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

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Introduction

Recently INCITS M1 has developed a number of biometric data interchange format standards for different biometric modalities or technologies. Other standards for additional modalities or technologies are expected to be developed in the future. End users of biometrics systems desire to use these standards to ensure that components of the biometric system can be substituted with other components from different vendors with a minimum of effort, and also to ensure that biometric data created by one system can be understood by another system. In order to achieve this, it is critical that systems claiming conformance to the system actually are conformant, and thus there is a need for conformance testing methodology standards for each of the data interchange formats, in order to provide a reasonable degree of assurance that a conformance claim has validity. In fact, no test can be absolutely comprehensive and prove that a given system is conformant under all possible circumstances, especially when there are optional components of the standard. A well designed conformance test can, however, test all of the most likely sources of problems and ensure that the system under test conforms under a reasonable set of circumstances, giving assurance, but not a guarantee, of conformance.

There are many different types of conformance testing that may be appropriate for the various data interchange format standards. Some of them are highly specific to each data interchange format but some of them have many common elements across all of the formats. Therefore, it appears that a multi-part conformance testing standard will be useful. The first part, contained in this document, describes the different types of conformance testing. It then goes on to provide details of the common elements for defining test assertions for Level 1 and Level 2 testing, which have many similarities among all of the data interchange format standards. Finally, it provides guidelines for conducting the tests and reporting the results of the tests. The specific tests and assertions for each format are left to the subsequent parts, one for each data interchange format base standard.

1 Scope

This part of the multi-part standard on data interchange formats conformance testing specifies the concepts, test types and test methodologies for conformance testing of biometric systems claiming conformance to data interchange format standards produced by INCITS M1. It defines two types (A and B) and three levels (1, 2 and 3) of conformance testing, with a general description and methodology for each one. In the case of the first two levels, there are many common test elements, and so the assertion language for specifying Level 1 and Level 2 test assertions is defined in this standard.

This standard explicitly does not provide the detailed test elements and assertions or descriptions of any mandatory standard datasets required for testing. They are provided in the other parts of this standard, which each cover a specific data interchange format base standard. This standard also explicitly does not cover conformance testing for CBEFF data structures in which the data interchange format data records must be embedded, since this is not part of conformance testing of the data interchange formats themselves. Finally, the details of Type B testing are currently still a research area, and so in this version of the standard, Type B testing is out of scope.

2 Conformance

Data interchange format conformance tests that claim conformance to this standard ***shall*** satisfy the normative requirements of the methodology for those levels of test they are claiming to perform, as described in Section 5.

Additionally any Level 1 or Level 2 tests ***shall*** use the assertion types defined in Section 6 with the specific assertion details given in the relevant subsequent part of this standard.

3 Normative References

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

INCITS 377-2004, Finger Pattern Based Interchange Format

INCITS 378-2004, Finger Minutiae Format for Data Interchange

INCITS 379-2004, Iris Image Interchange Format

INCITS 381-2004, Finger Image-Based Data Interchange Format

INCITS 385-2004, Face Recognition Format for Data Interchange

INICTS 395-2005 Biometric Data Interchange Formats - Signature/Sign Data

INCITS 396-2005, Hand Geometry Interchange Format

4 Terms and Definitions

4.1 **Assertion -** The specification for testing a conformance requirement in an implementation under test in the forms defined in this standard.

4.2 **Base standard** - The standard containing the specification that is the subject of the conformance testing.

4.3 **Biometric Data Interchange Record (BDIR)** – A data package containing biometric data that claims to be in the form prescribed by a data interchange format base standard.

4.4 **Conformance** – Fulfillment by a product, process, or service of all relevant specified conformance requirements.

4.5 **Conformance testing** – Captures the technical description of a specification and measures whether an implementation faithfully implements the specification by achieving conformance to the technical description of the specification.

4.6 **Conformance testing laboratory** – Organization that carries out conformance testing. This may be the creator of the IUT, the user of the IUT, or an unbiased third party.

