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

Part 8: Finger pattern skeletal data

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

Partie 8: Données des structures du squelette de l'empreinte

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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.

ISO/IEC 29109-8 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 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 10: Hand geometry silhouette data*

Finger pattern spectral data, signature/sign processed dynamic data, voice data and DNA data will form the subjects of future parts.

Introduction

ISO/IEC 19794-8:2006 specifies a data record interchange format for exchange of finger pattern skeletal data among systems within a Common Biometric Exchange Formats Framework (CBEFF) data structure. The data stored in a finger pattern skeletal data record often contains the metadata storing the subject-specific, the image-specific as well as the technology being used. This part of ISO/IEC 29109 establishes tests for checking the correctness of the binary record.

The objective of ISO/IEC 19794-8:2006 cannot be completely achieved until biometric products can be tested to determine whether they conform to those specifications. Conforming implementations are a necessary prerequisite for achieving interoperability among implementations; therefore there is a need for a standardized conformance testing methodology, test assertions, and test procedures as applicable to specific modalities addressed by each part of ISO/IEC 19794. The test assertions will cover as much as practical of the ISO/IEC 19794 requirements (covering the most critical features), so that the conformity results produced by the test suites will reflect the real degree of conformity of the implementations to ISO/IEC 19794 Data Interchange Format records. This is the motivation for the development of this conformance testing methodology.

This part of ISO/IEC 29109 supports those applications that require use of finger pattern skeletal data according to ISO/IEC 19794-8:2006. It defines a testing methodology to ensure conformance of a vendor's application or service to the base ISO/IEC 19794-8:2006 specification. Thus this part of ISO/IEC 29109 is intended to:

— establish elements of the conformance testing methodology framework that are specific to the finger pattern skeletal-based data record requirements of ISO/IEC 19794-8:2006 conformance testing,

— define requirements and guidelines for specifying conformance test suites and related test methods for measuring conformity of products and services to the finger pattern skeletal data record requirements of ISO/IEC 19794-8:2006, and

— define testing and reporting procedures to be followed before, during, and after conformance testing.

This part of ISO/IEC 29109 is applicable to the development and use of conformity test method specifications, conformity test suites for ISO/IEC 19794-8:2006 records, and conformance testing programs for ISO/IEC 19794-8:2006 conformant products. It is intended primarily for use by testing organizations, but may be applied by developers and users of test method specifications and test method implementations.

The table of test assertions (Clause 6.2) specifies levels 1, 2 or 3 testing for the conformance requirements of ISO/IEC 19794-8:2006.

Conformance testing of CBEFF requirements will be out of the scope of ISO/IEC 29109.

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

Part 8:
Finger pattern skeletal data

1 Scope

This part of ISO/IEC 29109 specifies elements of conformance testing methodology, test assertions, and test procedures as applicable to ISO/IEC 19794-8:2006.

This part of ISO/IEC 29109 establishes

— test assertions of the structure of the finger pattern skeletal data format as specified in ISO/IEC 19794-8:2006 (Type A Level 1 as defined in ISO/IEC 29109-1:2009),

— test asssertions of internal consistency by checking the types of values that may be contained within each field (Type A Level 2 as defined in ISO/IEC 29109-1:2009).

This part of ISO/IEC 29109 does not establish

— test of conformance of CBEFF structures required by ISO/IEC 19794-8:2006,

— test of consistency with input biometric data record (Level 3),

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

— test of conformance of systems that do not produce ISO/IEC 19794-8:2006 records.

2 Conformance

Biometric data interchange format conformance tests conform to this part of ISO/IEC 29109 if they satisfy all of the normative requirements related to Clause 6. Specifically, they shall use the test methodology specified in Clauses 6, 7 and 8 of ISO/IEC 29109-1:2009, and all Level 1 and Level 2 tests shall use the assertions defined in Table 2 of Clause 6 in this International Standard.

Implementations of ISO/IEC 19794-8:2006 tested according to the methodology specified shall be able to claim conformance only to those Biometric Data Record (BDR) requirements specified in ISO/IEC 19794-8:2006 that are tested by the test methods established by this methodology.

Implementations of ISO/IEC 19794-8:2006 do not necessarily need to conform to all possible aspects of ISO/IEC 19794-8:2006, but only to those ISO/IEC 19794-8:2006 requirements that are claimed to be supported by the implementation in an ICS, filled out in accordance with Clause 8 of ISO/IEC 29109-1:2009 and Table 1 of this part of ISO/IEC 29109.

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 19794-8:2006, *Information technology — Biometric data interchange formats — Part 8: Finger pattern skeletal data*

ISO/IEC 29109-1:2009, *Information technology — Conformance testing methodology for biometric data interchange formats defined in ISO/IEC 19794 — Part 1: Generalized conformance testing methodology*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 29109-1 apply.

5 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO/IEC 29109-1:2009 apply.

