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Information Technology: Conformance Testing Methodology Standard for Biometric Data Interchange Format Standards - Part 2: Conformance Testing Methodology for INCITS 378-2007, Finger Minutiae Format for Data Interchange

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Introduction

The ANSI INCITS 378-2007 Finger Minutia Format for Data Interchange provides an industry standard to allow for fingerprint minutia extracted with one vendor's algorithm to be useful to another vendor's matching algorithm. This standard defines means of assuring whether a vendor's fingerprint minutia template generator conforms to the standard.

For the purposes of this standard, conformance will be tested as described in Part 1 of this multipart standard. There will be conformance testing for Level 1 (Data Format Conformance) and Level 2 (Internal Consistency Checking).

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

This part of the multi-part standard is intended to help guide the development of a test suite to expose where a given fingerprint minutia data record does not conform to the ANSI-INCITS 378-2007 fingerprint minutia interchange format.

This standard details test assertions that will allow a testing process to establish whether a given data record is conformant to the ANSI INCITS 378-2007 standard.

1 Scope

This part of the multi-part standard specifies the tests required to assure a vendor's application or service's conformance to the Minutia Interchange Format.

This standard details conformance testing requirements for conformance testing for Level 1 (Data Format Conformance) and Level 2 (Internal Consistency Checking). The standard does not address Level 3 or Level B Testing.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI/INCITS 378 -2007 – Information Technology - Finger Minutiae Format for Data Interchange

INCITS 423.1-2007 - Information Technology – Conformance Testing Methodology Standard for Biometric Data Interchange Format Standards – Part 1: Generalized Conformance Testing Methodology

3 Terms and Definitions

4 Symbols (and abbreviated terms)

5 Testable Data Format Elements

5.1 General

This clause contains a general overview of the features that should be tested, including the general record header, view record header, and extension length.

5.2 General Record Header

5.2.1 General Record Header Contents

This clause contains a general overview of the mandatory features to be tested, i.e. general record header, view record header, and extension length.

5.2.2 Format Identifier

The 1st 4 bytes shall be encoded as 0x46,0x4D,0x52,0x00

5.2.3 Version Number

The 2nd 4 bytes shall be encoded as 0x20,0x32,0x30,0x00

5.2.4 Length of Record

The length of entire record shall be encoded in big endian format in the next bytes. If the length is less than 65535, then the next 2 bytes shall have the length encoded. If the length is greater or equal to 65535, then the next 2 bytes shall be 0x00,0x00, followed by a 4 byte length encoded in Big Endian format.

5.2.5 CBEFF Product Identifier (PID)

The next 4 bytes shall contain the vendor's product ID (2 bytes) and product version (2 bytes) as the vendor has registered with the IBIA.

5.2.6 Capture Equipment Compliance

The 4 most significant bits of the next bytes shall be encoded as 1000 if the equipment that the fingerprint image was scanned from was Appendix F certified. Otherwise, the 4 most significant bits of the next byte shall be encoded as 0000.

5.2.7 Capture Equipment ID

The 12 least significant bits of the next 2 bytes should contain information provided by the unique equipment used to capture the fingerprint image. This may be encoded with any value between 0 and 0x3FF.

5.2.8 Size of Scanned Image in X Direction

The next 2 bytes shall provide the image width information. The image width shall not be 0. It shall correspond to the images used for extraction. For multiple views, the scanned image width shall be the maximum width of all the input images used to create the multiple minutia.

5.2.9 Size of Scanned Image in Y Direction

The next 2 bytes shall provide the image height information. The image height shall not be 0. It shall correspond to the images used for extraction. For multiple views, the scanned image height shall be the maximum height of all the input images used to create the multiple minutia.

5.2.10 X (Horizontal) Resolution

The next 2 bytes shall provide the image horizontal resolution information. The horizontal resolution shall not be 0. The resolution shall correspond to the images used for extraction.

5.2.11 Y (Vertical) Resolution

The next 2 bytes shall provide the image vertical resolution information. The vertical resolution shall not be 0. The resolution shall correspond to the images used for extraction.

5.2.12 Number of Finger Views

The number of views shall be encoded into the next byte. It shall correspond to the total number of distinct minutia sets contained in the total record.

