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

Part 5: Face image data

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

Partie 5: Données d'image de la face

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see http://patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, SC 37, *Biometrics*.

This fourth edition cancels and replaces the third edition (ISO/IEC 29109-5:2014), which has been technically revised.

The main changes since the last edition include technical revision of the tables.

A list of all the parts in the ISO/IEC 29109 series, can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO/IEC 19794-5:2005 specifies a data record interchange format for storing, recording, and transmitting one or more face images within a Common Biometric Exchange Formats Framework (CBEFF) data structure. Each image is accompanied by subject-specific and image-specific metadata contained in a header record. This part of the ISO/IEC 29109 series establishes tests for checking the correctness of the binary record.

The objective of ISO/IEC 19794-5:2005 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 document supports those applications that require use of face image data according to ISO/IEC 19794-5:2005. It defines a testing methodology to ensure conformance of a vendor's application or service to the base ISO/IEC 19794-5:2005 specification. Thus this document is intended to:

— establish elements of the Conformance Testing Methodology framework that are specific to the Face Image-based Data Record requirements of ISO/IEC 19794-5:2005 conformance testing;

— define requirements and guidelines for specifying conformance test suites and related test methods for measuring conformity of products and services to the Face Image-based Data Record requirements of ISO/IEC 19794-5:2005; and

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

This document is applicable to the development and use of conformity test method specifications, conformity test suites for ISO/IEC 19794-5:2005 records, and conformance testing programs for ISO/IEC 19794-5:2005 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.

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

Part 5: Face image data

1 Scope

This document specifies elements of conformance testing methodology, test assertions, and test procedures as applicable to two-dimensional face images defined in the ISO/IEC 19794-5:2005 biometric data interchange format standard for face image data.

This document establishes

— test assertions of the structure of the face image data format as specified in ISO/IEC 19794-5:2005 (Type A Level 1 as defined in ISO/IEC 29109-1:2009),

— test assertions 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 document does not establish

— tests of conformance of 3D face records defined in ISO/IEC 19794-5:2005, 5.7.1, codes 0x80, 0x81, and 0x82,

— tests of conformance of CBEFF structures required by ISO/IEC 19794-5:2005,

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

— tests of conformance of the image data to the quality-related specifications of ISO/IEC 19794-5:2005,

— tests of conformance of the image data blocks to the respective JPEG or JPEG 2000 standards,

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 19794-5:2005, *Information technology — Biometric data interchange formats — Part 5: Face image 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<*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

4 Symbols and abbreviated terms

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

5 Conformance

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

Implementations of ISO/IEC 19794-5:2005 tested according to the methodology specified shall be able to claim conformance only to those biometric data record requirements specified in ISO/IEC 19794-5:2005 that are tested by the test methods established by this methodology.

Implementations of ISO/IEC 19794-5:2005 do not necessarily need to conform to all possible aspects of ISO/IEC 19794-5:2005, but only to those ISO/IEC 19794-5:2005 requirements that are claimed to be supported by the implementation in an Implementation Conformance Statement, filled out in accordance with ISO/IEC 29109-1:2009, Clause 8 and Table 1 of this document.

6 Conformance testing methodology

6.1 Overview

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

6.2 Table of requirements in the base standard

The normative requirements of ISO/IEC 19794-5:2005 are listed in Table 1. The supplier of the IUT can explain which optional components of the standard are supported and the testing laboratory can note the results of the test.

Under subformat applicability the columns labelled B, F and T indicate the Basic, Full Frontal and Token Frontal image types.

Table 1 — Requirements of the base international standard (ISO/IEC 19794-5:2005)