4.7 **Conformance Test Suite (CTS) -** Test software used to automate certain types of conformance testing.

4.8 **Implementation Under Test (IUT) -** That which implements the base standard(s) being tested. Depending on the conformance requirements of the base standard, this may simply be a set of data interchange records or it may be a computer algorithm in the form of a system under test that creates the BDIR and/or uses the data contained in the BDIR.

4.9 **Input Biometric Data Records (IBDR) –** A data package containing a less processed form of biometric data which is suitable for use in the creation of a BDIR. In some cases, this may be an image, but it may also be raw sensor output such as a time series of data points from a digitization tablet.

4.10 **Metadata Record** – A data record containing any specific parameters required by an IUT to transform an IBDR into a BDIR. Examples include the type of image (basic, full frontal, token frontal or other) and the level of compression for a face image BDIR, the presence of core, delta, or ridgecounts in the extended area for a finger minutiae BDIR, the size of each pattern in a finger pattern BDIR, etc.

4.11 **Reference data -** In conformance testing, reference data is any data used as a standard of evaluation for various attributes of conformance.

4.12 **Type A - Produce Conformant BDIR (Type A or PCB)** – A conformance claim by an IUT that it can create conformant BDIRs from appropriate IBDRs.

4.13 **Type B - Use Conformant BDIR (Type B or UCB)** – A conformance claim by an IUT that it can read conformant BDIRs, interpret them correctly, and perform its desired function upon them. Currently, it is not clear what the full scope of desired functions are nor how this should be tested.

5 Conformance Testing Levels

No conformance test can be complete or perfect. Ultimately, it is only possible to prove that an implementation under test is non-conformant. The goal of conformance testing is therefore to capture enough of the requirements of the base standard and test them under enough conditions, that any IUT that passes the conformance test is likely to be conformant. Two problems with base standards that may only become apparent during conformance testing are that some areas may be undefined (so that the specification of these areas is left to each vendor) or ill-defined (so that there is a contradiction between parts of the base standard or an easy misinterpretation caused by the wording of the base standard). The latter problem may be resolved by an amendment to the standard, but the former problem may be difficult to resolve. An obvious example is the use of proprietary extended data blocks within a data interchange format. There may be good reasons to allow such proprietary data, but very little conformance testing is possible while the data remains proprietary. Also, if the base standard includes a requirement to interpret the biometric interchange record or use it for biometric matching, then it is difficult to be sure of the effect of a proprietary data block produced by one IUT when another IUT is attempting to interpret it.

Generally, the goal of data interchange format conformance testing is to assure the end users of standards conformant biometric products that a BDIR produced by any conformant product can be interpreted and used correctly by any other conformant product. There are thus two types of fundamental conformance claims. **Type A** is the ability to **Produce** Conformant BDIRs (PCB) and **Type B** is the ability to **Use** Conformant BDIRs (UCB). Different IUTs may have different purposes for which they use a conformant BDIR, and thus Type B testing is more complex than Type A testing because it must account for all of these purposes. Type B testing is therefore a topic of ongoing research, and this standard is focused on Type A testing exclusively.

A first step towards the goal of demonstrating conformance is ensuring that all of the specified fields and data structures in the BDIR are correct and self-consistent. This does not validate the fidelity of the information contained in the BDIR, however, since that depends on the relationship between the original IBDR and the BDIR.

The conformance testing hierarchy presented in this standard has three levels. Generally they progress from least complex and expensive to test to most complex and expensive to test. They also progress from least useful in predicting the performance of real world systems using conformant products to most useful, although even Level 1 conformance testing represents a significant step towards that goal. The types of assertions for Level 1 and Level 2 testing for all published data interchange format base standards are fairly similar and so a list of assertion types with definitions is given in Section 6 of this part of

