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AMENDMENT 2
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Information technology — Biometric data interchange formats —

Part 2: Finger minutiae data

AMENDMENT 2: XML encoding and clarification of defects

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

Partie 2: Données du point caractéristique du doigt

AMENDEMENT 2: Codage XML et précisions concernant les défauts

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

Amendment 2 to ISO/IEC 19794-2:2011 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

Information technology — Biometric data interchange formats — Part 2: Finger minutia data

Amendment 2: XML encoding and clarification of defects

1. ***Append the following paragraph into introduction***

Additionally, this part of the ISO/IEC standard supports both binary and XML encoding, to support a spectrum of user requirement. With XML, this part will meet the requirements modern IT architectures. With binary encoding this part will also be able to be used in bandwitdth or storage constrained environments. Annex G specifies the schema that XML encoded finger minutia records must conform to, and Annex H provides an example of a valid XML encoded finger minutia record.

2. ***Replace the existing text in clause "2– Conformance" with the following***

A binary data record conforms to the finger minutiae record format of this part of ISO/IEC 19794 if it satisfies all the format requirements with respect to its structure, data values, relationships among its fields, and with respect to relations between its fields and the underlying input that are specified throughout clause 8 of this part of ISO/IEC 19794.

A binary data record conforms to the finger minutiae on-card comparison record format of this part of ISO/IEC 19794 if it satisfies all the format requirements with respect to its structure, data values, relationships among its fields, and with respect to relations between its fields and the underlying input that are specified throughout clause 9 of this part of ISO/IEC 19794.

An XML document conforms to this part of ISO/IEC 19794 if it satisfies the format requirements with respect to its structure, with respect to relations among its fields, and with respect to relations between its fields and the underlying input that are specified within Annex G of this part of ISO/IEC 19794.

A system that produces biometric data records is conformant to this part of ISO/IEC 19794 if all biometric data records that it outputs conform to this part of ISO/IEC 19794 (as defined above) as claimed in the Implementation Conformance Statement associated with that system. A system does not need to be capable of producing biometric data records that cover all possible aspects of this part of ISO/IEC 19794, but only those that are claimed to be supported by the system in the Implementation Conformance Statement (ICS).

A system that uses biometric data records is conformant to this part of ISO/IEC 19794 if it can read, and use for the purpose intended by that system, all biometric data records that conform to this part of ISO/IEC 19794 (as defined above) as claimed in the Implementation Conformance Statement associated with that system. A system does not need to be capable of using biometric data records that cover all possible aspects of this part of ISO/IEC 19794, but

only those that are claimed to be supported by the system in an Implementation Conformance Statement (ICS).

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 Annex A. Specifically, all Level-1, Level-2 and Level-3 tests shall use the assertions defined in Table A.2 and Table A.3 of clause A.3 in conformity with the concept and rules set in ISO/IEC 19794-1:2011 AMD 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 implementation in an implementation conformance statement (ICS), filled out in accordance with Annex A of ISO/IEC 19794-1:2011 AMD 1 and Table A.1 of clause A.2 of this part of ISO/IEC 19794.

3. *Insert the following text in the appropriate alphabetical order of Clause 3, Normative references:*

— http://www.w3.org/XML/Schema

4. *Replace in clause 9.5.1*

Table 19 shows the biometric data template with its embedded data objects.

With

Table 19 shows the biometric data template with its embedded data objects. All coordinate fields in extended data that express spatial resolution shall have units of 10^{-1} mm. If present, angle information for cores shall be expressed in the units of clause 8.5.3.2.4. If present, angle information for deltas shall be expressed in the units of clause 8.5.3.3.4.

5. *Replace Clause A.2 with the following text*

A.2 Table of requirements

The normative requirements specified in this Part of ISO/IEC 19794 are listed in Table A.1, which extends over multiple pages. 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.

35 (0023_{Hex})	XML-finger-image	{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) XML-finger-image(35)}