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-1	5.2.1	Within the record format and all well-defined data blocks therein, all multi-byte quantities are [implied shall] stored in Big-Endian format. That is, the more significant bytes of any multi-byte quantity are stored at lower addresses in memory than less significant bytes. For example, the value 1 025 (2 to the 10th power plus one) would be stored as first byte = 00000100 and second byte =00000001.	1	M	Y	Y	Y			
R-2	5.2.2	Numeric Values All numeric values are fixed-length unsigned integer quantities, unless otherwise specified.	3C	O-3	Y	Y	Y			
R-3	5.4.1	Format Identifier The (4 byte) Format Identifier shall consist of three ASCII characters “FAC” followed by a zero byte as a NULL string terminator to identify the record format as the face record format.	1	M	Y	Y	Y			
R-4	5.4.2	Version Number The (4 byte) Version Number block 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. The version number of this specification shall be 0x30313000; “010” – Version 1 revision 0. The version number in some implementations may also be 0x30323000, that is, “020”, however this setting is deprecated.	1	M	Y	Y	Y			
R-5	Table 2	$57 \leq$ Length of Record $\leq 2^{32} - 1$	1	M	Y	Y	Y			
R-6	5.4.3	Length of Record The (4 byte) Record Length Block shall be the combined length in bytes for the record. This is the entire length of the record including the Facial Record Header and Facial Record Data.	2	M	Y	Y	Y			
R-7	Table 2	$1 \leq$ Number of Facial Images $\leq 65\,535$	1	M	Y	Y	Y			
R-8	5.4.4	Number of Facial Images The (2 byte) Number of Facial Images block shall be the number of facial images included in the record.	2	M	Y	Y	Y			
R-9	5.5	The Facial Information block The (20 byte) Facial Information block is intended to describe discrete properties of the individual discernable from the image, one is included for each facial image included in the record. The structure of this block is shown in [ISO/IEC 19794-5:2005] Figure 2. Zero or more Facial Landmark blocks, one Image Information block, and one Image Data block follow this block.	2	M-2	Y	Y	Y			
R-10	5.5.1	Facial Record Data Length The (4 byte) Facial Record Data Length field denotes the sum of the lengths of the Facial Information block, the Landmark Point block(s), the Image Information block, and the Image Data block. The minimum value of the Facial Record Data Length is 32 bytes plus the size of the Image Data block (in bytes).	2	M	Y	Y	Y			
R-11	5.5.2	Number of Landmark Points The (2 byte) Number of Landmark Points block shall be the number of Landmark Point blocks that follow the Facial Information block. The Landmark Point block is defined in [ISO/IEC 19794-5:2005] Clause 5.6.	2	M	Y	Y	Y			
R-12	5.5.3	Gender The (1 byte) Gender block shall be specified in accordance with [ISO/IEC 19794-5:2005] Table 3.	1	M	Y	Y	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-13	5.5.4	Eye Colour The (1 byte) Eye Colour field shall represent the colour of irises of the eyes according to [ISO/IEC 19794-5:2005] Table 4. If the eyes are different colours, then right eye colour is to be encoded.	1	M	Y	Y	Y			
R-14	5.5.5	Hair Colour The (1 byte) Hair Colour field shall represent the colour of the hair according to the [ISO/IEC 19794-5:2005] Table 5.	1	M	Y	Y	Y			
R-15	5.5.6	Property Mask The (3 byte) Property Mask is a bit mask of 3 bytes and each bit of the mask position listed in [ISO/IEC 19794-5:2005] Table 6 shall be set to 1 if the corresponding property is present, and set to 0 if absent. The mask position starts from 0 at the lowest bit. The lowest bit set to 0 shall indicate that properties are not specified (and all bits shall be zero); the lowest bit set to 1 shall indicate that all listed properties have been considered and that a zero value of any property bit indicates an absence of that property. Note that a Blink flag set to "1" will indicate non-compliance with the Frontal, Full Frontal, and Token image types.	2	M	Y	Y	Y			
R-16	5.5.7	Expression The (2 byte) Expression field shall represent the expression of the face according to [ISO/IEC 19794-5:2005] Table 7.	1	M	Y	Y	Y			
R-17	5.5.8	Pose Angle The (3 multi byte) Pose Angle field (B_Y, B_P, B_R) shall represent the estimate or measure pose of the subject in the image. Each byte in the field respectively represents pose angles of yaw, pitch and roll in that order. The pose angle is given by Tait-Bryan angles. — Yaw angle: Rotation about the vertical (y) axis. — Pitch angle: Rotation about the horizontal side-to-side (x) horizontal axis. — Roll angle: Rotation about the horizontal back to front (z) axis. The angles are defined relative to the frontal view of the subject, which has angles (0,0,0) as shown in [ISO/IEC 19794-5:2005] Figure 5. The examples are shown in [ISO/IEC 19794-5:2005] Figure 6. As order of the successive rotation around the different axes does matter, the encoded rotation angle shall correspond to an order of execution starting from the frontal view. This order shall be given by Roll (about the front axis), then Pitch (about the horizontal axis) and finally Yaw (about the vertical axis). The (first executed) Roll transformation will therefore always be in the image (x,y) plane. From the point of view of executing a transformation from the observed view to a frontal view, the transformation order will therefore be Yaw, Pitch, and then Roll. Note however that the encoded angle is from the frontal view to the observed view.	3C	O-1	Y	Y	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-18	5.5.8.1	Pose Angle – Yaw The yaw angle, Y, is the rotation in degrees about the y-axis (vertical axis) shown in [ISO/IEC 19794-5:2005] Figure 5. Frontal faces have a yaw angle of 0 degrees. Positive angles represent faces looking to their left (a counter-clockwise rotation around the y-axis). "The encoded value, BY, shall be stored in 1 byte with values 0 to 180 computed from a real-valued yaw angle estimate, $-180 \le Y < 180$, as follows:" If $180 \ge Y \ge 0$ and Y is even, then $B_Y = Y/2 + 1$. If $180 \ge Y > 0$ and Y is odd, then $B_Y = (Y+1)/2$. If $-180 \le Y < 0$ and Y is even, then $B_Y = 181 + Y/2$. If $-180 \le Y < 0$ and Y is odd, then By = 181+ (Y-1)/2. The maximum value of B_Y is 180. If the yaw angle is not specified, the value of B_Y shall be 0.	1	M	Y	Y	Y			
R-19	5.5.8.2	Pose Angle – Pitch The pitch angle, P, is the rotation in degrees about the x-axis (horizontal axis) shown in [ISO/IEC 19794-5:2005] Figure 5. Frontal faces have a pitch angle of 0 degrees. Positive angles represent faces looking down (a counterclockwise rotation around the x-axis). The encoded value, B_P, shall be stored in 1 byte with values 0 to 180 computed from a real-valued pitch angle estimate, $-180 \le P < 180$, as follows: If $180 \ge P \ge 0$ and P is even, then $B_P = P/2 + 1$. If $180 \ge P > 0$ and P is odd, then $B_P = (P + 1)/2$. If $-180 \le P < 0$ and P is even, then $B_P = 181 + P/2$. If $-180 \le P < 0$ and P is odd, then $B_P = 181 + (P - 1)/2$. The maximum value of B_P is 180. If the pitch angle is not specified, the value of B_P shall be 0.	1	M	Y	Y	Y			
R-20	5.5.8.3	Pose Angle – Roll The roll angle, R, is the rotation in degrees about the z-axis (the horizontal axis from front to back) shown in [ISO/IEC 19794-5:2005] Figure 5. Frontal faces have a roll angle of 0 degrees. Positive angles represent faces tilted toward their right shoulder (counter-clockwise rotation around the z-axis). The encoded value, B_R, shall be stored in 1 byte with values 0 to 180 computed from a real-valued roll angle estimate, $-180 \le R < 180$, as follows: If $180 \ge R \ge 0$ and R is even, then $B_R = R/2 + 1$. If $180 \ge R > 0$ and R is odd, then $B_R = (R + 1)/2$. If $-180 \le R < 0$ and R is even, then $B_R = 181 + R/2$. If $-180 \le R < 0$ and R is odd, then $B_R = 181 + (R-1)/2$. The maximum value of B_R is 180. If the roll angle is not specified, the value of B_R shall be 0.	1	M	Y	Y	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-21	5.5.9	Pose Angle Uncertainty The (3 multi-byte) Pose Angle Uncertainty (U_Y, U_P, U_R) represents the expected degree of accuracy of the pose angle yaw, pitch, and roll. Each byte in the field respectively represents the uncertainty of yaw, pitch and roll in that order. The uncertainty is allowed to represent experimental uncertainty specified by each vendor. The encoding of Pose Angle Uncertainty is given by bytes (U_Y, U_P, U_R) where each byte U_K in the field (k = Y,P,R) represents degree of uncertainty with minimum and maximum values of 1 and 181 where U_K=(uncertainty+1). The more uncertain, the value of the uncertainty U_K shall become larger. If the uncertainty is not specified, then the values of U_Y, U_P and U_R shall be set to zero (0).	1	M	Y	Y	Y			
R-22	5.6	The Landmark Point Block The optional (8 byte) Landmark Point block specifies the type, code and position of a Landmark Point in the facial image. The number of Landmark Point blocks shall be specified in the Number of Landmark Points field of the Facial Information Block. The structure of this block is shown in [ISO/IEC 19794-5:2005] Table 8.	1	M	Y	Y	Y			
R-23	5.6.1	Landmark Point Type The (1 byte) Landmark Point Type field represents the type of the Landmark Point stored in the Landmark Point block. This field shall be set to 0x01 to denote that the position of the Landmark Point is represented by the coordinate of the image. All other field values are reserved for future definition of Landmark Point types.	1	M	Y	Y	Y			
R-24	5.6.2	Landmark Point Code The (1 byte) Landmark Point Code field shall specify the Landmark Point that is stored in the Landmark Point block. The codes of the Landmark Points in [ISO/IEC 19794-5:2005] Clause 5.6.3, taken from the MPEG4 standard and defined as MPEG4 Landmark Points, or the additional eye and nostril Landmark Points in [ISO/IEC 19794-5:2005] Clause 5.6.4 shall be stored in this block. Each Landmark Point code is represented by a notation A.B using a major (A) and a minor (B) value. The encoding of the Landmark Point code is given by the (1 byte) value of A*16 + B.	1	M	Y	Y	Y			
R-25	5.6.3	MPEG4 Landmark Points [ISO/IEC 19794-5:2005] Figure 7 denotes the Landmark Point codes associated with Landmark Points as given by Annex C of ISO/IEC 14496-2.	3C	O-1	Y	Y	Y			
R-26	5.6.4	Eye and nostril centre Landmark Points The eye centre Landmark Points 12.1 (left) and 12.2 (right) are defined to be the horizontal and vertical midpoints of the eye corners (3.7, 3.11) and (3.8, 3.12) respectively. The left nostril centre Landmark Point 12.3 is defined to be the midpoint of the nose Landmark Points (9.1, 9.15) in the horizontal direction and (9.3,9.15) in the vertical direction. Similarly, the right nostril centre Landmark Point 12.4 is defined to be the midpoint of the nose Landmark Points (9.2, 9.15) in the horizontal direction and (9.3,9.15) in the vertical direction. Both the eye centre and nostril centre Landmark Points are shown in [ISO/IEC 19794-5:2005] Figure 8 and values given in [ISO/IEC 19794-5:2005] Table 10.	3C	O-1	Y	Y	Y			
R-27	5.7	The Image Information Block The (16 byte) Image Information block is intended to describe digital properties of the facial image, one is included for each facial image included in the record. The structure of this block is shown in [ISO/IEC 19794-5:2005] Figure 2. One Image Data block shall follow this block.	2	M-2	Y	Y	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-28	5.7.1	Face Image Type The Face Image Type field shall represent the type of the facial image stored in the Image Data Block according to [ISO/IEC 19794-5:2005] Table 12. Note that all Frontal Image Types are either Full Frontal or Token Frontal. Therefore a separate Frontal Value is not required. The Basic Face Image Type is defined in [ISO/IEC 19794-5:2005] Clause 6. The Frontal, Frontal/Full and Frontal/Token Face Image Types are defined in [ISO/IEC 19794-5:2005] Clauses 7, 8, and 9 respectively. Face Image Types use the notion of inheritance. For example, the Frontal Face Image Type inherits all of the requirements of the Basic Face Image Type - the Frontal Face Image type obeys all normative requirements of the Basic Face Image Type. The inheritance structure of defined image types is shown in [ISO/IEC 19794-5:2005] Figure 10.	1	M	Y	Y	Y			
R-29	5.7.2	Image Data Type The (1 byte) Image Data Type field denotes the encoding type of the Image Data block. Either JPEG (ISO/IEC 10918-1 and ITU-T Rec. T.81) or JPEG2000 (ISO/IEC 15444-1) shall be specified. Note that a "Unspecified" Value cannot be encoded.	2	M	Y	Y	Y			
R-30	5.7.3	Width The (2 byte) Width field shall specify the number of pixels in the horizontal direction.	2	M	Y	Y	Y			
R-31	5.7.4	Height The (2 byte) Height field shall specify the number of pixels in the vertical direction.	2	M	Y	Y	Y			
