INTERNATIONAL STANDARD

ISO/IEC 39794-16

First edition
2021-06

Information technology — Extensible biometric data interchange formats —

Part 16:
Full body image data

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Reference number
ISO/IEC 39794-16:2021(E)

© ISO/IEC 2021

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

IECNORM.COM: Click to view the full PDF of ISO/IEC 39794-16:2021

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Foreword

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see patents.iec.ch).

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

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

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

A list of all parts in the ISO/IEC 39794 series can be found on the ISO website.

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

The purchase of this ISO/IEC document carries a copyright licence for the purchaser to use ISO/IEC copyright in the schemas in the annexes to this document for the purpose of developing, implementing, installing and using software based on those schemas, subject to ISO/IEC licensing conditions set out in the schemas.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

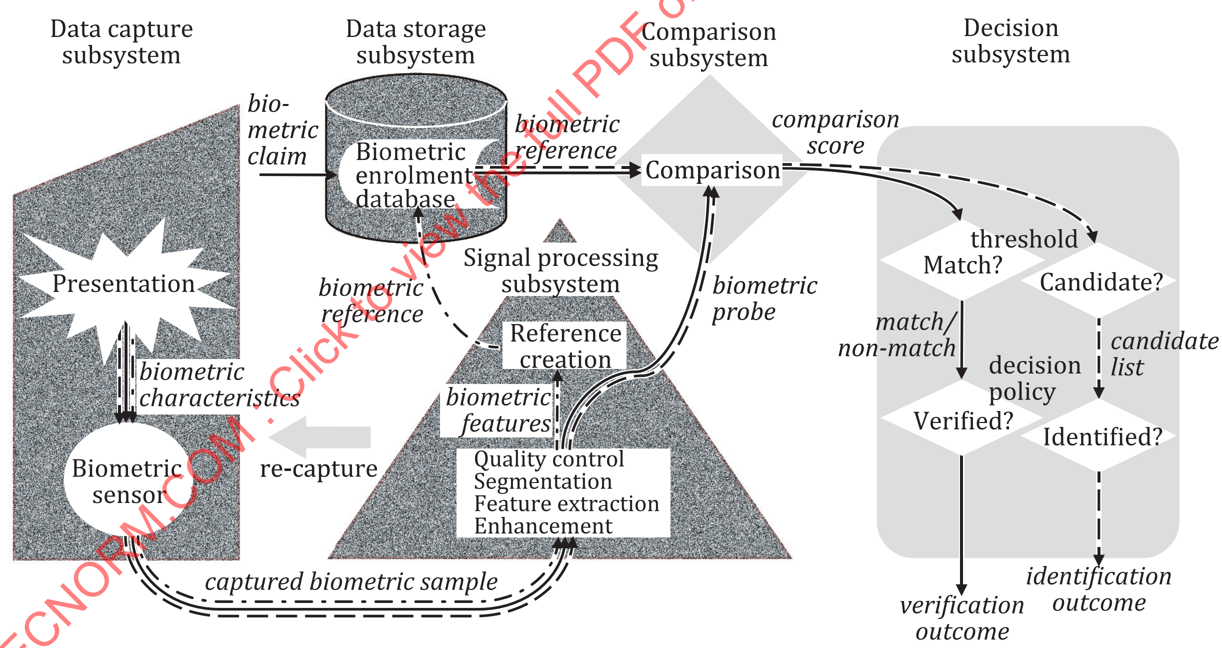
© ISO/IEC 2021 – All rights reserved

Introduction

Most countries around the world use biometric recognition systems for law enforcement and border control. Many of these systems are not limited to face recognition purposes. To be consistent in such deployments and processes, technical documents, guidelines and best practice recommendations are being developed by different groups. These documents are primarily focused on the issuance and use of identity documents and related border control systems, and the technical and operational issues to be considered when planning and deploying them. "Face" is the biometric mode most suited to the practicalities of travel documents and automated border processing. "Full body" is a biometric mode that can be used in addition to face (for example, in border-crossing watchlist scenarios, crime surveillance, etc.). Full body can also be used in forensic scenarios.

There is very little guidance covering full body imaging for cross-border or law enforcement biometric recognition purposes. There is a need for guidance for the use of high-quality digital cameras and video surveillance devices, as well as guidance on full body data interchange structure semantics, syntax and format for the collection and use of full body image data in biometric recognition scenarios. A specific extensible biometric data interchange format for cross-border interoperability is required for full body images. Full body image data standardization is required to ensure threshold quality for database images for identification and verification using video surveillance and other similar system-generated images.

Figure 1 illustrates components of a full body image biometric system on a checkered background.



Key

- ‐ · ‐ · ‐ → enrolment
- ——→ verification
- ‐ ‐ ‐ ‐ → identification

NOTE Figure 1 shows the information flow within a general biometric system, showing a general biometric system consisting of data capture, signal processing, data storage, comparison and decision subsystems. Each of these subsystems are defined in ISO/IEC 39794-1 in more detail.

Figure 1 — Components of a biometric system

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Border personnel, immigration officials and police officers take full body images using local practices where no international standards are available to outline the practices which enable cross-border interoperability. This document can therefore be helpful for the description of the full body biometric characteristics and associated non-biometric information for identification purposes in disaster victim and law enforcement scenarios (e.g. victim identification, unknown bodies and missing individuals).

To enable applications on a wide variety of devices, including devices that have limited data storage, and to improve biometric recognition accuracy, other parts of the ISO/IEC 39794 series address data format, scene constraints (lighting, pose, expression, etc.), photographic properties (positioning, camera focus, etc.), and digital image attributes (image resolution, image size, etc.).

In order to fully understand the requirements implied in this document, it is recommended that the user become acquainted with certain other documents:

— ISO 22311: this document specifies a common output file format that can be extracted from the video-surveillance contents collection systems to perform necessary processing.

— The ISO/IEC 30137 series: this series specifies the use of biometrics in video surveillance systems.

— EN 62676[22]: this document defines video surveillance systems for use in security applications.

This document (ISO/IEC 39794-16) is originally based on CEN/TS 17051.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Information technology — Extensible biometric data interchange formats —

Part 16:
Full body image data

1 Scope

This document is intended to provide a generic extensible full body image data format for biometric recognition applications requiring exchange of human full body image data. Typical applications are:

a) automated body biometric verification and identification of an unknown individual or cadaver (one-to-one as well as one-to-many comparison);

b) support for human verification of identity by comparison of individuals against full body images; and

c) support for human examination of full body images with sufficient resolution to allow a human examiner to verify identity or identify a living individual or a cadaver.

This document ensures that full human body images and image sequence data generated by video surveillance and other similar systems are suitable for identification and verification.

The structure of the data format in this document is compatible with ISO/IEC 39794-5. In addition to the data format, this document specifies application-specific profiles including scene constraints, photographic properties and digital image attributes like image spatial sampling rate, image size, etc. These application profiles are contained in a series of annexes.

The 3D encoding types "3D point map" and "range image" are not supported by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of basic notation*

ISO/IEC 10918-1, *Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines*

ISO 12052, *Health informatics — Digital imaging and communication in medicine (DICOM) including workflow and data management*

ISO 12233, *Photography — Electronic still picture imaging — Resolution and spatial frequency responses*

ISO/IEC 14496-2:2004, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

ISO/IEC 14496-14, *Information technology — Coding of audio-visual objects — Part 14: MP4 file format*

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

ISO/IEC 15444-1, *Information technology — JPEG 2000 image coding system — Part 1: Core coding system*

ISO/IEC 15444-3, *Information technology — JPEG 2000 image coding system: Motion JPEG 2000 — Part 3*

ISO/IEC 15948, *Information technology — Computer graphics and image processing — Portable Network Graphics (PNG): Functional specification*

ISO/IEC 39794-1, *Information technology — Extensible biometric data interchange formats — Part 1: Framework*

ISO/IEC 39794-5, *Information technology — Extensible biometric data interchange formats — Part 5: Face image data*

ITU-T Rec. T.81, *Information technology — Digital compression and coding of continuous-tone still images — Requirements and guidelines*

ITU-T Rec. T.802, *Information technology — JPEG 2000 image coding system: Motion JPEG 2000*

XML Schema Part 1: Structures Second Edition, W3C Recommendation, 28 October 2004, http://www.w3.org/TR/xmlschema-1/

XML Schema Part 2: Datatypes Second Edition, W3C Recommendation, 28 October 2004, http://www.w3.org/TR/xmlschema-2/

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 39794-1 and ISO/IEC 2382-37 and the following apply.

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

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

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

3.1
2D image
two-dimensional biometric capture *subject* (3.67) body representation that *encodes* (3.18) the luminance and/or colour variations of a biometric capture subject in a given lighting environment or a set of images recorded using required radiation bandwidths

3.2
3D shape
DEPRECATED 3D image
three-dimensional biometric capture *subject* (3.67) body representation that *encodes* (3.18) a surface or a volumetric shape in a 3D space

3.3
3D point map
3D point cloud representing a biometric capture *subject* (3.67), where each surface point is encoded with a triplet, representing the point as coordinate *values* (3.72) in a 3D *Cartesian coordinate system* (3.10) respectively

3.4
4K
UHDTV resolution of 3840 px × 2160 px to achieve a 16 × 9 aspect ratio

Note 1 to entry: UHDTV is an abbreviation for Ultra High Definition Television, defined in documents: SMPTE ST 2036-1 and Recommendation ITU-R BT.2020.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

3.5
anthropometric landmark
landmark point on the biometric capture *subject* (3.67) representation used for identification and classification of humans

3.6
artificial intelligence
AI
discipline concerned with the building of computer systems that perform tasks requiring intelligence when performed by humans

3.7
biometric feature vector
one-dimensional *matrix* (3.48) representation of biometric features

Note 1 to entry: Feature *vector* (3.73) is a list of numbers taken from the output of a *neural network* (3.51) layer or other biometric process capable of creating a one-dimensional matrix representation of biometric features.

