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AMENDMENT 1
2014-02-15

Information technology — Biometric data interchange formats —

Part 5: Face image data

AMENDMENT 1: Conformance testing methodology and clarification of defects

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

Partie 5: Données d'image de la face

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

Reference number
ISO/IEC 19794-5:2011/Amd.1:2014(E)

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Foreword

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

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

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

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

Amendment 1 to ISO/IEC 19794-5:2011 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 37, *Biometrics*.

Information technology — Biometric data interchange formats —

Part 5:
Face image data

AMENDMENT 1: Conformance testing methodology and clarification of defects

Add to the "Introduction" clause of ISO/IEC 19794-5:2011

The definition of conformance testing (Annex A) is distinct from the ISO/IEC 29109-5, which addressed conformance testing only of the first, 2005, edition of this part of the ISO/IEC 19794 standard.

Add to the "Scope" clause of ISO/IEC 19794-5:2011

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

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

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

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

Add at the end of clause 3:

"ISO/IEC/IEEE 60559, *Information technology — Microprocessor Systems — Floating-Point arithmetic*"

Replace in 2nd paragraph of clause 5.5.9.1

"The encoding B_Y of the yaw angle Y shall be in degrees as a byte (1 byte) with values from –180 to 180 modulo 2"

With

"The encoded value, B_Y, shall be stored in 1 byte with values 0 to 180 computed from a real-valued yaw angle estimate, $-180 \leq Y < 180$, as follows"

Replace in 2nd paragraph of clause 5.5.9.2

"The encoding B_P of the pitch angle P shall be in degrees as a byte (1 byte) with values from –180 to 180 modulo 2"

With

"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 ≤ P < 180, as follows:"

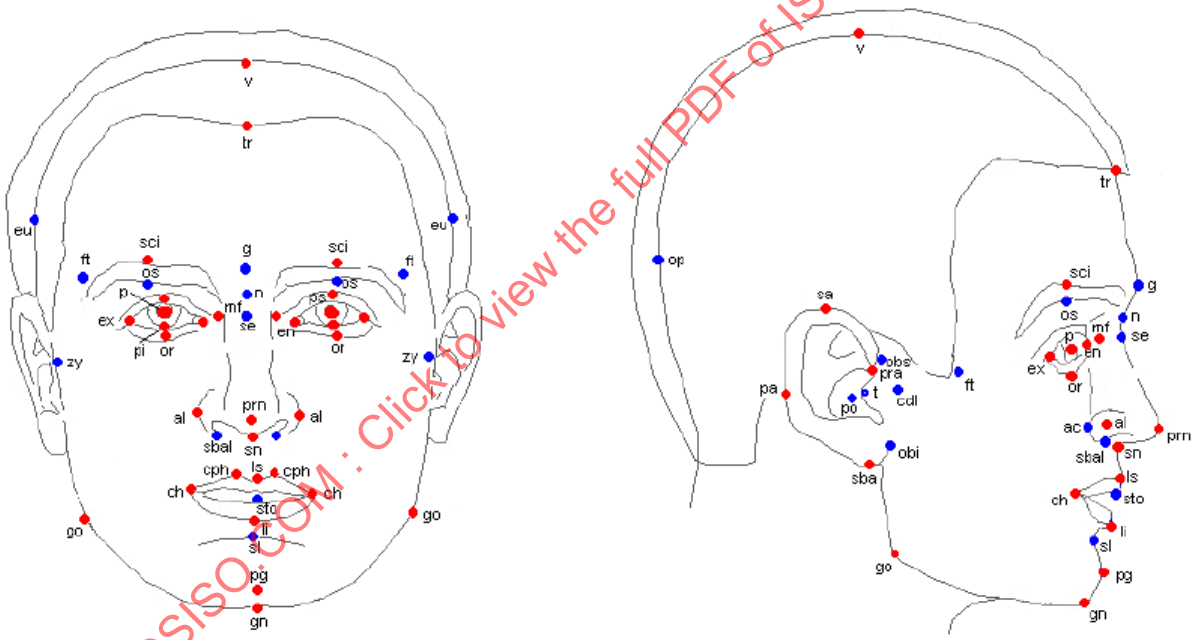
Replace in 2nd paragraph of clause 5.5.9.3

"The encoding B_R of the roll angle R shall be in degrees as a byte (1 byte) with values from –180 to 180 modulo 2"

With

"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 ≤ R < 180, as follows:"

Replace Figure 9 with



Replace Table 15 with

Table 15 — Definitions of the anthropometric landmarks

Point Identifier	Point Code	MPEG4	Anthropometric point name	How to point
v	1.1	11.4	vertex	The highest point of head when the head is oriented in Frankfurt Horizon. Refer to Annex E for the definition of the Frankfurt Horizon.
g	1.2		glabella	The most prominent middle point between the eyebrows
op	1.3		opisthocranion	Situated in the occipital region of the head is most distant from the glabella
eu	1.5, 1.6		eurion	The most prominent lateral point on each side of the skull in the area of the parietal and temporal bones
ft	1.7, 1.8		frontotemporale	The point on each side of the forehead, laterally from the elevation of the linea temporalis
tr	1.9	11.1	trichion	The point on the hairline in the midline of the forehead
zy	2.1, 2.2		zygion	The most lateral point of each of the zygomatic
go	2.3,2.4	2.13, 2.14	gonion	The most lateral point on the mandibural angle close to the bony gonion
sl	2.5		sublabiale	Determines the lower border of the lower lip or the upper border of the chin
pg	2.6	2.10	pogonion	The most anterior midpoint of the chin, located on the skin surface in the front of the identical bony landmark of the mandible
gn	2.7	2.1	menton (or gnathion)	The lowest median landmark on the lower border of the mandible
cdl	2.9, 2.10		condylion laterale	The most lateral point on the surface of the condyle of the mandible
en	3.1, 3.2	3.11, 3.8	endocanthion	The point at the inner commissure of the eye fissure
ex	3.3, 3.4	3.7, 3.12	exocanthion (or ectocanthion)	The point at the outer commissure of the eye fissure
p	3.5, 3.6	3.5, 3.6	center point of pupil	Is determined when the head is in the rest position and the eye is looking straight forward
or	3.7, 3.8	3.9, 3.10	orbitale	The lowest point on the lower margin of each orbit
ps	3.9, 3.10	3.1, 3.2	palpebrale superius	The highest point in the midportion of the free margin of each upper eyelid
pi	3.11, 3.12	3.3, 3.4	palpebrale inferius	The lowest point in the midportion of the free margin of each lower eyelid
os	4.1, 4.2		orbitale superius	The highest point on the lower border of the eyebrow
sci	4.3, 4.4	4.3, 4.4	superciliare	The highest point on the upper border in the midportion of each eyebrow
n	5.1		nasion	The point in the middle of both the nasal root and nasofrontal suture
se	5.2		sellion (or subnasion)	Is the deepest landmark located on the bottom of the nasofrontal angle
al	5.3, 5.4	9.1, 9.2	alare	The most lateral point on each alar contour
prn	5.6	9.3	pronasale	The most protruded point of the apex nasi

Point Identifier	Point Code	MPEG4	Anthropometric point name	How to point
sn	5.7	9.15	subnasale	The midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet
sbal	5.9, 5.10		subalare	The point at the lower limit of each alar base, where the alar base disappears into the skin of the upper lip
ac	5.11, 5.12		alar curvature (or alar crest) point	The most lateral point in the curved base line of each ala
mf	5.13, 5.14	9.6, 9.7	maxillofrontale	The base of the nasal root medially from each endocanthion
cph	6.1, 6.2	8.9, 8.10	christa philtri landmark	The point on each elevated margin of the philtrum just above the vermilion line
ls	6.3	8.1	labiale (or labrale) superius	The midpoint of the upper vermillion line
li	6.4	8.2	labiale (or labrale) inferius	The midpoint of the lower vermillion line
ch	6.5, 6.6	8.3, 8.4	cheilion	The point located at each labial commissure
sto	6.7		stomion	The imaginary point at the crossing of the vertical facial midline and the horizontal labial fissure between gently closed lips, with teeth shut in the natural position
sa	7.1, 7.2	10.1, 10.2	superaurale	The highest point of the free margin of the auricle
sba	7.3, 7.4	10.5, 10.6	subaurale	The lowest point of the free margin of the ear lobe
pra	7.5, 7.6	10.9, 10.10	preaurale	The most anterior point on the ear, located just in front of the helix attachment to the head
pa	7.7, 7.8	10.3, 10.4	postaurale	The most posterior point on the free margin of the ear
obs	7.9, 7.10		otobasion superious	The point of attachment of the helix in the temporal region
obi	7.11, 7.12		otobasion infrious	The point of attachment of the ear lobe to the cheek
po	7.13, 7.14		porion (soft)	The highest point of the upper margin of the cutaneous auditory meatus
t	8.1, 8.2		tragion	The notch on the upper margin of the tragus

Replace in clause 5.10.4

“Each factor is represented by a mandatory four byte float value”

With

“Each factor is represented by a mandatory four byte float value and be coded as defined in the ISO/IEC/IEEE 60559 single precision binary floating-point format, i.e. the ‘binary32’ format. The values NaN (Not a Number), positive inf (infinity) and negative inf shall not be encoded”

Replace in Clause 14, Table 38, Column 3, Row 2

{iso registration-authority cbeff(19785)organization(0) 257bdbs(0) face-image (8)}

with

{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) face-image(8)}

Replace Annex A with the following one.

Annex A
(normative)

Conformance testing methodology

A.1 Introduction

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

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

— test 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 19794-1:2011/Amd.1),

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

This conformance testing metodology does not establish

— tests of conformance of CBEFF structures required by ISO/IEC 19794-1:2011,

— tests of conformance of the image data to the quality-related specifications of ISO/IEC 19794-1:2011,

— 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).

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

A.2 Table of requirements

The normative requirements 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, T, P indicate the Basic, Full Frontal, Token Frontal and Post-Processed image types.