Table A.1 – Table of requirements

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-1	8.3.1	The format identifier shall be recorded in four bytes. The format identifier shall consist of three characters "FMR" followed by a zero byte as a NULL string terminator.	1	M	Y	N	N			
R-2	8.3.2	The number for the version of this part of ISO/IEC 19794 used for constructing the BDIR shall be placed in four bytes. This version number shall consist of three ASCII numerals followed by a zero byte as a NULL string terminator. The first and second character will represent the major version number and the third character will represent the minor revision number.	1	M	Y	N	N			
R-3	8.3.3	The length (in bytes) of the entire BDIR shall be recorded in four bytes. This count shall be the total length of the BDIR including the general record header and one or more finger representation records.	2	M	Y	N	N			
R-4	8.3.4	The total number of finger representation records contained in the BDIR shall be recorded in two bytes. A minimum of one finger representation is required.	2	M	Y	N	N			
R-5	8.3.5	The one-byte certification flag shall indicate whether each Representation Header includes a certification record. A value of 00_{Hex} shall indicate that no finger representation contains a certification record. A value of 01_{Hex} shall indicate that all finger representations contain a certification record.	2	M	Y	N	N			
R-6	8.4.1	A Representation Header shall precede each representation of finger data providing information for that finger representation. There shall be one finger header for each finger representation contained in the finger minutiae record.	1	M	Y	N	N			
R-7	8.4.2	The total number of bytes in the entire finger representation, including the representation header, shall be recorded in four bytes.	2	M	Y	N	N			
R-8	8.4.3	The Gregorian calendar year of the capture date and time field shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	N	N			
R-9	8.4.3	The month of the capture date and time field shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	N	N			
R-10	8.4.3	The day of the capture date and time field shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	N	N			
R-11	8.4.3	The hour of the capture date and time field shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	N	N			

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-12	8.4.3	The minute of the capture date and time field shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	N	N			
R-13	8.4.3	The second of the capture date and time field shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	N	N			
R-14	8.4.3	The millisecond of the capture date and time field shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	N	N			
R-15	8.4.3	The capture date and time field shall indicate when the capture of this finger representation started in Coordinated Universal Time (UTC).	3C	O-1	Y	N	Y			N/A
R-16	8.4.4	The capture device technology ID shall be encoded in one byte. This field shall indicate the class of capture device technology used to acquire the captured biometric sample. A value of 00_{Hex} indicates unknown or unspecified technology. See Table 5 for the list of possible values.	1	M	Y	N	N			
R-17	8.4.4	The capture device technology ID shall indicate the class of capture device technology used to acquire the captured biometric sample.	3C	O-1	Y	N	Y			N/A
R-18	8.4.5	The capture device vendor identifier shall be encoded in two bytes. A value of all zeros shall indicate that the capture device vendor is unreported.	1	M	Y	N	N			
R-19	8.4.5	The capture device vendor identifier shall be registered by IBIA or other approved registration authority.	3C	O-1	Y	N	Y			N/A
R-20	8.4.6	The capture device type identifier shall be encoded in two bytes. A value of all zeros shall indicate that the capture device type is unreported.	1	M	Y	N	N			
R-21	8.4.6	The capture device type identifier shall be assigned by the registered product owner or other approved registration authority.	3C	O-1	Y	N	Y			N/A
R-22	8.4.7.2	A quality record shall begin with a length field. The length field shall consist of one byte. It shall represent the number of quality blocks as an unsigned integer.	2	M	Y	N	N			
R-23	8.4.7.3	A quality score shall be encoded in one byte as an unsigned integer. Allowed values are – 0 to 100 with higher values indicating better quality, – 255, i.e. ff_{Hex}, for indicating that an attempt to calculate a quality score failed.	1	M	Y	N	N			

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-24	8.4.7.4	The quality algorithm vendor identifier shall be encoded in two bytes. A value of all zeros shall indicate that the quality algorithm vendor is unreported.	1	M	Y	N	N			
R-25	8.4.7.4	The quality algorithm vendor identifier shall be registered by IBIA or other approved registration authority.	3C	O-1	Y	N	Y			N/A
R-26	8.4.7.5	The quality algorithm identifier shall be encoded in two bytes. A value of all zeros shall indicate that the quality algorithm is unreported.	1	M	Y	N	N			
R-27	8.4.7.5	The quality algorithm identifier shall be registered by IBIA or other approved registration authority.	3C	O-1	Y	N	Y			N/A
R-28	8.4.8.2	A certification record shall begin with a length field. The length field shall consist of one byte. It shall represent the number of certification blocks as an unsigned integer.	2	M	Y	N	N			
R-29	8.4.8.3	The certification authority identifier shall be encoded in two bytes. A value of all zeros shall indicate that the certification authority is unreported.	1	M	Y	N	N			
R-30	8.4.8.3	The certification authority identifier shall be registered by IBIA or other approved registration authority.	3C	O-1	Y	N	N			N/A
R-31	8.4.8.4	The certification scheme identifier shall be encoded in one byte. A list of current certification scheme identifiers is contained in Table 6.	1	M	Y	N	N			
R-32	8.4.9	The finger position shall be recorded in one byte.	1	M	Y	N	N			
R-33	8.4.10	The number associated with the specific representation shall be recorded in one byte.	1	M	Y	N	N			
R-34	8.4.10	If there is more than one finger representation from the same finger in a finger minutiae record, each finger representation shall have a unique representation number. The combination of finger location and representation number shall uniquely identify a particular finger representation within a minutiae record.	2	M	Y	N	N			
R-35	8.4.10	Multiple finger representations from the same finger shall be numbered with increasing representation numbers, beginning with 0. Where only one finger representation is taken from each finger, this field shall be set to 0.	2	M	Y	N	N			

