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Information technology — Biometric data interchange formats —

Part 4: Finger image data

AMENDMENT 1: Conformance testing methodology and clarification of defects

Technologies de l'information — Formats d'échange de données biométriques —

Partie 4: Données d'image du doigt

AMENDEMENT 1: Méthodologie d'essai de conformité et précisions concernant les défauts

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to ISO/IEC 19794-4:2011 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

Information technology — Biometric data interchange formats —

Part 4:
Finger image data

AMENDMENT 1: Conformance testing methodology and clarification of defects

1. *The following text is to be added to the "Introduction" clause of ISO/IEC 19794-4:*

   Annex A addresses conformance testing to this part of ISO/IEC 19794. Annex A is distinct from ISO/IEC 29109-4, which addresses conformance testing to ISO/IEC 19794-4:2005.

2. *The following text is to be added to the "Scope" clause of ISO/IEC 19794-4:*

   This part of ISO/IEC 19794 also specifies elements of conformance testing methodology, test assertions, and test procedures as applicable to this part of ISO/IEC 19794. It establishes test assertions pertaining to the structure of the finger image data format (Type A Level 1 as defined in ISO/IEC 19794-1:2011 AMD 1), test assertions pertaining to internal consistency of the types of values that may be contained within each field (Type A Level 2 as defined in ISO/IEC 19794-1:2011 AMD 1), and semantic test assertions (Type A Level 3 as defined in ISO/IEC 19794-1:2011 AMD 1).

   The conformance testing methodology specified in this part of ISO/IEC 19794 does not establish:

   — tests of other characteristics of biometric products or other types of testing of biometric products (e.g. acceptance, performance, robustness, security),

   — tests of conformance of systems that do not produce data records conforming to the requirements of this part of ISO/IEC 19794.

3. *The following text is to be added to the "Conformance" clause of ISO/IEC 19794-4:*

   Biometric data interchange format conformance tests conform to this part of ISO/IEC 19794 if they satisfy all of the normative requirements set forth in clause 8. Specifically, they shall use the test methodology specified in Clauses A.1, A.2 and A.3 of ISO/IEC 19794-1:2011 AMD 1, and all Level 1, Level 2 and Level 3 tests shall use the assertions defined in Table A.2 of Clause A.3 of this part of ISO/IEC 19794 in conformity with the concept and rules set in 19794-1 Annex A[1].

   Implementations of this part of ISO/IEC 19794 tested according to the specified methodology shall be able to claim conformance only to those biometric data record (BDB) requirements specified in this part of ISO/IEC 19794 that are tested by the test methods established by this methodology.

   Implementations of this part of ISO/IEC 19794 do not necessarily need to conform to all possible aspects of this part of ISO/IEC 19794, but only to those requirements that are claimed to be supported by the

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1 Annex A is specified in ISO/IEC 19794-1:2011 Amendment 1.

implementation in an implementation conformance statement (ICS), filled out in accordance with Clause A.3 of ISO/IEC 19794-1:2011 AMD 1 and Table A.2 of Clause A.3 of this part of ISO/IEC 19794.

4. *In clause 8.3.1 of ISO/IEC 19794-4:2011, Table 2, row "Image compression algorithm", Replace "0 to 5" with "0 to 6".*

5. *Replace Annex A of ISO/IEC 19794-4:2011 with the following one:*

Annex A
(normative)

Conformance testing methodology

A.1 Introduction

This normative annex specifies elements of conformance testing methodology, test assertions, and test procedures as applicable to this part of biometric data interchange format standard. Specifically, it establishes

— test assertions of the structure of the finger image data format as specified in this Part of ISO/IEC 19794 (Type A Level 1 as defined in ISO/IEC 19794-1:2011 AMD 1),

— test asssertions of internal consistency by checking the types of values that maybe contained within each field (Type A Level 2 as defined in ISO/IEC 19794-1:2011 AMD 1),

— tests of semantic assertions (Type A Level 3 as defined in ISO/IEC 19794-1:2011 AMD 1).

This normative annex does not establish

— test assertions on other characteristics of biometric products (e.g. acceptance, performance, robustness, security),

— conformance test assertions on systems that do not produce finger image record as specified in this part of ISO/IEC 19794.