Table A.1 — Normative requirements

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-1	5.1	The ISO/IEC 19794-5 BDIR format specified in this part of ISO/IEC 19794 is a format to store face representations within a biometric data record.	3C	O-1	Y	Y	Y	Y			
R-2	5.1	Each BDIR shall pertain to a single subject	3C	O-1	Y	Y	Y	Y			
R-3	5.1	Each BDIR shall contain at least one or more 2D image and zero or more geometric representations (range images, 3D point maps, 3D vertex representations) of a human face.	3C	M	Y	Y	Y	Y			
R-4	5.1	2D image data will be encoded using JPEG, JPEG2000 or PNG.	3C	O-1	Y	Y	Y	Y			
R-5	5.1	With the exception of the Format Identifier and the Version Number for the standard, which are null-terminated ASCII character strings, all data is represented in binary format.	3C	O-1	Y	Y	Y	Y			
R-6	5.1	There are no record separators or field tags; fields are parsed by byte count.	3C	O-1	Y	Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-7	5.1	The organization of the record format is as follows: - A fixed-length (17 byte) **General Header** containing information about the overall record, including the number of facial images represented and the overall record length in bytes. - A Representation block for each facial representation. This data consists of a Representation Header and the Representation Data. - The Representation Header consists of • A fixed length (19 bytes) common elements defined in ISO/IEC 19794-1:2011 • Multiple (including none) fixed length (5 byte) **Quality** blocks describing the quality of the representation. • A fixed length (17 byte) **Facial Information** block describing discernable characteristics of the subject such as gender. • Multiple (including none) fixed length (8 byte) **Landmark Point** blocks describing Landmark Points in a facial image. • A fixed length (11 byte) **Image Information** block describing digital properties of the image such as Face Image Type and dimensions such as width and height. - The Representation Data consists of • **Image data** consisting of a JPEG, JPEG2000 or PNG encoded data block. • For Face Image Types containing 3D information a **3D Information** block (95 byte) describing properties of this data. • For Face Image Types containing 3D information the **3D Data** block describing the 3D shape of the face.	3C	O-1	Y	Y	Y	Y			
R-8	5.1	Multiple 2D / 3D representations of the same biometric data subject can be described in a single record. This is accomplished by including multiple representation blocks after the General Header block.	3C	O-1	Y	Y	Y	Y			
R-9	5.1	Representation blocks containing 2D data can be stored together with Representation blocks also containing 3D data.	3C	O-1	Y	Y	Y	Y			
R-10	5.2.1	Within the record format and all well-defined data blocks therein, all multi-byte quantities are stored in Big-Endian format.	1	M	Y	Y	Y	Y			
R-11	5.2.2	All numeric values are fixed-length unsigned integer quantities, unless otherwise specified.	3C	O-1	Y	Y	Y	Y			
R-12	5.2.3	The conversion of a numeric value to integer is given by rounding down if the fractional portion is less than 0,5 and rounding up if the fractional value is greater than or equal to 0,5.	3C	O-1	Y	Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-13	5.2.4	the following fields are mandatory, but the value of the field can indicate that the field is unspecified: Capture Device Technology Identifier, Capture Device Vendor Identifier, Capture Device Type Identifier, Gender, Eye Colour, Hair Colour, Subject Height, Property, Expression, Pose Angle, Pose Angle Uncertainty, Image Colour Space, 3D Capture Device Technology Identifier, 3D Capture Device Vendor Identifier, 3D Capture Device Type Identifier, 3D to 2D Image Temporal Synchronicity, 3D to 2D Texture Temporal Synchronicity, 3D Acquisition Time, 2D Texture Acquisition Time, Texture Map Type, and Texture Map Spectrum.	3C	O-1	Y	Y	Y	Y			
R-14	5.2.5	A field value labelled by the identifier “Unknown” shall be used to denote that the information encoded by the field cannot be determined by examination of the face image.	3C	O-1	Y	Y	Y	Y			
R-15	5.3.1	The General Header block consists of seven fields: Format Identifier, Version Number, Length of Record, Number of Representations, Capture Device Vendor Identifier, Capture Device Type Identifier and the Temporal Semantics field as shown in Table 2.	3C	O-1	Y	Y	Y	Y			
R-16	5.3.2	The format identifier shall be recorded in four bytes.	1	M	Y	Y	Y	Y			
R-17	5.3.2	The format identifier shall consist of three characters "FAC" followed by a zero byte as a NULL string terminator.	1	M	Y	Y	Y	Y			
R-18	5.3.3	The number for the version of ISO/IEC 19794-5 used for constructing the BDIR shall be placed in four bytes.	1	M	Y	Y	Y	Y			
R-19	5.3.3	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. The Version Number of ISO/IEC 19794-5:2010 shall be 30333000_{HEX}; “030” – Version 3 revision 0.	1	M	Y	Y	Y	Y			
R-20	5.3.4	The length (in bytes) of the entire BDIR shall be recorded in four bytes.	1	M	Y	Y	Y	Y			
R-21	5.3.4	This count shall be the total length of the BDIR including the general record header and one or more representation records.	2	M	Y	Y	Y	Y			
R-22	5.3.5	The total number of representation records contained in the BDIR shall be recorded in two bytes.	1, 2	M	Y	Y	Y	Y			
R-23	5.3.5	A minimum of one representation is required.	1	M	Y	Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-24	5.3.6	**Certification Flag** The value shall be 00_{HEX}.	1	M	Y	Y	Y	Y			
R-25	5.3.7	**Temporal Semantics** This two byte (2 byte) field shall be assigned according to Table 3.	1	M	Y	Y	Y	Y			
R-26	5.3.7	This supports storage of multiple representations: from a single session (e.g. from a photo shoot); from distinct sessions (e.g. from cash dispenser transactions); and from a temporal sequence (e.g. a video sequence of equally time-spaced representations).	3C	O-1	Y	Y	Y	Y			
R-27	5.4.1	**The Representation Header Structure** The Representation Header is intended to describe discrete properties of the individual discernable from the image, one is included for each facial representation included in the record.	3C	O-1	Y	Y	Y	Y			
R-28	5.4.1	The Representation Header consists of the Representation Length, the Capture Date and Time, the Capture Device Technology Identifier, the Capture Device Vendor Identifier. These are followed by the Number of Quality Blocks field and the related number of Quality blocks. Finally the Representation Header contains the Facial Information block, the optional multiple Landmark Point blocks, and the Image Information block.	3C	O-1	Y	Y	Y	Y			
R-29	5.4.2	**Representation Length** The (4 byte) Representation Length field denotes the length in bytes of the representation including the representation header fields.	1, 2	M	Y	Y	Y	Y			
R-30	5.4.2	The minimum value of the Representation Length is 51 bytes, consisting of a minimum 47 bytes for the Representation Header plus the size of the Representation Data, i.e. minimum 4 bytes for the Length of Image Data Block field assuming 0 bytes for the variable data.	1	M	Y	Y	Y	Y			
R-31	5.4.3	**Capture Date and Time** The capture date and time field shall indicate when the capture of this representation started in Coordinated Universal Time (UTC).	3C	O-1	Y	Y	Y	Y			
R-32	5.4.3	The capture date and time field shall consist of 9 bytes.	1	M	Y	Y	Y	Y			
R-33	5.4.3	Its value shall be encoded in the form given in ISO/IEC 19794-1.	1	M	Y	Y	Y	Y			
R-34	5.4.4	**Capture Device Technology Identifier** Capture device technology Identifier shall be encoded in one byte.	1	M	Y	Y	Y	Y			

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-35</td><td>5.4.4</td><td>This field shall indicate the class of device technology used to acquire the captured biometric sample.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-36</td><td>5.4.4</td><td>Many different types of capture devices work in the visible spectrum or in near infra-red (NIR). To indicate that the capture device operates in NIR the highest bit in the Capture Device Technology Identifier field shall be set to 1.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-37</td><td>5.4.4</td><td>See Table 4 for the enumerated list of possible values.
Table 4 — Capture Device Technology Identifier codes
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Unknown or Unspecified</td><td>00_{HEX}</td></tr>
<tr><td>Static photograph from an unknown source</td><td>01_{HEX}</td></tr>
<tr><td>Static photograph from a digital still-image camera</td><td>02_{HEX}</td></tr>
<tr><td>Static photograph from a scanner</td><td>03_{HEX}</td></tr>
<tr><td>Video frame(s) from an unknown source</td><td>04_{HEX}</td></tr>
<tr><td>Video frame(s) from an analogue video camera</td><td>05_{HEX}</td></tr>
<tr><td>Video frame(s) from a digital video camera</td><td>06_{HEX}</td></tr>
<tr><td>Reserved by SC37 for future use</td><td>07_{HEX} to $7F_{HEX}$</td></tr>
<tr><td>Vendor specific</td><td>80_{HEX} to FF_{HEX}</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-38</td><td>5.4.5</td><td>Capture Device Vendor Identifier
The (2 byte) Capture Device Vendor Identifier shall identify the biometric organisation that owns the product that created the BDIR.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-39</td><td>5.4.5</td><td>The capture device algorithm vendor identifier shall be encoded in two bytes carrying a CBEFF biometric organization identifier (registered by IBIA or other approved registration authority).</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-40</td><td>5.4.5</td><td>A value of all zeros shall indicate that the capture device vendor is unreported.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-41</td><td>5.4.6</td><td>Capture Device Type Identifier
The (2 byte) Capture Device Type Identifier shall identify the product type that created the BDIR.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-42	5.4.6	It shall be assigned by the registered product owner or other approved registration authority.	3C	M	Y	Y	Y	Y			
R-43	5.4.6	A value of all zeros shall indicate that the capture device type is unreported.	1	M	Y	Y	Y	Y			
R-44	5.4.6	If the capture device vendor identifier is 0000_{HEX}, then also the capture device type identifier shall be 0000_{HEX}	2	M	Y	Y	Y	Y			
R-45	5.4.7	**Number of Quality Blocks** This field is followed by the number of 5 byte Quality blocks reflected by its value.	2	M	Y	Y	Y	Y			
R-46	5.4.7	A value of zero (0) means that no attempt was made to assign a quality score. In this case, no Quality blocks are present.	2	M	Y	Y	Y	Y			
R-47	5.4.8	**Quality Score** The (1 byte) Quality Score, as defined in ISO/IEC 29794-1, shall be a quantitative expression of the predicted verification performance of the biometric sample.	1, 3C	M	Y	Y	Y	Y			
R-48	5.4.8	Valid values for Quality Score are integers between 0 and 100, where higher values indicate better quality.	1	M	Y	Y	Y	Y			
R-49	5.4.8	A value of 255 is to handle a special case.	1	M	Y	Y	Y	Y			
R-50	5.4.8	An entry of 255 shall indicate a failed attempt to calculate a quality score.	3C	O-1	Y	Y	Y	Y			
R-51	5.4.9	**Quality Algorithm Vendor Identifier** To enable the recipient of the quality score to differentiate between quality scores generated by different algorithms, the provider of quality scores shall be uniquely identified by this two-byte field.	1	M	Y	Y	Y	Y			
R-52	5.4.9	This is registered with the IBIA or other approved registration authority.	3C	O-1	Y	Y	Y	Y			
R-53	5.4.10	**Quality Algorithm Identifier** The (2 byte) Quality Algorithm Identifier specifies an integer product code assigned by the vendor of the quality algorithm.	1	M	Y	Y	Y	Y			
R-54	5.4.10	It indicates which of the vendor's algorithms (and version) was used in the calculation of the quality score and should be within the range 1 to 65 535.	1	M	Y	Y	Y	Y			