the multi-part standard. The details of all the Level 1 and Level 2 assertions for each data interchange format base standard are given in the appropriate subsequent parts of the multi-part standard. For the more complex Level 3 testing, where the actual fidelity of the information in the BDIR is compared to that in the IBDR, the subsequent parts of this multi-part standard will eventually define exactly what comparisons are required for conformance as well as the particular elements that must be provided in the metadata records for each of the base standards. For some standards, this is another area of ongoing research and thus the first version of many of the parts may be restricted to Type A Level 1 and Level 2 testing only. Each testing laboratory will thus have to decide which levels of testing they can support for which data interchange format standards. If there is a formal laboratory accreditation process, then a testing laboratory ***shall*** be accredited for the maximum level (from 1 to 3) of conformance testing it can perform, since there are different requirements for each level. It will then be up to application profiles or to individual users 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, the importance of matching performance, the implications of non-interoperability and the current state of the published versions of the various parts of this multi-part standard.

Since conformance may occur to different levels of testing for a given data interchange format base standard, a conformance testing lab ***shall*** be required to provide a conformance testing report that provides certain key information about the types of conformance testing used to declare a particular IUT conformant or non-conformant. The primary information in this report ***shall*** be whether or not the IUT was conformant at each level tested. Other specific information required to be declared at each level is included in the sections below.

Note that since CBEFF conformance testing is out of scope for this standard, it is generally assumed that the BDIRs have been removed from their CBEFF data structures prior to beginning the conformance test. In a real system, the individual data interchange format standards require that they be embedded in CBEFF data structures. Typically, the system will manage this, selecting a CBEFF patron format that is appropriate for the application in which the BDIRs are being used. Thus, the inserting the BDIR into or extracting it from a CBEFF patron format is not the responsibility of an IUT that is concerned with producing or using data interchange formats. If there is a particular patron format that is normally used by the IUT, then it will be up to the testing laboratory to work with the supplier of the IUT to determine how to extract BDIRs from or insert BDIRs into that format. If the IUT does not use CBEFF directly but relies on the system to deal with CBEFF data structures, then the IUT ***shall*** provide a means of passing the CBEFF Format Type either to or from the IUT, depending on whether it is being tested for UCB or PCB respectively. This may be as simple as the supplier of the IUT sending a written instruction to the testing laboratory that all BDIRs produced by this IUT would have a particular Format Type, or it may involve the IUT passing a parameter or using a specific CBEFF patron format that is not part of its normal function outside the test. The reason this is required is that several standards have different format types that determine whether or not certain optional data is present. Thus Format Type is an extra field that

shall always be present together with a BDIR when conformance testing using that BDIR occurs.

5.1 Level 1 – Data Format Conformance

In Level 1 testing, a set of BDIRs ***shall*** be checked for field by field and byte by byte conformance with the specification of the data interchange format base standard, both in terms of fields included and the ranges of the values in those fields. The specific assertions tested for each base standard ***shall*** be those described in the appropriate part of this multi-part standard.

The advantage of this testing is that it does not require an implementation under test to be a computer algorithm or a set of hardware and software. It can simply be a set of BDIRs. Then the proprietary hardware or software of the product being tested does not have to come into the possession of the testing lab, only biometric data interchange records created with that system.

The test laboratory ***shall*** declare in the conformance report whether the IUT was a set of BDIRs provided by the manufacturer of the IUT or an actual computer algorithm or combination of hardware and software that was used to produce BDIRs in the test lab. In either case, the total number of BDIRs tested and the total number of different IBDRs used to create the BDIRs ***shall*** be reported.

The test laboratory ***shall*** describe in the conformance report the structure of the BDIRs tested. Specifically, the presence or absence of optional fields and the value of variable fields such as number of views ***shall*** be listed. The total number of BDIRs tested and of IBDRs used to create those BDIRs ***shall*** be reported for each structural variant of the BDIR. Note that in some cases, multiple IBDRs (containing single views of the same or of different biometric characteristics) may have had to be combined to produce a single BDIR. The number of live biometric characteristics involved in generating each structural variant of the BDIRs (either through live capture and BDIR generation by an IUT or through the previous generation of an IBDR library) ***shall*** be reported. In this case, multiple presentations of a specific biometric characteristic (i.e. one face or one right hand or one left thumb) from the same person on different occasions only count as a single live biometric characteristic, but do count as multiple IBDRs. If the IUT is in the form of a set of BDIRs, then the supplier of the IUT will have to provide the information on the number of IBDRs and biometric characteristics to the testing laboratory.