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-36	8.4.11	The horizontal spatial sampling rate of the minutiae coordinate system shall be recorded in two bytes having the units of pixels per centimeter. The value of the X spatial sampling rate shall not be less than 98.45 pixels per centimeter (250 pixels per inch).	1	M	Y	N	N			
R-37	8.4.12	The vertical spatial sampling rate of the minutiae coordinate system shall be recorded in two bytes having the units of pixels per centimeter. The value of the Y spatial sampling rate shall not be less than 98.45 pixels per centimeter (250 pixels per inch).	1	M	Y	N	N			
R-38	8.4.13	The impression type of the finger images from which the minutiae data was derived shall be recorded in this one-byte field.	1	M	Y	N	N			
R-39	8.4.14	The value for the size of the scanned image in x direction shall be written in a two-byte binary field. It shall be used to specify the number of pixels contained on a single horizontal line of the transmitted image. The range of allowed values is 0000_{Hex} to $3FFF_{Hex}$ for compatibility with the Minutia, Core, and Delta Position fields.	1	M	Y	N	N			
R-40	8.4.15	The value for the size of the scanned image in y direction shall be written in a two-byte binary field. It shall be used to specify the number of horizontal lines contained in the transmitted image. The range of allowed values is 0000_{Hex} to $3FFF_{Hex}$ for compatibility with the Minutia, Core, and Delta Position fields.	1	M	Y	N	N			
R-41	8.4.16	The number of bytes required to describe each minutia shall be recorded in the four high-order (most significant) bits of the byte. Allowed values are 5 (to indicate a 5-byte minutia format with no quality information, or 6 to indicate a 6-byte minutia format, including a 1-byte quality field.	1	M	Y	N	N			
R-42	8.4.17	The method used to determine the location of a ridge ending shall be recorded in the four low-order (least significant) bits of the byte.	1	M	Y	N	N			
R-43	8.4.18	The number of minutiae extracted and encoded for the finger shall be recorded in this one byte.	2	M	Y	N	Y			
R-44	8.4.19.1.2	The type of minutia shall be recorded in the upper two bits of the first byte of the minutia representation.	1	M	Y	N	N			
R-45	8.4.19.1.2, 9.2.4	'00' shall represent a minutia of "other" type.	3C	O-1	Y	Y	N			N/A
R-46	8.4.19.1.2, 9.2.4	'01' shall represent a ridge ending.	3C	O-1	Y	Y	N			N/A

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-47	8.4.19.1.2, 9.2.4	'10' shall represent a ridge bifurcation.	3C	O-1	Y	Y	N			N/A
R-48	8.4.19.1.3	The X coordinate of the minutia shall be recorded in the lower fourteen bits of the first two bytes of the minutia representation.	1	M	Y	N	N			
R-49	8.4.19.1.3	The upper two bits of the next byte of the minutia representation shall be set to '00'.	1	M	Y	N	N			
R-50	8.4.19.1.3	The Y coordinate of the minutia shall be recorded in the lower fourteen bits of the third and fourth byte of the minutia representation.	1	M	Y	N	N			
R-51	8.4.19.1.4	The angle of the minutia shall be recorded in one byte.	1	M	Y	N	N			
R-52	8.4.19.1.4	The angle of the minutia shall be recorded in units of 1,40625 (360/256) degrees.	3C	O-1	Y	N	Y			N/A
R-53	8.4.19.1.5	The quality of the minutia shall be recorded in one byte. The quality value shall range from 100 as a maximum to 0 as a minimum. A value of 254 indicates the quality was not reported and a value of 255 indicates a failure to acquire a quality score.	1	M	Y	N	N			
R-54	6.3.2	A minutia point shall be encoded once. A minutia point is uniquely identified by the location and angle.	2	M	Y	Y	Y			
R-55	8.5.1.1	The extended data length field shall consist of two bytes.	1/2	M	Y	N	N			
R-56	8.5.1.2	The extended data area type code shall be recorded in two bytes. A value of zero in both bytes shall not be used.	1	O	Y	N	N			
R-57	8.5.1.3	The length of the extended data section shall be recorded in two bytes.	1/2	O	Y	N	N			
R-58	8.5.2.1	Each ridge count area shall begin with a single byte indicating the ridge count extraction method. Allowed values are 00_{Hex}, 01_{Hex}, and 02_{Hex}.	1	O	Y	N	N			
R-59	8.5.2.1	Each ridge count area shall begin with a single byte indicating the ridge count extraction method. A value of 00_{Hex} shall indicate no specific ridge count extraction method. A value of 01_{Hex} shall indicate the four-neighbour ridge count extraction method. A value of 02_{Hex} shall indicate the eight-neighbour ridge count extraction method.	3C	O-1	Y	N	N			N/A
R-60	8.5.2.2	The first and second bytes of a ridge count area are index numbers, indicating which minutiae in the corresponding minutiae area are considered.	3C	O-1	Y	N	N			N/A
R-61	8.5.3.2.1	The number of core points shall be recorded in the least significant four bits of the first byte of the core data. Allowed values are from 0 to 15.	1/2	O	Y	N	N			