<table>
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<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-55</td><td>5.4.10</td><td>Table 5 summarizes the quality field. All values are fixed-length unsigned integer quantities represented in Big-Endian format.
Table 5 — Structure of Quality blocks
<table>
<tr><th colspan="2">Description</th><th>Length</th><th>Valid values</th><th>Note</th></tr>
<tr><td colspan="2">Number of Quality Blocks</td><td>1 byte</td><td>[0,255]</td><td>This field is followed by the number of 5-byte Quality Blocks reflected by its value.
A value of zero (0) means that no attempt was made to assign a quality score. In this case, no Quality Blocks are present.</td></tr>
<tr><td rowspan="3">Quality Block</td><td>Quality Score</td><td>1 byte</td><td>[0,100]
255</td><td>0: lowest
100: highest
255: failed attempt to assign a quality score</td></tr>
<tr><td>Quality algorithm vendor Identifier</td><td>2 bytes</td><td>[1,65535]</td><td>Quality Algorithm Vendor Identifier shall be registered with IBIA or other approved registration authority as a CBEFF biometric organization. Refer CBEFF vendor Identifier registry procedures in ISO/IEC 19785-2.</td></tr>
<tr><td>Quality algorithm Identifier</td><td>2 bytes</td><td>[1,65535]</td><td>Quality Algorithm Identifier may be optionally registered with IBIA or other approved registration authority as a CBEFF Product Code. Refer to CBEFF product registry procedures in ISO/IEC 19785-2.</td></tr>
</table></td><td>1, 3C</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-56</td><td>5.5.1</td><td>The Facial Information Block Structure
The Facial Information Block consists of the Number of Landmark Points, the Gender, the Eye Colour, the Hair Colour, the Subject Height, the Property Mask, the Expression Mask, the Pose Angle, and the Pose Angle Uncertainty fields.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-57</td><td>5.5.2</td><td>Number of Landmark Points
The (2 byte) Number of Landmark Points field shall be the number of Landmark Point blocks that follow the Facial Information block.</td><td>1, 2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-58</td><td>5.5.3</td><td>Gender
The (1 byte) Gender field shall represent the gender of the subject according to Table 6.
Table 6 — Gender codes<table><tr><th>Description</th><th>Value</th></tr><tr><td>Unspecified</td><td>00_{HEX}</td></tr><tr><td>Male</td><td>01_{HEX}</td></tr><tr><td>Female</td><td>02_{HEX}</td></tr><tr><td>Unknown</td><td>FF_{HEX}</td></tr></table></td><td>1, 3C</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-59</td><td>5.5.4</td><td>Eye Colour
The (1 byte) Eye Colour field shall represent the colour of irises of the eyes according to Table 7.
Table 7 — Eye Colour codes<table><tr><th>Description</th><th>Value</th></tr><tr><td>Unspecified</td><td>00_{HEX}</td></tr><tr><td>Black</td><td>01_{HEX}</td></tr><tr><td>Blue</td><td>02_{HEX}</td></tr><tr><td>Brown</td><td>03_{HEX}</td></tr><tr><td>Gray</td><td>04_{HEX}</td></tr><tr><td>Green</td><td>05_{HEX}</td></tr><tr><td>Multi-Coloured</td><td>06_{HEX}</td></tr><tr><td>Pink</td><td>07_{HEX}</td></tr><tr><td>Reserved by SC 37 for future use</td><td>08_{HEX} to FE_{HEX}</td></tr><tr><td>Other or Unknown (e.g. cannot be determined from image, monochrome image)</td><td>FF_{HEX}</td></tr></table></td><td>1, 3C</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-60</td><td>5.5.4</td><td>If the eyes are different colours, then the right eye colour is to be encoded.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-61</td><td>5.5.5</td><td>Hair Colour
The (1 byte) Hair Colour field shall represent the colour of the hair according to Table 8.
Table 8 — Hair Colour codes
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Unspecified</td><td>00_{HEX}</td></tr>
<tr><td>Bald</td><td>01_{HEX}</td></tr>
<tr><td>Black</td><td>02_{HEX}</td></tr>
<tr><td>Blonde</td><td>03_{HEX}</td></tr>
<tr><td>Brown</td><td>04_{HEX}</td></tr>
<tr><td>Gray</td><td>05_{HEX}</td></tr>
<tr><td>White</td><td>06_{HEX}</td></tr>
<tr><td>Red</td><td>07_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>08_{HEX} to FE_{HEX}</td></tr>
<tr><td>Unknown or Other</td><td>FF_{HEX}</td></tr>
</table></td><td>1, 3C</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-62</td><td>5.5.6</td><td>Subject Height
The (1 byte) Subject Height field shall represent the height of the subject according to Table 9.
Table 9 — Subject Height codes
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Unspecified</td><td>00_{HEX}</td></tr>
<tr><td>Subject Height in cm</td><td>01_{HEX} to FF_{HEX}</td></tr>
</table></td><td>1, 3C</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-63</td><td>5.5.7</td><td>Property Mask
The (3 byte) Property Mask is a bit mask of 3 bytes and each bit of the mask position listed in Table 10 shall be set to 1 if the corresponding property is present, and set to 0 if absent.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-64</td><td>5.5.7</td><td>The mask position starts from 0 at the lowest bit.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-65	5.5.7	The lowest bit set to 0 shall indicate that properties are not specified (and all bits shall be zero);	3C	O-1	Y	Y	Y	Y			
R-66	5.5.7	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.	1	M	Y	Y	Y	Y			
R-67	5.5.7	All reserved bits shall be zero.	1	M	Y	Y	Y	Y			
R-68	5.5.7	A “Pupil or iris not visible” flag set to “1” shall indicate non-compliance with the Frontal, Full Frontal, and Token image types.	2	M	Y			Y			
R-69	5.5.8	**Expression** The (2 byte) Expression Mask is a bit mask of 2 bytes and each bit of the mask position listed in Table 11 shall be set to 1 if the corresponding expression is present, and set to 0 if absent.	1, 3C	M	Y	Y	Y	Y			
R-70	5.5.8	The mask position starts from 0 at the lowest bit.	1	M	Y	Y	Y	Y			
R-71	5.5.8	The lowest bit set to 0 shall indicate that properties are not specified (and all bits shall be zero);	1	M	Y	Y	Y	Y			
R-72	5.5.8	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 expression.	1	M	Y	Y	Y	Y			
R-73	5.5.8	All reserved bits shall be zero.	1	M	Y	Y	Y	Y			
R-74	5.5.9	**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.	3C	O-1	Y	Y	Y	Y			
R-75	5.5.9	Each byte in the field respectively represents pose angles of yaw, pitch and roll in that order.	3C	O-1	Y	Y	Y	Y			
R-76	5.5.9	The angles are defined relative to the frontal pose of the subject, which has angles (0,0,0) as shown in Figure 5. The frontal pose is defined by the Frankfurt Horizon FH (see Annex E) as the xz plane and the vertical symmetry plane as the yz plane with the z axis oriented in the direction of the face sight.	3C	O-1	Y	Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-77	5.5.9	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.	3C	O-1	Y	Y	Y	Y			
R-78	5.5.9	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	Y			
R-79	5.5.9.1	**Pose Angle – Yaw** The yaw angle Y is the rotation in degrees about the y-axis (vertical axis) shown in Figure 5.	3C	O-1	Y	Y	Y	Y			
R-80	5.5.9.1	Frontal poses have a yaw angle of 0 degrees.	3C	O-1	Y	Y	Y	Y			
R-81	5.5.9.1	Positive angles represent faces looking to their left (a counter-clockwise rotation around the y-axis).	3C	O-1	Y	Y	Y	Y			
R-82	5.5.9.1	The encoded value, B_Y, shall be stored in 1 byte with values 0 to 180 computed from a real-valued yaw angle estimate, $-180 \leq Y < 180$, as follows: • If $180 \geq Y \geq 0$ then $B_Y = Y/2+1$. The remainder is discarded. • If $-180 \leq Y < 0$ then $B_Y = 181+Y/2$. The remainder is discarded. The maximum value of B_Y is 180. If the pose angle is not specified, the value of B_Y shall be 0.	1	M	Y	Y	Y	Y			
R-83	5.5.9.2	**Pose Angle – Pitch** The pitch angle P is the rotation in degrees about the x-axis (horizontal axis) shown in Figure 5.	3C	O-1	Y	Y	Y	Y			
R-84	5.5.9.2	Frontal poses have a pitch angle of 0 degrees.	3C	O-1	Y	Y	Y	Y			
R-85	5.5.9.2	Positive angles represent faces looking down (a counter-clockwise rotation around the x-axis).	3C	O-1	Y	Y	Y	Y			
R-86	5.5.9.2	The encoded value, B_P, shall be stored in 1 byte with values 0 to 180 computed from a real-valued pitch angle estimate, $-180 \leq P < 180$, as follows: • If $180 \geq P \geq 0$ then $B_P = P/2+1$. The remainder is discarded. • If $-180 \leq P < 0$ then $B_P = 181+P/2$. The remainder is discarded. 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	Y			
R-87	5.5.9.3	**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 Figure 5. Frontal poses have a roll angle of 0 degrees.	3C	O-1	Y	Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-88	5.5.9.3	Positive angles represent faces tilted toward their right shoulder (counter-clockwise rotation around the z-axis).	3C	O-1	Y	Y	Y	Y			
R-89	5.5.9.3	A roll angle of 0 degrees denotes that the left and right eye centres have identical Y coordinates.	3C	O-1	Y	Y	Y	Y			
R-90	5.5.9.3	The encoded value, B_R, shall be stored in 1 byte with values 0 to 180 computed from a real-valued roll angle estimate, $-180 \leq R < 180$, as follows: • If $180 \geq R \geq 0$ then $B_R = R/2+1$. The remainder is discarded. • If $-180 \leq R < 0$ then $B_R = 181+R/2$. The remainder is discarded. 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	Y			
R-91	5.5.10	**Pose Angle Uncertainty** The (3 multi-byte) Pose Angle Uncertainty (U_Y, U_P, U_R) represents the expected degree of uncertainty 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.	3C	O-1	Y	Y	Y	Y			
R-92	5.5.10	The encoding of Pose Angle Uncertainty is given by three bytes (U_Y, U_P, U_R) where each byte U_K in the field (k=Y,P,R) represents 1 degree of uncertainty with minimum and maximum values of 1 and 181 where U_K=(uncertainty+1).	1	M	Y	Y	Y	Y			
R-93	5.5.10	The more uncertain, the value of the uncertainty U_K shall become larger.	3C	O-1	Y	Y	Y	Y			
R-94	5.5.10	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	Y			
R-95	5.6.1	**The Landmark Point Block Structure** The optional (8 byte) Landmark Point block specifies the type, code and position of a Landmark Point in the facial image.	2	M	Y	Y	Y	Y			
R-96	5.6.1	The number of Landmark Point blocks shall be specified in the Number of Landmark Points field of the Facial Information block.	2	M	Y	Y	Y	Y			
R-97	5.6.2	**Landmark Point Type** The (1 byte) Landmark Point Type field represents the type of the Landmark Point stored in the Landmark Point block.	1	M	Y	Y	Y	Y			
R-98	5.6.2	This field shall be set to 01_{HEX} to denote that landmark point is an MPEG4 Feature Point as given by Annex C of ISO/IEC 14496-2 and is represented by the 2D image coordinates.	1	M	Y	Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-99	5.6.2	The field shall be set to 02_{HEX} to denote that the landmark point is an Anthropometric 2D landmark and is represented by the 2D image coordinates.	1	M	Y	Y	Y	Y			
R-100	5.6.2	Finally, the field shall be set to 03_{HEX} to denote that the Landmark Point is an anthropometric 3D landmark and is represented by its 3D coordinates.	1	M	Y	Y	Y	Y			
R-101	5.6.2	All other field values are reserved by SC 37 for future definition of Landmark Point Types.	1	M	Y	Y	Y	Y			
R-102	5.6.3	**Landmark Point Code** The (1 byte) Landmark Point Code field shall specify the Landmark Point that is stored in the Landmark Point block.	1	M	Y	Y	Y	Y			
R-103	5.6.3	For the Landmark Point Type 01_{HEX} the codes of the Landmark Points in clause 5.6.4, taken from Annex C of ISO/IEC 14496-2 and defined as MPEG4 Feature Points, or the additional eye and nostril Landmark Points in clause 5.6.5 shall be stored in this block.	3C	O-1	Y	Y	Y	Y			
R-104	5.6.3	If the Landmark Point Type is 02_{HEX} or 03_{HEX}, i.e. anthropometric 2D landmark or anthropometric 3D landmark, the codes of the Landmark Points defined in 5.6.6 shall be stored in this block.	3C	O-1	Y	Y	Y	Y			
R-105	5.6.3	The horizontal and vertical positions of Landmark Points are either texture image coordinates or in the Cartesian coordinate system (see clause 5.10.2.2).	3C	O-1	Y	Y	Y	Y			
R-106	5.6.4	**MPEG4 Landmark Points** The normative Figure 7 denotes the Landmark Point codes associated with Feature Points as given by Annex C of ISO/IEC 14496-2. 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.	3C	O-1	Y	Y	Y	Y			
R-107	5.6.5	**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 Figure 8 and values given in Table 14.	3C	O-1	Y	Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-108	5.6.6	**Anthropometric Landmarks** Anthropometric landmarks extend the MPEG4 feature model with new points that are used in forensics and anthropology for person identification via two facial images or image and skull over a long time. They also allow specification of points that are in use by criminal experts and anthropologists [10]. Figure 9 and Table 15 show the definition of the anthropometric landmarks. The set of points represents the craniofacial landmark points of the head and face. The latter are used in forensics for “Face to face” and “Skull to face” identification. Some of these points have MPEG 4 counterparts, others not. The anthropometric landmark code has the format: A.B. A specifies the global landmark of the face to which this landmark belongs such as nose, mouth, etc. B specifies the particular point. In case a Landmark Point has two symmetrical entities (left and right) the right entity always has a greater and even minor code value. Hence, all Landmark Points from the left part of the face have odd minor codes, and from the right part – even minor codes. **Both A and B are in the range from 1 to 15. Hence, the code A*16 + B is written to the 1 byte Landmark Point Code field.**	3C	O-1	Y	Y	Y	Y			
R-109	5.6.7	**Anthropometric 3D landmark** The error of an anthropometric 3D landmark point location should be no greater than 3 mm. The point shall withstand from the nearest point on the surface no further than 3 mm. The point on the surface is a vertex, or a point on an edge, or a point on a face of the surface.	3C	O-1	Y	Y	Y	Y			
R-110	5.6.8	**Z coordinate** This field is not used if the Landmark Point Type is equal to MPEG4 feature or anthropometric 2D landmark.	2	M	Y	Y	Y	Y			
R-111	5.6.8	In case the Landmark Point Type equals anthropometric 3D landmark this field along with the horizontal and vertical positions denotes the coordinates of the landmark point in the 3D Cartesian coordinate system. The metric coordinates of 3D landmarks shall be obtained by multiplying the X, Y, and Z coordinates by a fixed scale of 0,02 mm. Note, that the Landmark Point Type field codes the type of the Landmark Point and determines the interpretation of the Z coordinate.	3C	O-1	Y	Y	Y	Y			
R-112	5.7.1	**The Image Information Block** **Data Structure** The (11 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.	3C	O-1	Y	Y	Y	Y			
R-113	5.7.1	One Representation data block shall follow this block.	3C	O-1	Y	Y	Y	Y			