The conformance testing methodology specified in ISO/IEC 19794-1: 2011 AMD 1 shall apply. The content of the tables below is based on ISO/IEC 19794-1:2011, AMD 1 and shall only be used in the context of that conformance testing methodology.

A.2 Table of requirements

The normative requirements specified in this Part of ISO/IEC 19794 are listed in Table A.1. The supplier of the IUT should explain which optional components of the standard are supported and the testing laboratory shall note the results of the test.

Table A.1 — Data format requirements specified in this Part of ISO/IEC 19794

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
Finger image general header							
R-1.	8.1	Each record shall pertain to a single subject.	3C	O-1		N/A	N/A
R-2.	8.1	Each record shall contain at least one representation for each of one or more fingers, multiple fingers (single image records), or palms.	3C	O-1		N/A	N/A
R-3.	8.2.1	Information shall be included for each field within the header.	1	M			
R-4.	8.2.2 Table 1	The format identifier shall be recorded in four bytes.	1	M			

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
R-5.	8.2.2 Table 1	The format identifier shall consist of three characters "FIR" (0x464952) followed by a zero byte as a NULL string terminator. Therefore, the format identifier shall be 0x46495200.	1	M		N/A	
R-6.	8.2.3 Table 1	The Version Number shall be recorded in four bytes.	1	M		N/A	
R-7.	8.2.3 Table 1	This version number shall consist of three ASCII numerals “020” (0x30323000) followed by zero byte as a NULL string terminator.	1	M		N/A	
R-8.	8.2.4 Table 1	The length (in bytes) of the entire image data record shall be recorded in four bytes. Valid values are 57 to (2^{32} -1)	2	M			
R-9.	8.2.4	This length of entire record shall be total length of the general record header and one or more representation records.	2	M			
R-10.	8.2.5 Table 1	The total number of finger image representations contained in the finger image data record shall be recorded in two bytes. Valid values are 1 to 672.	1,2	M			
R-11.	8.2.5	A minimum of one representation is required.	1	M			
R-12.	8.2.6 Table 1	The one-byte certification flag shall indicate whether each representation header includes a certification record. Valid values are 00_{Hex} and 01_{Hex}.	1	M			
R-13.	8.2.6	A value of 00_{Hex} shall indicate that none of the representations contains a certification record.	2	M			
R-14.	8.2.6	A value of 01_{Hex} shall indicate that all representations contain a certification record.	2	M			
R-15.	8.2.7 Table 1	The number of finger or palm images included in the record shall be recorded in one byte. Valid values are 1 to FF_{HEX}.	1	M			
Finger image representation header							
R-16.	8.3.1	A finger or palm representation header shall start each section of finger data providing information for that representation of a single finger image, multi-finger image or palm image.	3C	O-1		N/A	N/A
R-17.	8.3.1	For each such image there shall be one finger header record accompanying the representation of the image data.	2	M		N/A	
R-18.	8.3.1	The representaion header shall occupy a minimum of 41 bytes (assuming no certification blocks and no quality blocks are present). Otherwise, it shall be 42+ 5*num_quality_block+ 3*num_certification_block	2	M			
R-19.	8.3.1	The compressed or uncompressed image data for that image representation shall immediately follow the image representation header.	3C	O-1		N/A	N/A
R-20.	8.3.1	Subsequent image representations (including the image representation header) will be concatenated to the end of the previous image representation.	3C	O-1		N/A	N/A