R-32	5.7.5	Image Colour Space The (1 byte) Image Colour Space field indicates the colour space used in the encoded Image Data block according to the values in [ISO/IEC 19794-5:2005] Table 14. The values of 128-255 are vendor specific. Application developers may obtain the values for these codes from the vendor.	2	M	Y	Y	Y			
R-33	5.7.6	Source Type The (1 byte) Source Type field denotes the classification of the source of the captured image and is given in [ISO/IEC 19794-5:2005] Table 15.	1	M	Y	Y	Y			
R-34	5.7.7	Device Type The (2 byte) Device Type field denotes the vendor specific capture device type ID. A value of all zeros will be acceptable and will indicate that the capture device type ID is unspecified. Application developers may obtain the values for these codes from the vendor.	1	M	Y	Y	Y			
R-35	5.7.8	Quality The (2 byte) Quality field shall be reserved for future definition to represent a quality of the facial image. This field shall be set to the value 0 indicating "unspecified".	1	M	Y	Y	Y			
R-36	5.8.1	Data structure The (variable byte) Image Data block shall be the image data encoded by either the JPEG or JPEG2000 standards.	2	M	Y	Y	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
Basic Face Image Type										
R-37	6.2	Image data encoding requirements for the Basic Face Image Type One of two possible encodings is to be used for all image types (Basic) 1) The JPEG Sequential baseline (ISO/IEC 10918-1) mode of operation and encoded in the JFIF file format (the JPEG file format) 2) The JPEG-2000 Part-1 Code Stream Format (ISO/IEC 15444-1) and encoded in the JP2 file format (the JPEG2000 file format).	2	M	Y	Y	Y			
R-38	6.4.1	Facial Header [for the Basic Face Image Type] The Format Identifier, Version Number, Length of Record, and Number of Faces fields shall be specified.	1	M	Y	Y	Y			
R-39	6.4.2	Facial Information [for the Basic Face Image Type] The Block Length and Number of Landmark Points fields shall be specified.	1	M	Y	Y	Y			
R-40	6.4.3	Image Information [for the Basic Face Image Type] The Face Image Type field shall be specified with value 0x00.	1	M	Y	Y	Y			
R-41	6.4.3	The Image Data Type, Width, and Height fields shall be specified.	1	M	Y	Y	Y			
The Frontal Face Image Type										
R-42	7.2.2	Pose Thus, the full-face frontal pose shall be used. Rotation of the head shall be less than ±5° from frontal in pitch and yaw (ref 5.5.8). Pose variations that lead to an in-plane rotation of the head can be more easily compensated by automated face recognition systems. Therefore, the rotation of the head shall be less than ±8° from frontal in roll (ref 5.5.8). [ISO/IEC 19794-5:2005] Figure 13 shows an example of ±8° rotation in roll. The best practice recommendation as outlined in A.2.2 is that the rotation of the head should be less than ±5° from frontal in roll. This constraint refers to the pose of the subject associated with the face image format data for all applications that call for this format to be used.	3C	O-1	N	Y	Y			
R-43	7.2.4	Assistance in positioning the face In no cases will any other face be captured in the Frontal image. See informative annex A.2 for best practices on this topic.	3C	O-1	N	Y	Y			
R-44	7.2.5	Shoulders Shoulders shall be “square on” to the camera. “Portrait style” photographs where the subject is looking over one shoulder are not acceptable.	3C	O-1	N	Y	Y			
R-45	7.2.7	Subject and scene lighting Lighting shall be equally distributed on the face.	3C	O-1	N	Y	Y			
R-46	7.2.7	There shall be no significant direction of the light from the point of view of the photographer, as further described in [ISO/IEC 19794-5:2005] Clauses 7.2.8 and 7.2.9.	3C	O-1	N	Y	Y			
R-47	7.2.8	Shadows over the face The region of the face, from the crown (as defined in section 4.6) to the base of the chin, and from ear-to-ear, shall be clearly visible and free of shadows.	3C	O-1	N	Y	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-48	7.2.8	Special care shall be taken in cases when veils, scarves or headdresses cannot be removed for religious reasons to ensure these coverings do not obscure any facial features and do not generate shadow. In all other cases head coverings shall be absent .	3C	O-1	N	Y	Y			
R-49	7.2.9	Shadows in eye-sockets There shall be no dark shadows in the eye-sockets due to the brow.	3C	O-1	N	Y	Y			
R-50	7.2.9	The iris and pupil of the eyes shall be clearly visible.	3C	O-1	N	Y	Y			
R-51	7.2.10	Hot Spots Care shall be taken to avoid "hot spots" (bright areas of light shining on the face). These artefacts are typically caused when one, high intensity, focused light source is used for illumination.	3C	O-1	N	Y	Y			
R-52	7.2.10	Instead, diffused lighting, multiple balanced sources or other lighting methods shall be used. A single bare “point” light source is not acceptable for imaging. Instead, the illumination should be accomplished using other methods that meet requirements specified in this [ISO/IEC 19794-5:2005] Clause.	3C	O-1	N	Y	Y			
R-53	7.2.11	Eye Glasses If the person normally wears glasses then they should wear glasses when their photograph is taken. Glasses shall be clear glass and transparent so the eye pupils and irises are clearly visible.	3C	O-1	N	Y	Y			
R-54	7.2.11	Permanently tinted glasses or sunglasses are acceptable only for medical reasons (and shall otherwise be removed). In cases where tinted glasses or sunglasses are worn, the specification of dark glasses in the header structure is recommended.	3C	O-1	N	Y	Y			
R-55	7.2.11	Care shall be taken that the glasses frames do not obscure the eyes.	3C	O-1	N	Y	Y			
R-56	7.2.11	There shall be no lighting artefacts or flash reflections on glasses. This can typically be achieved by increasing the angle between the lighting, subject and camera to 45º (degrees) or more.	3C	O-1	N	Y	Y			
R-57	7.2.12	Eye Patches The wearing of eye patches is allowed only for medical reasons. In these cases, the specification of the patch, in the header structure is recommended.	3C	O-1	N	Y	Y			
R-58	7.3.2	No Over or Under Exposure For each patch of skin on the person’s face, the gradations in textures shall be clearly visible. In this sense, there will be no saturation (over or under exposure) on the face.	3C	O-1	N	Y	Y			
R-59	7.3.3	Focus and Depth of Field The subject’s captured image shall always be in focus from nose to ears and chin to crown.	3C	O-1	N	Y	Y			
R-60	7.3.3	All images will have sufficient depth of focus to maintain greater than two millimetre resolution on the subject’s facial features at time of capture.	3C	O-1	N	Y	Y			
R-61	7.3.4	Unnatural Color Unnaturally coloured lighting, yellow, red, etc. is not allowed. Care shall be taken to correct the "white balance" of image capture devices.	3C	O-1	N	Y	Y			
R-62	7.3.4	The lighting shall produce a face image with natural looking flesh tones when viewed in typical examination environments.	3C	O-1	N	Y	Y			
R-63	7.3.4	“Red-eye” is not acceptable.	3C	O-1	N	Y	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-64	7.3.5	Color or Grayscale Enhancement A process that overexposes or under-develops a colour or greyscale image for purposes of beauty enhancement or artistic pleasure is not allowed. The full spectrum shall be represented on the face image where appropriate. Teeth and whites of eyes shall be clearly light or white (when appropriate) and dark hair or features (when appropriate) shall be clearly dark.	3C	O-1	N	Y	Y			
R-65	7.3.6	Radial Distortion of the Camera Lens The fish eye (ref. 4.11) that is associated with unusually large noses in the image is not allowed.	3C	O-1	N	Y	Y			
R-66	7.4.1.1	Pixel aspect ratio Digital cameras and scanners used to capture facial images shall produce images with a pixel aspect ratio of 1:1. That is, the number of pixels per inch in the vertical dimension shall equal the number of pixels per inch in the horizontal direction.	3C	O-1	N	Y	Y			
R-67	7.4.1.2	Origin at Upper Left The origin of coordinates shall be at the upper left given by coordinate (0,0) with positive entries from left to right (first dimension) and top to bottom (second dimension).	3C	O-1	N	Y	Y			
R-68	7.4.2.3	Colour space Frontal images shall be represented as one of the following a) The 24-bit RGB colour space where for every pixel, eight (8) bits will be used to represent each of the Red, Green, and Blue components. b) An 8-bit monochrome colour space where for every pixel, (8) bits will be used to represent the luminance component. c) The YUV422 colour space where twice as many bits are dedicated to luminance as to each of the two colour components. YUV422 images typically contain two 8-bit Y samples along with one 8-bit sample of each of U and V in every four bytes.	2	O-1	N	Y	Y			
R-69	7.4.3	Video interlacing Interlaced video frames are not allowed for the Frontal Image Type. All interlacing must be absent (not simply removed, but absent).	3C	O-1	N	Y	Y			
R-70	7.5.2	Image Information [for the Frontal Image Type] Frontal Images are either Full Frontal or Token Frontal images and the Face Image Type field shall be set accordingly (ref. 8.5.2, 9.3.2).	1	M	N	Y	Y			
		The Full Frontal Image Type								
R-71	8.3.1	Introduction In addition to the requirements of 8.3.2 to 8.3.6, the face from chin to crown as defined in 8.3.5 and with the full width as defined in 8.3.4 shall be visible in the image.	3C	O-1	N	Y	Y			
R-72	8.3.2	Horizontally centred face The approximate horizontal midpoints of the mouth and of the bridge of the nose define the imaginary line AA (usually the symmetry axis of the face). Furthermore, the imaginary line BB is defined as the line through the centres of the left and right eye. The intersection of AA and BB defines the point M as the centre of the face. The x-coordinate M_x of M shall be between 45 % and 55 % of the image width.	3C	O-1	N	Y	N			
R-73	8.3.3	Vertical position of the face The y-coordinate M_y of M shall be between 30 % and 50 % of the image height.	3C	O-1	N	Y	N			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-74	8.3.3	A single exception is allowed for children under the age of 11 years, in which case the higher limit shall be modified to 60 % (i.e. the centre point of the head is allowed to be lower in the image for children under the age of 11). The origin O of the coordinate system is defined to be in the upper left corner of the image.	3C	O-1	N	Y	N			
R-75	8.3.4	Width of head The width of a head is defined as the distance between the two imaginary lines parallel to the line AA; each imaginary line is drawn between the upper and lower lobes of each ear and shall be positioned where the external ear connects to the head. The head width is shown as length CC in Figure 14.	3C	O-1	N	Y	N			
R-76	8.3.4	To ensure that the entire face is visible in the image, the head width (CC) shall be between 50 % and 75 % of the image width (A).	3C	O-1	N	Y	N			
R-77	8.3.5	Length of head The length of a head is defined as the distance between the base of the chin and the crown measured on the imaginary line AA. This is shown as length DD in Figure 14. The crown is defined as the top of the head ignoring any hair. In order to assure that the entire face is visible in the image, the minimum image height shall be specified by requiring that the crown-to-chin portion (DD) of the full frontal image pose shall be between 60 % and 90 % of the vertical length of the image (B).	3C	O-1	N	Y	N			
R-78	8.3.5	A single exception is allowed for children under the age of 11 years, in which case the lower limit shall be modified to 50 %.	3C	O-1	N	Y	N			
R-79	8.4.1	Resolution [Digital requirements for the Full Frontal Face Image Type] For an image for optimal human examination and permanent storage, the resolution of the full images shall be at least 180 pixels of resolution for the width of the head, or roughly 90 pixels from eye centre to eye centre. See informative annex section A.3.1.1 for best practices on this topic.	3C	O-1	N	Y	N			
R-80	8.5.2	Image Information The Face Image Type field shall be specified with value 0x01.	1	M	N	Y	N			
The Token Face Image Type										
R-81	9.2.2	Eye positions To create a Token Face image, the eye socket centres, or simply eye positions, defined as Landmark Points 12.1 and 12.2, shall be determined. For the determination of eye positions, it is possible: 1) to use computer inspection 2) to use human visual inspection 3) to use computer and human visual inspection.	3C	O-1	N	N	Y			
R-82	9.2.3	Token image geometric format A Token image is a colour or greyscale image with image dimensions and eye position coordinates given by [ISO/IEC 19794-5:2005] Table 16. Note that [ISO/IEC 19794-5:2005] Clause 5.2.3 specifies conversion of values to integer. Image Height W/0,75 where W is the Image Width.	2	M	N	N	Y			
R-83	9.2.3	Y coordinate of Eyes 0,6 * W	3C	O-1	N	N	Y			
R-84	9.2.3	X coordinate of First (right) Eye 0,375 * W	3C	O-1	N	N	Y			
R-85	9.2.3	X coordinate of Second (left) Eye = (0,625 * W) – 1	3C	O-1	N	N	Y			
R-86	9.2.3	Width from eye to eye (inclusive) 0,25 *W	3C	O-1	N	N	Y			