All of the above is important because an IUT may have the capability to produce multiple BDIRs, depending on the requirements of the application in which it is used. Some of these BDIRs may be conformant and others may not, and so it is important to specify which types were tested and how many of each type. In an ideal world every possible combination of parameters for a particular data interchange format would be tested, but this is not realistic given the resources that would be required for such testing. By reporting the presence or absence of optional fields and the values for variable structural fields, it is possible for an end user of the base standard to determine if the particular variant of the base standard tested is appropriate for their needs. The end user may also

require conformance certification for a specific type of BDIR. An obvious example would be a two finger BDIR or two iris BDIR, since many applications require enrollment of more than one biometric characteristic in order to allow for a back-up if one of them becomes damaged or temporarily unusable. Some IUTs might be PCB or UCB conformant with a single view BDIR, or even with multiple views of a single finger or iris, but might fail conformance testing when the BDIR contains more than one finger or iris.

5.2 Level 2 – Internal Consistency Checking

In Level 2 testing, a set of BDIRs ***shall*** be checked to determine if they are internally consistent. The specific assertions tested for each base standard ***shall*** be those described in the appropriate part of this multi-part standard.

The nature of Level 2 testing is that it relates values from one part of the BDIR to values from other parts of the BDIR. This may be due to explicit requirements in the base standard, such as a requirement that the record length actually does indicate the number of bytes in the BDIR. It may also be implicit in the standard, such as determining that the coordinates of a particular feature (such as eye positions in a face image record or minutiae positions in a finger minutiae record) actually fall within the specified size of the image.

In some cases, test assertions for Level 2 and higher conformance testing will have to make specific assumptions about interpreting the base standard. In those cases, this standard and the other parts of this multi-part standard ***shall*** be considered normative in their interpretation of the base standard and any other interpretations ***shall*** be considered non-conformant to the base standard.

Once again the advantage of this testing is that it does not require an implementation under test to be a computer algorithm or a set of hardware and software. It can simply be a set of BDIRs. Then the proprietary hardware or software of the product being tested does not have to come into the possession of the testing lab, only biometric interchange records created with that system. The disadvantage is similar to Level 1, in that there are a limited number of BDIRs and it is quite possible that some of the internal consistency checks will never be tested because they are not relevant for the set of BDIRs in the IUT. The solution is to test a larger number of BDIRs that represent multiple different structural variants of the data interchange format under test. Of course it then becomes necessary to report on the structure of each BDIR variant in the conformance test.

The test laboratory ***shall*** declare in the conformance report whether the IUT was a set of BDIRs provided by the manufacturer of the IUT or an actual computer algorithm or combination of hardware and software that was used to produce BDIRs in the test lab. In either case, the test laboratory ***shall*** describe in the conformance report the structure of the BDIRs tested. Specifically, the presence or absence of optional fields and the value of variable fields such as number of views ***shall*** be listed. The total number of BDIRs tested and of IBDRs used to create those BDIRs ***shall*** be reported for each structural variant of

the BDIR. The number of live biometric characteristics involved in generating each structural variant of the BDIRs (either through live capture and BDIR generation by an IUT or through the previous generation of an IBDR library) ***shall*** be reported. If the IUT is in the form of a set of BDIRs, then the supplier of the IUT will have to provide the information on the number of IBDRs and biometric characteristics to the testing laboratory.