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-62	8.5.3.2.2	The core information type shall be recorded in the first two bits of the upper byte of the first byte of the core data. Allowed values are ‘00’ and ‘01’.	1	O	Y	N	N			
R-63	8.5.3.2.2	The core information type shall be recorded in the first two bits of the upper byte of the first byte of the core data. A value of ‘01’ indicates that angular information is present while ‘00’ indicates no angular information is present.	3C	O-1	Y	N	N			N/A
R-64	8.5.3.2.3	The X coordinate of the core shall be recorded in the lower fourteen bits of the first two bytes of the core data.	3C	O-1	Y	N	N			N/A
R-65	8.5.3.2.3	The Y coordinate of the core shall be placed in the lower fourteen bits of the following two bytes.	3C	O-1	Y	N	N			N/A
R-66	8.5.3.2.4	The angle of the core shall be recorded in one byte.	3C	O-1	Y	N	Y			N/A
R-67	8.5.3.3.1	The number of delta points shall be recorded in the least significant four bits of the first byte of the core data. Allowed values are from 0 to 15.	1/2	O	Y	N	N			
R-68	8.5.3.3.2	The delta information type shall be recorded in the first two bits of the upper byte of the first byte of the delta data. Allowed values are ‘00’ and ‘01’.	1	O	Y	N	N			
R-69	8.5.3.3.2	The delta information type shall be recorded in the first two bits of the upper byte of the first byte of the delta data. A value of ‘01’ indicates that angular information is present while ‘00’ indicates no angular information is present.	3C	O-1	Y	N	N			N/A
R-70	8.5.3.3.3	The X coordinate of the delta shall be recorded in the lower fourteen bits of the first two bytes of the delta data.	3C	O-1	Y	N	N			N/A
R-71	8.5.3.3.3	The Y coordinate of the delta shall be placed in the lower fourteen bits of the following two bytes.	3C	O-1	Y	N	N			N/A
R-72	8.5.3.3.4	The angle of the delta shall be recorded in one byte.	3C	O-1	Y	N	Y			N/A
R-73	8.5.4.2	The provider of zonal quality scores shall be identified in two bytes.	3C	O-1	Y	N	Y			N/A
R-74	8.5.4.3	The zonal quality algorithm shall be identified in two bytes.	3C	O-1	Y	N	Y			N/A
R-75	8.5.4.4	The number of pixels in cells in the x direction shall be stored in one byte.	3C	O-1	Y	N	Y			N/A
R-76	8.5.4.4	The number of pixels in cells in the y direction shall be stored in one byte.	3C	O-1	Y	N	Y			N/A
R-77	8.5.4.5	The bit depth of the cell quality information shall be contained in one byte.	1/2	O	Y	N	Y			