Table 1 *(continued)*

Requirement ID	Ref. in base std	Requirement summary	Level	Status	Subformat applicability			IUT support	Supported range	Test result
					B	F	T			
R-87	9.2.4	Minimum Width Token Image The minimum required image width is 240 pixels.	2	M	N	N	Y			
R-88	9.2.4	The distance from eye to eye (inclusive) in this case is therefore [at least] 60 pixels. This example is shown in Figure 16.	3C	O-1	N	N	Y			
R-89	9.2.4	Coordinates are relative to the top left corner of the image (0,0) and all measurements are in units of pixels.	3C	O-1	N	N	Y			
R-90	9.2.5	Padding The normative practice shall be to fill any undefined set of pixels with any colour. See informative annex A.4.3 for best practices on this matter.	3C	O-1	N	N	Y			
R-91	9.3.2	Image Information The Face Image Type field in the Image Information structure shall be specified with value 0x02.	1	M	N	N	Y			

NOTE 1 Level 3C conformance test assertions are not specified. In all cases, the reason for this is that no method has been defined to test the conformance of the IUT or BDIR for this mandatory requirement of the base standard. For the purposes of this document, the requirements are optional ("O") until an appropriate test method is established. The 3C label indicates that conformance testing of this Level 3 conformance requirement is beyond the scope of the present version of the conformance testing standard containing the table. However, most of the requirements can be tested by means of suitable image processing operations. For example, there is a large academic literature on pose estimation (see [5] for a review).

NOTE 2 These Level 2 requirements appear in clauses which define the block structure of a conformant ISO/IEC 19794-5:2005 record. The requirements do not appear in Tables 2, 3, and 4 below because other conformance test assertions cover these requirements.

NOTE 3 This is not a Level 1 requirement because testing requires more information than is contained in the field. It can be addressed on a case-by-case basis by the requirements / assertions pertaining to those fields.