6 Conformance testing methodology

The testing methodology specified in Clauses 6, 7 and 8 of ISO/IEC 29109-1:2009 shall apply. The content of the tables below is based on the conformance testing methodology outlined in ISO/IEC 29109-1:2009 and shall only be used in the context of that testing methodology.

6.1 Table of requirements in the base standard

Under subformat applicability the columns labelled R, N and C indicate Finger pattern skeletal data record format, Normal size finger pattern skeletal format and Compact size finger pattern skeletal format.

Table 1 — Requirements of the Base Standard (ISO/IEC 19794-8:2006)

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
					R	N	C			
R-1	6.1.1	Minutiae are points located at the places in the fingerprint image where friction ridges end or split into two ridges. Each minutia point has a "type" associated with it. There are two major types of minutia: a "ridge ending" represented by the 2-bit value 01 and a "ridge bifurcation" or split point represented by 2-bit value 10.	1	M	Y	Y	Y			
R-2	6.1.2	The coordinate system used to express the position of the minutiae points of a fingerprint shall be a Cartesian coordinate system. For the skeletal pattern card format, the resolution of the x and y coordinates of the minutia shall be in metric units. The position of the minutia for a ridge ending shall be defined as the coordinates of the skeleton point with only one neighbour pixel belonging to the skeleton. The position of the minutia for a ridge bifurcation shall be defined as the point of forking of the skeleton of the ridge. The position of a virtual ending shall be defined like the position of a real ridge ending.	3C	O-1	Y	Y	Y		N/A	N/A
R-3	6.1.3	The direction of the lines starting or ending at a point with more than three arms (trifurcation, etc.) shall be defined like the direction of a real ridge ending.The direction of a virtual ending shall be defined like the direction of a real ridge ending.	3C	O-1	Y	Y	Y		N/A	N/A
R-4	6.2.2	To keep the encoding size small a line shall start with a real minutia (type 01 or 10) if possible. No assumption shall be made about the order of the line encodings in the record. The skeleton shall be encoded only for image areas where the ridge lines are displayed with a sufficient quality. The reconstructed ridge lines shall describe the fingerprint image in ridge position and structure. The reconstructed skeleton line polygon element shall be inside the area of the ridge it is describing for most part of its length.	3C	O-1	Y	Y	Y		N/A	N/A

