FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/IEC
FDIS
29109-1**

ISO/IEC JTC **1**

Secretariat: **ANSI**

Voting begins on:
2009-04-30

Voting terminates on:
2009-06-30

Information technology — Conformance testing methodology for biometric data interchange formats defined in ISO/IEC 19794 —

Part 1: Generalized conformance testing methodology

Technologies de l'information — Méthodologie d'essai de conformité pour les formats d'interéchange de données biométriques définis dans l'ISO/CEI 19794 —

Partie 1: Méthodologie d'essai de conformité généralisée

Please see the administrative notes on page iii

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Reference number
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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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ISO/IEC 29109-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

ISO/IEC 29109 consists of the following parts, under the general title *Information technology — Conformance testing methodology for biometric data interchange formats defined in ISO/IEC 19794*:

— *Part 1: Generalized conformance testing methodology*

— *Part 2: Finger minutiae data*

— *Part 4: Finger image data*

— *Part 10: Hand geometry silhouette data*

The following parts are under preparation:

— *Part 3: Finger pattern spectral data*

— *Part 5: Face image data*

— *Part 6: Iris image data*

— *Part 7: Signature/sign time series data*

— *Part 8: Finger pattern skeletal data*

— *Part 9: Vascular image data*

— *Part 11: Signature/sign processed dynamic data*

— *Part 13: Voice data*

— *Part 14: DNA data*

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Introduction

ISO/IEC 19794 is a multi-part International Standard developed by ISO/IEC JTC 1, SC 37 that specifies a biometric data interchange format for different biometric modalities or technologies. It is expected that future parts of ISO/IEC 19794 for additional modalities or technologies will be developed. End users of biometric systems desire to use ISO/IEC 19794 and other 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 produced by one system can be used by another system. In order to achieve this, it is critical that systems claimed to conform to a standard actually are conformant, and thus there is a need for conformance testing methodology standards for each of the biometric data interchange formats specified in ISO/IEC 19794, 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 implementation 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 parts of ISO/IEC 19794. Some of these tests 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, ISO/IEC 29109, will be useful. This part of ISO/IEC 29109 describes the different types of conformance testing. It then goes on to provide details of the common elements for defining test assertions. This part of ISO/IEC 29109 also provides guidelines for conducting the tests and reporting the results of the tests. The specific tests and assertions for each biometric data interchange format are left to the subsequent parts, one for each part of ISO/IEC 19794.

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Information technology — Conformance testing methodology for biometric data interchange formats defined in ISO/IEC 19794 —

Part 1: Generalized conformance testing methodology

1 Scope

This part of ISO/IEC 29109 specifies the concepts, test types and conformance testing methodologies to test biometric data interchange records, as specified in ISO/IEC 19794, or computer algorithms that create biometric data interchange records. This part of ISO/IEC 29109 defines two types (A and B) and three levels (1, 2 and 3) of conformance testing, but it only provides a detailed description and methodology for the three levels of Type A testing. 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 part of ISO/IEC 29109. ISO/IEC 29109 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).

This part of ISO/IEC 29109 explicitly does not cover the following areas:

— detailed test elements and assertions or descriptions of any mandatory standard datasets required for testing, which are provided in the other parts of ISO/IEC 29109, each of which specifies conformance testing for a specific base standard;

— testing whether implementations under test (IUTs) that claim to be able to use conformant biometric data interchange records can correctly process such biometric data interchange records (Type B testing).

2 Conformance

Biometric data interchange format conformance tests that claim conformance to this part of ISO/IEC 29109 shall satisfy the normative requirements of the methodology for those levels of test they are claiming to perform, as specified in Clauses 6, 7 and 8.

Additionally, any Level 1 or Level 2 tests shall use the assertion types defined in Clause 7 with the specific assertion details given in the relevant subsequent parts of ISO/IEC 29109.

Implementations of ISO/IEC 19794 tested according to the methodology specified in ISO/IEC 29109 may claim conformance only to those requirements specified in ISO/IEC 19794 that are tested by the test methods established by this methodology.

3 Normative references

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

ISO/IEC 19794-1:2006, *Information technology — Biometric data interchange formats — Part 1: Framework*

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4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19794-1 and the following apply.

4.1
assertion
specification for testing a conformance requirement in an implementation under test expressed in a formal assertion definition language

4.2
assertion test
specification of software or procedural methods that generate the test outcomes used for assessment of conformance to an assertion

NOTE Adapted from the definition of “assertion test” in ISO/IEC 13210:1999.

4.3
attestation
issue of a statement, based on a decision that fulfillment of specified requirements has been demonstrated

NOTE Adapted from the definition of “attestation” in ISO/IEC 17000:2004.

4.4
base standard
part of ISO/IEC 19794 containing the specification that is the subject of the conformance testing

4.5
biometric characteristic
biological and behavioural characteristic of an individual that can be detected and from which distinguishing, repeatable biometric features can be extracted for the purpose of automated recognition of individuals

4.6
biometric data interchange record
BDIR
data package containing biometric data that claims to be in the form prescribed by a base standard

NOTE If the BDIR is encapsulated in a Common Biometric Exchange File Format (CBEFF) record, then the BDIR is also a biometric data block (BDB), as defined in ISO/IEC 19785 (all parts), but this will not always be the case for data records defined in ISO/IEC 19794.

4.7
certification
third-party attestation related to products

[ISO/IEC 17000:2004]

4.8
conformance
fulfillment by a product, process, or service of all relevant specified conformance requirements

4.9
conformance requirement
requirement stated in a base standard and defined in a finite, measurable, and unambiguous manner

NOTE Adapted from the definition of “conformance requirement” in ISO/IEC 13210:1999.

4.10
conformance test
specified technical procedure of conformance testing

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4.11
conformance testing laboratory
organization that carries out conformance testing

NOTE This can be the creator of the IUT, the user of the IUT, or an unbiased third party.

4.12
conformance testing suite
test software used to automate certain types of conformance testing

4.13
conformity assessment
demonstration that specified requirements relating to a product, process, system, person or body are fulfilled

[ISO/IEC 17000:2004]

4.14
declaration
declaration of conformity
first-party attestation

[ISO/IEC 17000:2004]

4.15
implementation conformance statement
statement by the supplier of an implementation under test that indicates which mandatory and optional components of the base standard are supported by the implementation

4.16
implementation under test
IUT
that which implements the base standard being tested

NOTE Depending on the conformance requirements of the base standard, this can simply be a set of biometric data interchange records or it can be a computer algorithm in the form of an implementation under test that creates the BDIR and/or uses the data contained in the BDIR.