6.3 ISO/IEC 19794-5:2005 Level 1 and 2 test assertions

A subsystem that claims to produce face image records that conform to the Level 1 and Level 2 requirements of the **Basic** Face Image Type of ISO/IEC 19794-5:2005 Face Image Format for Data Interchange **shall** be assessed by execution of all of the specific test assertions listed in Table 2. The test notes which follow Table 2 are normative.

A subsystem that claims to produce face image records that conform to the Level 1 and Level 2 requirements of the Full Frontal Face Image Type of ISO/IEC 19794-5:2005 Face Image Format for Data Interchange **shall** be assessed by execution of all of the specific test assertions listed In Table 3. The test notes which follow Table 3 are normative.

A subsystem that claims to produce face image records that conform to the Level 1 and Level 2 requirements of the **Token** Face Image Type of ISO/IEC 19794-5:2005 Face Image Format for Data Interchange **shall** be assessed by execution of all of the specific test assertions listed in Table 4. The test notes which follow Table 4 are normative.

NOTE A blank entry in the Subformat column in Table 2 indicates assertions common to all Subformats (Basic, Full Frontal and Token Frontal).

Table 2 — Conformance test assertions for ISO/IEC 19794-5:2005 Basic Type Images

Test	Sub-format	Requirement ID	Level	Field	Operator	Operands	Test note	Status	IUT support	Supported range	Test result
1.		R-3	1	Format Identifier	EQ	0x46414300		M			
2.		R-3	1	Format Identifier	NEQ	0x00434146	1	M			
3.		R-4	1	Version Number	EQ	0x30313000	14	M			
4.		R-4	1	Version Number	NEQ	0x00303130	1	M			
5.		R-5, R-6	1	Record Length	C	57 to $2^{32} - 1$	2	M			
6.		R-5, R-6	2	Record Length	EQ	Total Bytes Read		M			
7.		R-5, R-6	2	Record Length	EQ	Total Bytes Expected	3	M			
8.		R-7, R-8	1	Number of Facial Images	EQ	1 to 65 535		M			
9.		R-7, R-8	2	Number of Facial Images	EQ	Total Number of Facial Images Read		M			
10.		R-10	2	Facial Record Data Length	C	See Note	4	M			
11.		R-10	2	Facial Record Data Length	EQ	Tot. Facial Record Data Bytes Read		M			
12.		R-10	2	Facial Record Data Length	EQ	Tot. Facial Record Data Bytes Expected	5	M			
13.		R-10	2	Facial Record Data Length	GT	Minimum {Facial Record Data Length} = 32 + sizeof {Image Data}		M			
14.		R-10	1	Facial Record Data Length	LE	0xFFFFFFFF – sizeof {Facial Header} = 0xFFFFFFFF – 0xE = 0xFFFFFFF1		M			
15.		R-11	1	Number of Landmark Points	EQ	0 to 65 535		M			
16.		R-11, R-22	2	Number of Landmark Points	EQ	Total Number of Landmark Points Read		M			
17.		R-12	1	Gender	EQ	0 to 2, 255		M			
18.		R-13	1	Eye Colour	EQ	0 to 7, 255		M			
19.		R-14	1	Hair Colour	EQ	0 to 7, 255		M			
20.		R-15	1	Property Mask	EQ	0x000000 to 0x0007FF	6	M			
20.1		R-15	1	Property Mask	EQ	{Property Mask} EQ 0 OR Is Odd ({Property Mask} Modulo 2 EQ 1)	13	M			
21.		R-16	1	Expression	EQ	0 to 7, 32 768 to 65 535		M			
22.		R-17, R-18	1	Pose Angle Yaw	EQ	0 to 180		M			
23.		R-17, R-19	1	Pose Angle Pitch	EQ	0 to 180		M			
24.		R-17, R-20	1	Pose Angle Roll	EQ	0 to 180		M			
25.		R-21	1	Yaw Angle Uncertainty	EQ	0 to 181		M			
26.		R-21	1	Pitch Angle Uncertainty	EQ	0 to 181		M			
27.		R-21	1	Roll Angle Uncertainty	EQ	0 to 181		M			

Table 2 *(continued)*

Test	Sub-format	Requirement ID	Level	Field	Operator	Operands	Test note	Status	IUT support	Supported range	Test result
28.		R-23	1	Landmark Point Type	EQ	1		O			
29.		R-24	1	Landmark Point Code	EQ	See Note	7	O			
30.		R-22,R-25	2	X coordinate range check	EQ	0 to (Width – 1)		O			
31.		R-22,R-26	2	Y coordinate range check	EQ	0 to (Height – 1)		O			
32.		R-22	1	Reserved	EQ	0		O			
33.		R-28	1	Face Image Type	EQ	0 to 2		M			
34.	Basic	R-40	1	Face Image Type	EQ	0		M			
35.		R-29	1	Image Data Type	EQ	0, 1		M			
36.		R-30	1	Image Width	EQ	0 to 65 535		M			
37.		R-31	1	Image Height	EQ	0 to 65 535		M			
38.		R-30	2	Image Width	C			M			
39.		R-31	2	Image Height	C			M			
40.	Basic	R-32	1	Colour Space	EQ	0 to 4, 128 to 255		M			
41.		R-33	1	Source Type	EQ	0 to 7, 128 to 255	10	M			
42.		R-34	1	Device Type	EQ	0 to 65 535		M			
43.		R-35	1	Quality	EQ	0		M			
44.		R-30, R-29, R-36, R-37	1	Image Marker	EQ	See Note	11	M			
45.		R-30, R-29, R-37	2	Image Data Length	EQ	Total Bytes Read	12	M			

Table 2 test notes

1	Test 2 and Test 4 check to see if these multi-byte quantities have been encoded as the Little-Endian equivalent of the correct Big-Endian value. These tests fail if that is true but pass in all other cases. By reviewing the combination of the results of Test 1, 2, 3 and 4, it should be simple to determine whether or not the implementation under test is using the correct Big-Endian encoding.
2	ISO/IEC 19794-5:2005, 6.2, requires JFIF File Interchange Format for JPEG image[1] and JP2 file type extension for JPEG2000[3].
	For JPEG [ref. ISO/IEC 10918-1 / Figure B.2, Table B.2, and "JPEG File Interchange Format, Version1.02"] Minimum {Image Data} = sizeof (Start of Image marker) + sizeof (Frame Header) + sizeof (JFIF marker) + sizeof (End of Image marker) Minimum {Image Data} = 2 + 2 + 5 + 2 bytes Minimum {Image Data} = 11 bytes
	For JPEG 2000 [Reference [3], specifically ISO/IEC 15444-1 / Figure I-1, Table I-2, and Annex I] Minimum {Image Data} = sizeof (Signature box) + sizeof (Profile box) + sizeof (JP2 Header box) + sizeof (Contiguous Codestream box) Minimum {Image Data} = 12 + 8 + 4 + 16 bytes Minimum {Image Data} = 40 bytes
	Therefore, Minimum {Image Data} Length = 11 bytes Minimum {Record Length} = sizeof {Facial Header} + sizeof {Facial Information} + sizeof {Image Information} + sizeof (Minimum {Image Data}) Minimum {Record Length} = 14 + 20 + 12 + 11 = 57 bytes
3	The following calculation will be evaluated once the Image Data block for the last Facial image has been parsed successfully (not having reached an End-of File marker prematurely). In the event that End-of-File marker is reached prematurely this will be marked as having failed, but no value of {Total Bytes Expected} will be produced.
	Length = 14 FOR j = 1 : {Number of Facial Images} Length = Length + 32 + {Number of Landmark Points} * 8 + sizeof {Image Data} END {Total Bytes Expected} = Length
4	Minimum {Facial Record Data Length} = 32 + sizeof {Image Data}

	IF {Image Data Type} EQ 0 THEN
	Minimum {Facial Record Data Length} = sizeof {Facial Information} + sizeof {Image Information} + sizeof (Minimum JPEG {Image Data})
	Minimum {Facial Record Data Length} = 20 + 12 + 11 = 43
	ENDIF

	IF {Image Data Type} EQ 1 THEN
	Minimum {Facial Record Data Length} = sizeof {Facial Information} + sizeof {Image Information} + sizeof (Minimum JPEG2000 {Image Data})
	Minimum {Facial Record Data Length} = 20 + 12 + 40 = 72
	ENDIF

5	The following calculation will be evaluated once the {Image Data} block for the last Facial image 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 will be marked as having failed, but no value of {Total Bytes Expected} will be produced.
	{Total Facial Record Data Bytes Expected} = 32 + {Number of Landmark Points} * 8 + sizeof {Image Data}
6	The Landmark Mask is a bit mask of 3 bytes with bits 11-23 currently reserved. Thus 0x7FF is the maximum value. Some combinations of bits may be inappropriate (if the least significant bit is set high to indicate that all bits in the mask count). Examples might include bit 5, bit 7 and bit 8 are high, since a blink should not be detectable if the subject has both left and right eye-patches. These issues are not obvious, however, and should not be used to make an absolute declaration of conformance so they are ignored here.