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
R-21.	8.3.2 Table 2	The four-byte representation length field shall contain the length in bytes of the finger representation including the representation header fields. The minimum length is 41.	2	M			
R-22.	8.3.3 Table 2	Capture date-time field shall indicate the date and time the representation was captured. This field is not intended to encode the time the record was instantiated.	3C	O-1			
R-23.	8.3.3 Table 2	Capture time field shall be encoded in accordance to the requirements given in Part 1 of this standard. Parts of the capture date and time that are unknown shall be filled with FF_{Hex}, or $FFFF_{Hex}$ for two-byte components and all subsequent components shall be unknown.	1	M			
R-24.	8.3.4 Table 4	The one-byte capture device technology ID shall contain the entry chosen from Table 4 to indicate the technology type used by the capture device. Valid values are 0 to 20.	1	M			
R-25.	8.3.5 Table 2	The capture device vendor ID shall be recorded in two bytes.	1	M			
R-26.	8.3.5 Table 2	The capture device vendor ID shall identify the biometric organisation that owns the product that created the biometric record (BDIR) and shall be registered with the IBIA or other approved registration authority. A value of all zeros shall indicate that the capture device vendor is unreported.	3B	M			
R-27.	8.3.6 Table 2	This capture device type ID shall be recorded in two bytes.	1	M			
R-28.	8.3.6 Table 2	This capture device type ID shall identify the product type that created the biometric record and shall be assigned by the registered biometric record product owner or other approved registration authority. A value of all zeros shall indicate that the capture device type is unreported.	3C	O-1			N/A
R-29.	8.3.7.1	The quality information of the overall finger image data shall be recorded in one or more five-byte blocks.	1	M			
R-30.	8.3.7.1	Each of these blocks shall pertain to a specific quality/vendor/algorithm evaluation.	2	M			
R-31.	8.3.7.2 Table 2	The first byte of the quality record is mandatory and shall contain the number of subsequent quality blocks. Valid values are 0 to 255.	2	M			
R-32.	8.3.7.2 Table 2	Subsequent 5-byte blocks shall contain the specific quality/vendor/algorithm information for each quality/vendor/algorithm evaluation.	1,3B	M			
R-33.	8.3.7.2 Table 2	A value of zero (0) means that no attempt was made to assign a quality score. In this case, no Quality Blocks are present.	2	M			
R-34.	8.3.7.3 Table 2	The quality score shall be recorded in the first byte of each of the five-byte quality blocks. Valid values for quality score are integers between 0 and 100, and 255.	1	M			

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
R-35.	8.3.7.3 Table 2	The quality score shall be the quantitative expression of the predicted verification performance of the biometric sample, per ISO/IEC 29794-1. For valid values 0 to 100, higher values shall indicate better quality.	3C	O-1			N/A
R-36.	8.3.7.3 Table 2	An entry of “255” shall indicate a failed attempt to calculate a quality score.	3C	O-1			N/A
R-37.	8.3.7.4 Table 2	The provider of quality scores shall be uniquely identified by bytes 2 and 3 of the 5-byte quality block.	1	M			
R-38.	8.3.7.4 Table 2	This Vendor ID shall be registered with the International Biometrics Industry Association (IBIA).	3B	M			
R-39.	8.3.7.5 Table 2	Bytes 4 and 5 of the 5-byte quality block shall specify an integer product code assigned by the vendor of the Quality Algorithm ID. It indicates which of the vendor’s algorithms (and version) was used in the calculation of the quality score and shall be within the range of 0 to 65535.	1	M			
R-40.	8.3.7.5 Table 2	Multiple quality scores calculated by the same algorithm (same vendor ID and algorithm ID) shall not be present in a single representation.	2	M			
R-41.	8.3.8.1 Table 2	The certification record shall consist of a length field followed by zero or more 3-byte certification blocks. Each certification block shall consist of a certification authority identifier and a certification scheme identifier.	2	M			
R-42.	8.3.8.1 Table 2	If the certification block flag in the general header has a value of 00_{Hex}, no capture device certification information shall be present in any of the representation header records for that finger image record.	2	M			
R-43.	8.3.8.2 Table 2	The first byte of the certification record is mandatory and shall contain the number of 3-byte certification blocks for the capture device. Valid values are 0 to 255.	1,2	M			
R-44.	8.3.8.3	The first two bytes of each 3-byte certification block shall contain the certification authority identifier agency or organization that certified the device according to a particular capture device quality specification.	1	M			
R-45.	8.3.8.3	The Certification Authority Identifier shall be registered by the IBIA or other approved registration authority.	3C	O-1			N/A
R-46.	8.3.8.4 Table 5	The 3rd and last byte of certification block shall identify a certification scheme identifier used to certify the capture device as listed in Table 5.	1	M			
R-47.	8.3.9 Table 2 Tables 6-8	The one-byte finger or palm position field shall contain the finger or palm position code. Valid values are 0-10, 13-15, 20-36, and 40-50.	1	M			
R-48.	8.3.10 Table 2	The one-byte representation number shall contain the specific image representation number associated with the image data (or finger, multi finger or palm image data).	2	M			