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-78	8.5.4.6	The quality of the fingerprint image in a cell shall be represented by one or more bits, as indicated by the bit depth.	3C	O-1	Y	N	Y			N/A
R-79	6.4.2	The coordinate system used to express the minutiae of a fingerprint shall be a Cartesian coordinate system. Points shall be represented by their X and Y coordinates. The origin of the coordinate system shall be the upper left corner of the original image with X increasing to the right and Y increasing downward.	3C	O-1	Y	Y	Y			N/A
R-80	6.4.3	The minutia for a ridge ending shall be defined as the point of forking of the medial skeleton of the valley area immediately in front of the ridge ending.	3C	O-1	Y	Y	Y			N/A
R-81	6.4.4	The minutia for a ridge bifurcation shall be defined as the point of forking of the medial skeleton of the ridge.	3C	O-1	Y	Y	Y			N/A
R-82	6.4.5	The minutia for a ridge skeleton endpoint shall be defined as the center point of the ending ridge.	3C	O-1	Y	Y	Y			N/A
R-83	6.7	All multibyte quantities are represented in Big-Endian format; that is, the more significant bytes of any multibyte quantity are stored at lower addresses in memory than (and are transmitted before) less significant bytes. All numeric values are fixed-length integer quantities, and are unsigned quantities.	1	M	Y	Y	N			
R-84	9.1	A series of minutiae descriptions shall be embedded in a tag-length-value encoded biometric data object as defined in ISO/IEC 7816-11.	1	M	N	Y	N			
R-85	9.2.3	The 8-bit X coordinate of the minutia shall be recorded in the first byte.	1	M	N	Y	N			
R-86	9.2.3	The 8-bit Y coordinate shall be placed in the second byte.	1	M	N	Y	N			
R-87	9.2.3	The coordinates shall be expressed such that each unit is equal to 10^{-1} mm.	3C	O-1	N	Y	N			N/A
R-88	9.2.4	The type of a minutia shall be recorded in the first two bits of the angle value for the minutia.	1	M	N	Y	N			
R-89	9.2.5	The angle of the minutia shall be recorded in six bits.	1	M	N	Y	N			
R-90	9.2.5	The angle of the minutia shall be recorded in units of 5.625 (360/64) degrees.	3C	O-1	N	Y	N			N/A
R-91	9.5.1	If extended data are present, finger-minutiae data shall be preceded by tag 81_{Hex} or $A1_{Hex}$ and a length field.	1	M	N	Y	N			

Requirement ID	Reference in main body	Requirement summary	Level	Status	Applicable to format type			IUT support	Supported range	Test result
					Record	On-card	XML			
R-92	9.5.1	If extended data in both, standardised and vendor-specific, formats are present, data in standardised format (data objects with tags 81_{Hex} and 91_{Hex} to 95Hex) shall be encapsulated in the data object with tag $A1_{Hex}$.	2	M	N	Y	N			
R-93	9.5.1, Table 19	If present, ridge-count data shall be preceded by tag 91_{Hex} and a length field.	1	O	N	Y	N			
R-94	9.5.1, Table 19	If present, core-point data shall be preceded by tag 92_{Hex} and a length field.	1	O	N	Y	N			
R-95	9.5.1, Table 19	If present, delta-point data shall be preceded by tag 93_{Hex} and a length field.	1	O	N	Y	N			
R-96	9.5.1, Table 19	If present, zonal-quality data shall be preceded by tag 94_{Hex} and a length field.	1	O	N	Y	N			
R-97	9.5.1, Table 19	If present, impression-type data shall be preceded by tag 95_{Hex} and a length field.	1	O	N	Y	N			
R-98	9.5.1, Table 19	If present, biometric data with vendor-specific format shall be preceded by tag 82_{Hex} or $A2_{Hex}$ and a length field.	1	O	N	Y	N			

6. ***Replace the header of A.3 with the following***

A.3 Table of test assertions for binary encoded records

The specific test assertions required for conformance testing for binary records 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.

7. ***Rename Table A.2 as Test assertions for binary encoded records***

8. **Add new section A.4**

A.4 Table of test assertions for xml encoded records

The specific test assertions required for conformance testing for xml encoded records to this Part of ISO/IEC 19794 are listed in Table A.3, which may extend over multiple pages. The conformance test assertions are listed in the order in that the corresponding fields are required to appear, if present, in a conforming record. As many requirements for encoding are described in the schema, the table only enumerates assertions that cannot be handled by using the schema. The normative requirements of this part of ISO/IEC 19794 as summarized in Table A.1 are referenced in Table.

Table A.3. Test assertions for xml encoded records

Test Num	Rqt ID	Level	Element Name	Operator	Opd	Test Note	Status	IUT Spt	Spt Range	Test Result
X1	R6-R7	1	FingerMinutia.Version.Major	EQ	3		M			
X2	R6-R7	1	FingerMinutia.Version.Minor	EQ	0		M			
X3		1	FingerMinutia. RepresentationList. Representation. Impression	NEQ	Any Value found in "**Invalid Enumerated Values for FrictionRidgeImpressionType in ISO/IEC 19794-2:2011 XML Encoding"** table		M			
X4		1	FingerMinutia. RepresentationList. Representation. Position	NEQ	Any Value found in "**Invalid Enumerated Values for FrictionRidgePositionType in ISO/IEC 19794-2:2011 XML Encoding**" table		M			
X5		2	FingerMinutia. RepresentationList. Representation. MinutiaPointList	C	All coordinates have a unique X,Y position	1	M			
X6		2	FingerMinutia. RepresentationList. Representation. MinutiaPointList. MinutiaPoint. Coordinate. X	LTE	FingerMinutia. RepresentationList. Representation. ImageWidth	1	M			
X7		2	FingerMinutia. RepresentationList. Representation. MinutiaPointList. MinutiaPoint. Coordinate. Y	LTE	FingerMinutia. RepresentationList. Representation. ImageHeight	1	M			