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
		The reconstructed skeleton line shall never be inside the area of any other ridge but the one it is describing. The reconstructed skeleton line shall preserve the topology of the ridges.								
R-5	6.2.3	In order to minimize integration of digitalisation error, each starting point must be computed with relatively high accuracy, i.e. its resolution shall be at least 100 times finer than the spatial resolution of the minutiae.	3C	O-1	Y	Y	Y		N/A	N/A
R-6	6.2.3	If the direction change of the skeleton line cannot be described by a direction element, the line encoding shall be interrupted by a “virtual continuation” and a new line encoding shall begin with the same point without repeating the minutia data.	3C	O-1	Y	Y	Y		N/A	N/A
R-7	6.3.2	It is not usefull to list a neighourhood relation twice, any of the other indices shall be different i.e. Ai-1>Ai .	3A	M	Y	Y	Y			
R-8	7.3, Table 5	There shall be one and only one record header for the finger pattern skeletal data record. The record header will contain information describing the identity and characteristics of the device that generated the data.	3A	M	Y	N	N			
R-9	7.3.1, Table 5	The finger pattern skeletal data record shall begin with a format identifier to be recorded in four bytes. For this part of ISO/IEC 19794, it shall consist of the three ASCII characters “FSK”, followed by a zero byte as a NULL string terminator.	1	M	Y	N	N			
R-10	7.3.2, Table 5	The version number for the version of this part of ISO/IEC 19794 used in constructing the record shall be placed in four bytes.	1	M	Y	N	N			
R-11	7.3.2, Table 5	The first and second character will represent the major revision number and the third character will represent the minor revision number. Upon approval of this specification, the version number shall be “010” (an ASCII ‘0’followed by an ASCII ‘1’ and an ASCII ‘0’).	1	M	Y	N	N			
R-12	7.3.3, Table 5	The length of the entire record shall be recorded in four bytes.	1	M	Y	N	N			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-13	7.3.4, Table 5	The least significant of the four bits is reserved for a future ISO finger image capture equipment certification.	1	O	Y	Y	Y			
R-14	7.3.4, Table 5	The two additional bits are reserved for future image quality certifications.	1	O	Y	Y	Y			
R-15	7.3.5, Table 5	The capture device type ID shall be recorded in twelve bits.	1	M	Y	Y	Y			
R-16	7.3.6, Table 5	The total number of finger views represented in the record shall be contained in 1 byte.	1	M	Y	Y	Y			
R-17	7.3.7, Table 5	The resolution (in ppcm) of the scaled finger image(s) shall be uniform in the x and y-directions and shall be stored in 1 byte	1	M	Y	N	N			
R-18	7.3.8, Table 5	The bit-depth used to represent the x and y-coordinate of the starting and ending point in the direction code description of the skeleton shall be recorded in 1 byte.	1	M	Y	N	N			
R-19	7.3.9, Table 5	The bit-depth used to represent the direction of the starting and ending point in the direction code description of the skeleton shall be recorded in 1 byte.	1	M	Y	N	N			
R-20	7.3.10, Table 5	The bit-depth used to represent the direction in the direction code shall be recorded in 1 byte.	1	M	Y	N	N			
R-21	7.3.11, Table 5	The maximal step size Ss in the current direction of each direction code step shall be recorded in 1 byte.	1	M	Y	N	N			
R-22	7.3.12, Table 5	The relative perpendicular step size floor(256 × Sp/Ss) of the direction code shall be recorded in 1 byte.	1	M	Y	N	N			
R-23	7.3.13, Table 5	The angular resolution of the direction code is stored as the number N_π of directions on 180° and shall be recorded in 1 byte.	1	M	Y	N	N			
R-24	7.3.14, Table 5	Two bytes are reserved for future revision of this specification. For version 1.0 of this part of ISO/IEC 19794, these byte values shall be set to 0.	1	M	Y	Y	Y			
R-25	7.4.1	A finger header shall start each area of finger data providing information for that finger. There shall be one finger header for each finger contained in the finger pattern skeletal data record. The finger header will occupy a total of 10 bytes as described below. Note that it is permissible for more than one single finger record to represent the same finger, with (presumably) different data.	1	M	Y	Y	Y			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-26	7.4.1.1	If more than one finger pattern record in a general record is from the same finger, each pattern record shall have a unique view number.	2	M	Y	Y	Y			
R-27	7.4.1.1	Multiple finger pattern records from the same finger shall be numbered with increasing view numbers, beginning with zero. Where only one finger pattern record is taken from each finger, this field shall be set to 0.	2	M	Y	Y	Y			
R-28	7.4.1.1	The view number shall be recorded in one byte.	1	M	Y	Y	Y			
R-29	7.4.1.2	The finger position shall be recorded in one byte.	1	M	Y	Y	Y			
R-30	7.4.1.2	The codes for this byte shall be as defined in Table 1.	2	M	Y	Y	Y			
R-31	7.4.1.3	The impression type of the finger images that the finger pattern skeletal data was derived from shall be recorded in one byte.	1	M	Y	Y	Y			
R-32	7.4.1.3	The codes for this byte are shown in Table 2.	1	M	Y	Y	Y			
R-33	7.4.1.4	The quality of the overall finger pattern skeletal data shall be between 0 and 100 and recorded in one byte.	1	M	Y	Y	Y			
R-34	7.4.1.5	The size of the skeleton image in pixels in the x direction shall be contained in two bytes.	1	M	Y	Y	Y			
R-35	7.4.1.6	The size of the skeleton image in pixels in the y direction shall be contained in two bytes.	1	M	Y	Y	Y			
R-36	7.4.1.7	The length (in bytes) of the finger pattern skeletal data block recorded for the finger shall be recorded in two bytes. The length provided includes any padding bits necessary to complete the last byte of finger pattern skeletal data.	1	M	Y	Y	Y			
R-37	7.4.2.1	The length (in bytes) of the finger pattern skeletal data shall be recorded in two bytes. The length provided includes any padding bits necessary to complete the last byte of finger pattern skeletal data.	1	M	Y	Y	Y			
R-38	7.4.2.2	The finger pattern skeletal data for a single finger shall be recorded as defined in Clauses 6.1 and 6.2.	3C	O-1	Y	Y	Y		N/A	N/A
R-39	7.4.2.3	The length (in bytes) of the skeleton line neighbourhood index data shall be recorded in two bytes. The length provided includes any padding bits necessary to complete the last byte of finger pattern skeletal data.	2	M	Y	Y	Y			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-40	7.4.2.4	The skeleton line neighbourhood index data for a single finger shall be recorded as defined in Clause 6.3.	3C	O-1	Y	Y	Y		N/A	N/A
R-41	7.5	The size of this area shall be kept as small as possible, augmenting the data stored in the standard pattern skeletal data area. The extended data for each finger view shall immediately follow the standard pattern skeletal data for that finger view and shall begin with the extended data block length.	3C	O-1	Y	Y	Y		N/A	N/A
R-42	7.5	In particular, ridge count data, core and delta data, zonal quality information or sweat pore positions shall not be represented in proprietary manner to the exclusion of the publicly defined formats in this part of ISO/IEC 19794.	3C	O-1	Y	Y	Y		N/A	N/A
R-43	7.5.1.1	All pattern skeletal data records shall contain the extended data block length. This field will signify the existence of extended data, and shall be recorded in 2 bytes.	1	M	Y	Y	Y			
R-44	7.5.1.1	A value of all zeros (0x0000 hexadecimal) will indicate that there is no extended data and that the file will end or continue with the next finger view. A nonzero value will indicate the length of all extended data starting with the next byte.	2	M	Y	Y	Y			
R-45	7.5.1.2	The extended data area type code shall be recorded in two bytes, and shall distinguish the format of the extended data area as defined by the Vendor specified by the CBEFF_BDB_product_owner and CBEFF_BDB_product_type in the CBEFF header.	1	M	Y	N	N			
R-46	7.5.1.2	A non-zero value in the first byte shall indicate a vendor specified format, with a code maintained by the vendor.	1	M	Y	Y	Y			
R-47	7.5.1.3	The length of the extended data area, including the extended data area type code and length of data fields, shall be recorded in two bytes.	1	M	Y	Y	Y			
R-48	7.5.1.3	If the extended data block length (7.5.1.1) for the finger view is zero, indicating no extended data, this field shall not be present.	2	M	Y	Y	Y			
R-49	7.5.1.4	If the extended data block length (7.5.1.1) for the finger view is zero, indicating no extended data, this field shall not be present.	2	M	Y	Y	Y			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-50	7.5.2	If the extended data area type code is 0x0001, the extended data area contains ridge count information. This format is provided to contain optional information	1	O	Y	N	N			