5.2.13 Reserved Field

The final byte of the general record header shall be encoded with a 0.

5.3 View Record Header

5.3.1 View Record Header Contents

The view record header contains information for that finger view.

5.3.2 Finger Position

The next byte shall contain a code that describes the finger position. The value may be a number between 0 and 10, inclusive.

5.3.3 View Number

The next byte's 4 most significant bits shall contain the view number associated with the previous byte's position. The first view for a particular position shall be 0. There shall be no view for a given position with a duplicate view number. Subsequent views for the same position shall use increasing view numbers, with an increment of 1.

5.3.4 Impression Type

The byte's 4 least significant bits shall contain the impression type for the encoded fingerprint. It shall be one of the following numbers: 0,1,2,3,8, or 9. It shall correspond to the fingerprint information provided at extraction.

5.3.5 Finger Quality

The next byte shall encode the quality of the encoded fingerprint. It shall be the number 254 to indicate unsupported quality, or a number between 0 and 100 to correctly relate to the quality of the encoded fingerprint.

5.3.6 Number of Minutia

The next byte shall encode the number of minutia that are encoded in this particular view.

5.3.7 Minutia Data Encoding

5.3.7.1 Minutia X Position

The x coordinate in pixels of the minutia shall be encoded in the lower 14 bits of the first 2 bytes. This shall be a member of the set {0, 1, …, W-1}, where W is the image width encoded in the header.

5.3.7.2 Minutia Y Position

The y coordinate in pixels of the minutia shall be encoded in the lower 14 bits of the second 2 bytes. This shall be a member of the set {0, 1, …, H-1}, where H is the image height encoded in the header.

5.3.7.3 Minutia Angle

The next byte shall contain a number between 0 and 179.

5.3.7.4 Minutia Quality

The next byte shall contain a quality metric for the minutia. A zero shall be used to indicate undetermined quality, else the byte shall contain a number between 1 and 100.

5.3.7.5 Minutia Type

The most significant 2 bits of the first 2 bytes shall contain an encoding of the minutia type. This value shall be 0, 1, or 2.

5.4 Extended Data Encoding

5.4.1 Extension Length

The next two bytes shall contain the total extended length for this encoded fingerprint. For fingerprints that are not encoded with any proprietary or standard extensions, the 2 bytes shall be encoded with 0x00, 0x00.

5.4.2 Ridge Count Extension (Optional)

5.4.2.1 Ridge Count Extension Type

The next two bytes shall be encoded with 0x00, 0x01.

5.4.2.2 Ridge Count Extension Length

The next two bytes shall contain the length of the ridge count data, including the length of the type fields and length fields. Note that there is no encoding of the actual number of ridge counts – this must be calculated from the length field.

5.4.2.3 Ridge Count Extraction Method Encoding

The next byte shall be encoded with a 0 to denote a nonspecific form of extraction, a 1 to denote a 4 neighbor extraction method, and a 2 to denote an 8 neighbor extraction method.

5.4.2.4 Ridge Count Encoding

5.4.2.4.1 From

The next byte shall be encoded with a number to denote the minutia index that is being used as the “from” minutia. The indexes are based with the first index encoded as 1. It is possible for an encoding to exist that has the From, To, and Ridge Count fields all set to 0 if the extraction method is not equal to 0.

5.4.2.4.2 To

The next byte shall be encoded with a number to denote the minutia index that is being used as the “to” minutia. The indexes are based with the first index encoded as 1. It is possible for an encoding to exist that has the From, To, and Ridge Count fields all set to 0 if the extraction method is not equal to 0.

5.4.2.4.3 Ridge Count

The next byte shall be encoded with a number to denote the number of ridges crossed between the “from” minutia and the “to” minutia. It is possible for an encoding to exist that has the From, To, and Ridge Count fields all set to 0 if the extraction method is not equal to 0.

5.4.3 Core/Delta Encoding (Optional)

5.4.3.1 Core/Delta Extension Type

The next two bytes shall be encoded with 0x00, 0x02.

5.4.3.2 Core/Delta Extension Length

The next two bytes shall contain the length of the core delta data, including the length of the type fields and length fields.