3.8
cadaver
dead body of a human

Note 1 to entry: The definition of "cadaver" does not include the dead body of an animal.

3.9
camera to subject distance
CSD
distance between the eyes or the body surface plane of a capture *subject* (3.67) and the sensor/image plane of the camera

Note 1 to entry: In *full body images* (3.32) body surface plane is used when eyes plane is not visible.

3.10
Cartesian coordinate system
3D orthogonal coordinate system

3.11
CIE standard illuminant D65
commonly used standard illuminant defined by the International Commission on Illumination (CIE) that is intended to represent average daylight and has a correlated colour temperature of approximately 6 500 K

Note 1 to entry: CIE standard illuminant D65 is specified in ISO/IEC 11664-2.

3.12
colour image
continuous tone image (3.15) that has more than one channel, each of which is coded with one or multiple bits

3.13
colour space
way of representing colours of pixels in an image

EXAMPLE RGB, YUV and LAB are colour spaces typically used in this document.

3.14
common biometric exchange formats framework
CBEFF
data format specifically for exchanging biometric data that provides for the encompassing of any biometric type into a standard format

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

3.15
continuous-tone image
image whose channels have more than one bit per pixel

Note 1 to entry: An image, such as a photograph, where the grey levels in the image are continuous and not discrete.

3.16
Digital Imaging and Communications in Medicine
DICOM
standard for the communication and management of medical *imaging* (3.41) information and related data

Note 1 to entry: The DICOM Standard facilitates interoperability of medical imaging equipment.

Note 2 to entry: DICOM is defined in ISO 12052.

3.17
deoxyribo nucleic acid
DNA
complex molecule found in virtually every cell in the body that carries genetic information from one generation to another

3.18
encode
convert information into a coded form

3.19
eye centre
centre of the line connecting the inner and the outer corner of the eye

Note 1 to entry: The eye centres are the *feature points* (3.25) 12.1 and 12.2 as defined in ISO/IEC 14496-2.

Note 2 to entry: The inner and the outer corner of the eye are defined by ISO/IEC 14496-2. They are the feature points 3.12 and 3.8 for the right eye, and 3.11 and 3.7 for the left eye.

3.20
eye to mouth distance
EMD
distance between the *face centre, M* (3.22), and the mouth midpoint

Note 1 to entry: This corresponds to *feature point* (3.25) 2.3 from ISO/IEC 14496- 2.

3.21
f-stop
ratio of the lens focal length to the diameter of the entrance pupil

3.22
face centre
M
midpoint of the line connecting the two *eye centres* (3.19)

3.23
face image
electronic image-based representation of the *portrait* (3.55) of a capture *subject* (3.67)

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

3.24
facial animation parameter
FAP
standard for virtual representation which includes visual speech intelligibility, mood and gesture by using *feature points* (3.25)

Note 1 to entry: This standard is specified in ISO/IEC 14496-1 and ISO/IEC 14496-2.

3.25
feature point
reference point in a biometric capture *subject* (3.67) image as used by feature recognition algorithms

Note 1 to entry: Commonly referred to as a landmark, an example being the position of the eyes.

3.26
far-infrared
FIR
section of infrared band with *wavelength* (3.74) from 50 µm - 1000 µm

Note 1 to entry: See ISO 20473.

3.27
fisheye
type of distortion where central objects of the image erroneously appear closer than those at the edge

3.28
forensic
related to methods, techniques and processes used to establish conclusions and/or opinions, facts and findings, which can be used for legal proceedings[SOURCE: ISO 21043-1:2018, 3.14].

3.29
forensic analysis
scientific tests or techniques used in connection with the detection of crime

3.30
Frankfurt Horizon
FH
standard plane for orientation of the head

Note 1 to entry: The Frankfurt Horizon is defined by a line passing through the right tragion (the front of the ear) and the lowest point of the right eye socket. It can be hard to define, as it is related to the ear position, which can be covered by hair.

3.31
full body
anatomical structure of an individual that includes any or all of the head, torso and limbs

Note 1 to entry: Full body refers to a living person or a dead body, and/or *personal data* (3.53) related to this full body.

3.32
full body image
representation of a data *subject* (3.67) covering the *full body* (3.31)

Note 1 to entry: Full body image is not limited to the anatomical structure of the full body as the data subject refers to any individual person who can be identified, directly or indirectly, via an identifier such as a name, an ID number, location data, or via factors specific to the person's physical, physiological, genetic, mental, economic, cultural or social identity.

3.33
gait
subject's (3.67) manner of walking

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

3.34
gamma rays
electromagnetic ionizing radiation, emitted by specific radioactive materials

EXAMPLE Cobalt-60 i.e. ^{60}Co.

Note 1 to entry: Gamma rays shall be used only to make examinations of non-living matter i.e. *cadavers* (3.8) or chemical traces.

[SOURCE: ISO 5576:1997, 2.61, modified — EXAMPLE and Note 1 to entry added.]

3.35
gradation
passing by small degrees from one tone or shade, as of colour, to another

3.36
greyscale image
continuous-tone image (3.15) encoded with one luminance channel

Note 1 to entry: For example, if the luminance channel is coded with 8 bits, the greyscale image is also referred to as a monochrome or black and white image.

3.37
histogram
accurate representation of the distribution of numerical data

3.38
human body
data describing the anatomical structure of an individual that includes the head, torso and limbs

3.39
human examination
process of human comparison of the characteristics and structures in a biometric capture *subject* (3.67) image with those of an individual, or those in another biometric capture subject image

3.40
human verification
validation of the identity of a biometric capture *subject* (3.67) image by means of comparison with an individual or other biometric capture subject image

Note 1 to entry: Also known as one-to-one (1:1) comparison.

3.41
imaging
process of making a visual representation of something by scanning it with a detector or electromagnetic beam

Note 1 to entry: Biometric imaging can produce a feature *vector* (3.73) or feature *tensor* (3.68) of the biometric *subject* (3.67) instead of a visual representation.

3.42
inter eye distance
IED
length of the line connecting the *eye centres* (3.19) of the left and right eye

3.43
implementation under test
IUT
implementation of a technical system currently tested

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

3.44
lateral
of, at, towards, or from the side or sides

3.45
lower camel-case notation
naming convention in which compound words are joined together without spaces, where the first letter of the entire word is lowercase, and the first letter of subsequent words is uppercase

3.46
machine learning
ML
process by which a functional unit improves its performance by acquiring new knowledge or skills, or by reorganizing existing knowledge or skills

Note 1 to entry: Machine learning is a form of computer *artificial intelligence* (3.6) that uses software based on concepts understood from biological *neural networks* (3.51) to adaptively perform a task.

3.47
magnetics
science of magnetism used in Magnetic Resonance Imaging (MRI) utilizing the body's natural magnetic properties to produce detailed images from any part of the body

Note 1 to entry: Magnetism is a physical property of materials that causes forces between objects, either pulling them towards each other or pushing them apart.

Note 2 to entry: MRI is a non-invasive *imaging* (3.41) technology that produces three dimensional detailed anatomical images without the use of damaging radiation.

3.48
matrix
an arrangement of numbers, symbols, etc. in rows and columns, treated as a single quantity

3.49
mid-infrared
MIR
section of infrared band with *wavelength* (3.74) from 3 µm - 50 µm

Note 1 to entry: See ISO 20473.

3.50
near-infrared
NIR
section of infrared band with *wavelength* (3.74) from 0,78 µm - 3 µm

Note 1 to entry: See ISO 20473.

3.51
neural network
NN
artificial intelligence (3.6) technique that mimics the operation of the human brain

Note 1 to entry: In practice, the neural network is a network of primitive processing elements connected by weighted links with adjustable weights, in which each element produces a *value* (3.72) by applying a nonlinear function to its input values, and transmits it to other elements or presents it as an output value.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

3.52
neutron
subatomic particles used for neutron *imaging* (3.41) (NI) purposes by the neutron attenuation process in a similar fashion to *X-rays* (3.76)

Note 1 to entry: Neutron imaging can be used to detect changes in hydrogen abundance that can be correlated with the *post-mortem* (3.57) interval, i.e. the time that has elapsed since a person has died.

3.53
personal data
information that relates to an identified or identifiable human being

3.54
Portable Network Graphics
lossless image compression standard

Note 1 to entry: This is specified in ISO/IEC 15948.

3.55
portrait
photograph of a capture *subject* (3.67) which includes the full head, with all hair in most cases, as well as neck and top of shoulders

Note 1 to entry: This can also refer to vertical camera orientation which is opposite to landscape orientation.

3.56
positron
positively charged subatomic particle used in the positron emission tomography (PET) *imaging* (3.41) technique

3.57
post-mortem
PM
after death

Note 1 to entry: Sometimes used to refer to examination or autopsy of a corpse in order to determine cause of death.