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-114</td><td>5.7.2</td><td>Face Image Type
The Face Image Type field shall represent the type of the facial image stored in the Image Information block and, if applicable, the 3D Data block according to Table 16.
Note that all Frontal Image Types are either Full Frontal, Token Frontal, Post-processed Frontal or one of the respective 3D Full Frontal or Token Frontal Image Types.
Table 16 — Face Image Type codes
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Basic</td><td>00_{HEX}</td></tr>
<tr><td>Full Frontal</td><td>01_{HEX}</td></tr>
<tr><td>Token Frontal</td><td>02_{HEX}</td></tr>
<tr><td>Post-processed Frontal</td><td>03_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>04_{HEX} to $7F_{HEX}$</td></tr>
<tr><td>Basic 3D</td><td>80_{HEX}</td></tr>
<tr><td>Full Frontal 3D</td><td>81_{HEX}</td></tr>
<tr><td>Token Frontal 3D</td><td>82_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>83_{HEX} to FF_{HEX}</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

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<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-115</td><td>5.7.3</td><td>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, [18]) or JPEG2000 (ISO/IEC 15444-1) or PNG (ISO/IEC 15948:2003) shall be specified. (Ref. Table 17)
Table 17 — Image Data Type codes<table><tr><th>Description</th><th>Value</th></tr><tr><td>JPEG</td><td>00_{HEX}</td></tr><tr><td>JPEG2000 lossy</td><td>01_{HEX}</td></tr><tr><td>JPEG 2000 lossless</td><td>02_{HEX}</td></tr><tr><td>PNG</td><td>03_{HEX}</td></tr><tr><td>Reserved by SC 37 for future use</td><td>04_{HEX} to FF_{HEX}</td></tr></table></td><td>1</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-116</td><td>5.7.3</td><td>For lossless compression PNG or JPEG2000 lossless shall be used.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-117</td><td>5.7.3</td><td>For lossless representation of images using more than 8 bits per channel PNG or JPEG2000 lossless shall be used.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-118</td><td>5.7.3</td><td>For lossy representation of images using more than eight bit per channel JPEG2000 shall be used.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-119</td><td>5.7.3</td><td>Table 17 — Image Data Type codes<table><tr><th>Description</th><th>Value</th></tr><tr><td>JPEG</td><td>00_{HEX}</td></tr><tr><td>JPEG2000 lossy</td><td>01_{HEX}</td></tr><tr><td>JPEG 2000 lossless</td><td>02_{HEX}</td></tr><tr><td>PNG</td><td>03_{HEX}</td></tr><tr><td>Reserved by SC 37 for future use</td><td>04_{HEX} to FF_{HEX}</td></tr></table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-120</td><td>5.7.4</td><td>Width
The (2 byte) Width field shall specify the number of pixels in the horizontal direction.</td><td>1, 2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-121</td><td>5.7.5</td><td>Height
The (2 byte) Height field shall specify the number of pixels in the vertical direction.</td><td>1, 2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-122</td><td>5.7.6</td><td>Spatial Sampling Rate Level
For specific application domains different minimal spatial sampling rates of the interchange data may be required. For example using higher spatial sampling rate images allow for specific human as well as machine inspection methods that depend on the analysis of very small details. The (1 byte) Spatial Sampling Rate Level field (see Table 18) provides information on the number of pixels in the image across the width of the head. (The Width of Head (CC) is defined in Figure 14)
NOTE Interocular distance in pixels will be approximately half of the head widths.

Table 18 — Spatial Sampling Rate Level codes
<table>
<tr><th>Width of Head, CC</th><th>Spatial Sampling Rate Level</th></tr>
<tr><td>CC ≤ 180</td><td>00_{HEX}</td></tr>
<tr><td>180 <CC ≤ 240</td><td>01_{HEX}</td></tr>
<tr><td>240 < CC ≤ 300</td><td>02_{HEX}</td></tr>
<tr><td>300 < CC ≤ 370</td><td>03_{HEX}</td></tr>
<tr><td>370 < CC ≤ 480</td><td>04_{HEX}</td></tr>
<tr><td>480 < CC ≤ 610</td><td>05_{HEX}</td></tr>
<tr><td>610 < CC ≤ 750</td><td>06_{HEX}</td></tr>
<tr><td>750 < CC</td><td>07_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>08_{HEX} to FF_{HEX}</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-123	5.7.7	**Post-acquisition Processing** While the alteration of face image data is discouraged, there are cases when no alternative may exist: - legacy database of . frontal face images shall be rotated to full frontal prior to biometric comparison, - from a frontal image artificial non-frontal facial images at predetermined non-frontal poses are automatically generated (multi-view images) using an implicit head model or similar. These images can be beneficial during the comparison process or a manual review process as they show a more similar pose than the original frontal image, - a single image is to be age progressed and used for verification of a passport holder, - a short video stream is super-resolved to a single face image for comparison against a watchlist.	3C	O-1	Y	Y	Y	Y			
R-124	5.7.7	The (2 byte) Post-acquisition Processing bit field allows the specification of the kind of post processing that has been applied to the original captured image.	1	M	Y	Y	Y	Y			

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-125</td><td>5.7.7</td><td>Each bit of the mask position listed in Table 19 shall be set to 1 if the corresponding processing has been applied, and set to 0 if not.
Table 19 — Post acquisition Processing
<table>
<tr><th>Post-acquisition Processing</th><th>Mask Position</th><th>Use of post-processed image type mandatory</th></tr>
<tr><td>Rotated (in-plane)</td><td>0</td><td>No</td></tr>
<tr><td>Cropped</td><td>1</td><td>No</td></tr>
<tr><td>Downsampled</td><td>2</td><td>No</td></tr>
<tr><td>White balance adjusted</td><td>3</td><td>No</td></tr>
<tr><td>Multiply compressed</td><td>4</td><td>Yes</td></tr>
<tr><td>Interpolated (upsample)</td><td>5</td><td>Yes</td></tr>
<tr><td>Contrast stretched</td><td>6</td><td>Yes</td></tr>
<tr><td>Pose corrected</td><td>7</td><td>Yes</td></tr>
<tr><td>Multi View Image</td><td>8</td><td>Yes</td></tr>
<tr><td>Age progressed</td><td>9</td><td>Yes</td></tr>
<tr><td>Super-resolution processed</td><td>10</td><td>Yes</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>11 to 15</td><td></td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-126</td><td>5.7.7</td><td>The mask position starts from 0 at the lowest bit.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-127</td><td>5.7.7</td><td>All bits set to zero indicates that no post-acquisition processing has been applied at all.</td><td>1, 3C</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-128	5.7.7	All reserved bits shall be zero.	1	M	Y	Y	Y	Y			
R-129	5.7.7	On the one hand a captured image typically needs some post-processing so that the resulting representation conforms to the clauses of this part of ISO/IEC 19794, especially for the frontal image type. On the other hand these processing steps should be minimal and not distort the characteristics of the original image. The right column in Table 19 clearly states, what post-acquisition processes can be applied without having to store the resulting representation in the post-processed image type as defined in clause 10.	2	M	Y			Y			
R-130	5.7.8	**Cross Reference** The (1 byte) Cross Reference Data Type field denotes inter-dependencies when multiple representations are stored in the interchange record. This is of particular interest in the case post-processing has been used (see clause 10).	1	M				Y			
R-131	5.7.8	Then representations that are of type Post-processed shall code the ordinal number of the representation that they have been derived from, in the Cross Reference Field. Example: There are four representations in the overall record. The second representation has been postprocessed and resulted in the fourth representation. Then, the fourth representation shall have Cross Reference set to 2, all other Records shall have set Cross Reference to 0.	2	M				Y			
R-132	5.7.8	The first representation of the interchange format has the code 01_{HEX}.	1	M				Y			