5.4.3.3 Core Header

The first 2 bits shall be encoded with 00 to denote that no angles will be encoded, and with 01 to denote that an angle will be encoded.

The next 2 bits shall be set to 0.

The next 4 bits shall be encoded with the number of cores (0-15).

5.4.3.4 Core Encoding

5.4.3.4.1 Core X Position

The x coordinate in pixels of the core shall be encoded in the lower 14 bits of the first 2 bytes. This shall be a member of the set {0, 1, …, W-1}, where W is the image width encoded in the header.

5.4.3.4.2 Core Y Position

The y coordinate in pixels of the core shall be encoded in the lower 14 bits of the second 2 bytes. This shall be a member of the set {0, 1, …, H-1}, where H is the image height encoded in the header.

5.4.3.4.3 Core Angle

If the Core Header byte denotes that angles will be encoded, then the next byte shall contain a number between 0 and 179.

5.4.3.5 Delta Header

The first 2 bits shall be encoded with 00 to denote that no angles will be encoded, and with 01 to denote that an angle will be encoded.

The next 2 bits shall be set to 0.

The next 4 bits shall be encoded with the number of delta (0-15).

5.4.3.6 Delta Encoding

5.4.3.6.1 Delta X Position

The x coordinate in pixels of the delta shall be encoded in the lower 14 bits of the first 2 bytes. This shall be between 0 and the image width encoded in the header.

5.4.3.6.2 Delta Y Position

The y coordinate in pixels of the delta shall be encoded in the lower 14 bits of the second 2 bytes. This shall be between 0 and the image height encoded in the header.

5.4.3.6.3 Delta Angles

If the Delta Header byte denotes that angles will be encoded, then the next three bytes shall each contain a number between 0 and 179.

5.4.4 Vendor Specific Extended Data Encoding (Optional)

5.4.4.1 Vendor Specific Extension Type

The next two bytes shall be encoded such that the first byte is not equal to 0.

5.4.4.2 Vendor Specific Extension Length

The next two bytes shall contain the length of the proprietary extension data, including the length of the type fields and length fields.

6 Conformance

6.1 General

6.1.1 Implementation Under Test

6.1.1.1 Definition

Implementation under test (IUT) is an object that is being tested for conformity. For complete implementation of INCITS 378-2007 specifications, it should be a collection of data records containing information from one or more finger minutia, as well as a system or application that implements the INCITS 378-2007 specification according to its conformance clause:

A system conforms to this standard for producing data interchange records if it satisfies the mandatory requirements herein for extraction of minutiae from a fingerprint image as described in Section 5 and the generation of a data interchange record as described in Section 6. A system conforms to this standard for using data interchange records if it can parse a pair of data interchange records as described in Section 6 and compare them to determine the likelihood that they were generated from the same finger. A data record conforms to this standard if it satisfies the mandatory requirements for structure and content as described in Section 6.

6.1.1.2 Claimed Conformance

IUT claiming conformance to INCITS 378-2007 are expected to conform to all the applicable requirements in its conformity Clause 2, as well as other requirements set forth in the INCITS 378-2007 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.

As described in Part 1 of INCITS 423.1-2007, and for the purposes of this part of INCITS 423.1-2007, the IUT shall be tested for conformity specified in INCITS 378-2007 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, detailed in Clause 6.2.

6.1.1.3 Evaluation of Conformity

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 INCITS 378-2007 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 378-2007 Finger Minutia-based 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 378-2007 standard that included in the IUT. See **Error! Reference source not found.** and Annex A – Level 1 and 2 Assertions for INCITS 378-2007

6.1.2 Test Method

6.1.2.1 Testing Overview

For conformance testing to be meaningful, all implementations of the INCITS 378-2007 shall be tested in the same manner. Conformance testing reflects the essence of technical requirements of INCITS 378-2007 specifications and measures whether a biometric product faithfully implements the specification.

For the purpose of this part of INCITS 423.1-2007, conformance testing methodology consists of:

a) Preparation of the format as referenced in Clause 7 of INCITS 378-2007. 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 describe in this part of INCITS 423.1-2007.