Note 2 to entry: Latin *post mortem.*

3.58
presentation attack
presentation of an artefact or human characteristic to the biometric capture subsystem in a fashion that can interfere with the intended policy of the biometric system

3.59
presentation attack detection
PAD
automated determination of a *presentation attack* (3.58)

3.60
proton
subatomic particles used in proton computed tomography (pCT, or Proton CT)

3.61
quantum
discrete quantity of energy, proportional in magnitude to the frequency of the radiation it represents

Note 1 to entry: This can also refer to the minimum amount of any physical entity involved in an interaction.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

3.62
quantum entanglement
phenomenon in *quantum* (3.61) mechanics in which a particle or system does not have a definite state but exists as an intermediate form of two 'entangled' states

Note 1 to entry: Quantum entanglement is a physical phenomenon which occurs when pairs or groups of particles are generated, interact, or share spatial proximity in ways such that the quantum state of each particle cannot be described independently of the state of the other(s), even when the particles are separated by a large distance. Instead, a quantum state is described for the system as a whole.

3.63
quantum sensor
piece of equipment that exploits *quantum* (3.61) correlations, such as *quantum entanglement* (3.62), to achieve a sensitivity or resolution that is higher than using only classical systems

3.64
radial distortion
image imperfection where the degree of magnification varies with the distance from the optical axis

3.65
range image
numerical *matrix* (3.48) that *encodes* (3.18) a surface point in 3D space, where the position encodes the first two coordinates and the *value* (3.72) at that position encodes the third coordinate

3.66
submillimetre
terahertz (THz) radiation, known as submillimetre radiation, consisting of electromagnetic waves within the ITU-designated band of frequencies from 0,3 THz to 3 THz (300 GHz - 3000 GHz)

3.67
subject
person who is to be displayed on the image or from whom samples are to be taken

Note 1 to entry: A capture subject becomes a data subject when the subject's biometric samples are entered into a biometric system.

3.68
tensor
mathematical object analogous to but more general than a *vector* (3.73), represented by an array of components that are functions of the coordinates of a space

3.69
texture image
two-dimensional representation of the luminance and/or colour of a biometric capture *subject* (3.67) in a given lighting environment

3.70
ultraviolet radiation
UV
wavelength (3.74) of the electromagnetic spectrum of radiation from 10 nm to 400 nm

[SOURCE: ISO 15858:2016, 3.3, modified — Note 1 to entry removed.]

3.71
upper camel-case notation
naming convention in which compound words are joined together without spaces and the first letter of every word is uppercase

3.72
value
numerical or categorical result assigned to a base measure, derived measure or indicator

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

3.73
vector
matrix (3.48) with one row or one column

3.74
wavelength
distance between repeating units of a wave pattern

Note 1 to entry: Commonly designated by the Greek letter lambda (λ).

3.75
white light
apparently colourless light

EXAMPLE Ordinary daylight.

Note 1 to entry: White light contains all the *wavelengths* (3.74) of the visible spectrum from 380 nm to 760 nm at equal intensity, based on human perception.

3.76
X-rays
penetrating electromagnetic radiation, within the approximate *wavelength* (3.74) range of 1 nm to 0,0001 nm, produced when high velocity electrons impinge on a metal target

Note 1 to entry: Wavelength range is from 10 nm to 0,001 nm according to ISO 21348.

[SOURCE: ISO 5576:1997, 2.129, modified — Note 1 to entry added.]

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

4 Abbreviated terms

2CIF	common interchange format 2 image format having width 704 pixels and height 288 pixels
4CIF	common interchange format 4 image format having width 704 pixels and height 576 pixels
ASN.1	abstract syntax notation one
AVC	advanced video coding
BAP	body animation parameters
BDB	biometric data block
BER	basic encoding rules
B&W	black and white
CAESAR	civilian American and European surface anthropometry resource
CBEFF	common biometric exchange formats framework
CEN	European Committee for Standardization
CIE	International Commission on Illumination (Commission Internationale de l'Eclairage)
CIEDE2000	CIE CIEDE2000 colour-difference formula defined in ISO/CIE 11664-6
CIELAB	CIE 1976 L*a*b* colour space defined in ISO/CIE 11664-4
CIF	common interchange format image format having width 352 pixels and height 288 pixels
CNN	convolutional neural network

 © ISO/IEC 2021 – All rights reserved

CT	computed tomography
DCI	Digital Cinema Initiatives consortium
DER	distinguished encoding rules
DNA	deoxyribonucleic acid
DOF	depth-of-field
DSLR	digital single-lens reflex camera
DVI	disaster victim identification
EMD	eye to mouth distance
EV	exposure value
EXIF	exchangeable image file format
HD	high definition or horizontal deviation angle
HDR	high dynamic range
HDRI	high-dynamic-range imaging
Hex	hexadecimal
IBIA	International Biometrics + Identity Association
ICS	implementation conformance statement
INTERPOL	International Criminal Police Organization
IRI	international resource identifier
IUT	implementation under test
JFIF	JPEG file interchange format
JPEG	image compression standard specified as ISO/IEC 10918 NOTE The JPEG baseline standard was published as ISO/IEC 10918-1 and ITU-T Rec. T.81.
JPEG2000	image compression standard specified as ISO/IEC 15444 NOTE The JPEG2000 baseline standard was published as ISO/IEC 15444-1 and ITU-T Rec. T.800.
LED	light emitting diode
MeSH	medical subject headings resource[49]
MP4	digital multimedia file format used to store video and audio
MPEG	Moving Picture Experts Group
MRI	magnetic resonance imaging
MTF	modulation transfer function
MTF20	highest spatial frequency where the MTF is 20 % or above

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

NI	neutron imaging
NLM	United States National Library of Medicine
NTSC	National Television System Committee analogue television colour system
OWL	web ontology language
PAD	presentation attack detection
PAL	phase alternating line colour encoding system for analogue television
pCT	proton computed tomography
PET	positron-emission tomography
PNG	portable network graphics format specified in ISO/IEC 15948
QCIF	quarter common interchange format image format having width 176 pixels and height 144 pixels
RDB	relational database
RDF	resource description framework
RDFS	resource description framework schema
RFID	radio-frequency identification
RGB	red green blue colour representation
RIF	rule interchange format
SD	standard-definition television
SFR	spatial frequency response
SPARQL	standard protocol and RDF query language
sRGB	standard RGB colour space created for use on monitors, printers and the Internet using the ITU-R BT.709 primaries
SVGA	super video graphics array image format having width 800 pixels and height 600 pixels
THz	terahertz
TIFF	tagged image file format
UMLS	unified medical language system
URI	uniform resource identifier
URL	uniform resource locator
URN	uniform resource name
USAF	US Air Force
UTC	coordinated universal time
UTF-8	universal character set transformation format — 8-bit

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

VGA	video graphics array image format having width 640 pixels and height 480 pixels
WSVGA	wide super video graphics array image format having width 1024 pixels and height 576 pixels or 600 pixels
VUTOT	vermisste / unbekannte tote i.e. "missing or unknown dead (person)"
XDR	external data representation
XML	extensible markup language
XOP	XML-binary optimized packaging
XPath	XML path language
XSD	XML schema definition

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

5 Conformance

A BDB conforms to this document if it satisfies all relevant normative requirements related to:

— its data structure, data values and the relationships between its data elements, as specified throughout Clauses 7, 8, 9 and Annex A of this document;

— the relationship between its data values and the input biometric data from which the biometric data record was generated as specified throughout Clauses 7, 8, 9 and Annex A of this document; and

— the application profile specific conformance specifications given in C.4.

A system that produces biometric data records is conformant to this document if all biometric data records that its outputs conform to this document (as defined in the bullet points above) as claimed in the ICS associated with that system. A system does not need to be capable of producing biometric data records that cover all possible aspects of this document, but only those that are claimed to be supported by the system in the ICS.

A system that uses biometric data records is conformant to this document if it can read and use, for the purpose intended by that system, all biometric data records that conform to this document (as defined above) as claimed in the ICS associated with that system. A system does not need to be capable of using biometric data records that cover all possible aspects of this document, but only those that are claimed to be supported by the system in an ICS.

6 Modality specific information

6.1 Purpose

Within the context of full body imaging, there are certain generic requirements which are common to both face and full body. For example, most of the quality measures that are used to qualify perceived image degradation, compared to a reference standard quality image, are common to several modalities. In this case, such quality measures are image contrast, brightness, sharpness and illumination. Other common quality measures, also given in ISO/IEC 39794-5, include but are not limited to:

a) Digital formatting of images, image resolution, and greyscale contrast.

b) Scene deviation due to subject rotation, and illumination.

c) Position of subject.

d) Camera position, exposure, image brightness, focus and sharpness.

© ISO/IEC 2021 – All rights reserved

If a full body image is used to extract a passport quality face image, then the face image quality requirements defined in ISO/IEC 39794-5 shall be followed. For evaluation of the facial image quality for face recognition in video (FRiV), it is recommended to establish a multi-level evaluation methodology that is suitable for video surveillance applications[48].

The use of "imaging" as a term within this document is intended to underline the specific nature of imaging requiring post-processing when compared to traditional white light photography.

6.2 Digital image encoding

For digital image encoding, one of four possible encodings shall be used:

1) The JPEG Sequential baseline format (ISO/IEC 10918-1), lossy or lossless, and encoded in the JFIF file format (the JPEG file format)[35].

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 format.

4) The MPEG-4 ISO/IEC 14496-2 format.

NOTE MP4 is a digital multimedia container file format for MPEG-4 as defined in ISO/IEC 14496-14.