Test Notes:

1. For values within the same Representation

9. Insert the following text as a new Annex G normative clause

Annex G (normative) XML schema definition

This annex defines the schema that shall be used to validate XML finger minutia records encoded in an XML format. Additionally, this annex provides mappings from binary values to xml values.

G.1 Finger Minutia Schema

```
<?xml version="1.0" encoding="utf-8" ?>
<!--Permission is hereby granted, free of charge in perpetuity, to any person obtaining a copy of the
Schema, to use, copy, modify, merge and distribute free of charge, copies of the Schema for the purposes
of developing, implementing, installing and using software based on the Schema, and to permit persons to
whom the Schema is furnished to do so, subject to the following conditions:
THE SCHEMA IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT
LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO
EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER
IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SCHEMA OR THE
USE OR OTHER DEALINGS IN THE SCHEMA. In addition, any modified copy of the Schema shall include the
following notice: THIS SCHEMA HAS BEEN MODIFIED FROM THE SCHEMA DEFINED IN ISO/IEC 19794-2, AND SHOULD NOT
BE INTERPRETED AS COMPLYING WITH THAT STANDARD-->
```

```
<xs:schema xmlns="http://standards.iso.org/iso-iec/19794/-2/ed-2/amd/2"
xmlns:cmn="http://standards.iso.org/iso-iec/19794/-1/ed-2/amd/2" attributeFormDefault="unqualified"
elementFormDefault="qualified" targetNamespace="http://standards.iso.org/iso-iec/19794/-2/ed-2/amd/2"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
    <xs:import schemaLocation="19794-1_ed2_amd2.xsd" namespace="http://standards.iso.org/iso-iec/19794/-
1/ed-2/amd/2" />
```

```
    <xs:simpleType name="MinutiaDimension">
        <xs:restriction base="xs:unsignedInt">
            <xs:maxInclusive value="16383" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:complexType name="MinutiaCoordinateType">
        <xs:sequence>
            <xs:element name="X" type="MinutiaDimension" />
            <xs:element name="Y" type="MinutiaDimension" />
        </xs:sequence>
    </xs:complexType>
```

```
    <xs:simpleType name="MinutiaKindType">
        <xs:restriction base="xs:string">
            <xs:enumeration value="RidgeEnding" />
            <xs:enumeration value="RidgeBifurcation" />
            <xs:enumeration value="Other" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:simpleType name="MinutiaIndexType">
        <xs:restriction base="xs:unsignedByte">
            <xs:minInclusive value="1" />
            <xs:maxInclusive value="254" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:simpleType name="FingerMinutiaQualityScoreType">
        <xs:restriction base="xs:unsignedByte">
            <xs:minInclusive value="0" />
            <xs:maxInclusive value="100" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:complexType name="FingerMinutiaQualityType">
        <xs:sequence>
            <xs:choice>
```

```
            <xs:element name="Score" type="FingerMinutiaQualityScoreType" />
            <xs:element name="QualityCalculationFailed" type="xs:string" />
        </xs:choice>
    </xs:sequence>
</xs:complexType>

<xs:complexType name="MinutiaPointType">
    <xs:sequence>
        <xs:element name="Coordinate" type="MinutiaCoordinateType" />
        <xs:element name="Angle" type="xs:unsignedByte" />
        <xs:element name="Quality" type="FingerMinutiaQualityType" minOccurs="0" />
        <xs:element name="MinutiaIndex" type="MinutiaIndexType" />
        <xs:element name="MinutiaKind" type="MinutiaKindType" />
    </xs:sequence>
</xs:complexType>

<xs:complexType name="RidgeCountType">
    <xs:sequence>
        <xs:element name="MinutiaIndex1" type="MinutiaIndexType" />
        <xs:element name="MinutiaIndex2" type="MinutiaIndexType" />
        <xs:element name="RidgeCount" type="xs:unsignedByte" />
    </xs:sequence>
</xs:complexType>

<xs:complexType name="RelativeRidgeCountType">
    <xs:sequence>
        <xs:element name="RelativeMinutiaIndex" type="MinutiaIndexType" />
        <xs:element name="RidgeCount" type="xs:unsignedByte" />
    </xs:sequence>
</xs:complexType>

<xs:complexType name="FourNeighborRidgeCountType">
    <xs:sequence>
        <xs:element name="CenterMinutiaIndex" type="MinutiaIndexType" />