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 Part 1 of INCITS 423.1-2007.

Considering the complexity of the INCITS 378-2007 specification, and many possible ways of generating the minutia format files, the testing methodology, as defined in this part of INCITS 423.1-2007, consists of the following steps:

1) For each finger minutia record, Level 1 conformance testing shall parse and verify the minutia data field by field and byte by byte conformance against the requirements of INCITS 378-2007 both in terms of fields included and ranges of the values in those fields.

2) For each finger minutia 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 minutia record; this flow shall be repeated for every finger minutia record in the data file.

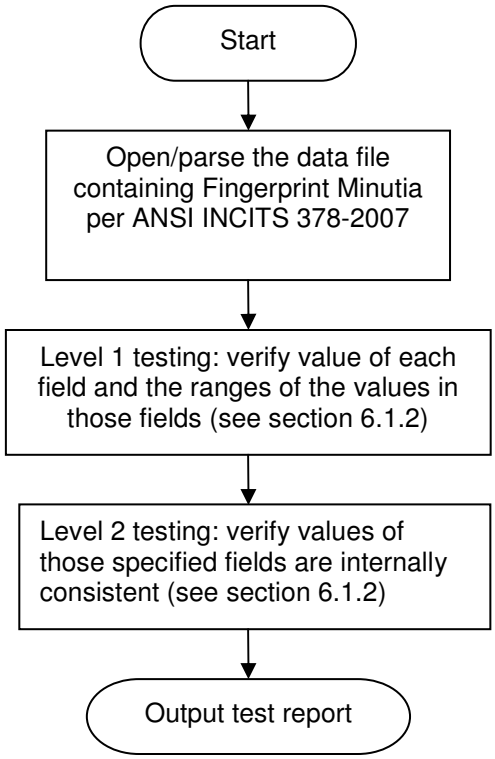

Figure 1. INCITS 378-2007 BDR File Format Level 1 and Level 2 Conformance Test Flow

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.

6.1.2.2 Test Method Implementation Requirements

A test method implementation shall document that it conforms to this part of INCITS 423.1-2007. Each test method implementation shall include the following:

a) a CTS conformant to INCITS 378-2007 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 part of INCITS 423.1-2007 as applicable. It shall use test result codes specified in this part of INCITS 423.1-2007 for test results defined by this part of INCITS 423.1-2007.

6.1.2.3 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 378-2007. 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 minutia 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 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.

6.2 Test Procedures

6.2.1 General

A software product can claim conformance to requirements as specified in INCITS 378-2007 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 minutia data records shall be verified by testing the conformance of a reasonable number of data records created by the product. Please refer to section 6.1 of part 1. The product shall be determined to be conformant to the requirements as specified in INCITS 378-2007 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 minutia 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 378-2007 file must be able to be fully parsed or partially parsed by the CTS. Failure to meet the INCITS 378-2007 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 Part 1 of INCITS Project 1749-D

6.2.2 INCITS 378-2007 Data File Level 1 and 2 Conformant Testing Procedure Flow Charts

The following Figure 2 shows the flow of INCITS 378-2007 Data File conformant testing procedure. In the flow, INCITS 378-2007 data records that claim Level 1 and 2 conformance to INCITS 378-2007 are delivered to the CTS. The CTS then performs the Level 1 and 2 testing.

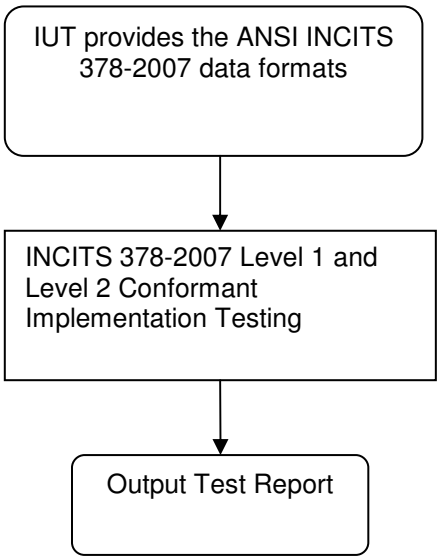

Figure 2. INCITS 378-2007 Data File Conformance Testing Procedure

6.3 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;

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

k) conformance testing results / test verdicts;

Annex A – Level 1 and 2 Assertions for INCITS 378-2007 (Normative)

The specific test assertions required for Level 1 and 2 conformance testing of INCITS 378-2007, Finger Minutiae Format for Data Interchange are listed in the Table below.