4.17
input biometric data record
IBDR
data package containing a less processed form of biometric data which is suitable for use in the creation of a BDIR

NOTE In some cases, this can be an image, but it can also be raw sensor output such as a time series of data points from a digitization tablet.

4.18
Level 1 testing
conformance testing methodology that checks field-by-field and byte-by-byte conformance with the specification of the BDIR as specified in the base standard, both in terms of fields included and the ranges of the values in those fields

NOTE This type of testing tests syntactic requirements of the base standard.

4.19
Level 2 testing
conformance testing methodology that tests the internal consistency of the BDIR under test, relating values from one part or field of the BDIR to values from other parts or fields of the BDIR

NOTE This type of testing tests syntactic requirements of the base standard.

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4.20
Level 3 testing
conformance testing methodology that tests that a BDIR produced by an IUT is a faithful representation of the IBDR subject to the constraints of the parameters in the metadata records

NOTE This type of testing tests semantic requirements of the base standard.

4.21
metadata record
data record containing any specific parameters required by an IUT to transform an IBDR into a BDIR

EXAMPLE 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.

4.22
procedure
specified way to carry out an activity or a process

[ISO 9000:2005]

4.23
requirement
provision that conveys criteria to be fulfilled

[ISO/IEC Guide 2:2004]

4.24
testing
conformance testing
determination of one or more characteristics of an object of conformity assessment, according to a procedure

[ISO/IEC 17000:2004]

4.25
testing standard
conformance testing standard
standard that is concerned with test methods, sometimes supplemented with other provisions related to testing, such as sampling, use of statistical methods, and sequence of tests

[ISO/IEC Guide 2:2004]

4.26
test method
specified technical procedure for performing a test

[ISO/IEC Guide 2:1996]

4.27
test method implementation
software, procedures, or other means used to measure conformance by means of testing

NOTE Adapted from the definition of “test method implementation” in ISO/IEC 13210:1999.

4.28
test method specification
document that expresses the required functionality and behavior of a base standard as assertions and specifies the complete set of conforming test results

NOTE Adapted from the definition of “test method specification” in ISO/IEC 13210:1999.

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4.29
test report
document that presents test results and other information relevant to the execution of the test methods against an implementation under test

NOTE Adapted from the definition of "test report" in ISO/IEC 13210:1999 and ISO/IEC Guide 2:1996.

4.30
Type A conformance claim
conformance claim that an implementation under test either consists of or is able to produce conformant biometric data interchange records from appropriate input biometric data records

4.31
Type B conformance claim
conformance claim that an implementation under test is able to read conformant biometric data interchange records, interpret them correctly, and perform its desired function upon them

5 Abbreviated terms

BDIR Biometric Data Interchange Record

CTS Conformance Testing Suite

ICS Implementation Conformance Statement

IUT Implementation Under Test

IBDR Input Biometric Data Record

PCB Produce Conformant BDIRs

UCB Use Conformant BDIRs

6 Conformance testing framework

6.1 Limitations

No conformance test can be complete or perfect. Ultimately, it is only possible to prove that an IUT 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 a base standard 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 BDIR. 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 BDIR or use it for biometric comparison, 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.

6.2 Managing data records

Note that since CBEFF conformance testing is out of scope for this standard, it is generally assumed that the BDIRs will have been removed from any CBEFF data structures prior to beginning the conformance test. Typically, for Type A testing as described in ISO/IEC 29109, either the IUT will provide BDIRs without a CBEFF encapsulator or the CTS will remove them from such an encapsulator if one exists. Regardless of the

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method used, the test shall provide a means of passing the CBEFF format type corresponding to the IBDRs in the IUT or produced by the IUT to the CTS. 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 special 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 parts of ISO/IEC 19794 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.

6.3 Conformance testing types

Generally, the goal of biometric data interchange format conformance testing is to assure the end users of 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 and Type B is the ability to use conformant BDIRs. 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. When biometric data interchange records themselves are tested in the absence of any software or hardware that produced them or uses them, this is treated as Type A testing.

6.4 Conformance testing levels

6.4.1 Hierarchy of Conformance Tests

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. This leads to a natural hierarchy of conformance testing levels.

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 less useful in predicting the performance of real world systems using conformant products, to more 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 parts of ISO/IEC 19794 are similar and so a list of assertion operators and operands that can be used to define assertions is given in Clause 7 of this part of ISO/IEC 29109. The details of all the Level 1 and Level 2 assertions for each base standard are given in the appropriate subsequent parts of ISO/IEC 29109. 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 ISO/IEC 29109 may provide, as far as it is possible, guidance on how to carry out Level 3 testing for their specific data interchange formats. A given conformance test may therefore involve conformance testing at different levels.

It will ultimately be up to application profiles or to individual end users of ISO/IEC 19794 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, importance of biometric performance, implications of non-interoperability and the current state of the published versions of the various parts of ISO/IEC 29109.

6.4.2 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 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 ISO/IEC 29109.

The advantage of this testing is that it does not require an IUT to be a computer algorithm or a set of hardware and software. It can simply be a set of BDIRs. Thus, any hardware or software components of the implementation being tested do not have to come into the possession of the testing lab, only BDIRs created with those components.

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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 biometric data interchange format would be tested, but this is not realistic given the resources that would be required for such testing. Provided a test reports 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 standard tested is appropriate for their needs. The end user may also require conformance test results 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 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.

6.4.3 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 ISO/IEC 29109.

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, ISO/IEC 29109 shall be considered normative in its 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 IUT to be a computer algorithm or a set of hardware and software. It can simply be a set of BDIRs. Then the hardware or software of the IUT does not have to be part of the test, only BDIRs created with that implementation. The disadvantage is 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 biometric data interchange format under test. This is why it is so vital to report on the structure of each BDIR variant in the conformance test.

Since Level 1 and Level 2 conformance testing are both required in order to properly test that the structure of a BDIR is conformant to a base standard, and since the execution of Level 1 and Level 2 tests will frequently be intermingled, a conformance test should always include all relevant Level 1 and Level 2 test assertions.