R-51	7.5.2	Ridge counts shall not include the ridges represented by either of the associated minutiae points.	3C	O-1	Y	N	N		N/A	N/A
R-52	7.5.2.1	The ridge count data area shall begin with a single byte indicating the ridge count extraction method.	1	O	Y	N	N			
R-53	7.5.2.1	In 4 Neighbor Ridge Count Method, For each center minutia used, ridge count data was extracted to the nearest neighboring minutia in four quadrants, and ridge counts for each center minutia are listed together.	2	O	Y	N	N			
R-54	7.5.2.1	In 8 Neighbor Ridge Count Method, For each center minutia used, ridge count data was extracted to the nearest neighboring minutia in eight octants, and ridge counts for each center minutia are listed together.	2	O	Y	N	N			
R-55	7.5.2.1	All ridge counts for a particular center minutia shall be listed together;	2	O	Y	N	N			
R-56	7.5.2.1	The center minutia shall be the first minutia references in the three-byte ridge count data;	2	O	Y	N	N			
R-57	7.5.2.1	If a given quadrant or octant has no neighboring minutiae in it, a ridge count field shall be recorded with both the minutia index and the ridge count fields set to zero (so that, for each center minutia, there shall always be four ridge counts recorded for the quadrant method and eight ridge counts recorded for the octant method);	2	O	Y	N	N			
R-58	7.5.2.1	No assumption shall be made regarding the order of the neighboring minutiae.	2	O	Y	N	N			
R-59	7.5.2.2	The ridge count data shall be represented by a list of threebyte elements.	1	O	Y	N	N			
R-60	7.5.2.2	No assumption shall be made about the geometric relationships of the various ridge count items.	2	O	Y	N	N			
R-61	7.5.3	If the extended data area type code is 0x0002, the extended data area contains core and delta information.	2	O	Y	N	N			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-62	7.5.3.1	The number of core points represented shall be recorded in the least significant four bits of this byte. Valid values are from 0 to 15.	1	O	Y	N	N			
R-63	7.5.3.2	The core information type shall be recorded in the two most significant bits of the two bytes of the x coordinate of the core position. The bits “01” will indicate that the core has angular information while “00” will indicate that no angular information is relevant for the core type. If this field is “00”, then the angle field shall not be present for this core.	3C	O-1	Y	N	N		N/A	N/A
R-64	7.5.3.3	The X coordinate of the core shall be recorded in the lower fourteen bits of the first two bytes (fourteen bits).	1	O	Y	N	N			
R-65	7.5.3.3	The Y coordinate shall be placed in the lower fourteen bits of the following two bytes.	1	O	Y	N	N			
R-66	7.5.3.3	The coordinates shall be expressed in pixels at the resolution indicated in the record header.	3C	O-1	Y	N	N		N/A	N/A
R-67	7.5.3.4	The angle of the core shall be recorded in one byte in units of 1,40625 (360/256) degrees. The core angle is measured increasing counter-clockwise starting from the horizontal axis to the right. The value shall be a non-negative value between 0 and 255, inclusive.	1	O	Y	N	N			
R-68	7.5.3.5	The number of delta points represented shall be recorded in the least significant four bits of this byte. Valid values are from 0 to 15.	1	O	Y	N	N			
R-69	7.5.3.6	The delta information type shall be recorded in the two most significant bits of the two bytes of the x coordinate of the delta position. The bits “01” will indicate that the delta has angular information while “00” will indicate that no angular information is relevant for the delta type. If this field is “00”, then the angle fields shall not be present for this delta.	3C	O-1	Y	N	N		N/A	N/A
R-70	7.5.3.7	The X coordinate of the delta shall be recorded in the lower fourteen bits of the first two bytes (fourteen bits).	1	O	Y	N	N			
R-71	7.5.3.7	The Y coordinate shall be placed in the lower fourteen bits of the following two bytes.	1	O	Y	N	N			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-72	7.5.3.7	The coordinates shall be expressed in pixels at the resolution indicated in the record header.	3C	O-1	Y	N	N		N/A	N/A
R-73	7.5.3.8	The three angle attributes of the delta shall each be recorded in one byte in units of 1.40625 (360/256) degrees. The delta angle is measured increasing counter -clockwise starting from the horizontal axis to the right. The value shall be a non - negative value between 0 and 255, inclusive.	1	O	Y	N	N			
R-74	7.5.3.8	If not all three angles can be extracted from the image because of noise or image cropping, the angle fields affected shall be filled by repeating any of the other angle(s) for the same delta.	3C	O-1	Y	N	N		N/A	N/A
R-75	7.5.4	If the extended data area type code is 0x0003, the extended data area contains zonal quality data.	2	O	Y	N	N			
R-76	7.5.4.1	The number of pixels in cells in the x -direction (horizontal) shall be stored in one byte. Permissible values are 1 to 255.	1	O	Y	N	N			
R-77	7.5.4.2	The bit depth of the cell quality information shall be contained in one byte.	1	O	Y	N	N			
R-78	7.5.4.3	The quality of the fingerprint image in each cell shall be represented by one or more bits, as indicated in 7.5.4.2.	1	O	Y	N	N			
R-79	7.5.4.3	Quality data for cells shall be stored in usual “raster” order – left to right, then top to bottom	3C	O-1	Y	N	N		N/A	N/A
R-80	7.5.4.3	If the finger image within this cell is of good clarity and significant ridge data is present, the cell quality shall be represented by higher values (by the bit value ‘1’ if the information depth is 1). If the cell does not contain significant ridge data, or the ridge pattern within the cell is blurred, broken or otherwise of poor quality, the cell quality shall be represented by lower values (the bit value‘0’ if the information depth is 1).	3C	O-1	Y	N	N		N/A	N/A
R-81	7.5.4.3	The cell quality shall be packed into bytes. The final byte in the cell quality data may be packed with bit values of zero (‘0’) on the right as required to complete the last byte.	1	O	Y	N	N			
R-82	7.5.4.4	The zonal quality data format shall be as follows:	1	O	Y	N	N			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-83	7.5.5.3	The final byte in the sweat pore position data shall be packed with bit values of zero ('0') for the least significant bits as required to complete the last byte.	2	O	Y	N	N			
R-84	7.5.5.4	The sweat pore position data format shall be as follows:	1	O	Y	N	N			
R-85	7.5.6.1	The finger pattern skeleton structural data format shall be as follows:	2	O	Y	N	N			
R-86	8.1	Resolution of direction code start and stop point	3C	O-1	N	Y	N		N/A	N/A
R-87	8.1	Bit-depth of direction code start and stop point in x	3C	O-1	N	Y	N		N/A	N/A
R-88	8.1	Bit-depth of direction code start and stop point in y	3C	O-1	N	Y	N		N/A	N/A
R-89	8.1	Bit-depth of direction code start and stop direction	3C	O-1	N	Y	N		N/A	N/A
R-90	8.1	Bit-depth of direction in direction code	3C	O-1	N	Y	N		N/A	N/A
R-91	8.1	Step size *Ss* of direction code	3C	O-1	N	Y	N		N/A	N/A
R-92	8.1	Relative perpendicular step size 256 × *Sp*/*Ss*	3C	O-1	N	Y	N		N/A	N/A
R-93	8.1	Number *N*π of directions on 180°	3C	O-1	N	Y	N		N/A	N/A
R-94	8.2	Resolution of direction code start and stop point	3C	O-1	N	N	Y		N/A	N/A
R-95	8.2	Bit-depth of direction code start and stop point in x	3C	O-1	N	N	Y		N/A	N/A
R-96	8.2	Bit-depth of direction code start and stop point in y	3C	O-1	N	N	Y		N/A	N/A
R-97	8.2	Bit-depth of direction code start and stop direction	3C	O-1	N	N	Y		N/A	N/A
R-98	8.2	Bit-depth of direction in direction code	3C	O-1	N	N	Y		N/A	N/A
R-99	8.2	Step size *Ss* of direction code	3C	O-1	N	N	Y		N/A	N/A
R-100	8.2	Relative perpendicular step size 256 × *Sp*/*Ss*	3C	O-1	N	N	Y		N/A	N/A
R-101	8.2	Number *N*π of directions on 180°	3C	O-1	N	N	Y		N/A	N/A
R-102	8.3.1	The skeleton image size in pixels in x is stored in 2 bytes at a resolution of 100 ppcm for the compact and 200 ppcm for the normal format.	3C	O-1	N	Y	Y		N/A	N/A
R-103	8.3.1	The skeleton image size in pixels in y is stored in 2 bytes at a resolution of 100 ppcm for the compact and 200 ppcm for the normal format.	3C	O-1	N	Y	Y		N/A	N/A
R-104	8.3.2	The length (in bytes) of the finger pattern skeletal data shall be recorded in two bytes.	1	M	N	Y	Y			
R-105	8.3.3	The finger pattern skeletal data for a single finger shall be encoded as defined in Clauses 6.1 and 6.2 with the definitions of 8.1 respectively. 8.2.	3C	O-1	N	Y	Y		N/A	N/A
R-106	8.3.4	The length (in bytes) of the skeleton line neighbourhood index data shall be recorded in two bytes.	1	M	N	Y	Y			