        <xs:element name="TopRightMinutiaCount" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="BottomRightMinutiaCount" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="BottomLeftMinutiaCount" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="TopLeftMinutiaCount" type="RelativeRidgeCountType" minOccurs="0" />
    </xs:sequence>
</xs:complexType>

<xs:complexType name="EightNeighborRidgeCountType">
    <xs:sequence>
        <xs:element name="CenterMinutiaIndex" type="MinutiaIndexType" />
        <xs:element name="Octant0Count" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="Octant1Count" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="Octant2Count" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="Octant3Count" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="Octant4Count" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="Octant5Count" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="Octant6Count" type="RelativeRidgeCountType" minOccurs="0" />
        <xs:element name="Octant7Count" type="RelativeRidgeCountType" minOccurs="0" />
    </xs:sequence>
</xs:complexType>

<xs:complexType name="CoreDataType">
    <xs:sequence>
        <xs:element name="Coordinate" type="MinutiaCoordinateType" />
        <xs:element name="Angle" type="xs:unsignedByte" minOccurs="0" />
    </xs:sequence>
</xs:complexType>

<xs:complexType name="DeltaDataType">
    <xs:sequence>
        <xs:element name="Coordinate" type="MinutiaCoordinateType" />
        <xs:sequence minOccurs="0">
            <xs:element name="Angle1" type="xs:unsignedByte" />
            <xs:element name="Angle2" type="xs:unsignedByte" />
            <xs:element name="Angle3" type="xs:unsignedByte" />
        </xs:sequence>
    </xs:sequence>
</xs:complexType>

<xs:complexType name="ZonalQualityDataType">
    <xs:sequence>
        <xs:element name="Algorithm" type="cmn:RegistryIDType" />
```

```
            <xs:element name="CellWidth" type="xs:unsignedByte" />
            <xs:element name="CellHeight" type="xs:unsignedByte" />
            <xs:element name="CellQualityList">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="CellQuality" type="xs:unsignedByte" maxOccurs="unbounded" />
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
        </xs:sequence>
    </xs:complexType>
```

```
    <xs:simpleType name="PositionType">
        <xs:restriction base="xs:string">
            <xs:enumeration value="UnknownFinger" />
            <xs:enumeration value="RightThumb" />
            <xs:enumeration value="RightIndex" />
            <xs:enumeration value="RightMiddle" />
            <xs:enumeration value="RightRing" />
            <xs:enumeration value="RightLittle" />
            <xs:enumeration value="LeftThumb" />
            <xs:enumeration value="LeftIndex" />
            <xs:enumeration value="LeftMiddle" />
            <xs:enumeration value="LeftRing" />
            <xs:enumeration value="LeftLittle" />
            <xs:enumeration value="RightSlap" />
            <xs:enumeration value="LeftSlap" />
            <xs:enumeration value="BothThumbs" />
            <xs:enumeration value="RightIndexMiddle" />
            <xs:enumeration value="RightMiddleRing" />
            <xs:enumeration value="RightRingLittle" />
            <xs:enumeration value="LeftIndexMiddle" />
            <xs:enumeration value="LeftMiddleRing" />
            <xs:enumeration value="LeftRingLittle" />
            <xs:enumeration value="RightIndexLeftIndex" />
            <xs:enumeration value="RightIndexMiddleAndRing" />
            <xs:enumeration value="RightMiddleRingAndLittle" />
            <xs:enumeration value="LeftIndexMiddleAndRing" />
            <xs:enumeration value="LeftMiddleRingAndLittle" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:simpleType name="ImpressionType">
        <xs:restriction base="xs:string">
            <xs:enumeration value="LiveScanPlain" />
            <xs:enumeration value="LiveScanRolled" />
            <xs:enumeration value="NonLiveScanPlain" />
            <xs:enumeration value="NonLiveScanRolled" />
            <xs:enumeration value="LatentImpression" />
            <xs:enumeration value="LatentTracing" />
            <xs:enumeration value="LatentPhoto" />
            <xs:enumeration value="LatentLift" />
            <xs:enumeration value="LiveScanVerticalSwipe" />
            <xs:enumeration value="LiveScanVerticalRolled" />
            <xs:enumeration value="LiveScanOpticalContactlessPlain" />
            <xs:enumeration value="Other" />
            <xs:enumeration value="Unknown" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:simpleType name="UnitDimensionType">