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
R-49.	8.3.11 Table 2	Scale units field shall specify the units used to describe the scanning and image spatial sampling rate of the image.	3C	O-1			
R-50.	8.3.11 Table 2	Valid values (for scale units) are 01_{Hex} (indicating pixels per inch), or 02_{Hex} (indicating pixels per centimetre).	1	M			
R-51.	8.3.12 Table 2	The two-byte capture device spatial sampling rate (horizontal) shall specify the rounded scanning spatial sampling rate used in the horizontal direction.	3C	O-1			
R-52.	8.3.13 Table 2	The two-byte capture device spatial sampling rate (vertical) shall specify the rounded spatial sampling rate used in the vertical direction.	3C	O-1			
R-53.	8.3.14 Table 2	The two-byte image spatial sampling rate (horizontal) shall specify the rounded image spatial sampling rate used in the horizontal direction. Valid values are values smaller or equal to device spatial sampling rate (horizontal).	2	M			
R-54.	8.3.15 Table 2	The two-byte image spatial sampling rate (vertical) shall specify the rounded image spatial sampling rate used in the vertical direction. Valid values are values smaller or equal to device spatial sampling rate (vertical).	2	M			
R-55.	8.3.16 Table 2	The one-byte bit-depth field shall contain the number of bits used to represent a pixel. This field shall contain an entry of 01_{Hex}(=1) to 10_{Hex}(=16).	1	M			
R-56.	8.3.17 Table 9	The one-byte image compression algorithm field shall specify the method used to record the uncompressed or compressed grayscale images. Valid values are 0 to 6 as listed in Table 9.	1,2	M			
R-57.	8.3.17 Table 9	If compression algorithm code is 0, for grayscale pixels greater than eight bits, each pixel shall be recorded in a pair of bytes right justified.	3C	O-1			
R-58.	8.3.17 Table 9	When the compression algorithm code is 2, a certified version of the Wavelet Scalar Quantization (WSQ) algorithm as described in Annex E shall be used.	3C	O-1			
R-59.	8.3.17 Table 9	WSQ compression for 8-bit, 197 ppcm (500 ppi) grayscale images.shall be limited to a 15:1 compression ratio.	2	M			
R-60.	8.3.17	WSQ shall not be used to compress images scanned at 394 ppcm (1000 ppi).	2	M			
R-61.	8.3.17	JPEG shall not be used for new applications.	2	M			
R-62.	8.3.17	Fingerprint/palm print images scanned at 394 ppcm (1000 ppi), if compressed, shall be compressed using the JPEG 2000 algorithm as described in the ISO Standard 15444.	2	M			
R-63.	8.3.17	When JPEG 2000 is used, the JPEG 2000 profile settings as specified in the "Profile for 1000ppi Fingerprint Compression" normative reference are required to be incorporated.	3C	O-1			N/A
R-64.	8.3.17	If compression algorithm is 5, the ISO/IEC 15948 PNG algorithm shall be used.	2	M			

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
R-65.	8.3.18 Table 10	The impression type code of the finger or palm image shall be recorded in one byte. Valid values are 0 to 15, and 20 to 29.	1 3C	M O-1			
R-66.	8.3.19	The two-byte horizontal line length field shall be used to specify the number of pixels contained on a single horizontal line of the transmitted image.	2	M-2			
R-67.	8.3.20	The two-byte vertical line length field shall be used to specify the number of horizontal lines contained in the transmitted image.	2	M-2			
R-68.	8.3.21 Table 2	The 4-byte image data length field shall contain the length (expressed as the number of bytes) of the compressed or uncompressed image data contained in this representation. Valid values are 0 to (2^{32}-58).	1	M			
R-69.	8.3.22	The finger or palm image data field shall contain the grayscale image data formatted and recorded in accordance with the image compression algorithm.	2	M			
Extended data							
R-70.	8.4.1	The size of extended data block shall be kept as small as possible, augmenting the image data stored in the standard image data section.	3C	O-1			N/A
R-71.	8.4.1	The extended data for each finger representation shall immediately follow the standard image data for that finger representation.	1	M			
R-72.	8.4.1	The extended data is not intended to allow for alternate representations of data that can be represented in open manner as defined in this standard. The intention of this standard is to provide interoperability.	3C	O-1			N/A
R-73.	8.4.2.1 Table 11	Extended data block type identification code shall have a length of two bytes. Valid values: A value of zero in both bytes is a reserved value and shall not be used. A value of zero in the first byte, followed by a non-zero value in the second byte, shall indicate that the extended data section has a format defined in this standard; currently, only segmentation, annotation, and comment formats are specified (refer to clauses 8.4.3, 8.4.4, and 8.4.5). A non-zero value in the first byte shall indicate a vendor-specified format with a code maintained by the vendor.	2	M			
R-74.	8.4.2.2	The length of the extended data section shall be recorded in two bytes. This length field includes the count of the length and type identification fields (four bytes total).	2	M			
R-75.	8.4.3	If the extended data type identification code is 0x0001, the extended data section contains segmentation and image quality data for each segment of the flat fingerprint image.	2	M			