6.4.4 Level 3 — Content checking

Level 3 conformance testing is defined as a conformance testing methodology that tests that a BDIR produced by an IUT is a faithful representation of the IBDR subject to the constraints of the parameters in the metadata records. Effectively this is intended to test that the BDIRs produced by an IUT are faithful representations of the original biometric data and that they satisfy those requirements of the base standard that are not simply a matter of syntax and format. In some cases the requirements of the base standard may specify biometric data capture conditions. An example would be the use of a fingerprint sensor of a particular resolution or having a particular certification by an external body to capture fingerprints and generate fingerprint image records that are noted in the BDIR as having a particular image acquisition level. The only way to test that such a requirement has been correctly implemented by the IUT is to require that in Level 3 testing, an IUT shall be a combination of computer hardware and/or software that is used in the testing laboratory. If the IUT is software only, then a set of IBDRs and corresponding metadata records shall be provided and the IUT shall produce a set of corresponding BDIRs. This, however, only tests the ability of the IUT to parse the metadata records and the IBDRs and insert the appropriate information in correctly formatted BDIRs. For some requirements it is essential that the entire process from data capture to BDIR production be included in the test, and in those cases the IUT will have to be a complete set of hardware and software. Finally, there are some requirements that can not be quantitatively tested without significant special effort or extra equipment and for which the

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conformance testing standard may simply define that no Level 3 test is possible. An example would be the pose angles listed in a face image data record. Without an external three dimensional reference frame for the head containing the face that is represented in the data record, there is no absolute mechanism to verify that these pose angles are correct.

This leads to the following methodology for handling Level 3 conformance tests. As indicated in Clause 8 below, all of the requirements of the base standard shall be listed in a conformance requirements table that is in the same form as an implementation conformance statement. This will help the supplier of the IUT to clearly identify which requirements of the base standard are supported by the implementation. Certain columns in this table indicate whether each requirement is a Level 1, Level 2 or Level 3 requirement and for each Level 3 requirement, indicate whether it can be tested using a software only solution with a database of IBDRs and metadata records, whether it requires a complete hardware and software IUT, or whether it can't be tested at all without special effort. Where they are available, the specific test methodologies to be used for Level 3 testing involving IUTs composed of both hardware and software are found within specific clauses, as referenced in the table, in each of the subsequent parts of ISO/IEC 29109. A general methodology to test some Level 3 requirements using a software only solution and a database of IBDRs and metadata records is described in this part of ISO/IEC 29109, but even it will require specific clauses in the subsequent parts on how to use this methodology for specific requirements.

The basic structure of a software only Level 3 conformance 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 IBDRs to determine if the IUT has faithfully reproduced that information subject to the constraints of the parameters in the metadata records. Note that this form of testing is not possible for any IUT in which a correlation between a set of IBDRs and BDIRs cannot be established. A set of BDIRs, for instance, provided without any knowledge of the corresponding IBDRs, can be tested for Level 1 and Level 2 conformance but not for Level 3 conformance.

There is potentially significant difficulty in assigning the correspondence between IBDRs with metadata records as input and BDIRs as output. The features that shall be contained in the BDIR need to be identified either by a reference BDIR generation algorithm already known to be conformant acting upon the IBDRs and metadata records or by a human investigator reviewing them in detail. Such features could include, for instance, ground truth minutiae data such as position, angle and quality which have been generated by human inspection of the fingerprint images constituting the IBDRs for a specific Level 3 conformance test of ISO/IEC 19794-2 BDIRs. 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 biometric 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 essential to include in the test report all of the structural variants of the BDIRs generated in the testing, in this case defined by the metadata records in the input data set. It is also essential to explain the principles by which the reference BDIRs were generated and what tolerances were permitted when data elements were different between the BDIRs produced by the IUT and the BDIRs in the reference data set. This makes a test report for Level 3 conformance testing a significantly more detailed document than is required for Level 1 and 2 conformance testing.

The exact nature of some minimum set of BDIRs (or of corresponding IBDRs and metadata records) that shall be used in testing Level 3 conformance in order to declare the IUT minimally conformant to the relevant base standard is defined, where possible, in each of the subsequent parts of ISO/IEC 29109.

6.5 Sample data sets for Level 3 conformance testing

In order to support Level 3 conformance testing, it is necessary to define specific minimum data sets. Ideally, to ensure consistency among conformance tests key data sets should be common to all conformance tests. Although some data sets may be publicly available, there is also a benefit to having sequestered data sets that were not available to the supplier of the IUT prior to the start of the conformance test. 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

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produced the appropriate conformant BDIRs whenever it encountered one of the input data sets. This would invalidate the conformance test.

The details of Level 3 conformance testing using databases of IBDRs and metadata records, including which requirements of each base standard can be addressed using this method, are described in the subsequent parts of ISO/IEC 29109. At the time of development of this part of ISO/IEC 29109, appropriate data sets did not exist, but initial steps had been taken to develop them. As conformance testing for biometric data interchange formats becomes more common, contributions from different test laboratories should eventually result in acceptable data sets that can be referenced in the subsequent parts of ISO/IEC 29109. This part of ISO/IEC 29109 simply defines a universal nomenclature for the data sets so that references to data sets in the subsequent parts of ISO/IEC 29109 and by testing laboratories following this test methodology can be harmonized. Eventually a minimum data set for each of the subsequent parts should be developed that permits conformance testing of all Level 3 requirements that can be tested by a software only IUT. A subset of this data should be kept sequestered and provided only to testing laboratories who are not themselves suppliers of IUTs. The remainder of the data set should be made public. At that point, all Level 3 conformance tests should utilize one or both of these 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 should be based on either data set serial number 01 or 02. Data set 01 of both IBDRs and metadata records shall be kept sequestered so that no supplier of an IUT shall have access to it and data set 02 shall be made publicly available. Each IBDR or metadata record used in any data set for Level 3 conformance testing shall be assigned a unique identifier following the convention described below:

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 reserved for a universal sequestered data set that would be described, if it exists, in part “xx” of ISO/IEC 29109. “02” is reserved for a universal public data set that would be described, if it exists, in part “xx” of ISO/IEC 29109. Other numbers may be assigned as specific data sets are created for specific conformance tests.

“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 It will not be necessary to change IBDR sets whenever a base standard is updated, since the biometric 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.

7 Common assertion descriptors for Level 1 and 2 testing

7.1 General considerations

Regardless of the specific 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.

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7.2 Assertions for big-endian encoding

All parts of ISO/IEC 19794 specify that multi-byte values are to be recorded using big-endian encoding. Since there is no specific test assertion to check for big endian encoding of an entire data record, each part of ISO/IEC 29109 will select a few specific multi-byte fields from its corresponding base standard that can only have a single value. One test assertion for each field will test that it is equal to its correctly big-endian encoded value. Another test assertion for each field will test that it is not equal to the value it would have had if it had been incorrectly encoded using little-endian encoding. The tests for both of these assertions should pass for each field if the fields have been correctly big-endian encoded with the correct value. If a random incorrect value has been used, then the first test should fail but the second test should pass for each field where an incorrect value has been used. If the correct values have been used but with the incorrect little-endian encoding, however, then both tests should fail on all the fields for which this check is performed. This test shall be performed on at least two separate multi-byte fields in each BDIR in order to ensure that big-endian encoding has taken place. The specific fields to be used are noted in each subsequent part of ISO/IEC 29109 using the table and test notes described in Clause 8 below.