Requirement Identifier	Reference in Base Standard	Requirement Summary	Level	Status	Sub-format / Format Type Applicability			IUT Support	Supported Range	Test Result
R-107	8.3.5	The skeleton line neighbourhood index data for a single finger shall be recorded as defined in Clause 6.3.	3C	O	N	Y	Y			
R-108	8.4	Only the x or the y-image size, not both, shall exceed the range of 255.	3A	M	N	Y	Y			
R-109	8.5	If proprietary data are appended, then the biometric data in standardized format (DOs with tag '90' – '93') shall be encapsulated in the DO with tag 'A1'.	2	O	N	Y	Y			
R-110	8.6.1	The maximal data size accepted is therefore an implementation dependent value and shall be indicated using the DO 'Maximal data size' (tag '81', value field 2 bytes). The nesting of this DO in the DO 'Biometric algorithm parameters' is shown in Table 7.	2	O	N	Y	Y			
R-111	8.6.1	If still the data length is too large, then truncation shall be made by peeling off skeleton segments from the convex hull of the described area.	2	O	N	Y	Y			
R-112	8.6.1	For the indication of the maximal data size expected by the card the DO Maximal data size as shown in Table 7 shall be used.	2	O	N	Y	Y			
R-113	8.6.1	If a card with on-card comparison supports one or more of the additional features, then the capabilities shall be indicated using the DO 'Feature handling indicator' (tag '83', value field 1 byte).	2	O	N	Y	Y			