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<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-133</td><td>5.7.9</td><td>Image Colour Space
The (1 byte) Image Colour Space field indicates the colour space used in the encoded Image Information block according to the values in Table 21. The values of 80_{HEX}-FF_{HEX} are vendor specific. Application developers may obtain the values for these codes from the vendor.
Table 21 — Colour Space codes<table><tr><th>Colour Space</th><th>Value</th></tr><tr><td>Unspecified</td><td>00_{HEX}</td></tr><tr><td>24 bit RGB</td><td>01_{HEX}</td></tr><tr><td>YUV422</td><td>02_{HEX}</td></tr><tr><td>8 bit greyscale</td><td>03_{HEX}</td></tr><tr><td>48 bit RGB</td><td>04_{HEX}</td></tr><tr><td>16 bit Greyscale</td><td>05_{HEX}</td></tr><tr><td>Other</td><td>06_{HEX}</td></tr><tr><td>Reserved by SC 37 for future use</td><td>07_{HEX} to $7F_{HEX}$</td></tr><tr><td>Vendor specific</td><td>80_{HEX} to FF_{HEX}</td></tr></table></td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-134</td><td>5.8</td><td>The Representation Data block
The Representation Data consists of the Image Data Block, the 3D Information Block and the 3D data Block.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
<tr><td>R-135</td><td>5.9.1</td><td>The Image Data Block
Data structure
The (variable byte) Image Data block shall consist of two fields as shown in Table 22.
Table 22 — Image data structure<table><tr><th>Field</th><th>Size</th><th>Value</th><th>Notes</th></tr><tr><td>Length of Image data</td><td>4 byte</td><td>$K \leq Length \leq 2^{32} - 53$</td><td>Length of "Image data". K is minimum JPEG or JPEG 2000 or PNG header length.</td></tr><tr><td>Image data</td><td>Variable</td><td>See Table 17</td><td>Either JPEG or JPEG2000 or PNG</td></tr></table></td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-136	5.9.2	**Image Data Length** This four byte field shall indicate the length of the image data in bytes.	1, 2	M	Y	Y	Y	Y			
R-137	5.9.3	**Image data** This variable length field shall contain the image data encoded by the JPEG or JPEG2000 or PNG standards	2	M	Y	Y	Y	Y			
R-138	5.10	**The 3D Information Block** The 3D Information block consists of the following fields and sub-blocks: The Length of 3D Data Representation, the Coordinate System Type, the Texture Projection Matrix, Scale, Offset, the 3D Representation Type, the 3D Supplemental Data, a field reserved for future use, the 3D Capture Device Technology Identifier, the 3D Capture Device Vendor Identifier, the 3D Capture Device Type Identifier, the 3D to 2D Image Temporal Synchronicity, the 3D to 2D-Texture Temporal Synchronicity, the 3D Acquisition Time, the 2D-Texture Acquisition Time, the Texture Map Type and finally the Texture Map Spectrum.	3C	O-1	Y	Y	Y				
R-139	5.10.1	**Length of 3D Data Representation** This (4 byte) field codes the length of the 3D Information and 3D Data block including the optional fields and blocks, if they are present.	1, 2	M	Y	Y	Y				
R-140	5.10.2.1	**Coordinate System Type** **General** All representations support a Cartesian coordinate system. The range data representation additionally supports a cylindrical coordinate system.	3C	O-1	Y	Y	Y				
R-141	5.10.2.1	The (1 byte) Coordinate System Type field specifies the coordinate system of the 3D data by using the following values. **Table 23 — The Coordinate System Type** **Description** / **Value** Cartesian coordinate system / 00_{HEX} Cylindrical coordinate system / 01_{HEX} Reserved by SC 37 for future use / 02_{HEX} to FF_{HEX}	1	M	Y	Y	Y				

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-142	5.10.2.2	In the Cartesian coordinate system the point of origin of the sensor data typically is used as the point of origin of the coordinate system. The transformation from Cartesian coordinates to metric Cartesian coordinates is derived as follows: *X = x*ScaleX+OffsetX* *Y = y*ScaleY+OffsetY* *Z = z*ScaleZ+OffsetZ*	3C	O-1	Y	Y	Y				
R-143	5.10.2.2	A strong relation between anthropometric landmarks and the coordinate system is still established by - the anatomical alignment requirements of the corresponding 2D image and - the alignment between the 3D range data and the corresponding 2D image after applying the Texture Projection Matrix	3C	O-1	Y	Y	Y				
R-144	5.10.2.3	**The Cylindrical Coordinate System** A point in the Cylindrical Coordinate System is given by (α , h, r).	3C	O-1	Y	Y	Y				
R-145	5.10.2.3	The angle α and the h -axis are defined in a way that they form a clockwise coordinate system.	3C	O-1	Y	Y	Y				
R-146	5.10.2.3	The transformation from cylindrical coordinates to metric Cartesian coordinates is derived as follows: *X=r*ScaleZ*sin(α*ScaleX)+OffsetX;* *Y=h*ScaleY+OffsetY;* *Z=r*ScaleZ*cos(α*ScaleX)+OffsetZ*	3C	O-1	Y	Y	Y				
R-147	5.10.2.3	ScaleX, ScaleY, ScaleZ, OffsetX, OffsetY and OffsetZ are the necessary constants for the transformation.	3C	O-1	Y	Y	Y				
R-148	5.10.2.3	ScaleX has the physical unit of rad (degree radian). ScaleY, ScaleZ, OffsetX, OffsetY and OffsetZ are given in the physical unit mm (millimetre).	3C	O-1	Y	Y	Y				
R-149	5.10.2.3	Typically, the point of origin of the sensor data is used as the point of origin of the cylindrical coordinate system.	3C	O-1	Y	Y	Y				
R-150	5.10.2.3	A strong relation between anthropometric landmarks and the coordinate system is still established by - the anatomical alignment requirements of the corresponding 2D image and - the alignment between the 3D data and the corresponding 2D image after applying the Texture Projection Matrix.	3C	O-1	Y	Y	Y				

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-151	5.10.3	**Texture Projection Matrix** The Texture Projection Matrix P (3x4 float, 48 bytes) is required to map the 3D data onto the 2D texture image of the Image Data block.	1	M	Y	Y	Y				
R-152	5.10.3	The matrix shall be stored row by row starting from the left top.	3C	O-1	Y	Y	Y				
R-153	5.10.3	One can project a point in 3D space $[X ,Y,Z]^T$ on the texture image of the Image Data block by multiplying the Texture Projection Matrix P with the so called homogeneous 3D coordinates of the 3D point [11]. $[x, y,w]^T = P *[X ,Y,Z,1]^T$	3C	O-1	Y	Y	Y				
R-154	5.10.3	Homogeneous 3D coordinates are a vector of four values $[X ,Y,Z,1]^T$.	3C	O-1	Y	Y	Y				
R-155	5.10.3	Here X, Y, Z are the coordinates of a point in the metric cartesian coordinate system.	3C	O-1	Y	Y	Y				
R-156	5.10.3	The multiplication results in $[x, y,w]T$, the so called homogeneous 2D coordinates with the auxiliary coordinate *w*. One obtains the resulting 2D image pixel coordinates of the texture image in the Image Data block by dividing the first two coordinates of the 2D homogeneous coordinates by the respective 3rd auxiliary coordinate *w*. Hence [x:w, y:w] are the resulting image pixel coordinates of the texture image related to the given 3D point $[X,Y,Z]^T$. Note, that the obtained coordinates are floating point values. In this part of ISO/IEC 19794 there are no rules about how the necessary rounding or interpolation to the integer pixel coordinates has to be done.	3C	O-1	Y	Y	Y				
R-157	5.10.3	In case the cylindrical coordinate system is used one shall transform to the metric Cartesian coordinate system to map the 3D data onto the texture.	3C	O-1	Y	Y	Y				
R-158	5.10.3	If there is overlapping, the texture is mapped to the first 3D point in the line of sight (closest to the observer).	3C	O-1	Y	Y	Y				
R-159	5.10.3	The next two blocks store all necessary data to compute metric depth values from the 3D data.	3C	O-1	Y	Y	Y				
R-160	5.10.4	**ScaleX, ScaleY, ScaleZ, OffsetX, OffsetY, OffsetZ** As outlined in clause 5.10.2.2and 5.10.2.3 ScaleX, ScaleY, ScaleZ, OffsetX, OffsetY and OffsetZ are needed to transform digital coordinates to metric coordinates. This applies to all three 3D representations defined in this part of ISO/IEC 19794. The values are given in the physical unit mm (millimetre).	3C	O-1	Y	Y	Y				

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-161	5.10.4	In the case of Cartesian coordinates ScaleX also has the physical unit mm	3C	O-1	Y	Y	Y				
R-162	5.10.4	in the case of a cylindrical coordinate system ScaleX has the physical unit of rad (degree radian).	3C	O-1	Y	Y	Y				
R-163	5.10.4	Each factor is represented by a mandatory four byte float value and be coded as defined in the ISO/IEC/IEEE 60559 single precision binary floating-point format, i.e. the 'binary32' format. The values NaN (Not a Number), positive inf (infinity) and negative inf shall not be encoded	1	M	Y	Y	Y				
R-164	5.10.4	Large values of ScaleX, ScaleY or ScaleZ indicate a low spatial sampling rate in the respective dimension. Boundary values of ScaleX, ScaleY and ScaleZ may be strongly restricted for different Face Image Types (see clauses 11 to 13, and Annex B.7).	3C	O-1	Y	Y	Y				
R-165	5.10.4	ScaleX and ScaleY in a range image represent sampling intervals while the ones in a 3D Point Map do quantization of the 3D space. Also, ScaleZ in either of these representations denotes quantization.	3C	O-1	Y	Y	Y				
R-166	5.10.5	**3D Representation Type** The (1 byte) 3D Representation Type shall be used to indicate the representation type that codes the 3D data.	3C	O-1	Y	Y	Y				
R-167	5.10.5	**Table 24 — 3D Representation Type** **Description** / **Value** Range Image / 00_{HEX} 3D Point Map / 01_{HEX} Vertex Data / 02_{HEX} Reserved by SC 37 for future use / 03_{HEX} to FF_{HEX}	1	M	Y	Y	Y				

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<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-168</td><td>5.10.6</td><td>3D Supplemental Data
The (1 byte) 3D Supplemental Data mask is a bit mask of one byte and each bit of the mask position listed in Table 25 shall be set to 1 if the corresponding 3D information is present and set to 0 if absent.
Table 25 — 3D Supplemental Data<table><tr><th>Description</th><th>Mask Position</th></tr><tr><td>Error Map or Vertex Error present</td><td>0</td></tr><tr><td>Texture Map present</td><td>1</td></tr><tr><td>Reserved by SC 37 for future use</td><td>2 to 7</td></tr></table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-169</td><td>5.10.6</td><td>So, a bit mask of all zeros will indicate, that none of the options are present.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-170</td><td>5.10.6</td><td>The mask position starts from 0 at the lowest significant bit.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-171</td><td>5.10.6</td><td>The mask indicates if an Error Map/Vertex Error and/or a Texture Map is attached to the data.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-172</td><td>5.10.6</td><td>All reserved bits shall be zero.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-173</td><td>5.10.7</td><td>3D Capture Device Technology Identifier
In analogy to the Capture Device Technology Identifier field in the 2D Image Information block, where the source of the 2D data can be coded, the (1 byte) 3D Capture Device Technology Identifier field should be used to indicate the type of the source that was used to acquire the 3D data.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-174</td><td>5.10.7</td><td>Additionally, the most significant bit (MSB) indicates if the scanning technology is active or passive for each source type.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
</table>