The recorded image data shall appear to be the result of a capture process of a full body or a body part. For the purpose of describing the position of each pixel within an image to be exchanged, a pair of reference axes shall be used. The origin of the axes, pixel location (0,0), shall be located at the upper left-hand corner of each image, which corresponds to the upper right-hand side of the forehead from the perspective of the capture subject. The x-coordinate (horizontal) position shall increase positively from the origin to the right side of the image (i.e. left-hand forehead). The y-coordinate (vertical) position shall increase positively from the origin to the bottom of the image.

Landmark points should be determined on images before compression is applied. Landmark points should be included in the record format if they have been accurately determined, thereby providing the option that these parameters do not have to be re-determined when the image is processed for body recognition tasks.

The Landmark points should be determined by computer-automated detection mechanisms followed by human validation. No recommendations are currently applicable for the landmark points.

NOTE JPEG File Interchange Format (JFIF) is a minimal file format which enables JPEG bitstreams to be exchanged between a wide variety of platforms and applications. Although any JPEG process is supported by the syntax of the JFIF it is strongly recommended that the JPEG baseline process be used for the purposes of file interchange as recommended by INTERPOL[28]-[29].

6.3 Photographic requirements and recommendations for white light imaging

6.3.1 General

This subclause specifies photographic constraints for the capture of white light post-processed images. Rather than imposing a particular hardware and lighting system, this clause specifies the type of output from these systems that is allowed. See Annex E for further guidance on making the required quality measurements.

6.3.2 Contrast and saturation

For each patch of skin on the subject, the gradiations in luminance and hue shall be clearly visible, i.e. be of reasonable contrast. In this sense, there shall be no saturation (over or under exposure) on the subject.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

The colour saturation of a 24-bit colour image should be such that after conversion to greyscale, there are at least 7 bits of intensity variation on the image.

6.3.3 Focus and depth of field

The subject's captured image shall always be in focus. Although this can result in the background behind the subject being out of focus, this is not a problem.

NOTE In a typical photographic situation, the f-stop of the lens is set at two (or more) f-stops below the maximum aperture opening when possible to obtain enough DOF.

All images shall have sufficient depth of focus to maintain greater than 2 mm spatial sampling rate on the subject's features at time of capture.

Greater than 1 mm spatial sampling rate is considered to have been accomplished if the individual millimetre markings of rulers placed on the subject facing the camera are visible simultaneously in a captured test image.

If the camera lacks auto focus, all subject positions shall be maintained in a defined area for all image captures.

6.3.4 Greyscale density

The dynamic range of the image should have at least 7 bits of intensity variation (span a range of at least 128 unique values). This recommendation can require camera settings to be changed on an individual basis when the subject is significantly lighter or darker than the average subject.

If required in a forensic examination environment, it is recommended to use high-dynamic-range imaging (HDRI), which is a high dynamic range (HDR) technique used in imaging and photography to reproduce a greater dynamic range of luminosity than is possible with standard digital imaging or photographic techniques.

6.3.5 Colour

Unnaturally coloured lighting (yellow, red, etc.) shall not be used. Care shall be taken to correct the "white balance" of image capture devices. Photographs should use colour-balancing techniques such as using xenon flash or high colour quality led lights.

A process that overexposes or under-develops a colour or greyscale image for purposes of beauty enhancement or artistic pleasure is not allowed. The full spectrum shall be represented on the image where appropriate.

Colour calibration using an 18 % grey background or other method (such as white balancing) is recommended.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

6.3.6 Radial distortion of the camera lens

The 'fisheye' 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.

While some distortion is almost always present during photography, that distortion should not be noticeable by human examination.

The purpose of this requirement is to reduce variations in radial distortion between images due to differing focal lengths. For a typical biometric capture system with a subject 1,5 to 4 meters from the camera, the focal length of the camera lens should be 50 mm or more for 35 mm compatible (i.e. full frame) photography.

© ISO/IEC 2021 – All rights reserved

6.4 Digital requirements and recommendations for images

6.4.1 General

This subclause specifies digital requirements for digital camera image geometry, colour representation and image formatting. See Annex E for greyscale and colour-checking using IEC 61966-8[24] test charts.

6.4.2 Geometry

Digital cameras shall produce images with a pixel aspect ratio of 1:1.

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).

6.4.3 Colour

Post-processed images shall be represented as one of the following:

a) The 24-bit RGB colour space where for every pixel, eight (8) bits are used to represent each of the Red, Green, and Blue components.

b) An 8-bit monochrome colour space where for every pixel, (8) bits are 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.

To achieve device-independence, the RGB values from the camera should be converted to values in a defined standard RGB space, such as sRGB[19], using the device's colour profile and colour management processing. Information regarding device profiling and colour management can be downloaded from the International Color Consortium URL[29].

All interlacing shall be absent (not simply removed, but absent).

6.4.4 Formatting requirements and recommendations

As biometric comparison subsystems can be very sensitive to image artefacts caused by post-processing, for interoperability reasons the original image should be stored in addition to the processed image.

If the receiver of an interchange record containing post-processed image data has better technology than the encoder of this record they can still rely on the original image data.

To encode the relationship between the different representations, the Derived from element shall be used. Multiple cross-referencing of one original representation is possible. Furthermore, the representation identifier element of the original image shall be present.

The post-acquisition processing element shall be present.

6.5 Recommendations for full body image data systems

6.5.1 General

This subclause describes architectural aspects, usability and accessibility considerations. Rather than imposing a particular system architecture, this subclause presents practical applications and recommendations.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

6.5.2 Architecture

The architectural aspects that can be considered by the definition of full body image data system architecture are:

— biometric capture sub-processing, carried out by a biometric capture device;

— image formatting sub-processing, carried out by a biometric capture subsystem;

— visualization of process and results, both for operator and the subject of biometric processes;

— integrity of full body image data system;

— security of the system to ensure only authorized access, use, disclosure and disposal of biometric and related data records is possible; and

— connection to other systems (databases, etc.) with the focus on protocols and the integrity of such connections.

Only the first two aspects are within the scope of this document. The other aspects are covered in documents listed in the Bibliography.

6.5.3 Usability and accessibility

Biometric systems should be designed to be accessible for all, including those that have disabilities, or special needs. For subjects that cannot use a biometric system, alternatives should be provided.

General guidance on these aspects is given in ISO/IEC TR 24714-1. Pictogram recommendations can be found in the ISO/IEC 24779 series.

6.5.4 Practical applications

In practice, full body images and videos of crime suspects are collected using a biometric capture process. This process can involve one or more high resolution biometric capture devices, including 4K video devices. Biometric features are extracted from the captured biometric samples to generate a biometric reference. This reference is stored for use in subsequent biometric comparisons.

In automated systems, it is possible to create a biometric reference from a biometric probe captured during routine surveillance. In crime scenarios, such a probe-based reference shall be marked in the personal data basic data element (nature of disaster sub-element) as a crime suspect.

Depending on the cultural requirements, individuals are photographed wearing clothing or near naked. According to INTERPOL Disaster Victim Identification guidelines[28], photographic and video recording of bodies at the disaster site and within the mortuary is important both for evidence and because it can help to establish the cause of the incident.

INTERPOL photographic documentation recommendations for bodies and/or body parts[29] are as follows:

a) Digital cameras should be used wherever possible.

b) Body numbers should be clearly visible on each photograph.

c) Dirt on faces and clothing should be removed.

The following photographs should be taken:

1) Photograph of the entire body.

2) Photograph of the face.

3) Photograph of the torso.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

4) Photograph of the lower body.

State-of-the-art image recognition algorithms can be used to select images of people with almost no useful identity information in the face. Recognition of the face alone in these cases are near chance level, but recognition of the individual based on a larger part of the body presents a significantly higher level of accuracy, according to research carried out at the University of Texas in Dallas[35].

Body images appear in video surveillance videos more often than clear face images. Faces and body images are added to watch lists (for example, in border-crossing watchlist scenarios) from observation of behaviours in video material. A standard has been created describing the biometric sample formats for full body images in order to increase the international interoperability of biometric samples.

SD video frame comparison with high quality reference images gives better results than comparing two SD level images. 4K DSLRs capable of taking high resolution still images and 4K video are currently available at a reasonable price. Video surveillance systems are likely evolve from HD to 4K in the near future and therefore the resolution level of still images should be high. A passport-quality face image is obtained by cropping the 4K full body frontal image of an individual.

Annotation data formats for biometrics in video surveillance systems (ISO/IEC 30137-4) and high efficiency coding (ISO/IEC 23008-12) are standardized for data format integration work.

6.6 Full body imaging technical requirements

6.6.1 General

This subclause specifies technical requirements for optical distortion and colour fidelity and shows examples of full body photographs. The colour fidelity is extended to cover non-visual wavelengths in addition to visual wavelengths.

6.6.2 Optical distortion

Radial distortion due to lens properties can be noticeable to human examiners. In particular, fisheye effects caused by wide angle lenses combined with camera placement too close to the subject's body shall not be present.

If the radial distortion is less than 2 %, the human eye cannot easily perceive it. It is recommended that radial distortion be less than 2,5 %.

The general assessment of an optical system is discussed in Annex E.

6.6.3 Colour fidelity

The image shall be colour neutral and correctly exposed. It is important that the boundary between the whole body and the background should be clearly identifiable about the entire subject. There should be no shadows visible on the background behind the body image. The background should be plain and should contain no dots, lines or curves that can cause computer pattern recognition algorithms to become confused. Therefore, the background should be a uniform colour or a single colour pattern with gradual changes from light to dark luminosity in a single direction.