7	Valid range for specific Landmark Point(s)			
		Major value	Minor value	Range
		2	1 to 14	33 to 46
		3	1 to 14	49 to 62
		4	1 to 6	65 to 70
		5	1 to 4	81 to 84
		6	1 to 4	97 to 100
		7	1	113
		8	1 to 10	129 to 138
		9	1 to 15	145 to 159
		10	1 to 10	161 to 170
		11	1 to 6	177 to 182
		12	1 to 4	193 to 196
10	Note that values 0 to 7 have specific meaning from Table 13, but 128 to 255 are vendor defined. Values 8 to 127 are reserved.			
11	ISO/IEC 19794-5:2005, 6.2 requires JFIF File Interchange Format for JPEG images and JP2 file type extension for JPEG2000. Minimum conformance and extended requirements need to be tested[2][4].			
	IF {Image Data Type} EQ 0 THEN (JPEG format) first four bytes of image = 0xFFD8 FFE0 last two bytes of image = 0xFFD9 ENDIF			
	IF {Image Data Type} EQ 1 THEN (JPEG 2000) Start of Image Marker = 0x0000 000C 6A50 2020 0D0A 870A (See Reference [3], Signature box, ISO/IEC 15444-1:2016, I.7.1). ENDIF			
12	{Image Data Length} = sizeof {Facial Data} - sizeof {Facial Information} - sizeof{Facial Features} - sizeof {Image Information}			
13	The least significant bit determines whether an integer value is even or odd. Even numbers have a least significant bit of 0, odd numbers have 1. When the least significant bit is 0 (even) all other bits shall be 0 according to requirement R-15, or to say the integer value of the whole field shall be 0.			
14	When a CTS detects the version number '020' it should generate a warning indicating that the 19794-5 record was produced in conformance with a now-deprecated edition of ISO/IEC 19794-5.			

Table 3 — Conformance test assertions for ISO/IEC 19794-5:2005 Full Frontal Images

Test	Sub-format	Requirement ID	Level	Field	Operator	Operands	Test note	Status	IUT support	Supported range	Test result
1.		R-3	1	Format Identifier	EQ	0x46414300		M			
2.		R-3	1	Format Identifier	NEQ	0x00434146	1	M			
3.		R-4	1	Version Number	EQ	0x30313000	14	M			
4.		R-4	1	Version Number	NEQ	0x00303130	1	M			
5.		R-5, R-6	1	Record Length	C	57 to $2^{32} - 1$	2	M			
6.		R-5, R-6	2	Record Length	EQ	Total Bytes Read		M			
7.		R-5, R-6	2	Record Length	EQ	Total Bytes Expected	3	M			
8.		R-7, R-8	1	Number of Facial Images	EQ	1 to 65 535		M			
9.		R-7, R-8	2	Number of Facial Images	EQ	Total Number of Facial Images Read		M			
10.		R-10	2	Facial Record Data Length	C	See Note	4	M			
11.		R-10	2	Facial Record Data Length	EQ	Tot. Facial Record Data Bytes Read		M			
12.		R-10	2	Facial Record Data Length	EQ	Tot. Facial Record Data Bytes Expected	5	M			
13.		R-10	2	Facial Record Data Length	GT	Minimum {Facial Record Data Length} = 32 + sizeof {Image Data}		M			
14.		R-10	1	Facial Record Data Length	LE	0xFFFFFFFF – sizeof {Facial Header} = 0xFFFFFFFF – 0xE = 0xFFFFFFF1		M			
15.		R-11	1	Number of Landmark Points	EQ	0 to 65 535		M			
16.		R-11, R-22	2	Number of Landmark Points	EQ	Total Number of Landmark Points Read		M			
17.		R-12	1	Gender	EQ	0 to 2, 255		M			
18.		R-13	1	Eye Colour	EQ	0 to 7, 255		M			
19.		R-14	1	Hair Colour	EQ	0 to 7, 255		M			
20.		R-15	1	Property Mask	EQ	0x000000 to 0x0007FF	6	M			
20.1		R-15	1	Property Mask	EQ	{Property Mask} EQ 0 OR Is Odd ({Property Mask} Modulo 2 EQ 1)	13	M			
21.	Full Ftl	R-15	2	Property Mask & 0x000020 (Blink Bit 5)	EQ	0		M			
22.		R-16	1	Expression	EQ	0 to 7, 32 768 to 65 535		M			
23.		R-17, R-18	1	Pose Angle Yaw	EQ	0 to 180		M			
24.		R-17, R-19	1	Pose Angle Pitch	EQ	0 to 180		M			
25.		R-17, R-20	1	Pose Angle Roll	EQ	0 to 180		M			
26.	Full Ftl	R-18, R-42	1	Pose Angle Yaw	EQ	0 to 5		M			

Table 3 *(continued)*

Test	Sub-format	Requirement ID	Level	Field	Operator	Operands	Test note	Status	IUT support	Supported range	Test result
27.	Full Ftl	R-19, R-42	1	Pose Angle Pitch	EQ	0 to 5		M			
28.	Full Ftl	R-20, R-42	1	Pose Angle Roll	EQ	0 to 8		M			
29.		R-21	1	Yaw Angle Uncertainty	EQ	0 to 181		M			
30.		R-21	1	Pitch Angle Uncertainty	EQ	0 to 181		M			
31.		R-21	1	Roll Angle Uncertainty	EQ	0 to 181		M			
32.		R-23	1	Landmark Point Type	EQ	1		O			
33.		R-24	1	Landmark Point Code	EQ	See Note	7	O			
34.		R-22,R-25	2	X coordinate range check	EQ	0 to (Width – 1)		O			
35.		R-22,R-26	2	Y coordinate range check	EQ	0 to (Height – 1)		O			
36.		R-22	1	Reserved	EQ	0		O			
37.		R-28	1	Face Image Type	EQ	0 to 2		M			
38.	Full Ftl	R-70, R-80	1	Face Image Type	EQ	1		M			
39.		R-29	1	Image Data Type	EQ	0, 1		M			
40.		R-30	1	Image Width	EQ	0 to 65 535		M			
41.		R-31	1	Image Height	EQ	0 to 65 535		M			
42.		R-30	2	Image Width	C			M			
43.		R-31	2	Image Height	C			M			
44.	Full Ftl	R-76, R-79	1	Image Width (relation to head width)	GTE	240	9	M			
45.	Full Ftl	R-32, R-68	2	Colour Space	EQ	1 to 3		M			
46.		R-33	1	Source Type	EQ	0 to 7, 128 to 255	10	M			
47.		R-34	1	Device Type	EQ	0 to 65 535		M			
48.		R-35	1	Quality	EQ	0		M			
49.		R-30, R-29, R-36, R-37	1	Image Marker	EQ	See Note	11	M			
50.		R-30, R-29, R-37	2	Image Data Length	EQ	Total Bytes Read	12	M			