Notes for Level 3 Requirements:

These are short notes that provide more detail about why a specific conformance test assertion or requirement is difficult to test.

1) Level 3C Difficulty

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. No method has been defined to test the conformance of the IUT or BDIR for this mandatory requirement of the base standard.

2) The reason for O-1.

The reason for status O-1 is derived from the difficulty of Level 3 conformance tests of the skeleton representation of friction ridges.

6.2 Table of test assertions

The specific test assertions required for conformance testing of ISO/IEC 19794-8:2006 Finger pattern skeletal data are listed in Table 2.

Table 2 — Conformance Test Assertions for Finger pattern skeletal data record format

Test	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
1	General Record Header	R-9	1	Format Identifier	EQ	0x 46534b00	1	M			
1.1	General Record Header	R-9	1	Format Identifier	NEQ	0x004b5346	1	M			
2	General Record Header	R-10,R-11	1	Version	EQ	0x30313000		M			
2.1	General Record Header	R-10,R-11	1	Version	NEQ	0x0030313	1	M			
3	General Record Header	R-12	1	Record Length	EQ	54 to 4294967295		M			
3.1	General Record Header	R-12	2	Record Length	EQ	Total Bytes Read		M			
3.2	General Record Header	R-12	2	Record Length	EQ	Total Bytes Expected		M			
4	Record Header	R-13	1	Capture Equipment Certification	MO	{0,8}		M			
5	Record Header	R-14	1	The two additional bits are reserved for future image quality certifications.	EQ	0 to 4		M			
5	Record Header	R-15	1	Capture Device Type ID	N/A	N/A		M			
5.1	Record Header	R-15	1	Capture Device Type ID	EQ	0x0000		M			
6	Record Header	R-16	N/A	Number of finger views in record	EQ	1 to 255		M			
7	Record Header	R-17	N/A	Resolution of finger pattern [ppcm]	EQ	1 to 255		M			
8	Record Header	R-18	1	Bit-depth of direction code start and stop point coordinates	EQ	8 to 16		M			
9	Record Header	R-19	1	Bit-depth of direction code start and stop direction	EQ	4 to 8		M			