        <xs:restriction base="xs:string">
            <xs:whiteSpace value="collapse" />
            <xs:enumeration value="Inch" />
            <xs:enumeration value="Cm" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:complexType name="SpatialSamplingRateType">
        <xs:sequence>
            <xs:element name="SamplesPerUnit" type="xs:unsignedShort" />
            <xs:element name="UnitDimension" type="UnitDimensionType" />
        </xs:sequence>
    </xs:complexType>
```

```
    <xs:simpleType name="CaptureDeviceTechnologyType">
```

```
        <xs:restriction base="xs:string">
            <xs:whiteSpace value="collapse" />
            <xs:enumeration value="Unknown" />
            <xs:enumeration value="WhiteLightOpticalTIR" />
            <xs:enumeration value="WhiteLightOpticalDirectPlatenView" />
            <xs:enumeration value="WhiteLightOpticalTouchless" />
            <xs:enumeration value="MonochromaticVisibleOpticalTIR" />
            <xs:enumeration value="MonochromaticVisibleOpticalDirectPlatenView" />
            <xs:enumeration value="MonochromaticVisibleOpticalTouchless" />
            <xs:enumeration value="MonochromaticIROpticalTIR" />
            <xs:enumeration value="MonochromaticIROpticalDirectPlatenView" />
            <xs:enumeration value="MonochromaticIROpticalTouchless" />
            <xs:enumeration value="MultispectralOpticalTIR" />
            <xs:enumeration value="MultispectralOpticalDirectPlatenView" />
            <xs:enumeration value="MultispectralOpticalTouchless" />
            <xs:enumeration value="ElectroLuminescent" />
            <xs:enumeration value="SemiconductorCapacitive" />
            <xs:enumeration value="SemiconductorRF" />
            <xs:enumeration value="SemiconductorThermal" />
            <xs:enumeration value="PressureSensitive" />
            <xs:enumeration value="Ultrasound" />
            <xs:enumeration value="Mechanical" />
            <xs:enumeration value="GlassFiber" />
        </xs:restriction>
    </xs:simpleType>
```

```
    <xs:complexType name="CaptureDeviceType">
        <xs:sequence>
            <xs:element name="DeviceID" type="cmn:RegistryIDType" />
            <xs:element name="ScannerXSpatialSamplingRate" type="SpatialSamplingRateType" />
            <xs:element name="ScannerYSpatialSamplingRate" type="SpatialSamplingRateType" />
            <xs:element name="CertificationIDList" type="cmn:CertificationIDListType" minOccurs="0" />
            <xs:element name="Technology" type="CaptureDeviceTechnologyType" />
        </xs:sequence>
    </xs:complexType>
```

```
    <xs:complexType name="FingerMinutiaRepresentationType">
        <xs:sequence>
            <xs:element name="CaptureDevice" type="CaptureDeviceType" />
            <xs:element name="QualityList" type="cmn:QualityListType" minOccurs="0" />
            <xs:element name="Position" type="PositionType" />
            <xs:element name="Impression" type="ImpressionType" />
            <xs:element name="ImageXSpatialSamplingRate" type="SpatialSamplingRateType" />
            <xs:element name="ImageYSpatialSamplingRate" type="SpatialSamplingRateType" />
            <xs:element name="CaptureDateTime" type="xs:dateTime" />
            <xs:element name="ImageWidth" type="MinutiaDimension" />
            <xs:element name="ImageHeight" type="MinutiaDimension" />
            <xs:element name="RidgeEndingIsValleyBifurcation" type="xs:boolean" />
            <xs:element name="MinutiaPointList">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="MinutiaPoint" type="MinutiaPointType" maxOccurs="254" />
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
            <xs:element name="GenericRidgeCountList" minOccurs="0">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="RidgeCountList" type="RidgeCountType" maxOccurs="unbounded" />
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
            <xs:element name="FourNeighborRidgeCountList" minOccurs="0">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="FourNeighborRidgeCountList" type="FourNeighborRidgeCountType"
maxOccurs="unbounded" />
                    </xs:sequence>
                </xs:complexType>
            </xs:element>
            <xs:element name="EightNeighborRidgeCountList" minOccurs="0">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="EightNeighborRidgeCountList" type="EightNeighborRidgeCountType"
maxOccurs="unbounded" />
                    </xs:sequence>
```