Full body imaging covers both visual and non-visual wavelengths[45]. Infrared covering both near and far infrared wavelengths and millimetre wavelength imaging covering both passive and active systems in submillimetre and millimetre wavelengths are in use. In full body imaging, both still and video recordings are made for enrolment, verification and identification purposes.

Figure 2 illustrates the wavelengths commonly used in biometric imaging. In Figure 2, wavelengths start from visual light (marked with rainbow) wavelengths between 400 nm and 700 nm and go down to millimetre waves.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

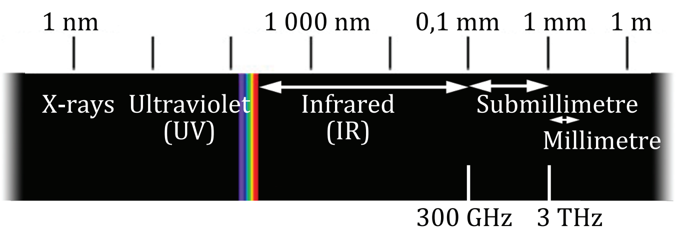


Figure 2 — Wavelengths commonly used in biometric imaging

Note that ionizing X-rays or UV radiation should not be used for living human tissue biometrics.

The UV radiation range between 100 nm and 400 nm is commonly subdivided into:

— UVA: 315 nm to 400 nm;

— UVB: 280 nm to 315 nm;

— UVC: 200 nm to 280 nm;

— Vacuum UV: 100 nm to 200 nm.

UVC radiation is a low-penetrating form of UV as compared to UVA or UVB radiation. Measurements of human tissue show that 4 % to 7 % of UVC radiation, along with a wide range of wavelengths from 250 nm to 400 nm, is reflected and absorbed in the first 2 µm of the stratum corneum. Hence, the amount of UVC transmitted through the epidermis is minimized.

Stratum corneum is the outermost layer of the epidermis, consisting of dead cells (corneocytes). UVA and UVB both contribute to sunburn, skin ageing, eye damage and melanoma and other skin cancers.

6.6.4 Example full body photographs

The light source type used in full body photography depends on the photographic needs. Electronic flash units are suitable for still photography. Video recording is carried out using either high quality LED-panels or similar high-quality video lights. A test chart shall be used to measure colour accuracy as shown in Annex E.

The following examples portrayed in Figure 3 and Figure 4 are produced in a full body photography studio.

Figure 3 illustrates different background types. Figure 3a) shows a photograph with a high-quality background, and Figure 3b) shows the same photograph posterized with 4 steps. Posterization of an image entails conversion of a continuous gradation of tone to several regions of fewer tones, with

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

abrupt changes from one tone to another. Posterizing the levels of brightness to 4 gives a good estimate of the light distribution on the subject.

a) High-quality background	b) Posterized with 4 steps

Figure 3 — Full body photographs

If the facial area and the rest of the body is illuminated evenly, then the light and dark areas cover the whole body evenly.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Figure 4 illustrates full body photographs showing the floor border [Figure 4a)] and unwanted objects marked with X [Figure 4b)]. All background objects are unwanted.

a) Full body photograph with floor border

b) Full body photograph with unwanted objects

Figure 4 — Full body photographs with unwanted background objects

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

In Figure 4a), there is a light shadow on the floor. All shadows should be minimized by adjusting the lighting. Floor borders should also be omitted and the wall and floor should be of the same plain colour.

6.7 Full body photography session

6.7.1 General

This subclause describes a typical workflow for a full body photography session and specifies content requirements for full body photographs.

6.7.2 Typical workflow for full body photography session

Proper positioning of the subject and control of the subject's pose can be improved through feedback to the operator via a live-video showing the subject during the capture process. Previewing of the captured image should be provided to allow the subject to be recaptured before the image is submitted for further processing. In legacy systems, pose-aware subject recognition[47] can not be available and therefore proper positioning is required.

The subject shall stay in a natural pose while being photographed. Standing straight is not natural for some people so such poses are not to be forced. It is good practice to take pictures using 45° steps in yaw angle.

© ISO/IEC 2021 – All rights reserved

The subject's clothing shall not hide body features as loose garments do not show enough bodily contour points for gait and posture silhouette matching. The hands shall be freely kept at the sides of the body in a natural hanging posture unless the subject is unable to do so because of medical reasons[40].

Notes should be taken regarding the subject’s distinguishing features and assumed state of mind. The subject’s state of mind has an effect on posture. For gait recognition, notes should also be taken regarding ailments in the skeletal system. In particular, arthritis and problems moving legs and hands should be carefully documented.

When retaking pictures of a subject who has been documented before, it is important to note the differences from the previous pictures and the associated documentation.

When the subject is wearing a scarf or other religion-related garment it is necessary to take into account the limitations posed by the religion and never insult the subject or undermine the cultural restrictions. When the cultural and religious rules demand the absence of the opposing gender in the same room then this shall be taken into account.

6.7.3 Full body photograph content requirements

The following requirements are applicable to full body photograph contents:

1) details shall be in focus;

2) camera height shall be kept at the level of the subject's navel;

3) the subject shall be centred on the viewfinder;

4) enough background shall be shown around the subject's body in the image to allow for automatic contour cropping[37];

5) the individual's whole body shall be visible on all images taken;

6) the subject shall be asked to wear indoor clothing;

7) the subject shall be encouraged to relax so that the pose is more natural;

8) the subject shall be instructed to keep their hands at their sides if possible;

9) if the subject is wearing a wig or similar head covering, then the images shall be taken with and without the said covering; and

10) the medical limitations of the subject shall be taken into account.

6.8 Photo studio recommendations for full body photography

6.8.1 General

This subclause gives guidance concerning the positioning of the subject and camera, as well as examples of lighting arrangements. The intention of this guidance is to ensure that the subject’s full body is properly positioned and uniformly illuminated, thereby producing images that are conformant with this document and are without shadows or hot spots on any part of the body.

Distortion that is noticeable by human examination shall not be present. In particular fisheye effects caused by wide angle lenses combined with too close camera placement shall not be present.

A photo studio is typically a professionally operated facility, equipped with a digital camera, multiple adjustable light sources, a suitable background or backdrop cloth, and subject positioning apparatus designed to obtain high quality full body images. This section provides expert guidance for the owners and operators of such facilities when they produce photographs conformant with the requirements of this document.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

6.8.2 Recommended camera orientation and margins

It is recommended to take pictures using vertical camera orientation. The original camera image is saved whenever possible without any additional cropping, rotation or other image processing. The full body pose shall be between 60 % and 95 % of the vertical length of the image. The whole-body height and width shall be visible.

Vertical orientation of the camera is recommended for full body images for two reasons:

— vertical orientation allows the use of available pixels in an economical manner; and

— vertical camera orientation gives Level-51/52 results when using an 8 megapixel camera and Level-50 results when using a 15 megapixel camera.

6.8.3 Recommended positioning and distance between camera and subject

The following recommendations concern the positioning of the full body subject and the camera. If full body image is used also for face image then it is recommended to take two pictures: one for the full body and at least one for the face based on the face image requirements[7]:

— the camera lens distance from the floor should be 1 m for full body photographs;

— the camera lens focal length should be in the order of 50 mm measured with a full-frame 35 mm digital camera in vertical orientation for 4 m subject distance for full body photographs;

— arranging the lighting without creating shadows is difficult if the surface area of the light source is small compared to the size of the body surface. Ideal light source length is approximately the same as the body length. A large radiating surface allows the positioning of the lights much nearer to the camera than is otherwise possible; and

— proper focus and DOF is assured by pre-focusing the lens at the distance of the subject's front and by selecting an appropriate aperture (f-stop) to ensure a DOF of at least 15 cm, or approximately the distance from a subject's nose to ears. The DOF of a lens is dependent upon its focal length, its effective aperture, and the focus distance. For practical purposes aperture values between f/5,6 and f/11 produce good DOF results for 50-85 mm lenses.

A normal lens is a lens that reproduces a field of view that generally looks "natural" to a human observer under normal viewing conditions. Normal lens focal lengths are considered to be between 40 mm and 55 mm.