Test	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
10	Record Header	R-20	1	Bit-depth of direction in direction code	EQ	3 to 8		M			
10.1	Record Header	R-21	2	Step size of direction code	EQ	1 to 255		M			
11	Record Header	R-22	1	Relative perpendicular step size of direction code	EQ	0 to 255		M			
12	Record Header	R-23	1	Number of directions on 180°	EQ	1 to 255		M			
13	Record Header	R-24	1	Reserved bytes	EQ	0		M			
14	Finger header	R-25,R-26, R-27, R-28	1	View number	EQ	0 to 15		M			
15	Finger header	R-29, R-30	1	Finger position	EQ	0 to 10		M			
16	Finger header	R-31	1	Impression type	EQ	0 to 3 or 8 to 9		M			
17	Finger header	R-32,R-33	1	Finger quality	EQ	0 to 100		M			
18	Finger header	R-34	1	Size of skeleton image in x direction	EQ	0 to 65535		M			
19	Finger header	R-35	1	Size of skeleton image in y direction	EQ	0 to 65535		M			
20	Finger header	R-36	1	Length of finger pattern skeletal data block	EQ	0 to 65535		M			
21	Finger header	R-37	1	Length of finger pattern skeletal data	EQ	0 to 65535		M			
22	Finger header	R-39	1	Length of skeleton line neighbourhood index data	EQ	0 to 65535		M			
23	Extended Data	R-41,R-42,R-43,R-44	1	Extended Data Block Length	EQ	0 to 65535		M			
24-1	Extended Data	R-41,R-42,R-43,R-44,R-49	2	Extended Data Block Length	EQ	Bytes Read		M			
24-2	Extended Data	R-41,R-42,R-43,R-44,49	2	Extended Data Block Length	EQ	Expected 8		M			
25	Extended Data	R-45,R-46	1	Extended Data Area Type Code	EQ	1 to 3, 0x0100 to 0xFFFF		M			
26	Extended Data	R-47,R-48	1	Extended Data Area Length	EQ	4 to 65535		M			
26-1	Extended Data	R-47,R-48	2	Extended Data Area Length	EQ	Bytes Read		M			
27	Ridge Count	R-52,R-53,R-54,R-55,R-56,R-57,R-58	1	Ridge Extraction Method	EQ	0 to 2		M			
28	Ridge Count	R-59	2	Ridge Index 1	C			M			

Test	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
29	Ridge Count	R-59	2	Ridge Index 2	C			M			
30	Ridge Count	R-59	2	Ridge Index 3	C			M			
31	Ridge Count	R-59,R-60	1	Ridge Count	EQ	0		M			
32	Core	R-61,R-62	1	Number of Cores	EQ	0 to 15		M			
32-1	Core	R-61,R-62	2	Number of Cores	C	Cores Read		M			
33	Core	R-63	1	Core Information Type	EQ	0 to 1		M			
34	Core	R-64,R-66	2	Core Location X	EQ	0 to 16383		M			
35	Core	R-65,R-66	2	Core Location Y	EQ	0 to 16383		M			
36	Core	R-67	1	Core Angle	EQ	0 to 255		M			
37	Delta	R-68	1	Number of Delta	EQ	0 to 15		M			
37-1	Delta	R-68	2	Number of Delta	C	Delta Read		M			
38	Delta	R-69	1	Delta Information Type	EQ	0 to 1		M			
39	Delta	R-70,R-72	2	Delta Location X	EQ	0 to 16383		M			
40	Delta	R-71,R-72	2	Delta Location Y	EQ	0 to 16383		M			
41	Delta	R-73,R-74	1	Delta Angle 1	EQ	0 to 255		M			
42	Delta	R-73,R-74	1	Delta Angle 2	EQ	0 to 255		M			
43	Delta	R-73,R-74	1	Delta Angle 3	EQ	0 to 255		M			
44	Zone Quality	R-75,R-76	1	Cell Width	EQ	1 to 255		M			
45	Zone Quality	R-75,R-76	1	Cell Height	EQ	1 to 255		M			
46	Zone Quality	R-77	1	Cell Bit Depth	EQ	1 to 255		M			
47	Zone Quality	R-78,R-79,R-80,R-81	2	Cell Quality Bits	C	Cell Bits Read		M			

Table 3 — Conformance Test Assertions for Finger pattern skeletal data card format – normal size

Test	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
1	Finger header	R-25,R-26, R-27, R-28	1	View number	EQ	0 to 15		M			
2	Finger header	R-29, R-30	1	Finger position	EQ	0 to 10		M			
3	Finger header	R-31	1	Impression type	EQ	0 to 3 or 8 to 9		M			
4	Finger header	R-32,R-33	1	Finger quality	EQ	0 to 100		M			
5	Finger header	R-34	1	Size of skeleton image in x direction	EQ	0 to 65535		M			
6	Finger header	R-35	1	Size of skeleton image in y direction	EQ	0 to 65535		M			
7	Finger header	R-36	1	Length of finger pattern skeletal data block	EQ	0 to 65535		M			
8	Finger header	R-37	1	Length of finger pattern skeletal data	EQ	0 to 65535		M			
9	Finger header	R-39	1	Length of skeleton line neighbourhood index data	EQ	0 to 65535		M			
10	Extended Data	R-41,R-42,R-43,R-44	1	Extended Data Block Length	EQ	0		M			