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<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-175</td><td>5.10.7</td><td>Table 26 — The 3D Capture Device Technology Identifier
<table>
<tr><th>Description</th><th>Value (passive technology)</th><th>Value (active technology)</th></tr>
<tr><td>Unspecified</td><td>00_{HEX}</td><td>00_{HEX}</td></tr>
<tr><td>stereoscopic scanner</td><td>81_{HEX}</td><td>01_{HEX}</td></tr>
<tr><td>moving (monochromatic) laser line</td><td>Not available</td><td>02_{HEX}</td></tr>
<tr><td>structured light</td><td>Not available</td><td>03_{HEX}</td></tr>
<tr><td>colour coded light</td><td>Not available</td><td>04_{HEX}</td></tr>
<tr><td>ToF (Time of Flight)</td><td>Not available</td><td>05_{HEX}</td></tr>
<tr><td>Shape from Shading</td><td>86_{HEX}</td><td>06_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>87_{HEX} to FF_{HEX}</td><td>07_{HEX} to 80_{HEX}</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-176</td><td>5.10.8</td><td>3D Capture Device Vendor Identifier
The (2 byte) 3D Capture Device Vendor Identifier shall identify the biometric organisation that owns the product that created the BDIR.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-177</td><td>5.10.8</td><td>The 3D capture device algorithm vendor identifier shall be encoded in two bytes carrying a CBEFF biometric organization identifier (registered by IBIA or other approved registration authority).</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-178</td><td>5.10.8</td><td>A value of all zeros shall indicate that the 3D capture device vendor is unreported.</td><td>1, 3C</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-179</td><td>5.10.9</td><td>3D Capture Device Type Identifier
The (2 byte) 3D Capture Device Type Identifier field denotes the vendor specific capture device type Identifier.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-180</td><td>5.10.9</td><td>A value of all zeros will be acceptable and will indicate that the 3D Capture Device Type Identifier is unspecified.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
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					B	F	T	P			
R-181	5.10.9	Application developers may obtain the values for these codes from the vendor.	3C	O-1	Y	Y	Y				
R-182	5.10.10	**3D to 2D Image Temporal Synchronicity** The mandatory (2 byte) 3D to 2D Image Temporal Synchronicity shall be used to indicate the temporal relation between the 3D data and the 2D image of the Image Data block.	3C	O-1	Y	Y	Y				
R-183	5.10.10	It does **not** reference to the optional Texture Map of the 3D Data block.	3C	O-1	Y	Y	Y				
R-184	5.10.10	The value indicates the temporal difference between the start of the 2D and the start of the 3D acquisition process in milliseconds (ms).	3C	O-1	Y	Y	Y				
R-185	5.10.10	The field allows the coding of positive as well as negative differences.	3C	O-1	Y	Y	Y				
R-186	5.10.10	Here, a negative time difference denotes that the 3D acquisition started before the 2D acquisition.	3C	O-1	Y	Y	Y				
R-187	5.10.10	The time difference in milliseconds (ms) is coded in the two's complement system.	3C	O-1	Y	Y	Y				
R-188	5.10.10	**Table 27 — The 3D to 2D Temporal Synchronicity** **Description** / **Value** Temporal difference between the start of the 2D and the 3D acquisition process in milliseconds (ms) in two's complement coding. / 0000_{HEX} to $7FFF_{HEX}$, 8001_{HEX} to $FFFF_{HEX}$ Unspecified / 8000_{HEX}	1	M	Y	Y	Y				
R-189	5.10.11	**3D to 2D Texture Temporal Synchronicity** The mandatory (2 byte) 3D to 2D Texture Temporal Synchronicity shall be used to indicate the temporal relation between the 3D data and the 2D textural data of the optional 2D Texture Map of the 3D Data block.	3C	O-1	Y	Y	Y				
R-190	5.10.11	The value indicates the temporal difference between the start of the Texture Map acquisition and the start of the 3D acquisition process in milliseconds (ms). NOTE It does **not** refer to the synchronicity between the acquisition of the 2D image in the Image Data block and the 3D data.	3C	O-1	Y	Y	Y				

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-191</td><td>5.10.11</td><td>The field allows the coding of positive as well as negative differences. Here a negative time difference denotes that the 3D acquisition started before the 2D acquisition.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-192</td><td>5.10.11</td><td>The time difference in milliseconds (ms) is coded in the two's complement system.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-193</td><td>5.10.11</td><td>Table 28 — The 3D to 2D Texture Temporal Synchronicity<table><tr><th>Description</th><th>Value</th></tr><tr><td>Temporal difference between the start of the optional 2D Texture Map and the 3D acquisition process in milliseconds (ms) in two's complement coding.</td><td>0000_{HEX} to $7FFF_{HEX}$
8001_{HEX} to $FFFF_{HEX}$</td></tr><tr><td>Unspecified</td><td>8000_{HEX}</td></tr></table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-194</td><td>5.10.12</td><td>3D Acquisition Time
Different 3D scanning techniques strongly vary in their acquisition time and this time may directly influence the quality of the data (if the subject moves during acquisition). Therefore, the (2 byte) 3D Acquisition Time field is used to code the time span between the start of the 3D acquisition process and the end of the 3D acquisition process in ms (milliseconds).</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-195</td><td>5.10.12</td><td>Table 29 — The 3D Acquisition Time<table><tr><th>Description</th><th>Value</th></tr><tr><td>Duration of the 3D acquisition process in milliseconds (ms)</td><td>0000_{HEX} to $FFFE_{HEX}$</td></tr><tr><td>Unspecified</td><td>$FFFF_{HEX}$</td></tr></table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-196</td><td>5.10.13</td><td>2D Texture Acquisition Time
The optional 2D Texture Map of the 3D record may or may not be simultaneously acquired with the 3D data.
Therefore, the (2 byte) 2D Texture Acquisition Time field is used to code the time span between the start ofthe 2D acquisition process and the end of the 2D acquisition process of the optional Texture Map in ms (milliseconds).</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-197	5.10.13	**Table 30 — The 2D Texture Acquisition Time** **Description** / **Value** Duration of the 2D acquisition process in milliseconds (ms) / 0000_{HEX} to $FFFE_{HEX}$ Unspecified / $FFFF_{HEX}$	1	M	Y	Y	Y				
R-198	5.10.14	**Texture Map Type** The (1 byte) Texture Map Type field denotes the encoding type of the Texture Map block.	3C	O-1	Y	Y	Y				
R-199	5.10.14	If the 3D Supplemental Data field specifies that there is a Texture Map in the record, either JPEG (ISO/IEC 10918-1 and ITU-T rec. T.81) or JPEG 2000 (ISO/IEC 15444-1) or PNG (ISO/IEC 15948:2004) shall be specified.	2	M	Y	Y	Y				
R-200	5.10.14	For JPEG, the data shall be formatted in accordance with the JPEG File Interchange Format, Version 1.02 (JFIF).	3C	O-1	Y	Y	Y				
R-201	5.10.14	If the 3D Supplemental Data field specifies that there is no Texture Map in the record the Texture Map Type shall be “Unspecified”.	2	M	Y	Y	Y				
R-202	5.10.14	**Table 31 — The Texture Map Type codes** **Description** / **Value** Unspecified / 00_{HEX} JPEG / 01_{HEX} JPEG2000 / 02_{HEX} PNG / 03_{HEX} Reserved by SC 37 for future use / 04_{HEX} to $0F_{HEX}$	1	M	Y	Y	Y				

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-203</td><td>5.10.15</td><td>Texture Map Spectrum
The (1 byte) Texture Map Spectrum field denotes the kind of spectrum that has been used for acquiring the Texture Map specified in clause 5.11.9.
Whereas the 2D face image always uses the spectrum of the visible light, this can be different for the acquisition of the Texture Map.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-204</td><td>5.10.15</td><td>If the 3D Supplemental Data field specifies that there is a Texture Map in the record, the Texture Map Spectrum field shall not be unspecified.</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-205</td><td>5.10.15</td><td>If the 3D Supplemental Data field specifies that there is no Texture Map in the record, the Texture Map Spectrum field shall be unspecified.</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-206</td><td>5.10.15</td><td>Table 32 — The Texture Map Spectrum codes
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Unspecified</td><td>00_{HEX}</td></tr>
<tr><td>Visible (380nm- 780nm)</td><td>01_{HEX}</td></tr>
<tr><td>Very-near infrared (photographic) (780nm-1000nm)</td><td>02_{HEX}</td></tr>
<tr><td>Short wave infrared (1000nm-1400nm)</td><td>03_{HEX}</td></tr>
<tr><td>Other</td><td>04_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>05_{HEX} to FF_{HEX}</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="12">The 3D Data Block</td></tr>
<tr><td>R-207</td><td>5.11.1</td><td>Data Structure
The 3D Data block contains the representation of the 3D data.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-208</td><td>5.11.1</td><td>There are three alternatives to store 3D data: a Range Image, 3D Point Map, or using the Vertex representation. Optionally, additional information can be stored in the Error Map and Vertex Error, respectively, and in the Texture Map.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-209</td><td>5.11.1</td><td>The 3D Representation Type field (see clause 5.10.5) is used to define the format of the 3D data representation that has been used in the actual record.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-210</td><td>5.11.2</td><td>Range Image Bit Depth
The (1 byte) Range Image Bit Depth field denotes the bit depth of the Range Image.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-211</td><td>5.11.2</td><td>This field is given for the sake of easier record parsing, as the bit depth can also be derived from the PNG record header.</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-212</td><td>5.11.2</td><td>Table 33 — The Range Image Bit Depth codes
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>8 bit</td><td>00_{HEX}</td></tr>
<tr><td>16 bit</td><td>01_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>02_{HEX} to FF_{HEX}</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-213</td><td>5.11.3</td><td>Range Image
The Range Image is a representation of the range data in a two dimensional form.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-214</td><td>5.11.3</td><td>The Range Image shall be stored in the PNG format (ISO/IEC 15948:2004).</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-215</td><td>5.11.3</td><td>The bit rate of the PNG code is written in the PNG header, but shall also be given in the Range Image Bit Depth field (see clause 5.11.2).
Hence whether the 8 or 16 bit depth coding is used shall be defined from the PNG record header.</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-216</td><td>5.11.3</td><td>The uncompressed data has the dimension Range Image Height x Range Image Width. These dimensions are encoded in the PNG header.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-217</td><td>5.11.3</td><td>Pixel of value FF_{HEX} for 8 bit PNG coding and $FFFF_{HEX}$ for 16 bit PNG coding shall indicate non-valid range data.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-218</td><td>5.11.4</td><td>3D Point Map Width and Height
These two fields define the width and height of the 3D Point Map where the 3D data is stored.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-219</td><td>5.11.4</td><td>Both fields are 2 byte values ranging from 0 to 65 535.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-220</td><td>5.11.5</td><td>3D Point Map
The 3D Point Map allows storing of raw 3D scanner data.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-221	5.11.5	The organization of this block is as follows. It consists of a three channel lossless compressed image in the PNG format with 16 bits per channel. The first channel represents the X, the second the Y, and the third the Z values.	1	M	Y	Y	Y				
R-222	5.11.5	A pixel value of (X,Y,Z) = ($FFFF_{HEX}$, $FFFF_{HEX}$, $FFFF_{HEX}$) shall be used to indicate a non-valid 3D point.	3C	O-1	Y	Y	Y				
R-223	5.11.5	The coordinates are given in an arbitrary cartesian coordinate system.	3C	O-1	Y	Y	Y				
R-224	5.11.5	Connectivity is not explicitly encoded.	3C	O-1	Y	Y	Y				
R-225	5.11.5	For valid points neighbouring pixel positions represent neighbouring positions on the face surface.	3C	O-1	Y	Y	Y				
R-226	5.11.6	**Vertex Data** The variable length Vertex Data block contains the Vertex Coordinates block, the optional Vertex Normals block, the optional Vertex Errors block, and the optional Vertex Textures block.	3C	O-1	Y	Y	Y				
R-227	5.11.6	Each of these blocks contains a list of vertex descriptions.	3C	O-1	Y	Y	Y				
R-228	5.11.6	The number of the vertex descriptions is given by the (2 byte) Vertex Count field.	1	M	Y	Y	Y				
R-229	5.11.6	The location of each vertex is represented by its X coordinate, Y coordinate, and Z coordinate as specified in the (2 byte) Vertex X Coordinate, Vertex Y Coordinate and Vertex Z Coordinate fields, respectively.	1	M	Y	Y	Y				
R-230	5.11.6	The values code the location with a fixed precision as specified in clause 11.3.2.	3C	O-1	Y	Y	Y				
R-231	5.11.6	If the Normal Flag is equal to 01_{HEX} the corresponding normal vector to each vertex shall be specified in the (2 byte) Normal X, Normal Y and Normal Z Coordinate fields, respectively.	2	M	Y	Y	Y				