7.3 Assertion element descriptions

7.3.1 Purpose of common assertion descriptions

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

7.3.2 Field Names

Every field within a set of test assertions for a particular base standard shall be uniquely named in order to 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. The relationship between the field names specified in the test assertion and the field names specified in the base standard is explicitly identified in the tables in the subsequent parts of ISO/IEC 29109.

7.3.3 Operators

7.3.3.1 Introduction to operators

The fundamental approach required to determine Level 1 or Level 2 conformance of a BDIR is to compare the value of each field with a value or range of values which are known to be either valid or invalid according to explicit or implicit requirements of the base standard. These values 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.

7.3.3.2 Equal (EQ)

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

7.3.3.3 Not-Equal (NEQ)

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

7.3.3.4 Greater Than or Equal (GTE)

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

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7.3.3.5 Less Than or Equal (LTE)

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

7.3.3.6 Greater Than (GT)

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

7.3.3.7 Less Than (LT)

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

7.3.3.8 Incremental (INC)

Indicates the IUT shall pass the test 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)

7.3.3.9 Calculation (C)

Indicates the IUT shall pass the test 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 1/100th mm to pixels) The algorithm required to perform the calculation is described in a note following the table.

7.3.3.10 Member Of (MO)

Indicates the IUT shall pass the test if the field value is a member of the specified set.

7.3.4 Operands

7.3.4.1 Introduction to 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). A set of values is expressed by enumerating its members enclosed in braces. 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.

7.3.4.2 {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}).

7.3.4.3 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.

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7.3.4.4 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.

7.3.4.5 Total Bytes Read

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

7.3.4.6 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 is typically be provided in a note following the assertion table in each subsequent part of ISO/IEC 29109.

7.3.4.7 Total Bytes Expected

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

7.3.5 Other assertion elements

7.3.5.1 Reference in Base Standard

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

8 Conformance testing and reporting methodology

8.1 Conformance requirements and implementation conformance statement

8.1.1 Necessity of clear description of requirements and capabilities

In order for the supplier of an IUT to have confidence that the IUT is conformant to a particular base standard, a precise statement of the requirements of the base standard is necessary. Although the base standard itself specifies these requirements, the companion conformance testing standard should provide a simple summary of the requirements as a checklist for the supplier of the IUT. In order for the testing laboratory to evaluate the conformance of an IUT, it needs to have a clear statement of which requirements of the standard are mandatory and which are optional, as well as a clear methodology for testing them. The testing laboratory also needs a statement from the supplier of the IUT that lists which mandatory and optional components of the base standard are supported by the IUT. Such a statement is known as an implementation conformance statement or ICS. To simplify and harmonize the communication of the requirements of the base standard and of the ICS among all of the parts of ISO/IEC 29109, a pair of tables has been developed that contain fixed information in a specific form about the requirements. The first details the general requirements of the standard and indicates what level of conformance testing is applicable to each requirement. The second gives specific test assertions to be tested for Level 1 and Level 2 testing, references corresponding requirements in the first table that these assertions test, as well as outlines the structure of all the fields that must be present in a conformant BDIR. The tables also have space for the supplier of the IUT to provide information about the IUT and its support of the standard and for the testing laboratory to record the results of the test. Both of these

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tables and their accompanying notes, as described below, shall be included in each test report produced by a testing laboratory that follows the conformance testing methodology defined in this standard. The specific details of the fixed information in the two tables of requirements is defined for each part of ISO/IEC 19794 in the corresponding part of ISO/IEC 29109, but the examples shown below contain excerpts of these tables associated with ISO/IEC 19794-2:2005.

8.1.2 Claimed conformance and declared conformance

An IUT does not need to support all possible requirements of a base standard in order to be declared conformant. It shall be declared conformant at a particular level of conformance testing by a testing laboratory if the following three conditions are met:

1. The supplier of the IUT claims conformance to all mandatory requirements for one of the format types defined in the standard as specified in both the general requirements table and the BDIR structure table corresponding to that format type.

   NOTE Many parts of ISO/IEC 19794 define only a single format type, but a few of them define multiple format types within a single biometric data interchange format, and those parts will require a separate table in the style of Table 3 below for each distinct format type.

2. The IUT successfully passes all mandatory conformance tests at the level at which conformance is being declared (Level 1, Level 2 or Level 3) and at all lower levels.

3. The IUT successfully passes all optional conformance tests at the level at which conformance is being declared (Level 1, Level 2 or Level 3) and at all lower levels for those optional requirements of the base standard to which the supplier of the IUT has claimed conformance.

Since an IUT consists of a set of BDIRs or is used to produce a set of BDIRs, conditions 2 and 3 shall be satisfied for every BDIR in the data set before a declaration that the IUT is conformant is made. In order to provide sufficient information about the IUT for the testing laboratory to properly conduct a conformance test and for an appropriate declaration of conformance to be made, the supplier of the IUT shall provide the information in Table 1 and also complete the IUT Support and Supported Range columns in Tables 2 and 3. All three Tables and any IUT Support notes for Tables 2 and 3 shall be provided to the testing laboratory prior to or at the same time as the IUT is provided to the testing laboratory.

Table 1 — Identification of the Supplier and the IUT

Supplier name and address	
Contact point for queries about the ICS	
Implementation name	
Implementation version	
Any other information necessary for full identification of the implementation	
Are any mandatory requirements of the standard not fully supported (Yes or No)	
Date of statement	

8.1.3 Requirements of the base standard

The requirements of the base standard should be summarized in a single table where the supplier of the IUT can explain which optional components of the standard are supported and the testing laboratory can note the results of the test. All of the subsequent parts of ISO/IEC 29109 contain a table similar to Table 2 below which lists the requirements of the corresponding part of ISO/IEC 19794. The example in Table 2 contains a select few of the requirements for ISO/IEC 19794-2:2005 and provides unique requirement identifiers for conformance tests to reference, as shown in the companion example Table 3.