Test	Field	Operator	Operands	Conditional	References	Level
1	Format Identifier	EQ	0x464D5200 (Note 1)		6.4.1	1
2	Version	EQ	0x20323000 (Note 1)		6.4.2	1
3	Record Length	EQ	26 - 65535	YES	6.4.3	1
3.1	Record Length	GTE	65536	YES	6.4.3	1
3.2	Record Length	EQ	Total Bytes Read		6.4.3	2
3.3	Record Length	EQ	Total Bytes Expected (Note 2)	YES	6.4.3	2
4	CBEFF PID Owner	NEQ	0		6.4.4	1
5	CBEFF PID Type	NONE			6.4.4	
6	Capture Equipment Compliance	NONE			6.4.5	
7	Capture Equipment ID	NONE			6.4.6	
8	Image Size X	NONE			6.4.7	
9	Image Size Y	NONE			6.4.8	
10	Resolution X	NEQ	0		6.4.9	1
11	Resolution Y	NEQ	0		6.4.10	1
12	Number of Finger Views	EQ	0-176 (Note 3)		6.4.11, 6.5.1.2	1
12.1	Number of Finger Views	EQ	Views Read		6.4.11	2
13	Reserved	EQ	0		6.4.12	1
14	Finger Position	EQ	0 - 10		6.5.1.1	1
15	View Number	C	Next Finger View (Note 4)	YES	6.5.1.2	2
16	Impression Type	EQ	0 - 3, 8, 9		6.5.1.3	1
17	Finger Quality	EQ	0 – 100,254,255		6.5.1.4	1

18	Number of Minutiae	EQ	Minutiae Read		6.5.1.5, 6.5.2	2
19	Minutiae Type	EQ	0, 1, 2		6.5.2.1	1
20	Minutiae Position X	LTE	Image Size X		6.5.2.2	2
21	Minutiae Position Y	LTE	Image Size Y		6.5.2.2	2
22	Minutiae Position	C	(Note 5)			2
23	Minutiae Angle	EQ	0 - 179		6.5.2.3	1
24	Minutiae Quality	EQ	0 – 100		6.5.2.4	1
25	Extended Data Block Length	EQ	Bytes Read		6.6.1.1	2
25.1	Extended Data Block Length	EQ	Bytes Expected (Note 6)	YES	6.6.1.1	2
26	Type of Extended Data Area	EQ	0x0001 – 0x0002, 0x0100 – 0xFFFF		6.6.1.2[1]	1
27	Length of Extended Data Area	GTE	4		6.6.1.3	1
27.1	Length of Extended Data Area	EQ	Bytes Read	YES	6.6.1.3	2
28	Ridge Extraction Method	EQ	0 - 2		6.6.2.1	1
29	Minutiae Index 1	C	(Note 7)		6.6.2	2
30	Minutiae Index 2	C	(Note 8)		6.6.2	2
30.1	Minutiae Index 2	C	(Note 9)	YES	6.6.2	2
31	Ridge Count	EQ	0 (Note 10)	YES	6.6.2.1	1
32	Core Information Type	EQ	0, 1		6.6.3.1	1
33	Core Reserved	EQ	0		6.6.3.2	1
34	Number of Cores	EQ	Cores Read		6.6.3.2	2
35	Core Position X	LTE	Image Size X		6.6.3.3	2
36	Core Position Y	LTE	Image Size Y		6.6.3.3	2
37	Core Angle	EQ	0 - 179		6.6.3.4	1
38	Delta Information Type	EQ	0, 1		6.6.3.5	1

[1] For the purposes of this standard, text of Clause 6.6.1.2 of ANSI INCITS 378-2007 is used. Table 3 of ANSI INCITS 378-2007 is ignored pending amendment to ANSI INCITS 378-2007.