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
R-76.	8.4.3.1 Table 12	The segmentation quality assessment algorithm owner's ID is encoded in the first two bytes of the segmentation data block. The 16-bit format owner value is assigned by the IBIA. A value of 0x00 indicates that segmentation algorithm and vendor ID is unreported.	1	M			
R-77.	8.4.3.1 Table 12	Bytes 3 and 4 of the segmentaion block shall contain a specific identifier for the segmentation quality assessment algorithm. This field contains the binary representation of the integer product code and should be within the range 1 to 65535. This value is assigned by the organization, and may be registered with the IBIA.	1	M			
R-78.	8.4.3.2 Table 12	The one-byte segmentation quality score shall be a measure of estimated correctness regarding the accuracy of the location of the segmented finger. Valid values: 0-100 quality score, 254: no attempt to calculate a segmentation quality score and 255 for a failed attempt to calculate a segmentation quality score.	1 3C	M O-1			
R-79.	8.4.3.3 Table 12	The quality assessment algorithm's supplier (owner) is contained in the 6th and 7th bytes of a segmentation data block. This field contains the binary representation of the integer product code and should be within the range 1 to 65535. This value is assigned by the organization, and may be registered with the IBIA. A value of 00_{Hex} indicates that the vendor ID is unreported.	1	M			
R-80.	8.4.3.3 Table 12	Bytes 8-9 of a segmentation block shall contain a specific identifier for the quality assessment algorithm. Valid values: 1 to 65535.	1	M			
R-81.	8.4.3.4 Table 12	The number of Finger Data Segment blocks shall be equal to the number stated in the Number of Segments field.	2	M			
R-82.	8.4.3.4 Table 12	Valid values for number of segments field are 0 to 4, and 255.	1	M			
R-83.	8.4.3.4	If an image is multi-finger impression then the number of segments shall be 0.	2	M			
R-84.	8.4.3.4	If the segmentation attempt fails then the number of segments shall be 255.	2	M			
R-85.	8.4.3.5.1 Table 12	Each finger segment shall be defined by finger position, image quality, the number of points used to define the segment and the coordinates of each point.	2	M			
R-86.	8.4.3.5.2 Table 12, Table 6	Finger position of segmented finger in one byte. Valid values: 0 to 10, and 13 to 15.	1	M			
R-87.	8.4.3.5.3 Table 12	Finger image quality is encoded in the 2nd byte of finger segmant data shall be a quantitative expression of the predicted verification performance of the biometric sample.	3C	O-1			N/A
R-88.	8.4.3.5.3 Table 12	The finger image quality of a segmentation block is calculated by the algorithm identified by finger quality owner ID.	3C	O-1			N/A