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Table 2 — Requirements of the Base Standard

Require-ment Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format/Format Type Applicability										IUT Support	Supported Range	Test Result
					1	2	3	4	5	6	7	8	9	10			
R-31	7.4.1.3	The impression type of the finger images that the minutiae data was derived from shall be recorded in four bits. The codes for this byte are shown in Table 3.	1	M	Y	Y	Y	Y	Y	Y	N	N	N	N			
R-32	7.4.1.4	The quality of the overall finger minutiae data shall be between 0 and 100 and recorded in one byte	1	M	Y	Y	N	N	N	N	N	N	N	N			
R-33	7.4.1.5	The number of minutiae recorded for the finger shall be recorded in one byte.	1	M	Y	Y	Y	Y	Y	Y	N	N	N	N			
R-34	7.4.2	The finger minutiae data for a single finger shall be recorded in blocks of six bytes per minutia	2	M	Y	Y	N	N	N	N	N	N	N	N			
R-35	7.4.2.1	The type of minutia will be recorded in the first two bits of the upper byte of the X coordinate. There will be two bits reserved at the beginning of the upper byte of the Y coordinate for future use. The bits “00” will represent a minutia of “other” type, “01” will represent a ridge ending and “10” will represent a ridge bifurcation.	1	M	Y	Y	Y	Y	N	N	Y	Y	N	N			
R-36	7.4.2.2	The X coordinate of the minutia shall be recorded in the rest of the first two bytes (fourteen bits).	1	M	Y	Y	Y	Y	N	N	Y	Y	N	N			
R-37	7.4.2.2	The Y coordinate shall be placed in the lower fourteen bits of the following two bytes	1	M	Y	Y	Y	Y	N	N	Y	Y	N	N			
R-38	7.4.2.2	The coordinates shall be expressed in pixels at the resolution indicated in the record header.	3C	O-1	Y	Y	Y	Y	N	N	Y	Y	N	N		N/A	N/A

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Status Notes:

These are the notes explaining why support for a particular requirement or group of requirements are mandatory or optional. Usually these would only be included for optional requirements. If all the requirements in an optional group must be used together, then there will be a single note for the group.

IUT Support Notes:

To be filled in by supplier of IUT on the copy of this table provided to the testing laboratory and to be included in the copy of this table that forms part of the test report.

Test Result Notes:

To be filled in by the testing laboratory if necessary during the execution of the conformance test and to be included in the copy of this table that forms part of the test report.

8.1.4 Explanations of columns in requirements table

Those columns of Table 2 to the left of the double line are fixed for a particular version of a particular part of ISO/IEC 29109. Those columns to the right of the double line are filled in separately for each test of an IUT either by the supplier of the IUT or by the testing laboratory. Explanations of the columns are given below.

- **Requirement Identifier** is a unique identifier for each requirement listed in the table that allows the requirements to be referenced by corresponding conformance tests (test assersions) thus establishing test/requirement traceability. The identifiers shall be in the form of R-n

- **Reference in Base Standard** is the clause reference in the base data interchange format standard that specifies the requirement on the current row of the table. This is exactly as defined in Clause 7.3.5.1 above.

- **Requirement Summary** is a simple text summary of the requirement. It may be a verbatim quote from the base standard or a synopsis of a more complex requirement. It carries the essentials of the requirement but may not provide all the text necessary to understand it. That text is to be found in the referenced portion of the base standard.

- **Level** indicates the level of conformance testing required to test for conformance to the requirement summarized on the current row of the table. Since many fields have syntactic requirements that can be tested with Level 1 or Level 2 conformance tests, but also semantic requirements that involve more complex Level 3 testing, it may be necessary to have multiple rows for those requirements. Each row in the table addresses one requirement at either conformance testing Level 1 and 2 or conformance testing Level 3. The permitted values are indicated in the list below:

  1 – Indicates that the requirement can be tested using Level 1 conformance testing. The required assertions from the Table of Level 1 and Level 2 test assertions are defined by the tests in that table referenced in the **Test Details** column.

  2 – Indicates that the requirement can be tested using Level 2 conformance testing. The required assertions from the Table of Level 1 and Level 2 test assertions are defined by the tests in that table referenced in the **Test Details** column.

  3A – Indicates that the requirement can be tested using Level 3 conformance testing using a software only IUT and a database of IBDRs and metadata records. The details on how to apply such databases to this test are found in the clause or clauses of the conformance testing standard containing this table that are referenced in the **Test Details** column.

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3B – Indicates that the requirement can be tested using Level 3 conformance testing using a hardware and software IUT that includes capture hardware or using special hardware provided by the testing laboratory. The details on the test procedure for using such hardware to test this requirement are found in the clause or clauses of the conformance testing standard containing this table that are referenced in the **Test Details** column.

3C – Indicates that conformance testing of this Level 3 conformance requirement is beyond the scope of the present version of the conformance testing standard containing the table. In this case the **Test Details** and **Test Result** columns will be marked N/A for not applicable.

- **Status** indicates whether the requirement is mandatory (M) or optional (O). If a dash and then a number follows the letter indicating mandatory or optional (e.g. M-1 or O-3) then the number refers to a numbered note in the **Status Notes** section that immediately follows the table. If a series of optional requirements must all be satisfied together or not at all (e.g. an extended data section consisting of multiple elements) then all the optional requirements should reference the same **Status Note**. In the case of Level 3C conformance requirements or for certain Level 3B conformance requirements that are difficult to test, these may have status listed as O-x, where x is the number of a **Status Note** that explains why this requirement which is mandatory in the base standard is considered too difficult to test and should therefore be treated as optional for purposes of a declaration of conformance.

- **Sub-format/Format Type Applicability** an optional set of columns applicable only to implementations of parts of ISO/IEC 19794 that allow for multiples format types or sub-formats. For these parts, the set of columns, one per format type, will indicate whether requirements are (Y) or are not (N) applicable for each format type. The supplier of the IUT shall provide a note indicating which applicable requirements are or are not supported (implemented) by the IUT for each format type the IUT claims conformance to.

- **IUT Support** is to be filled in by the supplier of the IUT. It should simply contain either a “Y” to indicate that a particular requirement is supported or an “N” to indicate that it is not. If any mandatory requirements for a particular conformance level are not supported then the IUT is not conformant to the base standard at that level. If the supplier wishes to provide a note providing more information about the support of a particular requirement then they should add a dash followed by a number (e.g. Y-2) where the number corresponds to one of the **IUT Support Notes** following the table.

- **Supported Range** is to be filled in by the supplier of the IUT. It indicates what range of values is supported when a particular requirement allows only a subset of values to be supported. When there is only a single value possible or the requirement does not involve a field that has specific requirements, then this column is pre-filled in with N/A, as shown in the example above in Table 2.

