byte location within the data record which corresponds to the field “Reserved Bytes” has a valid content according to the statement quoted below.

7.2.20.3 Expected results

Type-A Level 1 testing: The byte locations contain 0x0.

7.2.20.4 Test result code

This assertion shall return a “Pass-020” code for passing the conformance testing or a “Fail-020” for failing to pass the test.

7.3 Level 1 and Level 2 Testing of the Finger Pattern Record Header

7.3.1 Test Case #21: Finger Location Assertion

7.3.1.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.3.1.1

7.3.1.2 Description of test purpose

This assertion checks if the byte location within the Finger Pattern Record Header which corresponds to the field “Finger Location” has valid content according to the statement below.

7.3.1.3 Expected results

Type-A Level 1 testing: The content of this one byte location, interpreted as an unsigned integer value in big-endian order, should be between 0 and 10.

7.3.1.4 Test result code

This assertion shall return a “Pass-021” code for passing the conformance testing or a “Fail-021” code for failing to pass the test.

7.3.2 Test Case #22: Impression Type Assertion

7.3.2.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.3.1.2

7.3.2.2 Description of test purpose

This assertion checks if the byte location within the Finger Pattern Record Header which corresponds to the field “Impression Type” has valid content according to the statement below.

7.3.2.3 Expected results

Type-A Level 1 testing: The content of this one byte location, interpreted as an unsigned integer value in big-endian order, should have one of the following values: 0, 1, 2, 3, 8, 9.

7.3.2.4 Test result code

This assertion shall return a “Pass-022” code for passing the conformance testing or a “Fail-022” code for failing to pass the test.

7.3.3 Test Case #23: Number of Views in Finger Pattern Assertion

7.3.3.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.3.1.3

7.3.3.2 Description of test purpose

This assertion checks if the byte location within the Finger Pattern Record Header which corresponds to the field “Number of Views in Finger Pattern” has valid content according to the statement below.

7.3.3.3 Expected results

Type-A Level 1 testing: The content of this one byte location should not be zero.

7.3.3.4 Test result code

This assertion shall return a “Pass-023” code for passing the conformance testing or a “Fail-023” code for failing to pass the test.

7.3.4 Test Case #24: Finger Pattern Quality Assertion

7.3.4.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.3.1.4

7.3.4.2 Description of test purpose

This assertion checks if the byte location within the Finger Pattern Record Header which correspond to the field “Finger Pattern Quality” has valid content according to the statement below.

7.3.4.3 Expected results

Type-A Level 1 testing: The content of this one byte location, interpreted as a signed integer value in big-endian order, should have one of the following values: -2, -1 or be in the range 0 - 100.

7.3.4.4 Test result code

This assertion shall return a “Pass-024” code for passing the conformance testing or a “Fail-024” code for failing to pass the test.

7.3.5 Test Cases #25 and #25.1: Length of Data Block Assertion

7.3.5.1 INCITS 377 target

This assertion concerns INCITS 377-2004, sub-clause 6.3.1.5

7.3.5.2 Description of test purpose

This assertion checks if the two-byte location within the Finger Pattern Record Header which correspond to the field “Length of Data Block” has valid content according to the statement below.

7.3.5.3 Expected results[1]

Type-A Level 2 testing: If there is no extended data then {Length of Data Block} = “Bytes Expected” for every finger pattern in the BIR. If, however, there is extended data then some finger patterns may have extended data. Since the length of the extended data may vary from one pattern to the next within the same BIR, the only possible test is {Length of Data Block} GTE {Length of Data Block Bytes Expected}.

The following method of calculating {Length of Data Block Bytes Expected} assumes that the Finger Pattern Cell Data, Cell Quality Data and Finger Pattern Extended Data all begin at the start of a new byte, so there may be wasted bits within a byte at the end of each of these data sets. It also assumes that the cell quality groups are always square arrays of cells and that if there are insufficient pattern cells at the right edge or bottom edge of the pattern cell data to fit a complete cell quality group, then those cells don’t have any cell quality assigned to them. For example, if the image is divided into 9 by 11 cells and {Cell Quality Granularity} = 3, then there will be 3 by 3 = 9 cell structure quality values.

```
NUMCELLS = {X Number of Cells} * {Y Number of Cells}
```

PATTERNBYTES = CEILING (NUMCELLS * ({Bit-depth of Cell Structure Angle} + {Bit-depth of Cell Structure Wavelength} + {Bit-depth of Cell Structure Phase Offset}) / 8)

7.3.5.4 Test result code

This assertion shall return a “Pass-025” code for passing the conformance testing or a “Fail-025” or “Fail-025-1” code for failing to pass the test depending on the case.

Annex A – Notes (Informative)

There are no informative notes at this time.

[1] Editor’s Note: The test method in this clause needs to be further investigated and improved.