Requirement Identifier	Governing section	Requirement Summary	Level	Status	IUT Support	Supported Range	Test Result
R-89.	8.4.3.5.3 Table 12	Valid values for finger image quality of a segmentation block are: 0 to 100, 254 (not reported) and 255 (failed attempt)	2	M			
R-90.	8.4.3.5.4 Table 12	The third byte in a finger segment data block shall specify the number of points or vertexes used to enclose the segmented image.	3C	O-1			N/A
R-91.	8.4.3.5.4	For a finger segment enclosed by an n-sided polygon, this byte shall contain a value between 4 and 99.	1	M			
R-92.	8.4.3.5.4	The order of the vertices shall be in their consecutive order around the perimeter of the polygon, either clockwise or counterclockwise. The polygon side defined by the last subfield and the first subfield shall complete the polygon. The polygon shall be a simple, plane figure with no sides crossing and no interior holes. Each vertex of the rectangle or polygon shall be represented by a pair of coordinates.	3C	O-1			N/A
R-93.	8.4.3.5.4	No two vertices may occupy the same location.	2	M			
R-94.	8.4.3.5.4.1	Two bytes shall be used to contain the horizontal pixel offset to the right relative to the origin positioned in the upper left corner of the image.	1	M			
R-95.	8.4.3.5.4.2	Two bytes shall be used to contain the vertical pixel offset down relative to the origin positioned in the upper left corner of the image.	1	M			
R-96.	8.4.3.5.5	This one byte field shall encode the angle between the longitudinal axis of the finger and the horizontal axis to the right.	1	M			
R-97.	8.4.3.5.5	The integer value encoded shall be the physical estimate of the angle in degrees divided by 1.40625	3A	O			
R-98.	8.4.4	If the extended data type identification code is 0x0002, the extended data section contains annotation information.	2	M			
R-99.	8.4.4.1 Table 13	The one-byte number of annotations shall contain the number of annotations that follow. Each annotation will consists of two information items.	2	M			
R-100.	8.4.4.1 Table 13	The valid values for the number of annotations are 1 to 4.	2	M			
R-101.	8.4.4.2 Table 13	Finger position shall be encoded in byte 2 of annotation block. Valid values are 0 to 10, 13 to 15, 20 to 36, and 40 to 50.	1	M			
R-102.	8.4.4.3 Table 13	Annotation code shall be encoded in byte 3 of annotation block. Valid values are 01_{Hex} for an amputated finger and 02_{Hex} for a bandaged or otherwise unable to print finger.	1	M			
R-103.	8.4.5	If the extended data type identification code is 0003_{Hex}, the extended data section contains ASCII text information associated with the captured image or subject supplying the image. The comment is inputted by the individual generating the fingerprint or palmprint record. A null terminator for the ASCII string is not necessary, as the length is provided.	2	M			

Status Notes:

The following short notes provide more details about why a specific conformance test assertion is not specified for the corresponding requirement(s):

O-1. Level 3 Assertion is too difficult to test. No method has been defined to test the conformance of the IUT or BDIR for this mandatory requirement of the base standard.

M-2. No level 1 test is associated with this requirement, because the test will always pass.

A.3 Table of test assertions

The specific test assertions required for conformance testing to this Part of ISO/IEC 19794 are listed in Table A.2.

The conformance test assertions are listed in the order in that the corresponding fields are required to appear, if present, in a conforming record.

The normative requirements of this part of ISO/IEC 19794 as summarized in Table A.1 are referenced in Table A.2.

Table A.2 — Conformance test assertions

Test Num	Section	Requirement ID	Level	Field name	Operator	Operand	Test Note	Status	IUT support	Supported range	Test Result
1.1	general header	R-4, R-5	1	format identifier	EQ	46495200 $_{HEX}$	1	M		N/A	
1.2	general header	R-4, R-5	1	format identifier	NEQ	00524946$_{HEX}$		M		N/A	
2.1	general header	R-6, R-7	1	version	EQ	30323000 $_{HEX}$	1	M		N/A	
2.2	general header	R-6, R-7	1	version	NEQ	00303230 $_{HEX}$		M		N/A	
3.1	general header	R-8, R-11	1	record length	EQ	57 to (2^{32} -1)		M			
3.2	general header	R-8	2	record length	EQ	Total bytes read	2	M		N/A	
3.3	general header	R-9	2	record length	EQ	Total bytes expected	2	M		N/A	
4.1	general header	R-10	1	number of representation	EQ	1 to 672		M			
4.2	general header	R-10	2	number of representation	C	see note 3	3	M		N/A	
5.1	general header	R-12	1	certification flag	EQ	0 to 1		M			
5.2	general header	R-13, R-14, R-41	2	certification flag	C	see note 4	4	M			
6.1	general header	R-15	1	number of finger or palm images	EQ	1 to 255		M			
Finger image representaion header											
7.1	represent header	R-17, R-18	2	length of representation header	C	see note 5	5	M			
8.1	representaion header	R-21	2	length of representaion	C	see note 6	6	M			
8.2	capture time	R-23	1	capture time				M			
9.1	capture device	R-24	1	capture device technology ID	EQ	0 to 20		M			
9.2	capture device	R-25	1	capture device vendor ID	EQ	0 to (2^{16} – 1)		M			
9.3	capture device	R-27	1	capture device type ID	EQ	0 to (2^{16} – 1)		M			
10.1	quality block	R-31	1	number of quality blocks	EQ	0 to 255		M			
10.2	quality block	R-29, R-32, R-33	2	number of quality blocks	C	see note 7	7	M			
10.3	quality block	R-34	1	quality score	EQ	0 to 100, 255		M			
10.4	quality block	R-37, R-40	1	quality vendor ID	EQ	0 to (2^{16} -1)	8	M			
10.5	quality block	R-39, R-40	1	quality algorithm ID	EQ	0 to (2^{16} -1)	8	M			
11.1	certification block	R-41, R-42, R-43	1, 2	certification block	C	see note 9	9	M			
11.2	certification block	R-43	1	number of certifications	EQ	0 to 255		M			