5.3 Level 3 – Content Checking

5.3.1 General Methodology

In Level 3 testing an IUT ***shall*** be a combination of computer hardware and/or software that is used in the testing laboratory. The basic structure of this test is that a set of IBDRs and corresponding Metadata Records ***shall*** be provided and the IUT ***shall*** produce a set of corresponding BDIRs. The information in the BDIRs ***shall*** then be compared to the information in the input IBDRs to determine if the IUT has faithfully reproduced that information subject to the constraints of the parameters in the metadata records.

There is potentially significant difficulty in assigning the correspondence between IBDRs with metadata records as input and BDIRs as output. The features that must be contained in the BDIR need to be identified either by a reference BDIR generation algorithm already known to be conformant acting upon the input IBDRs and metadata records or by a human investigator reviewing them in detail. The permissible tolerances between the expected information in the BDIRs and the actual information in the BDIRs produced by the IUT need to be defined for each data element. The databases of IBDRs and metadata records need to be made general enough that they cover a wide range of possible biometric characteristics and variations of the data interchange format. On the other hand, some IUTs may not support all the different types of possible parameter combinations. A minimum test is therefore required to declare Level 3 conformance, but additional test sets may be used to test the conformance of algorithms with enhanced capabilities. Thus, it is once again necessary to report the structural variants of the BDIRs generated in the testing, in this case defined by the metadata records in the input data set.

The test laboratory ***shall*** describe in the conformance report the structure of the BDIRs expected to be generated by the IUT, as defined by the metadata records in the test set. Specifically, the presence or absence of optional fields and the value of variable fields such as number of views ***shall*** be listed. The total number of BDIRs generated by the IUT for testing and of IBDRs used to create those BDIRs ***shall*** be reported for each structural variant of the BDIR. The number of live biometric characteristics involved in generating each structural variant of the BDIRs (based on the original generation of the IBDR library) ***shall*** be reported. It is important to note that a single IBDR would typically be used with many different metadata records to produce different BDIRs, in order to test conformance to different aspects of the standard. Sometimes these different BDIRs would be of the same structural variant and sometimes of different structural variants, depending on which parameters were changing in the metadata records.

The exact nature of some minimum set of BDIRs (or of corresponding IBDRs and metadata records) that must be used in testing Level 3 conformance in order to declare

the IUT minimally conformant to the relevant data interchange format base standard will eventually be defined in each of the subsequent parts of this multi-part standard.

5.3.2 Data Sets

Since there is a need to define specific minimum data sets, there is a need to ensure consistency among testing laboratories. The simplest way to do this is by sharing data sets among all testing laboratories. Certain data sets may be publicly available, and can be used by suppliers of IUTs who wish to make self declarations about conformance or who wish to better prepare their products for formal testing by a third party or certified laboratory. Other data sets should only be made available to registered third party testing laboratories who have agreed not to disclose the data to any entity other than another registered testing laboratory. This is because advance knowledge of the data sets (IBDRs, metadata records and either the reference BDIR generation algorithm, or the corresponding BDIRs) would allow the supplier of an IUT to preprogram their IUT so it produced the appropriate conformant BDIRs whenever it encountered one of the input data sets. Thus they could "game" the conformance test.

All testing laboratories ***shall*** perform Level 3 conformance testing based on one of two minimum data sets of IBDRs and metadata records. Other data sets may also be included, but the minimum requirements for Level 3 conformance testing ***shall*** be based on either data set serial number 01 or 02 (see below). Data set 01 of both IBDRs and metadata records ***shall*** be kept sequestered and only shared among registered third party conformance testing laboratories. No entity that has had access to a data set 01 introduced in a specific year may submit an IUT for third party conformance testing with that same data set 01. Data set 02 ***shall*** be made publicly available. Other data sets may be shared among testing laboratories or kept privately. The set of IBDRs may change over time to support new biometric acquisition technology, but a change to data sets 01 or 02 ***shall*** be introduced at the same time at all conformance testing laboratories. Each IBDR or metadata record used in Level 3 conformance testing ***shall*** be assigned a unique identifier following the convention described below and the testing laboratory ***shall*** declare exactly which data sets were used in any given Level 3 conformance test.