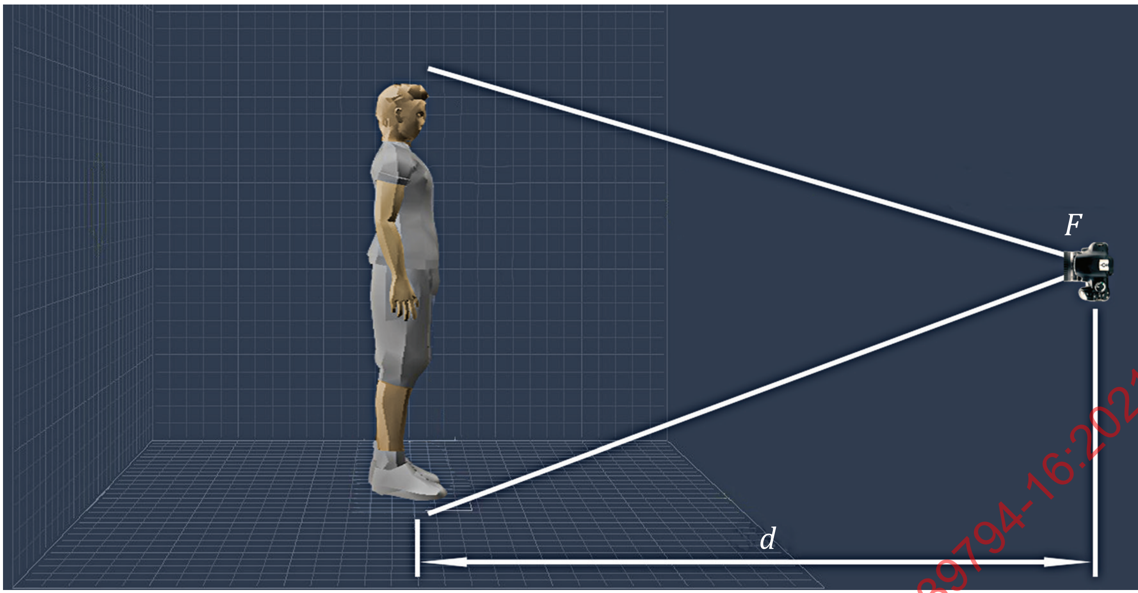
EXAMPLE Consider a 35 mm (i.e. full frame) camera with a lens having a focal length, *F*, of 50 mm. The dimensions of the full frame image are 24 mm × 36 mm, giving a vertical camera orientation maximum vertical angle at infinity focus, $f = F$:

$$\alpha_h = 2 \arctan \frac{h}{2f} = 2 \arctan \frac{36}{2 \times 50} \approx 39.6°$$

According to this calculation, a 50 mm normal lens vertical camera orientation vertical viewing angle is 39,6° when used with 36 mm × 24 mm format (that is, 135 film or full-frame 35 mm digital). Using this angle for a 2 m high subject, a full body image camera is subject to a minimum distance of 3 m when a 50 mm lens is in use. It is recommended to keep the distance from the subject to the camera at 4 m or more in order to assure good image cropping in all focusing situations. Use the camera lens focal length conversion factor to find the full frame compatible focal length for calculations. The multiplication factor is usually 1,5 or 1,6 for APS-C sensor cameras.

Figure 5 illustrates the relationship between the camera focal length and the distance from the subject to the camera.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021



Key

F 50 mm lens focal length

d 4 m distance

Figure 5 — Positions of subject and camera

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

6.8.4 Recommended focusing settings

Proper focus and DOF are assured by either using the camera auto focus function with manual aperture settings or by pre-focusing the lens at the distance of the subject's eyes. Selecting an appropriate aperture (f-stop) between f/5,6 and f/11 ensures a DOF of the distance from a subject's nose to ears. That is in most cases approximately 15 centimetres, which is sufficient.

6.8.5 Recommended white balance settings for white light imaging

White balance settings on the camera shall be properly set in order to achieve high fidelity skin tones. In order to assure the required image quality, system installers shall make quality assurance measurements of light conditions and camera system response. This shall be when a recommended CIE Standard Illuminant D65 high quality illuminant or similar continuous spectrum daylight illuminant (4 500 - 6 000 K) camera and control software is used. In practice it is necessary to reduce the ambient light pollution emanating from uncontrolled daylight sources, fluorescent or similar light sources and reflections from surfaces.

Imaging fidelity measurements for photo studio and stationary registration office installations can be done either using a light spectrum analyzer to define the spectral characteristics of the illuminants or analyzing measurement target images using software applications. For mobile registration office imaging, automatic white balance setting procedures and quality analysis should be used to ensure a high level of image conformance.

6.8.6 Recommended backdrop design

A continuous backdrop should be placed behind the subject in order to create a single colour pattern with gradual changes from light to dark luminosity in a single direction. In selecting the backdrop lightness, it is recommended to select a grey level that provides sufficient distinction between the subject and the background. It is recommended to use a light grey background with a plain, smooth surface.

Figure 6 illustrates the hanging of a seamless background.

 © ISO/IEC 2021 – All rights reserved

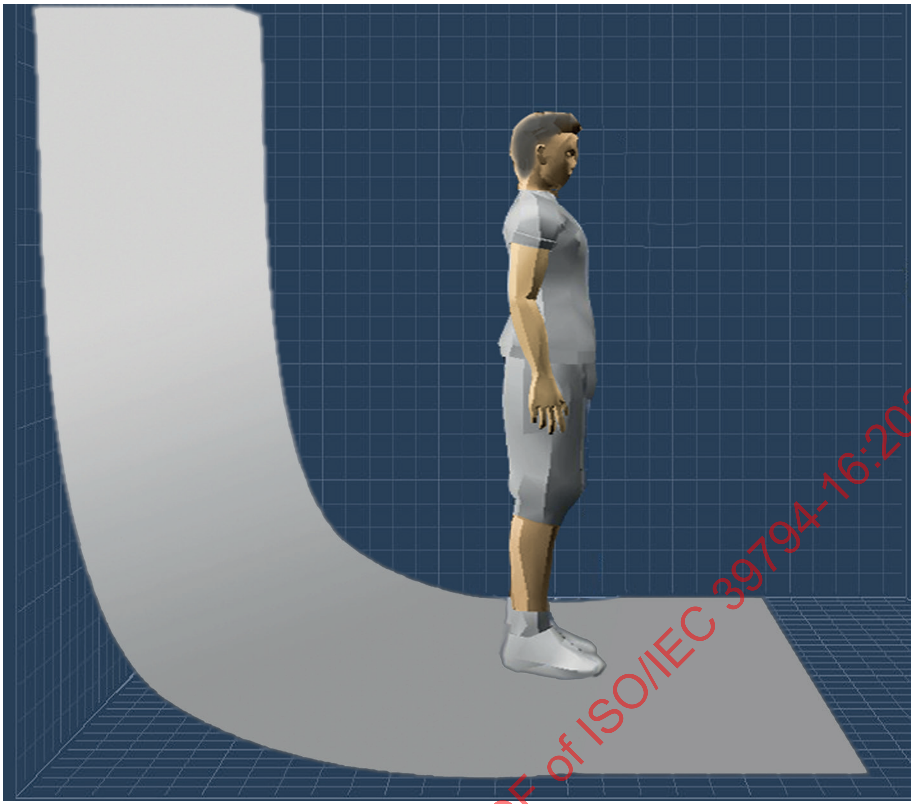


Figure 6 — Backdrop alignment

6.8.7 Example configurations for a photo studio

Figure 7 is showing minimum recommended measurements for the full body photography studio when using large surface light sources. Gait recognition walk through video recordings can require more horizontal space.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

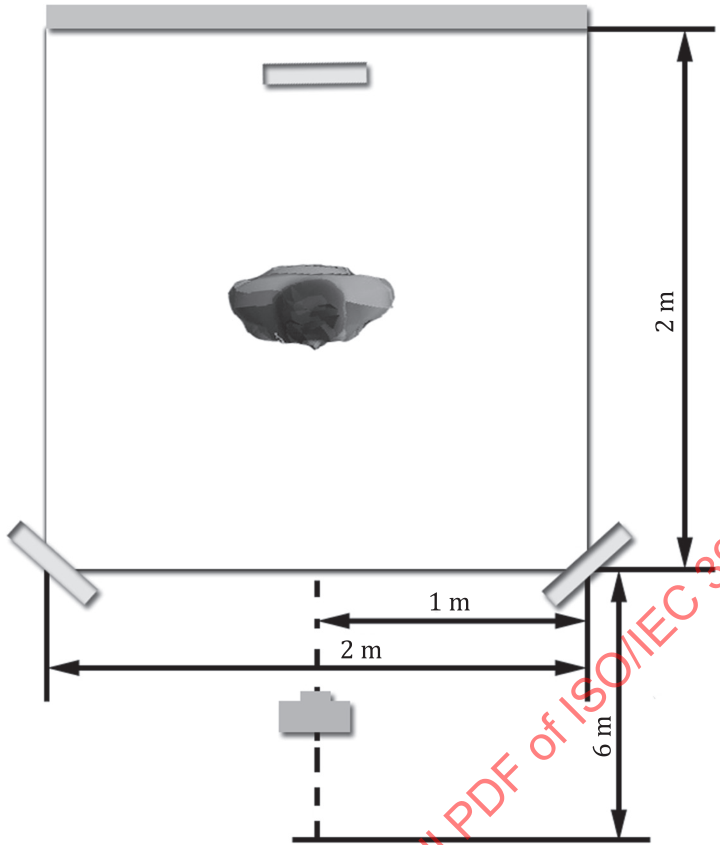


Figure 7 — Minimum recommended measurements

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

The use of a treadmill for a small recording studio setup is recommended to achieve good quality gait recognition recordings[39].

When setting up a studio, consideration should be given to safety and security measures to minimize the risk of injury or death. For example, the subject should always be located so that it is possible for the operator to evacuate the studio room through a door behind the operator. This arrangement is important especially in prisons, police stations and similar facilities.

6.8.8 Basic fidelity image test for white light imaging

Figure 8 demonstrates the visual fidelity test method. Basic camera image fidelity test is performed by taking a full body image of a test subject in the studio. The camera image is then enlarged using an application available for image viewing or editing found in the operating system on all computers.