Test Num	Section	Requirement ID	Level	Field name	Operator	Operand	Test Note	Status	IUT support	Supported range	Test Result
11.3	certification block	R-44	1	ceritification authority identifier	EQ	0 to (2^{16} -1)		M			
11.4	certification block	R-46	1	certification scheme identifier	EQ	1 to 3		M			
12	finger or palm positin	R-47	1	finger or palm position	EQ	0 to 10, 13 to 15, 20 to 36, 40 to 50		M			
13	representation number	R-48	2	representation number	INC	see note 18	18	M			
15	scale unit	R-50	1	scale unit	EQ	1 to 2		M			
16	spatial sampling rate	R-53	2	horizontal image spatial sampling rate	LTE	{captureDevice horiz spatial sampling rate}	16	M			
17	spatial sampling rate	R-54	2	vertical image spatial sampling rate	LTE	{captureDevice vert spatial sampling rate}	16	M			
18	bit depth	R-55	1	bit-depth	EQ	0 to 16		M			
19.1	compression algorithm	R-56	1	compression algorithm	EQ	0 to 6		M			
19.2	compression algorithm	R-56, R-69	2	compression algorithm	EQ	0 to 6	10	M			
19.3	compression algorithm	R-59	2	compression algorithm	C	see note 11	11	M			
19.4	compression algorithm	R-60	2	compression algorithm	C	see note 11	11	M			
19.5	compression algorithm	R-61	2	compression algorithm	C	see note 12	12	M			
19.6	compression algorithm	R-62	2	compression algorithm	C	see note 13	13	M			
19.7	compression algorithm	R-64	2	compression algorithm	C	see note 10	10	M			
20	impression type	R-65	1	impresion type	EQ	0 to 15, 20 to 29		M			
21	horizantal line length	R-66	2	horizantal line length	C	see note 14,15	14,15	M			
22	vertical line length	R-67	2	vertical line length	C	see note 14,15	14,15	M			
23	image data length	R-68	2	image data length	EQ	0 to (2^{32}-58).	17	M			
Extended data block											
24	type identification code	R-73	1	type identification code	EQ	0001_{HEX} to $FFFF_{HEX}$					
25.1	type identification code::Length data	R-74, R-75, R-98, R-99	1	length of data	EQ	0004_{HEX} to $FFFF_{HEX}$					