Table 4 — Conformance Test Assertions for Finger pattern skeletal data card format – compact size

Test	Section	Requirement ID	Level	Field Name	Operator	Operand	Test Note	Status	IUT Support	Supported Range	Test Result
1	Finger header	R-25,R-26, R-27, R-28	1	View number	EQ	0 to 15		M			
2	Finger header	R-29, R-30	1	Finger position	EQ	0 to 10		M			
3	Finger header	R-31	1	Impression type	EQ	0 to 3 or 8 to 9		M			
4	Finger header	R-32,R-33	1	Finger quality	EQ	0 to 100		M			
5	Finger header	R-34	1	Size of skeleton image in x direction	EQ	0 to 65535		M			
6	Finger header	R-35	1	Size of skeleton image in y direction	EQ	0 to 65535		M			
7	Finger header	R-36	1	Length of finger pattern skeletal data block	EQ	0 to 65535		M			
8	Finger header	R-37	1	Length of finger pattern skeletal data	EQ	0 to 65535		M			
9	Finger header	R-39	1	Length of skeleton line neighbourhood index data	EQ	0 to 65535		M			
10	Extended Data	R-41,R-42,R-43,R-44	1	Extended Data Block Length	EQ	0		M			

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 '0011' THEN

        FOR I = 1 TO {Number of Finger Views}

            SUMBYTES = SUMBYTES + 10 + {Length of finger pattern skeletal data block }
            SUMBYTES = SUMBYTES + {Extended Data Block Length}

        END

    IF {CBEFF Type} EQ '0012' THEN

        SUMBYTES = 6 + {Length of finger pattern skeletal data block }
        SUMBYTES = SUMBYTES + {Extended Data Block Length}

    IF {CBEFF Type} EQ '0013'

    SUMBYTES = 6 + {Length of finger pattern skeletal data block }
    SUMBYTES = SUMBYTES + {Extended Data Block Length}
```

This item applies to Finger pattern skeletal data record format only. The card formats do not have a view number.

3. {CBEFF Type Resolution}

```
IF {CBEFF Type} EQ '0011' THEN
    {Resolution X} GTE 1
    {Resolution Y} GTE 1

IF {CBEFF Type} EQ '0012' THEN
    {Resolution X} EQ 200
    {Resolution Y} EQ 200

IF {CBEFF Type} EQ '0013' THEN
    {Resolution X} EQ 100
    {Resolution Y} EQ 100
```

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 15 = 176.

This item applies to Finger pattern skeletal data record format only. The card formats do not have a view number.

5. {Incremental View Number Correctness}

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

This item applies to Finger pattern skeletal data record format only. The card formats do not have a view number.

6. {CBEFF Format Type Testing}

IF {CBEFF Type} EQ '0011' THEN
Finger pattern skeletal data record format

IF {CBEFF Type} EQ '0012' THEN
Finger pattern skeletal data card format – normal size

IF {CBEFF Type} EQ '0013' THEN
Finger pattern skeletal data card format – compact size

7. {Capture device ID}

If not zero, examine the validity of this code with the vendor.

8. { Zero Extended Data Length for No Extended Data}

As the individual extended data areas are read, the {Length of Extended Data Area} parameter for each one will become known. The sum of these is {Bytes Expected} for the extended data block, in accordance with Section 7.5.1.1 of the base standard. The test shall pass if the length is zero for a record that has no extended data.

9. { Ridge Count Indexing Consistency}

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

10. {Ridge Count Extraction Method Checking}

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

11. {Ridge Count Index 2 Uniqueness}

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

12. {Zero Ridge Count Index 2}

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

13. {Core and Delta Angles Present given Core Information Type of 01}

The following calculation will be evaluated once the {Extended Data Area Length} field for the core and delta data extended type 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.

{Total Bytes Expected} = Extended Data Area Length

IF {Core Information Type} EQ ‘0001’ THEN

NUMBER of BYTES for CORE Data EQ 1 + 5 * NUMBER_OF_CORES

ELSE

NUMBER of BYTES for CORE Data EQ 1 + 4 * NUMBER_OF_CORES

IF {Delta Information Type} EQ ‘0001’ THEN

NUMBER of BYTES for DELTA Data EQ 1 + 7 * NUMBER_OF_DELTAS

ELSE

NUMBER of BYTES for DELTA Data EQ 1 + 4 * NUMBER_OF_DELTAS

Total Bytes Expected EQ NUMBER of BYTES for CORE Data + NUMBER of BYTES for DELTA Data, such that the remaining bytes parsed are valid chains of extended data block lengths to end of file marker

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