- **Test Result** is to be filled in by the testing laboratory once the test has been completed. The only possible results are “P” to indicate that the IUT passed all tests related to this requirement or “F” to indicate that it failed at least one test related to this requirement or “N/A” to indicate that the test was not applicable or “N/T” to indicate that the requirement was not tested. The test may not be applicable because it is beyond the scope of the conformance testing standard (Level 3C), or it is related to an optional requirement that was not supported by the IUT. The requirement may not be tested because the testing laboratory was unable or unwilling to perform the test. For purposes of making a declaration of conformance based on the results of a conformance test, a result of “N/A” or “N/T” for a mandatory requirement or for an optional requirement for which the supplier of the IUT has claimed conformance is equivalent to a result of “F”. The only exception is if the test has a status of “O” with a note which explains that the requirement is mandatory in the base standard but has been declared optional for purposes of a declaration of conformance because it is too difficult to test. In that case, if the IUT claims conformance to the requirement, a result of “N/T” should be considered equivalent to a result of “P”. If the testing laboratory wishes to include short notes about particular test results then they may append a dash followed by a number (e.g. F-2, N/A-4, N/T-6) where the number refers to one of the **Test Result Notes** following the table.

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8.1.5 Level 1 and Level 2 conformance assertions

All of the Level 1 and Level 2 conformance requirements identified in the tables above will need specific test assertions and a testing methodology to allow them to be formally tested. The Level 3 assertions may have test methodologies and detailed test assertions provided in specific clauses of each conformance testing standard, but since some Level 3 conformance requirements can not be tested with current technology, this is optional and will vary across the subsequent parts of ISO/IEC 29109. All parts of ISO/IEC 29109 do address all Level 1 and Level 2 assertions by providing a table per format type in the form shown below. The other purpose of the table is to show all of the mandatory and optional content of a conformant biometric data interchange record so that IUT suppliers and testing laboratories have a clear understanding of how a conformant BDIR should be encoded or decoded. Since some fields in the BDIR may not have explicit requirements about them in the base standard, they may appear in this table without having a corresponding entry in the general requirements table above. Also, since some fields may be unconstrained in the values they contain, except for Level 3 testing of what those values represent, they may not have any associated Level 1 or Level 2 conformance tests. These fields are still included in this table so that a complete listing of required fields for a conformant BDIR is present. The fields shall be listed in the order that they are required to appear in a conformant BDIR. The example in Table 3 contains a select few of the assertions for ISO/IEC 19794-2:2005 as originally published and prior to any corrigenda or amendments.

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Table 3 — Conformance Test Assertions

Test	Section	Requirement ID	Level	Field	Operator	Operands	Test Note	Status	IUT Support	Supported Range	Test Result
1.1	Record Header	R-12, R-14	1	Format Identifier	EQ	0x464D5200		M			
1.2	Record Header	R-14	1	Format Identifier	NEQ	0x00524D46	1	M			
2.1	Record Header	R-10, R-15	1	Version	EQ	0x20323000		M			
2.2	Record Header	R-15	1	Version	NEQ	0x00303220		M			
3	Record Header	R-16	1	Record Length	EQ	24 – 4294967295		M			
3.1	Record Header	R-16	2	Record Length	EQ	Total Bytes Read		M			
3.2	Record Header	R-16	2	Record Length	EQ	Total Bytes Expected	2	M			
……											
5	Record Header	R-18	3B	Capture Device Type ID	N/A	N/A		M-1			
…											
8	Record Header	R-21	1	Resolution X	GTE	98/1 000/100	3	M			
9	Record Header	R-22	1	Resolution Y	GTE	98/1 000/100	3	M			
10	Record Header	R-23	1	Number of Finger Views	EQ	0 – 176	4	M			
10.1	Record Header	R-24	2	Number of Finger Views	EQ	Finger View Read		M			

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Test Notes:

These are short notes that provide more detail about a specific conformance test assertion or requirement. They use a combination of explanatory text and pseudo code for complex calculations. The pseudo code uses commonly used mathematical notations, rather than the specific logical operators developed for the assertion language.

1. {Format Identifier} and {Version} Little-Endian

Test 1 checks to see if these multi-byte quantities have been encoded as the Little-Endian equivalent of the correct Big-Endian value. This test fails if that is true but pass in all other cases. By reviewing the combination of the results of Tests 1, 1.1, 2, it should be simple to determine whether or not the implementation under test is using the correct Big-Endian encoding.

2. {Record Length}

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 BIR header in bytes (24).

```
SUMBYTES = BIR Header Length

IF {CBEFF Type} EQ ‘0001’ THEN

        FOR I = 1 TO {Number of Finger Views}

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

        END

IF {CBEFF Type} EQ ‘0002’ THEN

        FOR I = 1 TO {Number of Finger Views}

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

           SUMBYTES = SUMBYTES + {Extended Data Block Length}

        END

IF {CBEFF Type} EQ ‘0003’ OR

IF {CBEFF Type} EQ ‘0004’ THEN

        FOR I = 1 TO {Number of Finger Views}

           SUMBYTES = SUMBYTES + 6 + ({Number of Minutiae} * 5)

        END

IF {CBEFF Type} EQ ‘0005’ OR

IF {CBEFF Type} EQ ‘0006’ THEN

        FOR I = 1 TO {Number of Finger Views}
```

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SUMBYTES = SUMBYTES + 6 + ({Number of Minutiae} * 3)

END

{Total Bytes Expected} = SUMBYTES

3. {CBEFF Type Resolution}

IF {CBEFF Type} EQ '0001' OR

IF {CBEFF Type} EQ '0002' THEN

{Resolution X} GTE 98

{Resolution Y} GTE 98

IF {CBEFF Type} EQ '0003' OR

IF {CBEFF Type} EQ '0004' THEN

{Resolution X} EQ 1000

{Resolution Y} EQ 1000

IF {CBEFF Type} EQ '0005' OR

IF {CBEFF Type} EQ '0006' THEN

{Resolution X} EQ 100

{Resolution Y} EQ 100

The card formats have fixed resolution, whereas the standard format has a minimum resolution requirement.

4. {Number of Finger View Consistency}

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).

Maximum {Number of Finger View} = 11 x 16 = 176.

Status Notes:

These are the notes explaining why support for a particular requirement or group of requirements are mandatory or optional. Usually these would only be included for optional requirements. If all the requirements in an optional group must be used together, then there will be a single note for the group.

1. The base standard states that reporting the Capture Device Type ID is optional but recommended. Since a value of all zeros indicates that Capture Device Type ID is unreported, the 12 bits containing this field are mandatory to be present in the record header.

IUT Support Notes:

To be filled in by supplier of IUT on the copy of this table provided to the testing laboratory and to be included in the copy of this table that forms part of the test report.

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Test Result Notes:

To be filled in by the testing laboratory if necessary during the execution of the conformance test and to be included in the copy of this table that forms part of the test report.