Table 3 test notes

1	Test 2 and Test 4 check to see if these multi-byte quantities have been encoded as the Little-Endian equivalent of the correct Big-Endian value. These tests fail if that is true but pass in all other cases. By reviewing the combination of the results of Test 1, 2, 3 and 4, it should be simple to determine whether or not the implementation under test is using the correct Big-Endian encoding.
2	ISO/IEC 19794-5:2005, 6.2, requires JFIF File Interchange Format for JPEG images[1] and JP2 file type extension for JPEG2000[3].
	For JPEG [ref. ISO/IEC 10918-1 / Figure B.2, Table B.2, and "JPEG File Interchange Format, Version1.02"] Minimum {Image Data} = sizeof (Start of Image marker) + sizeof (Frame Header) + sizeof (JFIF marker) + sizeof (End of Image marker) Minimum {Image Data} = 2 + 2 + 5 + 2 bytes Minimum {Image Data} = 11 bytes
	For JPEG 2000 [Reference [3], specifically ISO/IEC 15444-1 / Figure I-1, Table I-2, and Annex I] Minimum {Image Data} = sizeof (Signature box) + sizeof (Profile box) + sizeof (JP2 Header box) + sizeof (Contiguous Codestream box) Minimum {Image Data} = 12 + 8 + 4 + 16 bytes Minimum {Image Data} = 40 bytes
	Therefore, Minimum {Image Data} Length = 11 bytes Minimum {Record Length} = sizeof {Facial Header} + sizeof {Facial Information} + sizeof {Image Information} + sizeof (Minimum {Image Data}) Minimum {Record Length} = 14 + 20 + 12 + 11 = 57 bytes
3	The following calculation will be evaluated once the Image Data block for the last Facial image has been parsed successfully (not having reached an End-of File marker prematurely). In the event that End-of-File marker is reached prematurely this will be marked as having failed, but no value of {Total Bytes Expected} will be produced.
	Length = 14 FOR j = 1 : {Number of Facial Images} Length = Length + 32 + {Number of Landmark Points} * 8 + sizeof {Image Data} END {Total Bytes Expected} = Length
4	Minimum {Facial Record Data Length} = 32 + sizeof {Image Data}

	IF {Image Data Type} EQ 0 THEN
	Minimum {Facial Record Data Length} = sizeof {Facial Information} + sizeof {Image Information} + sizeof (Minimum JPEG {Image Data})
	Minimum {Facial Record Data Length} = 20 + 12 + 11 = 43
	ENDIF

	IF {Image Data Type} EQ 1 THEN
	Minimum {Facial Record Data Length} = sizeof {Facial Information} + sizeof {Image Information} + sizeof (Minimum JPEG2000 {Image Data})
	Minimum {Facial Record Data Length} = 20 + 12 + 40 = 72
	ENDIF

5	The following calculation will be evaluated once the {Image Data} block for the last Facial image 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 will be marked as having failed, but no value of {Total Bytes Expected} will be produced.
	{Total Facial Record Data Bytes Expected} = 32 + {Number of Landmark Points} * 8 + sizeof {Image Data}
6	The Landmark Mask is a bit mask of 3 bytes with bits 11-23 currently reserved. Thus 0x7FF is the maximum value. Some combinations of bits may be inappropriate (if the least significant bit is set high to indicate that all bits in the mask count). Examples might include bit 5, bit 7 and bit 8 are high, since a blink should not be detectable if the subject has both left and right eye-patches. These issues are not obvious, however, and should not be used to make an absolute declaration of conformance so they are ignored here.

<table>
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<tr><td></td><td></td><td>Major value</td><td>Minor value</td><td>Range</td></tr>
<tr><td></td><td></td><td>2</td><td>1 to 14</td><td>33 to 46</td></tr>
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<tr><td></td><td></td><td>11</td><td>1 to 6</td><td>177 to 182</td></tr>
<tr><td></td><td></td><td>12</td><td>1 to 4</td><td>193 to 196</td></tr>
<tr><td>9</td><td colspan="4">IF {Face Image Type} EQ 1 THEN The minimum {Head Width} = 180</td></tr>
<tr><td></td><td colspan="4">IF {Face Image Type} EQ 1 THEN The maximum {Head Width : Image Width} ratio is 0,75</td></tr>
<tr><td></td><td colspan="4">IF {Face Image Type} EQ 1 THEN The minimum {Image Width} = maximum {Head Width} / 0,75 = 240</td></tr>
<tr><td>10</td><td colspan="4">Note that values 0 to 7 have specific meaning from Table 13, but 128 to 255 are vendor defined. Values 8 to 127 are reserved.</td></tr>
<tr><td>11</td><td colspan="4">ISO/IEC 19794-5:2005, 6.2, requires JFIF File Interchange Format for JPEG images and JP2 file type extension for JPEG2000.
Minimum conformance and extended requirements need to be tested[2][4]</td></tr>
<tr><td></td><td colspan="4">IF {Image Data Type} EQ 0 THEN (JPEG format)
first four bytes of image = 0xFFD8 FFE0
last two bytes of image = 0xFFD9
ENDIF</td></tr>
<tr><td></td><td colspan="4">IF {Image Data Type} EQ 1 THEN (JPEG 2000)
Start of Image Marker = 0x0000 000C 6A50 2020 0D0A 870A (See Reference [3], Signature box, ISO/IEC 15444-1:2016, I.7.1)
ENDIF</td></tr>
<tr><td>12</td><td colspan="4">{Image Data Length} = sizeof {Facial Data} - sizeof {Facial Information} - sizeof{Facial Features} - sizeof {Image Information}</td></tr>
<tr><td>13</td><td colspan="4">The least significant bit determines whether an integer value is even or odd. Even numbers have a least significant bit of 0, odd numbers have 1. When the least significant bit is 0 (even) all other bits shall be 0 according to requirement R-15, or to say the integer value of the whole field shall be 0.</td></tr>
<tr><td>14</td><td colspan="4">When a CTS detects the version number ‘020’ it should generate a warning indicating that the 19794-5 record was produced in conformance with a now-deprecated edition of ISO/IEC 19794-5.</td></tr>
</table>

Table 4 — Conformance test assertions for ISO/IEC 19794-5:2005 Token Frontal Images

Test	Sub-format	Requirement ID	Level	Field	Operator	Operands	Test note	Status	IUT support	Supported range	Test result
1.		R-3	1	Format Identifier	EQ	0x46414300		M			
2.		R-3	1	Format Identifier	NEQ	0x00434146	1	M			
3.		R-4	1	Version Number	EQ	0x30313000	14	M			
4.		R-4	1	Version Number	NEQ	0x00303130	1	M			
5.		R-5, R-6	1	Record Length	C	57 to 232 - 1	2	M			
6.		R-5, R-6	2	Record Length	EQ	Total Bytes Read		M			
7.		R-5, R-6	2	Record Length	EQ	Total Bytes Expected	3	M			
8.		R-7, R-8	1	Number of Facial Images	EQ	1 to 65 535		M			
9.		R-7, R-8	2	Number of Facial Images	EQ	Total Number of Facial Images Read		M			
10.		R-10	2	Facial Record Data Length	C	See Note	4	M			
11.		R-10	2	Facial Record Data Length	EQ	Tot. Facial Record Data Bytes Read		M			
12.		R-10	2	Facial Record Data Length	EQ	Tot. Facial Record Data Bytes Expected	5	M			
13.		R-10	2	Facial Record Data Length	GT	Minimum {Facial Record Data Length} = 32 + sizeof {Image Data}		M			
14.		R-10	1	Facial Record Data Length	LE	0xFFFFFFFF – sizeof {Facial Header} = 0xFFFFFFFF – 0xE = 0xFFFFFFF1		M			
15.		R-11	1	Number of Landmark Points	EQ	0 to 65 535		M			
16.		R-11, R-22	2	Number of Landmark Points	EQ	Total Number of Landmark Points Read		M			
17.		R-12	1	Gender	EQ	0 to 2, 255		M			
18.		R-13	1	Eye Colour	EQ	0 to 7, 255		M			
19.		R-14	1	Hair Colour	EQ	0 to 7, 255		M			
20.		R-15	1	Property Mask	EQ	0x000000 to 0x0007FF	6	M			
20.1		R-15	1	Property Mask	EQ	{Property Mask} EQ 0 OR Is Odd ({Property Mask} Modulo 2 EQ 1)	13	M			
21.	Token	R-15	2	Property Mask & 0x000020 (Blink Bit 5)	EQ	0		M			
22.		R-16	1	Expression	EQ	0 to 7, 32 768 to 65 535		M			
23.		R-17, R-18	1	Pose Angle Yaw	EQ	0 to 180		M			
24.		R-17, R-19	1	Pose Angle Pitch	EQ	0 to 180		M			
25.		R-17, R-20	1	Pose Angle Roll	EQ	0 to 180		M			
26.	Token	R-18, R-42	1	Pose Angle Yaw	EQ	0 to 5		M			