Ixxssyyyyzzzzzzzz or Mxxssyyyyzzzzzzzz

"I" indicates that this is an IBDR for conformance testing purposes.

"M" indicates that this is a metadata record for conformance testing purposes.

"xx" is a number indicating the part of this multipart standard with which the IBDR is to be used (e.g. 02 for finger minutiae, 05 for face image, etc.).

"ss" is the serial number of the IBDR set being used in the test. 01 is the universal sequestered data set and 02 is the universal public data set. Other numbers are for internal use by various testing laboratories or groups of testing laboratories.

“yyyy” is the four digit calendar year in which the IBDR data set “ss” was introduced. In the case of data set 01 and 02, these will need to be updated periodically as technology changes.

“zzzzzzzz” is an eight digit sequential number from 00000001 to 99999999 that uniquely identifies a specific IBDR or metadata record within a given set.

Note that it will not be necessary to change IBDR sets whenever a base standard is updated, since the data interchange format does not affect the IBDR. It is simply produced from the IBDR. The metadata records may need to be changed, however, since ranges of parameters available in the base standard may have changed.

6 Assertion Elements for Level 1 and 2 Testing

6.1 Introduction

Regardless of the specific data interchange format base standard in question, many of the elements of Level 1 and Level 2 testing will be the same. All of the tests are essentially dealing with mathematical operations performed on individual field values or lengths extracted from a BDIR. The only difference is that Level 1 tests involve a direct comparison between a field value and something stated in the base standard, whereas Level 2 tests involve interactions between multiple values from different parts of the standard and sometimes from implicit assumptions that are not expressly stated in the base standard. Thus Level 1 tests can be performed by a simple byte by byte reading of the standard and comparison to known values or ranges of values, whereas Level 2 tests require more complex validation, usually after the entire BDIR has been parsed.

In each case, a particular condition defined by a test assertion is checked and the BDIR is determined to have either passed or failed the test assertion depending on whether or not it satisfies the condition. If a BDIR passes all assertions for a given Level of conformance testing specified in the appropriate Annex of this standard, then the BDIR ***shall*** be declared conformant at that Level. If all BDIRs in the IUT (or produced by the IUT) are deemed to be conformant at a particular Level, then the testing laboratory ***shall*** report that the IUT was conformant at that Level. If even a single BDIR is not conformant, then the testing laboratory ***shall*** report that the IUT was not conformant at that level. A minimum of 100 BDIRs representing 25 IBDRs and 25 biometric characteristics ***shall*** be tested in order to declare conformance for either Level 1 or Level 2.

Note that the parsing of the BDIR is not within the scope of this standard, since each testing laboratory may have its own tools for parsing a BDIR either from a file on disk, an array in memory, etc. and these will be dependent on the hardware and operating systems selected by the testing laboratory as well as the nature of the IUT.

6.2 Assertion Element Descriptions

In order to document and express as many test assertions as possible for each data interchange format base standard using the same assertion vocabulary, this section provides a reference for the terms used. The assertions themselves are contained in the subsequent parts of this standard in Tabular Form.

6.2.1 Field Names

Every field within a set of test assertions for a particular data interchange format base standard ***shall*** be uniquely named in order to uniquely identify it when referencing fields within Level 2 assertions. This is particularly important when multiple fields within different parts of the base standard have the same name, and the relationship between the field names specified in the test assertion and the field names specified in the base standard are determined by the **References** in the tables in the subsequent parts of this multi-part standard.

6.2.2 Operators

The fundamental approach required to determine Level 1 or Level 2 conformance of a data interchange record is to compare the value of each field with a quantity or range of quantities which are known to be either valid or invalid according to explicit or implicit requirements of the data interchange format. These quantities may be determined in advance (e.g. Format Identifier), or calculated during the test from context dependant data within the BDIR (e.g. Length of Record). A list of specific operators is given below.

6.2.2.1 Equal (EQ)

Indicates the test ***shall*** pass if the field value matches a specified value or is within a specified range of values.