© ISO/IEC 2021 – All rights reserved

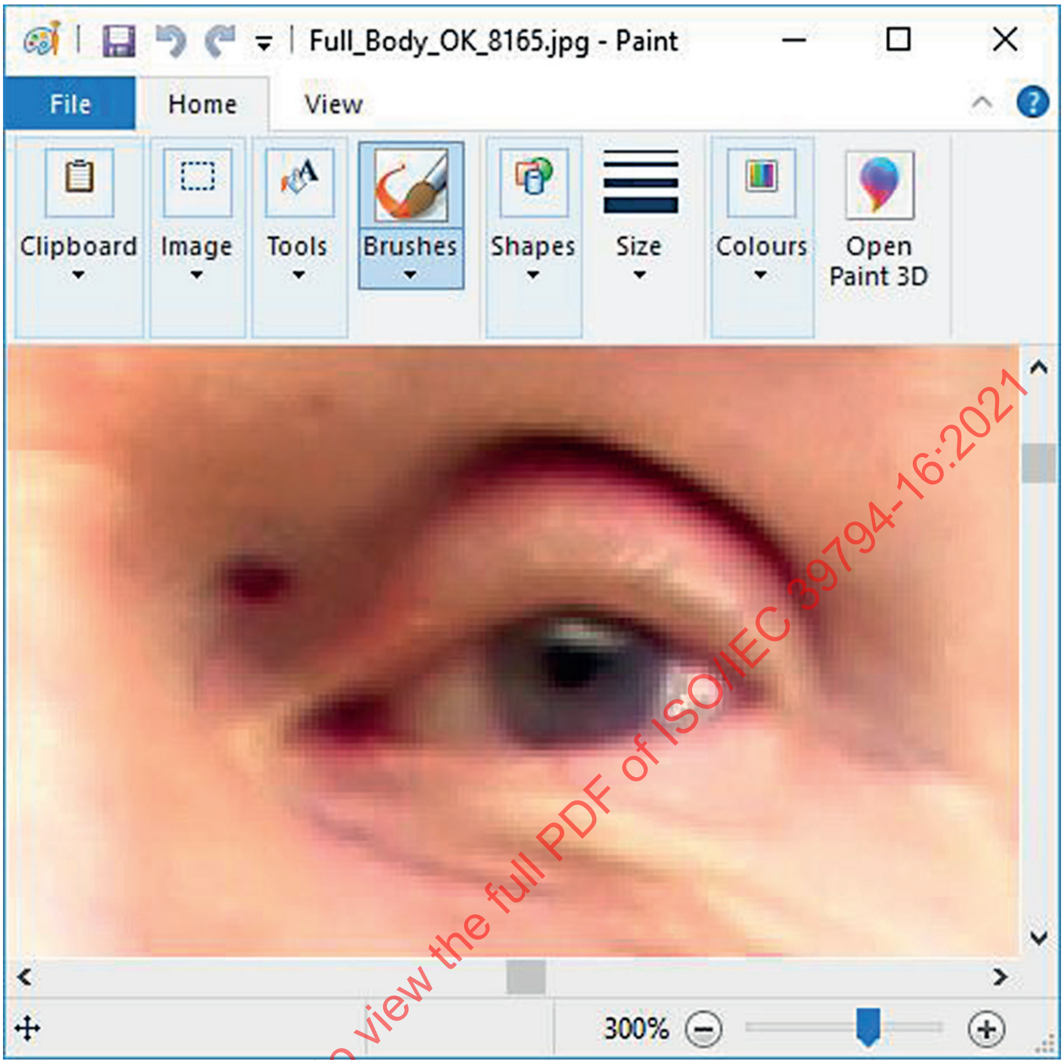


Figure 8 — Basic camera image fidelity test

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

The test image shall clearly show the pupil and iris of an eye when enlarged in the image editing or viewing application. Skin shall appear the same as when looking at the test subject and there should be fine contrasted face details, such as wrinkles and moles, as small as 1 mm in diameter visible on the image. This basic fidelity test is simple to perform and ensures that all settings are in order, i.e. camera is focused properly and white balance is showing the skin tone correctly.

6.9 Non-white light or multispectral imaging

6.9.1 General

Non-white light refers to wavelengths outside of the white light wavelength range. Multispectral imaging is operating in or involving several regions of the electromagnetic spectrum.

The requirements described in 6.3 and 6.4 also apply to non-white light and multispectral imaging when the imaging result is a picture excluding the colour requirements. Single wavelength band images are rendered using 8-bit monochrome colour space, where for every pixel, 8 bits are used to represent the luminance component. Colour in multispectral imaging is selected using a false colour substitute selected from the visual colour palette, e.g. deep red for infra red wavelengths. However, biometric multispectral imaging may produce a biometric feature vector or tensor of the biometric subject instead of a visual representation. It is possible to render an image based on the biometric feature

© ISO/IEC 2021 – All rights reserved

vector or tensor applying the requirements and recommendations of this document. For information interchange, the image format shall comply with one of the encodings given in 6.2.

6.9.2 Infrared imaging

An infrared energy source emits radiation that falls on the subject. In a camera able to take images using both infrared and visible light, it is necessary to place a barrier filter over the lens to prevent the visible light from passing through the lens when taking infrared images.

Luminescence occurs when certain materials emit infrared radiation caused by a shorter wavelength of visible light or ultraviolet radiation falling on the material. Luminescence is the spontaneous emission of light by a substance not resulting from heat. Fluorescence is the emission of light by a substance that has absorbed light or other electromagnetic radiation. It is a form of luminescence.

Visible light masks the effect of the luminescence on the digital sensor. Two filters are necessary to prevent this from occurring when using fluorescence. A blue green filter sometimes referred to as an exciter filter is placed over the multispectral light source. This limits the incident radiation to shorter wavelengths of light preventing any infrared radiation emitted by the energy source from falling on the subject. The second filter, referred to as a barrier filter is placed over the lens to prevent the visible light from passing through the lens.

Reflected infrared full body photography is useful for differentiating between parts of clothing that look the same in visible light but are actually different. In some cases, visibly dark or even black cloth can be rendered nearly white. Substances such as blood patterns are then revealed. Reducing backgrounds to reveal the presence of stains is a common application for infrared reflected photography.

Figures 9 and 10 illustrate the difference between visual wavelength and infrared photographs.

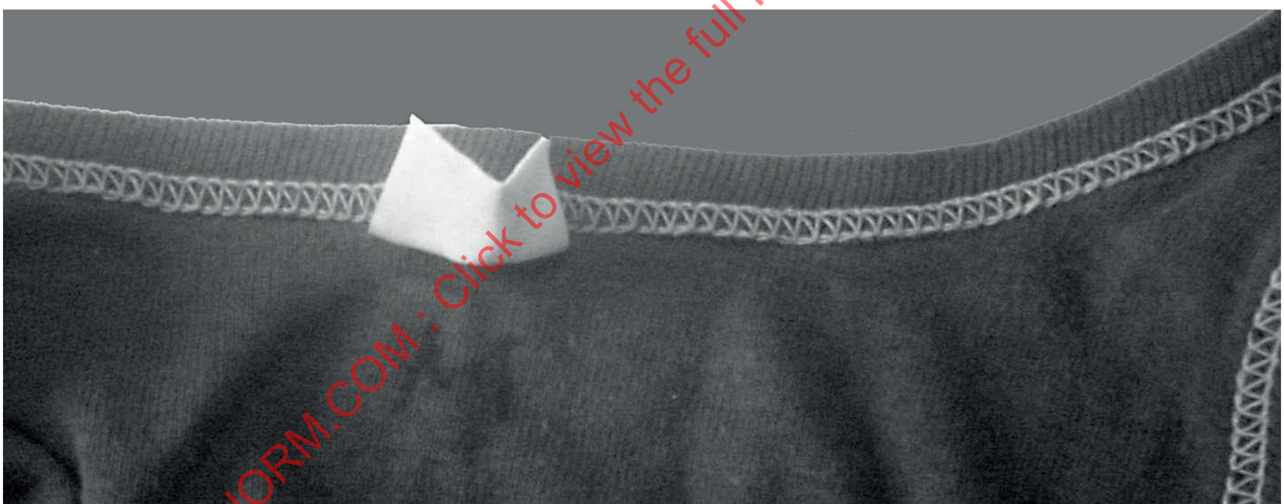


Figure 9 — Infrared image of a T-shirt

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

Figure 10 — White light photograph of a T-shirt

In Figure 9 the infrared image of a T-shirt is clearly showing the letter M under the white tag but in the white light photograph in Figure 10 the letter M marking is invisible. Stitches are seen in detail in the IR image.

6.9.3 Ultraviolet imaging

Reflected UV imaging is the only way to visualize certain phenomena, such as faint traces of substances on surfaces or the surface details on certain transparent materials. For example, imaging explosives residue or substances that are transparent to the eye and near-IR imaging become visible when UV is used for imaging. UVA, UVB, and UVC wavebands are useful because they allow the user to visualize evidence that is usually difficult or impossible to record with other imaging techniques.

The standard digital cameras do not respond to ultraviolet light to be used in forensics. Some specially modified digital single-lens reflex cameras (DSLRs) can be used for UVA photography. Cameras shall be used with bandpass filters to record UVA unless the lighting is pure UVA, with little or no visible light or IR present.

It is important to use the right wavelength of UV light for forensic imaging. Beware of any vendor of UV LED illuminators that is not explicit about the wavelength of their lights.

6.10 Submillimetre imaging

Terahertz (THz) radiation, known as submillimetre radiation, consists of electromagnetic waves within the ITU-designated band of frequencies from 0,3 to 3 terahertz (300-3000 GHz). Wavelengths of radiation in the terahertz band correspondingly range from 1 mm to 0,1 mm and this wavelength also sets the theoretical resolution limit for the images. Terahertz radiation is located in the terahertz gap between microwaves and infrared light waves in the electromagnetic spectrum.