Table 4 *(continued)*

Test	Sub-format	Requirement ID	Level	Field	Operator	Operands	Test note	Status	IUT support	Supported range	Test result
27.	Token	R-19, R-42	1	Pose Angle Pitch	EQ	0 to 5		M			
28.	Token	R-20, R-42	1	Pose Angle Roll	EQ	0 to 8		M			
29.		R-21	1	Yaw Angle Uncertainty	EQ	0 to 181		M			
30.		R-21	1	Pitch Angle Uncertainty	EQ	0 to 181		M			
31.		R-21	1	Roll Angle Uncertainty	EQ	0 to 181		M			
32.		R-23	1	Landmark Point Type	EQ	1		O			
33.		R-24	1	Landmark Point Code	EQ	See Note	7	O			
34.		R-22,R-25	2	X coordinate range check	EQ	0 to (Width – 1)		O			
35.	Token	R-22,R-23,R-24,R-25,R-84,R-85	2	First (right) eye position X	C	0,375 * Width	8	M			
36.	Token	R-22,R-23,R-24,R-25,R-84,R-85	2	Second (left) eye position X	C	(0,625 * Width) – 1	8	M			
37.		R-22,R-26	2	Y coordinate range check	EQ	0 to (Height-1)		O			
38.	Token	R-22,R-23,R-24,R-25,R-83	2	First (right) eye position Y	C	0,6 * Width	8	M			
39.	Token	R-22,R-23,R-24,R-25,R-83	2	Second (left) eye position Y	C	0,6 * Width	8	M			
40.		R-24	1	Reserved	EQ	0		O			
41.		R-28	1	Face Image Type	EQ	0 to 2		M			
42.	Token	R-70, R-91	1	Face Image Type	EQ	2		M			
43.		R-29	1	Image Data Type	EQ	0, 1		M			
44.		R-30	1	Image Width	EQ	0 to 65 535		M			
45.		R-31	1	Image Height	EQ	0 to 65 535		M			
46.		R-30	2	Image Width	C			M			
47.		R-31	2	Image Height	C			M			
48.	Token	R-87	1	Image Width	GTE	240		M			
49.	Token	R-82	2	Image Height	EQ	Width / 0,75		M			
50.	Token	R-32, R-68	2	Colour Space	EQ	1 to 3		M			
51.		R-33	1	Source Type	EQ	0 to 7, 128 to 255	10	M			
52.		R-34	1	Device Type	EQ	0 to 65 535		M			

Table 4 *(continued)*

Test	Sub-format	Requirement ID	Level	Field	Operator	Operands	Test note	Status	IUT support	Supported range	Test result
53.		R-35	1	Quality	EQ	0		M			
54.		R-30, R-29, R-36, R-37	1	Image Marker	EQ	See Note	11	M			
55.		R-30, R-29, R-37	2	Image Data Length	EQ	Total Bytes Read	12	M			

Table 4 test notes

1	Test 2 and Test 4 check to see if these multi-byte quantities have been encoded as the Little-Endian equivalent of the correct Big-Endian value. These tests fail if that is true but pass in all other cases. By reviewing the combination of the results of Test 1, 2, 3 and 4, it should be simple to determine whether or not the implementation under test is using the correct Big-Endian encoding.
2	ISO/IEC 19794-5:2005, 6.2, requires JFIF File Interchange Format for JPEG images[1] and JP2 file type extension for JPEG2000[3].
	For JPEG [ref. ISO/IEC 10918-1 / Figure B.2, Table B.2, and "JPEG File Interchange Format, Version1.02"]
	Minimum {Image Data} = sizeof (Start of Image marker) + sizeof (Frame Header) + sizeof (JFIF marker) + sizeof
	(End of Image marker)
	Minimum {Image Data} = 2 + 2 + 5 + 2 bytes
	Minimum {Image Data} = 11 bytes
	For JPEG 2000 [Reference 3, specifically ISO/IEC 15444-1 / Figure I-1, Table I-2, and Annex I]
	Minimum {Image Data} = sizeof (Signature box) + sizeof (Profile box) + sizeof (JP2 Header box) + sizeof (Contiguous
	Codestream box)
	Minimum {Image Data} = 12 + 8 + 4 + 16 bytes
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	Therefore, Minimum {Image Data} Length = 11 bytes
	Minimum {Record Length} = sizeof {Facial Header} + sizeof {Facial Information} + sizeof {Image Information} + sizeof
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	Minimum {Record Length} = 14 + 20 + 12 + 11 = 57 bytes
3	The following calculation will be evaluated once the Image Data block for the last Facial image has been parsed successfully (not having reached an End-of File marker prematurely). In the event that End-of-File marker is reached prematurely this will be marked as having failed, but no value of {Total Bytes Expected} will be produced.
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	Length = Length + 32 + {Number of Landmark Points} * 8 + sizeof {Image Data}
	END
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4	Minimum {Facial Record Data Length} = 32 + sizeof {Image Data}
	IF {Image Data Type} EQ 0 THEN
	Minimum {Facial Record Data Length} = sizeof {Facial Information} + sizeof {Image Information} + sizeof (Minimum JPEG {Image Data})
	Minimum {Facial Record Data Length} = 20 + 12 + 11 = 43
	ENDIF
	IF {Image Data Type} EQ 1 THEN
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	Minimum {Facial Record Data Length} = 20 + 12 + 40 = 72
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	{Total Facial Record Data Bytes Expected} = 32 + {Number of Landmark Points} * 8 + sizeof {Image Data}
6	The Landmark Mask is a bit mask of 3 bytes with bits 11-23 currently reserved. Thus 0x7FF is the maximum value.
	Some combinations of bits may be inappropriate (if the least significant bit is set high to indicate that all bits in the mask count).
	Examples might include bit 5, bit 7 and bit 8 are high, since a blink should not be detectable if the subject has both left and right eye-patches.
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<tr><td>8</td><td colspan="4">This test applies to Token images that include encoding of the eye centers in the optional feature block. The geometry of the Token image requires eyes to be placed at fixed coordinates whose X and Y values are determined solely as a function of the width of the image. This is not a Level 3C test of whether the eye coordinates are actually correct.</td></tr>
<tr><td></td><td colspan="4">IF {Face Image Type} EQ 2 AND optional feature point block includes the ISO/IEC 19794-5:2005 Figure 7 eye centers (points 12.1 and 12.2) THEN check positions were coded correctly</td></tr>
<tr><td></td><td colspan="4">First (right) eye position X-coordinate = 0,375 * {Width}</td></tr>
<tr><td></td><td colspan="4">Second (left) eye position X-coordinate = 0,625 * {Width} - 1</td></tr>
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ENDIF</td></tr>
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[1] ISO/IEC 10918-1:1994, *Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines*

[2] ISO/IEC 10918-2:1995, *Information technology — Digital compression and coding of continuous-tone still images: Compliance testing. This document is not a formal conformance test of JPEG encoders and streams*

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