6.2.2.2 Not-Equal (NEQ)

Indicates the test ***shall*** pass if the field value does not match a specified value or is outside a specified range of values.

6.2.2.3 Greater Than or Equal (GTE)

Indicates the test ***shall*** pass if the field value is greater than or equal to the specified value.

6.2.2.4 Less Than or Equal (LTE)

Indicates the test ***shall*** pass if the field value is less than or equal to the specified value.

6.2.2.5 Greater Than (GT)

Indicates the test ***shall*** pass if the field value is greater than the specified value.

6.2.2.6 Less Than (LT)

Indicates the test ***shall*** pass if the field value is less than the specified value.

6.2.2.7 Incremental (INC)

Indicates the test ***shall*** pass if the field value is in sequence and within the specified range relative to the last instance of this field within the current data set. This includes ensuring

that the value of the first field instance is at the start of the specified range. (e.g. View Number)

6.2.2.8 Calculation (C)

Indicates the test ***shall*** pass if the field value meets a certain criteria that can not be simply expressed by one of the other operations. (e.g. unit conversion from $1/100^{th}$ mm to pixels) The algorithm required to perform the calculation is described in a note following the table.

6.2.3 Operands

All absolute operand values are expressed in decimal (e.g. 73) or hexadecimal (e.g. 0x49) notation. A range of values are expressed by listing the lower bound, followed by a hyphen, followed by the upper bound (e.g. 1 – 255). Where a test requires more than one operand, values and ranges are separated by a comma. A very simple mathematical calculation, involving a number and a **Field Name** or a pair of **Field Names** may be expressed directly as an operand (i.e. 1 – ({Y Size of Finger Pattern} – {Y Cellular Offset}) indicates a range from a minimum of 1 to a maximum of the size of the finger pattern in the y-direction minus the cellular offset in the y-direction).

6.2.3.1 {Field Name}

When referring to a value stored within a particular field, the tables use the **Field Name** surrounded by braces (e.g. {Number of Views}).

6.2.3.2 Read

Refers to the number of data subsets within the BDIR which contain the data associated with a particular group of related elements defined in the base standard. The Read operand is always given in conjunction with a descriptive name that explains which data subsets it refers to from the base standard. This value is recorded by the conformance testing software when reading the BDIR. The particular data subsets read are context dependent, but examples would include Finger Views Read and Minutiae Read.

6.2.3.3 Bytes Read

Refers to the number of bytes within a specific subset of the BDIR which contains the data associated with a particular group of related elements defined in the base standard. The Bytes Read operand is always used in conjunction with a field which refers to the byte length of a subset of data from the base standard. This value is recorded by the conformance testing software when reading the BDIR. The particular sets of Bytes Read are context dependent, but examples would include Extended Data Block Bytes Read and Extended Data Area Bytes Read.

6.2.3.4 Total Bytes Read

Refers to the total number of bytes within the BDIR, as recorded by the conformance testing software when reading the BDIR.

6.2.3.5 Bytes Expected

Refers to the total number of bytes expected (calculated from the appropriate fields) within a specific subset of the BDIR which contains the data associated with a particular group of related elements defined in the base standard. The Bytes Expected operand is always used in conjunction with a field which refers to the byte length of a subset of data from the base standard. The particular sets of Bytes Expected are context dependent, but examples would include Extended Data Block Bytes Expected and Extended Data Area Bytes Expected. The calculation required for computing the Bytes Expected will be provided in a note following the table.

6.2.3.6 Total Bytes Expected

Refers to the total number of bytes expected (calculated from the appropriate fields) within the BDIR

6.2.4 Other Assertion Elements

6.2.4.1 Conditional

Indicates that one or more special conditions must be met for the test to be evaluated. For example, a test may be dependent on the value of the externally supplied CBEFF Format Type.

6.2.4.2 References

Indicates the relevant part of the data interchange format base standard pertaining to this test. In some cases, an implicit test may not have a corresponding reference.