<table>
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<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-232</td><td>5.11.6</td><td>The optional (1 byte) Vertex Error field codes additional information on the vertex as described in Table 35
Table 35 — The Error Map
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Reserved by SC 37 for future use</td><td>0 to 199</td></tr>
<tr><td>Depth value is considered correct</td><td>200</td></tr>
<tr><td>Depth value is interpolated, interpolation type isn't specified</td><td>201</td></tr>
<tr><td>Depth value is interpolated, linear interpolation has been used</td><td>202</td></tr>
<tr><td>Depth value is interpolated, bicubic interpolation has been used</td><td>203</td></tr>
<tr><td>Value of optional texture image potentially wrong (texture noisy, overexposure, etc.)</td><td>204</td></tr>
<tr><td>Value of optional texture image has been corrected by post processing (image processing)</td><td>205</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>206 to 255</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-233</td><td>5.11.6</td><td>If the existence of an Error Map is specified in the 3D Supplemental Data field, the Vertex Error field shall be present for each vertex.</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-234</td><td>5.11.6</td><td>The optional Vertex Texture X and Vertex Texture Y fields represent the corresponding x and y pixel position in the Texture Map with (0,0) denoting the upper left corner.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-235</td><td>5.11.6</td><td>If the existence of a Texture Map is specified in the 3D Supplemental Data field, Vertex Texture X and Vertex Texture Y shall be present for each vertex.</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-236</td><td>5.11.6</td><td>The number of triangles is specified in the (4 byte) Triangle Face Count field.</td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-237</td><td>5.11.6</td><td>The 3D Vertex Data representation optionally allows for the specification of additional normals to the vertexes.
This shall be indicated by the (1 byte) Normal Flag field.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-238	5.11.6	**Table 34 — The Normal Flag codes** **Description** / **Value** Normal information not used in Vertex Data / 00_{HEX} Normal information used in Vertex Data / 01_{HEX} Reserved by SC 37 for future use / 02_{HEX} to FF_{HEX}	1	M	Y	Y	Y				
R-239	5.11.7	**Triangle Data** The variable length Vertex Triangle Data contains a list of triangle descriptions.	3C	O-1	Y	Y	Y				
R-240	5.11.7	The number of the triangle descriptions is given by the Triangle Face Count field (see clause 5.11.6).	2	M	Y	Y	Y				
R-241	5.11.7	Each triangle is specified by the three (2 byte) indices of the vertices in the vertex data list forming the triangle.	1	M	Y	Y	Y				
R-242	5.11.7	The order of the vertex indices shall be counter clock wise to indicate the external face of the triangle.	3C	O-1	Y	Y	Y				
R-243	5.11.8	**Error Map** The optional Error Map can be used to further give information on how the 3D data has been processed before it was stored in the 3D representation.	3C	O-1	Y	Y	Y				
R-244	5.11.8	The Error Map shall be coded in the PNG format using an 8bit per pixel greyscale image.	1	M	Y	Y	Y				
R-245	5.11.8	The length of the map is variable, as it depends on the lossless compression algorithm.	3C	O-1	Y	Y	Y				
R-246	5.11.8	The uncompressed data has the dimension Range Image Height x Range Image Width in the case it is associated with a Range Image or 3D Point Map Width x 3D Point Map Height in case it is associated with a 3D Point Map.	3C	O-1	Y	Y	Y				
R-247	5.11.8	Pixel values *t* in the range of 0 to 199 are reserved for future use by SC 37.	3C	O-1	Y	Y	Y				
R-248	5.11.8	A value of *t* = 200 codes that the depth value is considered to be correct.	3C	O-1	Y	Y	Y				

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-249</td><td>5.11.8</td><td>Values of t = 201 and above code a specific potential or corrected defect of the 3D data or the corresponding Texture Image.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-250</td><td>5.11.8</td><td>See clause 5.11.6 of how the pixel values are used in the 3D Vertex representation.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-251</td><td>5.11.8</td><td>Table 35 — The Error Map
<table>
<tr><th>Description</th><th>Value</th></tr>
<tr><td>Reserved by SC 37 for future use</td><td>0 to 199</td></tr>
<tr><td>Depth value is considered correct</td><td>200</td></tr>
<tr><td>Depth value is interpolated, interpolation type isn't specified</td><td>201</td></tr>
<tr><td>Depth value is interpolated, linear interpolation has been used</td><td>202</td></tr>
<tr><td>Depth value is interpolated, bicubic interpolation has been used</td><td>203</td></tr>
<tr><td>Value of optional texture image potentially wrong (texture noisy, overexposure, etc.)</td><td>204</td></tr>
<tr><td>Value of optional texture image has been corrected by post processing (image processing)</td><td>205</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>206 to 255</td></tr>
</table></td><td>1</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-252</td><td>5.11.9</td><td>Texture Map
The optional Texture Map should only be used to store textural face data that is acquired by a scanning device during the 3D acquisition process, and therefore may have geometry other than the standard 2D image stored in the Image Data block of the same record.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-253</td><td>5.11.9</td><td>It is not a substitute for the mandatory 2D image of the Image Data block.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-254</td><td>5.11.9</td><td>The Texture Map has the format specified in the Texture Map Type field.</td><td>2</td><td>M</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-255</td><td>5.11.9</td><td>It shall be coded in 8 bit or 16 bit greyscale or 24 bit colour image.</td><td>3C</td><td>O-1</td><td>Y</td><td>Y</td><td>Y</td><td></td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-256	5.11.9	The length of the map is variable as it depends on the compression algorithm.	3C	O-1	Y	Y	Y				
R-257	5.11.9	The uncompressed data has the dimension Range Image Height x Range Image Width in the case it is associated with a Range Image or 3D Point Map Width x 3D Point Map Height in case it is associated with a 3D Point Map, and variable dimensions when associated with a 3D Vertex representation.	3C	O-1	Y	Y	Y				
The Basic Face Image Type											
R-258	6.2	**Image data encoding requirements for the Basic Face Image Type** One of four possible encodings shall be used for all 2-D Face Image Types 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), lossy or lossless, and encoded in the JP2 file format (the JPEG2000 file format) 3) The PNG (ISO/IEC 15948:2003) standard. PNG shall not be used in its interlaced mode and not for images that have been JPEG compressed before.	1	O-1	Y	Y	Y	Y			
R-259	6.3	**Image data compression requirements for the Basic Face Image Type** Both encoding methods allow for compression of image data.	3C	O-1	Y	Y	Y	Y			
R-260	6.4.1	**Format requirements for the Basic Face Image Type** **Facial Header** The Format Identifier, Version Number, Length of Record, and Number of Representations fields shall be specified.	1	M	Y	Y	Y	Y			
R-261	6.4.2	**Facial Information** The Representation Length and Number of Landmark Points fields shall be specified.	1	M	Y	Y	Y	Y			
R-262	6.4.3	**Image Information** The Face Image Type field shall be specified with value 00_{HEX}.	1	M	Y	Y	Y	Y			
R-263	6.4.3	The Image Data Type, Width, and Height fields shall be specified.	1	M	Y	Y	Y	Y			
The Frontal Face Image Type											
R-264	7.2.2	**Pose** Pose is known to strongly affect performance of automated face recognition systems. Thus, the full-face frontal pose shall be used.	3C	O-1		Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-265	7.2.2	Rotation of the head shall be less than +/- 5 degrees from frontal in pitch and yaw (ref. 5.5.9).	1	M		Y	Y	Y			
R-266	7.2.2	the rotation of the head shall be less than +/- 8 degrees from frontal in roll (ref. 5.5.9).	1	M		Y	Y	Y			
R-267	7.2.4	**Assistance in positioning the face** In no cases shall any other face be captured in the image.	3C	O-1		Y	Y	Y			
R-268	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		Y	Y	Y			
R-269	7.2.7	**Subject and scene lighting** Lighting shall be equally distributed on the face.	3C	O-1		Y	Y	Y			
R-270	7.2.7	There shall be no significant direction of the light from the point of view of the photographer	3C	O-1		Y	Y	Y			
R-271	7.2.7	The ratio between the median intensity on a square region centred around Landmark Points 5.3 and 5.4 with side length 20% of the inter-eye distance shall be between 0,5 and 2,0.	3C	O-1		Y	Y	Y			
R-272	7.2.8	**Hot spots and specular reflections** Hot spots (i.e., bright regions that results from light shining directly on the face) shall be absent.	3C	O-1		Y	Y	Y			
R-273	7.2.8	Diffused lighting, multiple balanced sources or other lighting methods shall be used.	3C	O-1		Y	Y	Y			
R-274	7.2.9	**Eye glasses** Glasses should be clear glass and transparent so that the eye pupils and irises shall be visible. Tinted glasses or sunglasses shall not be worn. An exception applies when the subject asserts a medical reason to retain the glasses; in these cases the dark glasses indicator in the header structure shall be set.	3C	O-1		Y	Y	Y			
R-275	7.2.9	The frames of glasses shall not obscure the eyes.	3C	O-1		Y	Y	Y			
R-276	7.2.9	The frames shall not be thicker than 5% of the distance between points 12.1 and 12.2 (midpoints of left and right eye) in Figure 8.	3C	O-1		Y	Y	Y			
R-277	7.2.10	**Head coverings** In cases where head coverings are present the related flag in the property mask shall be set.	3C	O-1		Y	Y	Y			
R-278	7.2.11	**Visibility of pupils and irises** In cases where pupils or irises are not visible the related flag in the property mask shall be set.	3C	O-1		Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-279	7.2.12	**Lighting artefacts** There shall be no lighting artefacts or flash reflections on glasses.	3C	O-1		Y	Y	Y			
R-280	7.2.12	Lighting artefacts covering any region of the eyes shall not be present. This applies to any region in polygon between landmark points 3.8, 3.2, 3.12 and 3.4 for the right eye and between landmark points 3.11, 3.1, 3.7 and 3.3 for the left eye in Figure 7.	3C	O-1		Y	Y	Y			
R-281	7.2.13	**Eye patches** Eye patches shall not be worn. An exception applies when the subject asserts a need to retain the patch (e.g. a medical reason) is claimed; in these cases the left or right patch indicators in the header structure shall be set.	3C	O-1		Y	Y	Y			
R-282	7.3.2	**Contrast and saturation** For each patch of skin on the person's face, the gradations in textures shall be clearly visible i.e. being of reasonable contrast. In this sense, there will be no saturation (over or under exposure) on the face.	3C	O-1		Y	Y	Y			
R-283	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		Y	Y	Y			
R-284	7.3.3	All images shall have sufficient depth of focus to maintain greater than two millimetre spatial sampling rate on the subject's facial features at time of capture.	3C	O-1		Y	Y	Y			
R-285	7.3.4	**Unnatural colour** Unnaturally coloured lighting, yellow, red, etc. is not allowed.	3C	O-1		Y	Y	Y			
R-286	7.3.4	Care shall be taken to correct the "white balance" of image capture devices.	3C	O-1		Y	Y	Y			
R-287	7.3.4	The lighting shall produce a face image with natural looking flesh tones when viewed in typical examination environments.	3C	O-1		Y	Y	Y			
R-288	7.3.4	Images showing the "red-eye effect", i.e. the common appearance of red eyes on photographs taken with a photographic flash when the flash is too close to the lens, are not acceptable.	3C	O-1		Y	Y	Y			
R-289	7.3.4	The iris and the iris colour shall be visible.	3C	O-1		Y	Y	Y			
R-290	7.3.5	**Colour or greyscale enhancement** A process that overexposes or under-develops a colour or greyscale image for purposes of beauty enhancement or artistic pleasure is not allowed.	3C	O-1		Y	Y	Y			