39	Number of Deltas	EQ	Deltas Read		6.6.3.6	2
40	Delta Position X	LTE	Image Size X		6.6.3.7	2
41	Delta Position Y	LTE	Image Size Y		6.6.3.7	2
42	Delta Angle 1	EQ	0 - 179		6.6.3.8	1
43	Delta Angle 2	EQ	0 - 179		6.6.3.8	1
44	Delta Angle 3	EQ	0 - 179		6.6.3.8	1

A.1 Test Notes

A.1.1 Note 1 (1,2) – {Format Identifier, Version}

If these tests fail, the result should be checked to see if the little Endian equivalence of the expected value matches, and if so, the conformance test report should indicate that there may be an issue with endianness.

A.1.2 Note 2 (3.3) – {Record Length} EQ {Total Bytes Expected}

The following calculation will be evaluated once the {Extended Data Block Length} field for the last finger view has been parsed successfully (not having reached an End-of-File marker prematurely). In the event that an End-of-File marker is reached prematurely this test will be marked as having failed, but no value of {Total Bytes Expected} will be produced.

The initial value of SUMBYTES below will correspond to the length of the BDIR header in bytes (26 or 30).

```
SUMBYTES = BDIR Header Length

FOR I = 1 TO {Number of Finger Views}

    SUMBYTES = SUMBYTES + 6 + ({Number of Minutiae} * 6)

    SUMBYTES = SUMBYTES + {Extended Data Block Length}

END


{Total Bytes Expected} = SUMBYTES
```

A.1.3 Note 3 (12) – {Number of Finger Views}

This test will pass if the value of {Number of Finger Views} is less than or equal to the sum of all possible finger positions (11) permitted by the standard multiplied by the maximum number of views per finger (16).

A.1.4 Note 4 (15) – {View Number}

As each finger view from the BDIR is read, a counter, {Next Finger View}, for the corresponding finger position (if valid) is incremented and compared to {View Number}. The test shall pass if {Next Finger View} is equal to {View Number}.

A.1.5 Note 5 (22) – {Minutiae Position}

Though not explicitly defined in the standard, all minutiae within a finger view should have unique X/Y coordinates to avoid potential interoperability issues. This test shall pass if the {Minutiae Position} is a unique pair of minutiae X/Y coordinates within the finger view.

A.1.6 Note 6 (25.1) – {Extended Data Block Length} EQ {Bytes Expected}

As the individual extended data areas are read, the {Length of Extended Data Area} parameter for each one will become known. The sum of these is {Bytes Expected} for the extended data block, in accordance with Section 6.6.1.1 of the base standard. The test shall pass if the length is zero for a record that has no extended data.

A.1.7 Note 7 (29) – {Minutiae Index 1}

If {Minutiae Index 1} corresponds with the first ridge count in a Four-neighbor or Eight-neighbor group, or if the {Ridge Extraction Method} is zero (0), the test shall pass if the index is between 1 and {Number of Minutiae}. Otherwise, the test shall pass only if the index is the same value as {Minutiae Index 1} of the first ridge count in the same Four-neighbor or Eight-neighbor group.

A.1.8 Note 8 (30) – {Minutiae Index 2}

If the {Ridge Extraction Method} is zero (0), the test shall pass if the index is between 1 and {Number of Minutiae}, and if the index is not equal to {Minutia Index 1}. If the {Ridge Extraction Method} is one (1) or two (2) then the test shall pass if the index is between 0 and {Number of Minutiae}.

A.1.9 Note 9 (30.1) – {Minutiae Index 2}

This test is only evaluated if {Minutiae Index 2} is not zero (0) and the {Ridge Extraction Method} is not zero (0). Each ridge count within the same Four-neighbor or Eight-neighbor group should refer to the same center minutiae, {Minutiae Index 1}, and a neighboring minutiae, {Minutiae Index 2}, from a different quadrant or octant. Thus, this test shall pass if {Minutiae Index 2} is unique within the same Four-neighbor or Eight-neighbor group.

A.1.10 Note 10 (31) – {Ridge Count2}

This test is only evaluated if {Minutiae Index 2} is zero (0) and {Ridge Extraction Method} is not zero (0). This test shall pass if {Ridge Count} is zero.