8.1.6 Explanations of columns in Level 1 and Level 2 assertions table

Those columns of Table 3 to the left of the double line are fixed for a particular version of a particular part of ISO/IEC 29109. Those columns to the right of the double line are filled in separately for each test of an IUT either by the supplier of the IUT or by the testing laboratory. Explanations of the columns are given below.

- **Test Number** is a numerical reference for a particular assertion in the table. These are used to reference individual tests in this table. If there are multiple test assertions associated with a single **Field Name** then they may be numbered as a principal assertion and sub-assertions as with **Test Numbers** 3, 3.1 and 3.2 in Table 3.

- **Section** is a reference to the section of the BDIR defined in the base standard that contains the field addressed by the current assertion. This is provided simply for clarity in understanding the structure of a conformant BDIR.

- **Requirement ID** is a reference to a requirement or requirements in the requirements table described in Clause 8.1.3. The purpose of this reference is to establish a backward traceability from each individual test assertion to requirement(s) this assertion is intended to test.

- **Level** indicates the level of conformance testing required to test for conformance to the requirement summarized on the current row of the table. Since Level 3 testing is not addressed by this table of assertions, any **Field Name** which has no requirements because its value is not specified in the standard or which can only be addressed through Level 3 conformance testing will simply have N/A marked in this column.

- **Field Name** is the name of the field from the BDIR defined in the base standard that is addressed in the current assertion, as specified in Clause 7.3.2 above.

- **Operator** is the operator from Clause 7.3.3 above that is used together with the **Field Name** and **Operand** to define a test assertion for the field addressed by the current row in the table.

- **Operand** is the operand from Clause 7.3.4 above that is used together with the **Field Name** and **Operator** to define a test assertion for the field addressed by the current row in the table.

  NOTE: For Level 3 assertions, where operators and operands may not apply, “N/A” should be entered to indicate this, with a corresponding test note to be used to describe the details of the testing method for such assertions.

- **Test Note** is a numerical reference to one of the **Test Notes** that follows the table. These are used when an assertion involves a complex calculation or when it requires further explanation than is provided by the simple test assertion in the table. The complex calculations can be expressed in a simple pseudo code as shown in the examples following Table 2, where the **Field Name** is surrounded in braces (e.g. {Number of Finger Views}) and standard mathematical and logical operators are used.

- **Status** indicates whether the requirement is mandatory (M) or optional (O). If a dash and then a number follows the letter indicating mandatory or optional (e.g. M-1 or O-3) then the number refers to a numbered note in the **Status Notes** section that follows the table. If a series of optional requirements must all be satisfied together or not at all (e.g. an extended data section consisting of multiple elements) then all the optional requirements should reference the same **Status Note**.

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- **IUT Support** is to be filled in by the supplier of the IUT. It should simply contain either a “Y” to indicate that a particular requirement is supported or an “N” to indicate that it is not. If any mandatory requirements for a particular conformance level are not supported then the IUT is not conformant to the base standard at that level. If the supplier wishes to provide a note providing more information about the support of a particular requirement then they should add a dash followed by a number (e.g. Y-2) where the number corresponds to one of the **IUT Support Notes** following the table.

- **Supported Range** is to be filled in by the supplier of the IUT. It indicates what range of values is supported when a particular requirement allows only a subset of values to be supported. When there is only a single value possible or the requirement does not involve a field that has specific range requirements, then this column is pre-filled in with N/A, as shown in the example above in Table 3.

- **Test Result** is to be filled in by the testing laboratory once the test has been completed. The only possible results are “P” to indicate that the IUT passed all tests related to this requirement or “F” to indicate that it failed at least one test related to this requirement or “N/A” to indicate that the test was not applicable or “N/T” to indicate that the requirement was not tested. The test may not be applicable because it is beyond the scope of the conformance testing standard (Level 3C), or it is related to an optional requirement that was not supported by the IUT. The requirement may not be tested because the testing laboratory was unable or unwilling to perform the test. For purposes of making a declaration of Level 1 and 2 conformance based on the results of a conformance test, a result of “N/A” or “N/T” for a mandatory requirement or for an optional requirement for which the supplier of the IUT has claimed conformance is equivalent to a result of “F”. If the testing laboratory wishes to include short notes about particular test results then they may append a dash followed by a number (e.g. F-2, N/A-4) where the number refers to one of the **Test Result Notes** following the table. A clear example of why this might be necessary is that the interaction between the IUT and the CTS caused the CTS to crash before all tests could be completed. In this case, many of the tests would be marked N/A with a reference to a **Test Result Note** that explained the situation.

8.2 Test procedures

8.2.1 Basic test workflow

For conformance testing to be meaningful, all IUTs must be tested in the same manner. The overall test framework outlined in Clause 6 can be combined with the specific versions of the tables shown in Clause 8.1 that are present in each subsequent part of ISO/IEC 29109. The result is sufficient information to conduct a complete conformance test, but in order to ensure that all conformance tests are performed in the same manner there are procedural steps that should be followed.

Any conformance test that follows this standard shall include the following steps:

a) Preparation of a set of biometric data interchange records which are not encapsulated in CBEFF wrappers. These may be provided to the testing laboratory by the supplier of the IUT or generated by the testing laboratory using the IUT. In the case of Level 3 conformance testing, some of these BDIRs may have to be generated in specific ways and under specific circumstances using appropriate hardware and software, as specified in the relevant clauses of the appropriate part of ISO/IEC 29109.

b) Inspection of the structure of each of the resulting BDIRs, including the size and value of each field in each BDIR.

c) Validation that the structure and values of the fields in each BDIR satisfy all of the Level 1 and Level 2 conformance assertions listed in the appropriate part of ISO/IEC 29109.

d) Validation of the Level 3 conformance assertions, where possible, using the methods described in the appropriate part of ISO/IEC 29109.

Considering the complexity of some of the BDIRs defined by the various parts of ISO/IEC 19794 and the different ways in which they can be generated, the precise workflow for steps 2 and 3 above can be expressed very simply. Each BDIR in the data set shall be inspected and tested for all Level 1 and Level 2 conformance assertions separately. The process for testing a single BDIR shall follow the chart given in Figure 1.