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-291	7.3.5	The full spectrum shall be represented on the face image where appropriate.	3C	O-1		Y	Y	Y			
R-292	7.3.5	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		Y	Y	Y			
R-293	7.3.6	**Radial distortion of the camera lens** The 'fish eye' effect associated with wide angle lenses and which can result in the subject appearing to have an unusually large nose in the image shall not be present.	3C	O-1		Y	Y	Y			
R-294	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		Y	Y	Y			
R-295	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		Y	Y	Y			
R-296	7.4.2.1	**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.	3C	O-1		Y	Y	Y			
R-297	7.4.3	**Video interlacing** Interlaced video frames are not allowed for the Frontal Image Type. All interlacing shall be absent (not simply removed, but absent).	3C	O-1		Y	Y	Y			
R-298	7.4.4	**Use of near infra-red cameras** Dedicated near infra-red cameras shall not be used for acquisition of image of the Frontal Image Type.	3C	O-1		Y	Y	Y			
The Full Frontal Image Type											
R-299	8.3.1	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		Y					

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-300	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 the 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		Y					
R-301	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. 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). Note that the origin O of the coordinate system is in the upper left corner of the image.	3C	O-1		Y					
R-302	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 the head. The head width is shown as length CC in Figure 142. To ensure that the entire face is visible in the image the head width CC shall be between 50% and 75% of theimage width (A).	3C	O-1		Y					
R-303	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). 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		Y					

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-304</td><td>8.4.1</td><td>Spatial Sampling Rate
For an image for optimal human examination and permanent storage, the spatial sampling rate of the full images shall be at least 180 pixels of spatial sampling for the width of the head, or roughly 90 pixels from eye centre to eye centre.
Table 18 — Spatial Sampling Rate Level codes
<table>
<tr><th>Width of Head, CC</th><th>Spatial Sampling Rate Level</th></tr>
<tr><td>CC ≤ 180</td><td>00_{HEX}</td></tr>
<tr><td>180 <CC ≤ 240</td><td>01_{HEX}</td></tr>
<tr><td>240 < CC ≤ 300</td><td>02_{HEX}</td></tr>
<tr><td>300 < CC ≤ 370</td><td>03_{HEX}</td></tr>
<tr><td>370 < CC ≤ 480</td><td>04_{HEX}</td></tr>
<tr><td>480 < CC ≤ 610</td><td>05_{HEX}</td></tr>
<tr><td>610 < CC ≤ 750</td><td>06_{HEX}</td></tr>
<tr><td>750 < CC</td><td>07_{HEX}</td></tr>
<tr><td>Reserved by SC 37 for future use</td><td>08_{HEX} to FF_{HEX}</td></tr>
</table></td><td>1</td><td>M</td><td></td><td>Y</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td>R-305</td><td>8.4.2</td><td>Post-acquisition processing
No other post processing than in-plane rotation and/or cropping and/or down sampling and/or multiple compression shall be applied to derive a Full Frontal Face image from a captured image.
Table 19 — Post acquisition Processing
<table>
<tr><th>Post-acquisition Processing</th><th>Mask Position</th><th>Use of post-processed image type mandatory</th></tr>
<tr><td>Rotated (in-plane)</td><td>0</td><td>No</td></tr>
<tr><td>Cropped</td><td>1</td><td>No</td></tr>
<tr><td>Downsampled</td><td>2</td><td>No</td></tr>
<tr><td>White balance adjusted</td><td>3</td><td>No</td></tr>
<tr><td>Multiply compressed</td><td>4</td><td>Yes</td></tr>
<tr><td>Interpolated (upsample)</td><td>5</td><td>Yes</td></tr>
<tr><td>Contrast stretched</td><td>6</td><td>Yes</td></tr>
<tr><td>Pose corrected</td><td>7</td><td>Yes</td></tr>
<tr><td>Multi View Image</td><td>8</td><td>Yes</td></tr>
<tr><td>Age progressed</td><td>9</td><td>Yes</td></tr>
<tr><td>Super-resolution processed</td><td>10</td><td>Yes</td></tr>
<tr><td>Reserved by SC 37 for futureuse</td><td>11 to 15</td><td></td></tr>
</table></td><td>1</td><td>M</td><td></td><td>Y</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-306</td><td>8.5.2</td><td>Image Information
The Face Image Type field shall be specified with value 1.</td><td>1</td><td>M</td><td></td><td>Y</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Requirement ID</th><th rowspan="2">Ref. in main body</th><th rowspan="2">Requirement Summary</th><th rowspan="2">Level</th><th rowspan="2">Status</th><th colspan="4">Subformat Applicability</th><th rowspan="2">IUT Support</th><th rowspan="2">Supported Range</th><th rowspan="2">Test Result</th></tr>
<tr><th>B</th><th>F</th><th>T</th><th>P</th></tr>
<tr><td colspan="12">The Token Face Image Type</td></tr>
<tr><td>R-307</td><td>9.2.1</td><td>The Token Face image is used to store the extracted face information from any other image source.</td><td>3C</td><td>O-1</td><td></td><td></td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-308</td><td>9.2.2</td><td>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.</td><td>1, 3C</td><td>M</td><td></td><td></td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-309</td><td>9.2.3</td><td>Geometric characteristics
A Token image is a colour or greyscale image with image dimensions and eye position coordinates given by Table 37.
Table 37 — The geometric characteristics of the Token Image Type
<table><tr><th>Feature or Parameter</th><th>Value</th></tr><tr><td>Image Width</td><td>W</td></tr><tr><td>Image Height</td><td>W / 0,75</td></tr><tr><td>Y coordinate of Eyes</td><td>0,6 * W</td></tr><tr><td>X coordinate of First (right) Eye</td><td>0,375 * W</td></tr><tr><td>X coordinate of Second (left) Eye</td><td>(0,625 * W) - 1</td></tr><tr><td>Width from eye to eye (inclusive)</td><td>0,25 * W</td></tr></table></td><td>2, 3C</td><td>O-1</td><td></td><td></td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-310</td><td>9.2.4</td><td>Minimum width of the Token Image Type
The minimum required image width is 240 pixels.</td><td>1</td><td>M</td><td></td><td></td><td>Y</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R-311</td><td>9.2.4</td><td>Coordinates are relative to the top left corner of the image (0,0) and all measurements are in units of pixels.</td><td>3C</td><td>O-1</td><td></td><td></td><td>Y</td><td></td><td></td><td></td><td></td></tr>
</table>

Requirement ID	Ref. in main body	Requirement Summary	Level	Status	Subformat Applicability				IUT Support	Supported Range	Test Result
					B	F	T	P			
R-312	9.2.5	**Padding** The normative practice shall be to fill any undefined set of pixels with any colour.	3C	O-1			Y				
R-313	9.2.6	**Post-acquisition processing** No other post processing than in-plane rotation and/or cropping and/or down sampling and/or multiple compression shall be applied to derive a Token Frontal Face image from a captured image.	1	M			Y				
R-314	9.3.2	**Image Information** The Face Image Type field in the Image Information structure shall be specified with value 02_{HEX}.	1	M			Y				
The Post-processed Frontal Face Image Type											
R-315	10.3.2	**Block referencing** To encode the relationship between the different representations, the Cross Reference field shall be used, i.e. the Cross Reference field shall not be zero. Multiple cross referencing of one original representation is possible.	1	M				Y			
R-316	10.3.3	**Image Information** The Face Image Type field in the Image Information structure shall be specified with value 03_{HEX}.	1	M				Y			
R-317	10.3.4	**Post-acquisition processing** The post acquisition processing bit-field shall be specified, i.e. its value shall be greater than 0.	1	M				Y			
The Basic 3D Image Type using the 3D Point Map representation											
R-318	11.2.1	**Coordinate System Type** The Coordinate System Type for the Basic 3D Image Type using the 3D Point Map representation shall be 00_{HEX}, i.e. a Cartesian coordinate system shall be used.	1	M	Y						
R-319	11.2.2	**ScaleX, ScaleY and ScaleZ** Basic 3D Images using the 3D Point Map representation shall use a fixed scaling and offset values. The following values shall be used: ScaleX = ScaleY = ScaleZ = 0,02 mm OffsetX = OffsetY = OffsetZ = -655,34mm	1	M	Y						
The Basic 3D Image Type using the 3D Vertex representation											
R-320	11.3.1	**Coordinate System Type** The Coordinate System Type for the Basic 3D Image Type using the 3D Vertex representation shall be 00_{HEX}, i.e. a Cartesian coordinate system shall be used.	1	M	Y						