Test Num	Section	Requirement ID	Level	Field name	Operator	Operand	Test Note	Status	IUT support	Supported range	Test Result
25.2	type identification code::Length data	R-74, R-75, R-98, R-99	2	length of data	EQ		19				
Extended data block :: Segmentation data											
26.1	segmentation owner and algorithm ID	R-76, R-77	1	segmentation owner and algorithm ID	EQ	00000000_{HEX} to $FFFFFFFF_{HEX}$					
26.2	segmentation owner and algorithm ID	R-76, R-77	3B	segmentation owner and algorithm ID	EQ	First Two bytes are IBIA Assigned					
27	segmentation quality score	R-78	1	segmentation quality score	EQ	00_{HEX} to 64_{HEX}, or FE_{HEX} or FF_{HEX}					
28.1	finger image quality algorithm and owner ID	R-79, R-80	1	finger image quality algorithm and owner ID	EQ	00000000_{HEX} to $FFFFFFFF_{HEX}$					
28.2	finger image quality algorithm and owner ID	R-79, R-80	3B	Finger image quality algorithm and owner ID	EQ	First Two Bytes are IBIA Assigned					
29.1	number of segments	R-82	1	number of segments	EQ	00_{HEX} to 04_{HEX} or FF_{HEX}					
29.2	number of segments	R-81	2	number of segments	EQ	Finger Segment Data Counted					
29.3	number of segments	R-83	2	Finger position and number of segments			20				
29.4	number of segments	R-84	2	failed segmentation attempt			23				
30	finger Segment data::finger position	R-86, R-85	1	finger position	EQ	00_{HEX} to $0A_{HEX}$					
31	finger Segment data::finger quality	R-89	1	finger quality	EQ	00_{HEX} to 64_{HEX}, or FE_{HEX} or FF_{HEX}					
32.1	finger Segment data::number of coordinate pairs	R-91	1	Number of coordinates	EQ	02_{HEX} to 63_{HEX}					
32.2	finger Segment data::number of coordinate pairs	R-91	2	number of coordinates	EQ	Coordinates Counted					
32.3	finger segment data::number of coordinate pairs	R-93	2	X-coordinate			21				
32.4	finger segment data::number of coordinate pairs	R-93	2	Y-coordinate			21				

Test Num	Section	Requirement ID	Level	Field name	Operator	Operand	Test Note	Status	IUT support	Supported range	Test Result
Annotation data											
33	number of annotations	R-100	1	number of annotations	EQ	01_{HEX} to 04_{HEX}					
34	finger position	R-101	1	finger position	MO	00_{HEX} to $0A_{HEX}$, $0D_{HEX}$ to $0F_{HEX}$, 14_{HEX} to 24_{HEX}, 28_{HEX} to 32_{HEX}					
35	annotation code	R-102	1	annotation code	EQ	01_{HEX} or 02_{HEX}					
Comment data format											
36	comment data fromat	R-103	2	Comment Data			22				

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 assertions 1.1 and 2.1 will test that these multi-byte fields are equal to their correctly big-endian encoded value. Test assertions 1.2 and 2.2 will test that these multi-byte fields are not equal to the value they would have had if it had been incorrectly encoded using little-endian encoding. The tests for both of these assertions (T1.1 & T1.2 or T2.1 & T2.2) 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 (T1.1 or T2.1) should fail but the second test (T1.2 or T2.2) should pass. If the correct values have been used but with the incorrect little-endian encoding, then both tests (T1.1 & T1.2 or T2.1 & T2.2) should fail.

2. {record length}
The following calculation will be evaluated once the {Image Data Block Length} field for the last finger or palm 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. Note that the calculation shown below shows a counter being incremented over each finger /palm and then over each view for that finger or palm. In an actual data record, the views for a given finger or palm do not have to be contiguous, but SUMBYTES must be incremented across the total count of all views for all fingers or palms.

```
SUMBYTES = 16  # i.e. length of General Header
For I = 1 to {Number of finger representations}
   SUMBYTES = SUMBYTES + 41      # i.e. length of representation header
   IF {certification flag} EQ 1      # i.e. certification blocks are present for all representations
      SUMBYTES = SUMBYTES + 1    # i.e. additional length for count of certification blocks
      SUMBYTES = SUMBYTES + (5 * {Number of Quality Blocks}) + (3 * {Number of Certification Blocks}) + {Image Data
Length} + {Size of Extended Data}
   ELSE IF {certification flag} EQ 0      # i.e. no certification blocks present for any representations
      SUMBYTES = SUMBYTES + (5 * {Number of Quality Blocks} + {Image data length} + {Size of extended data}
    END IF
END
{Total Bytes Expected} = SUMBYTES
```

3. {number of representations}
The following calculation checks if there are as many finger or palmrepresentations data as the {number of representation} field specifies. The four-byte {representation length} contains the length in bytes of the finger or palm representation.

```
fingerCounter = 0;
while (fingerCounter <= {number of representations}){
      m = {representation length}
      skip m bytes
      if (End-Of-File) exit(ERROR)
fingerCounter ++
}
```