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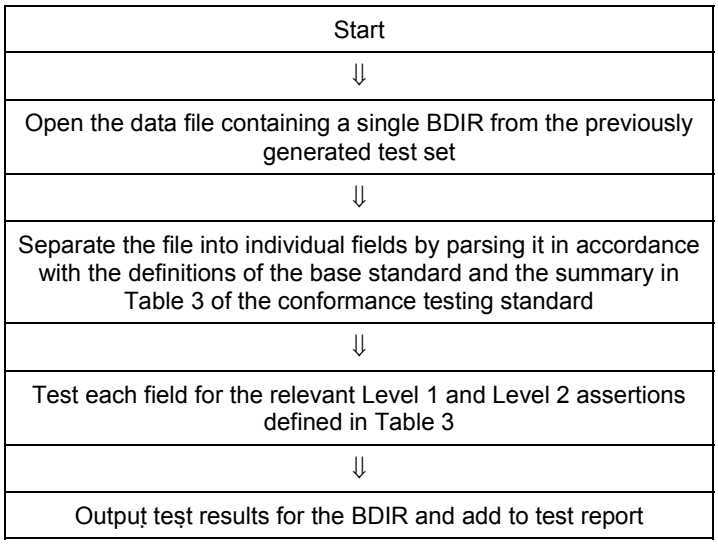


Figure 1 — Workflow for Level 1 and Level 2 Conformance Testing of a Single BDIR

The conformance test report shall contain enough information to ensure that a complete record of the test is made. Any repetition of a conformance test on the same IUT should produce identical results and it is therefore important that the test results output for each BDIR shall include any exceptions, errors or other unexpected results. It may be necessary to later review the observed test outcomes in order to make sure that all procedures have been correctly followed and a detailed test log that includes all relevant events is therefore important.

8.2.2 Minimum number of BDIRs and IBDRs required

If an IUT consists of a set of BDIRs then the number of BDIRs and of corresponding IBDRs is defined by the IUT. Even a single BDIR can be tested for conformance. When Level 1 and Level 2 conformance testing of an IUT that produces BDIRs takes place, however, the data set of BDIRs should contain a minimum number of BDIRs representing a minimum number of IBDRs and of live biometric characteristics (e.g. fingerprints, faces, DNA samples, etc.) in order to ensure that the natural variability in the production of BDIRs caused by the natural variability in biometric characteristics has been accounted for in the conformance test. Since the conformance test methodology described above requires that all BDIRs be tested sequentially, a declaration an IUT is conformant shall only take place if every BDIR in the set is individually conformant. For the purposes of Level 1 and Level 2 testing, a minimum of 100 BDIRs representing a minimum of 100 IBDRs derived from a minimum of 25 biometric characteristics shall be tested. 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. This minimum requirement applies to each different variant of the standard that is tested, so that if an IUT supports several different mutually exclusive optional components of the standard, then conformance to each different option shall be tested using a separate data set of at least 100 BDIRs.

Level 3 conformance testing may also require specific data sets of IBDRs, metadata records and BDIRs, as described in Clause 6.5 or may involve the creation of special sets of BDIRs using a hardware and software solution in accordance with the detailed requirements of the subsequent parts of ISO/IEC 29109. In these cases, any special data set for testing a particular aspect of Level 3 conformance testing shall also meet the minimum requirements. It is possible, however, that individual data sets could be used for multiple purposes, eliminating the need to create a new data set to test each Level 3 conformance requirement.

For each data set used in a particular conformance test, the test report shall contain Table 4.

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Table 4 — Test Data Description

Name or other designator of the BDIR data set	*Any designator can be used to aid in referencing this data set*
Name and year of the base standard for which conformance is being tested	
Total number of BDIRs in the data set	
Names of any IBDR and Metadata Record Data Sets used to produce this data set	*Provide names of IBDR or Metadata sets using the formats Ixxssyyyy or Mxxssyyyy as defined in Clause 6.5 or use "N/A"*
Total number of different IBDRs used to create the BDIRs in the data set	
Total number of input biometric characteristics involved in generating the BDIRs	
Was this data set provided as an IUT by the supplier of the IUT or generated using an IUT by the testing laboratory?	*Fill in "Provided" or "Generated"*
Do any of the BDIRs in this data set contain proprietary extended data?	*Fill in "Yes" or "No"*

8.3 Test reports

8.3.1 Purpose of the test report

Since conformance testing may occur at different levels and since different variants of the standard may be tested for a given base standard, any conformance test shall be required to provide a conformance testing report that provides key information about the types of conformance testing used to declare a particular IUT conformant or non-conformant. The goal is that sufficient information shall be provided to document all aspects of the test procedure, the test results and the mechanisms used to evaluate each test assertion or conformance requirement so that a future test on the same IUT would produce identical results and an identical declaration of conformance or non-conformance. For instance, it is possible to evaluate Level 1 and Level 2 conformance assertions manually using a hexadecimal file viewer and performing manual calculations, but it is much more likely that this would be done using an automated conformance test suite. In the former case, the name of the file viewer software used and the measures taken to ensure that no errors were made in calculation would be recorded in the test procedure. In the latter case, the name of the CTS and documentation of its function would be included in the test report. A summary of the test report is that it shall describe the IUT that was tested, the conditions and procedures of the test, the results of the test and the overall declaration of conformance or non-conformance.

8.3.2 Minimum content of the test report

The key elements of the test report are Tables 1, 2, 3 and as many copies of Table 4 as are required to cover all the data sets used in the conformance test. If the test is to be published and the supplier of the IUT wishes to remain anonymous, then the identifying information in Table 1 can be replaced with anonymized information such as alphanumeric codes that the testing laboratory can relate to the true information but which are meaningless to outside parties. Other than this single exception, all information in all tables shall be provided. These tables, with their accompanying notes, provide the essential information in the test report. For Level 3 tests, however, there is more variability in the procedures to be followed and so a detailed explanation of the methodology followed, using the instructions for each specific Level 3 test in the subsequent parts of ISO/IEC 29109 as a guide, shall be provided. A description of the contents of the BDIRs in each data set used for Level 3 conformance testing shall also be included in the test report. It is further mandatory to explain the principles by which any reference BDIRs were generated for comparison with those from the IUT and to explicitly state what tolerances were permitted when data elements were different between the BDIRs produced by the IUT and the BDIRs in the reference data set and how the two were compared. This makes a

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test report that includes Level 3 conformance testing a more detailed document than is required for Level 1 and 2 conformance testing.

The detailed test logs that are produced during the conformance test may be included in the test report, but are not mandatory as they may be very lengthy. If any exceptions or errors occurred during any of the conformance tests, however, these shall be included as **Test Result Notes** following the appropriate table.

In addition to all of this, the test report shall include the following minimum information:

- Name of the test laboratory performing the test
- Contact information for a person at the test laboratory with responsibility for the test
- Date of initialization of the test
- Date of completion of the test
- The total number of BDIRs tested in all data sets used in the test
- An overall declaration of conformance or non-conformance of the IUT

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