Imagers in this document are divided into two main categories: active and passive systems. The active imagers are based on a radar configuration, with synthetic or optical imaging schemes, whereas passive ones operate as cameras. The main challenge in all these systems is to achieve a large field of view (FOV) with satisfactory spatial resolution and fast image acquisition.

Figure 11 shows an identifiable Apache-SMG submachine gun hidden under subject's clothing. When object outlines are clearly visible then it is possible to react to the danger in a proper way.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

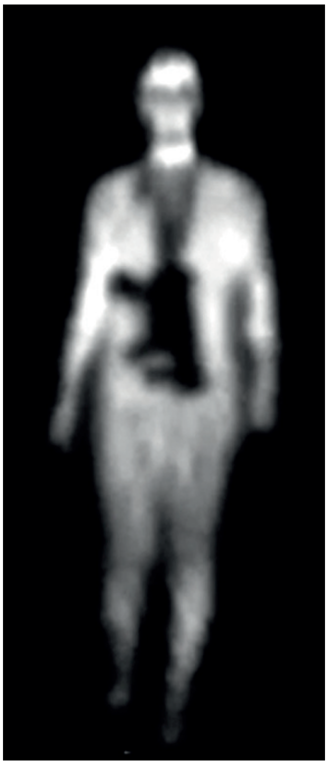


Figure 11 — Submillimetre image showing a gun hidden under subject's clothing

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

A THz beam can traverse non-metallic materials like clothing fabrics, paper and cardboard, plastic and ceramics. It cannot penetrate liquid water or metal. The imaging area depth is typically less than 10 m. At a 5 m distance it is possible to take a submillimetre picture of a height of 2 m using a passive system.

6.11 Imaging use cases

6.11.1 General

A use case is a written description of how users can perform tasks on the imaging system. It outlines, from a user's point of view, a system's behaviour as it responds to a request.

A more detailed definition of use cases is required when configuring the imaging system for a specific environment and for specialized use.

6.11.2 Imaging system baseline use cases

Tables 1 to 10 describe the baseline use cases.

Table 1 — Use case actors

Actor	Description
Subject	Subject for photography
Operator	Person who operates the imaging system
Technician	Person who maintains the imaging system

Table 2 — Use case 1: Give advice

Actor	Operator
Basic flow	Give advice to the subject on how to behave while photographed

© ISO/IEC 2021 – All rights reserved

Table 2 *(continued)*

Actor	Operator
Actor	Subject
Basic flow	Follow the instructions given by the operator

Table 3 — Use case 2: Input data

Actor	Operator
Basic flow	Input data describing the subject; ask the subject questions if needed
Actor	Subject
Basic flow	Answer questions asked by the operator

Table 4 — Use case 3: Take picture

Actor	Operator
Basic flow	Take a picture or shoot video of the subject with the imaging system
Actor	Subject
Basic flow	Pose for the camera

Table 5 — Use case 4: Save picture

Actor	Operator
Basic flow	Check the picture quality with the supplied software, make adjustments and calibrate the system if required to do so; save the picture or video and related data

Table 6 — Use case 5: Calibrate

Actor	Operator
Basic flow	Calibrate the system using imaging system adjustment and calibration software to conform to standard requirements
Actor	Technician
Basic flow	Calibrate the system using analysis software and make required hardware and software adjustments to conform to standard requirements

Table 7 — Use case 6: Install-calibrate

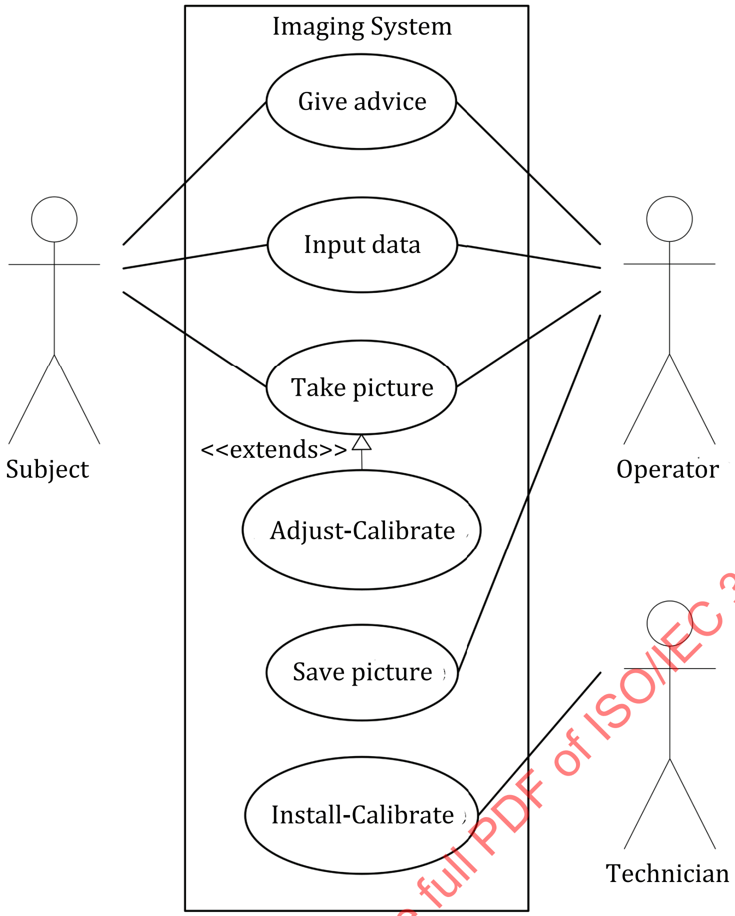
Actor	Technician
Basic Flow	Install, make adjustments and calibrate the system using software installation, analysis software and make required hardware and software adjustments to conform to standard requirements

"Install" involves placing of imaging equipment and other requisites in position and connecting and adjusting for use. It also includes the transfer of computer software from a distribution file to a permanent location on disk or other program storage media and preparing it for its particular environment and application [15].

Calibration involves adjustment of the imaging system so that it can be used in an accurate and exact way. Using measurement targets and measuring instruments the Technician is able to determine the deviation from a standard so as to ascertain the proper corrections. Using the imaging system for subject measurement requires calibration. Image calibration provides a pixel-to-real-distance conversion factor that allows image scaling to metric units. Accurate information on the height is obtained via photogrammetry, including the reference points in the photographed area, for example a standardized range pole.

Figure 12 illustrates the use cases described in Tables 1 to 10.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021



NOTE Taking a photograph can be interpreted also as taking a video clip.

Figure 12 — Imaging system use cases

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

7 Abstract data elements

7.1 Overview

7.1.1 Content and notation

This clause describes the contents of data elements defined in this document. These descriptions are independent of the encoding of the data elements.

The presence of data elements is specified in Annex A. Certain data elements are optional. Such data elements need not be included in a biometric data block. An optional data element may be omitted altogether from the encoding.

Application profiles as defined in Annex D may further restrict the presence of data elements. Such profiles may make optional elements mandatory, and they may exclude optional elements.

In an ASN.1 module, optional data elements are marked with the keyword OPTIONAL. When such an element is not present, then the tag, length, and value octets of this data element are omitted from the tagged binary encoding.

A data element in an XML schema definition is optional if the value of its minOccurs attribute is 0. When such an element is not present, then the opening and closing tags as well as the value of this data element are omitted from the XML encoding.

© ISO/IEC 2021 – All rights reserved

If all child elements of a data element are optional, then this data element shall be marked optional as well.

Type names are in upper camel-case notation derived from subclause titles in this clause. Element names are in lower camel-case notation derived from these subclause titles. If the generic name starts with a number, then this component is set to the end of the base name. In the XSD, type names end with the word “Type”.

EXAMPLE 1 The *Image colour space* element has the encoding name *imageColourSpace* and the type *ImageColourSpace* (in ASN.1) and *ImageColourSpaceType* (in XML).

EXAMPLE 2 An element value with the abstract name colour coded light has the value *colourCodedLight*. An element value with the abstract name *48 bit RGB* has the encoding value *rgb48Bit*.

Most of the body image data record parameters are considered as optional to allow application specific profiles and efficient storage of the available data.

Data elements shall use ISO/IEC 39794-5 definitions if so adviced in the element abstract value definition in this document.

7.1.2 Body tree concept

Tree structures are well suited to XML as the XML documents form a tree structure that starts at the root and branches to the leaves. ITU-T Rec. X.694 provides a mapping from XML Schema to ASN.1. The U.S. National Library of Medicine also designed four databases (Unified Medical Language System, UMLS) whose exchange formats are specified in ASN.1. The need to use a tree structure is application dependent and particularly useful in linked data systems.

MeSH (Medical Subject Headings) RDF is faithful to the MeSH XML data model that NLM (United States National Library of Medicine) has produced for a number of years. An underlying structure for full body elements is defined by the MeSH. MeSH descriptors form an organized way to describe different body parts. MeSH is the U.S. National Library of Medicine controlled vocabulary thesaurus. For example, ear is defined in a tree structure as A - Anatomy -> A01 - body regions -> A01.456 - head -> A01.456.313 - ear. This description method allows the use of unified representation blocks in linked data systems using well described links between resources. The main structure of an XML document is tree-like, and most of the lexical structure is devoted to defining that tree.

In Figure 13 the full body root node is the "Body regions 01" named after the MeSH descriptor. Other child elements are either entity references or elements containing allowed element contents.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

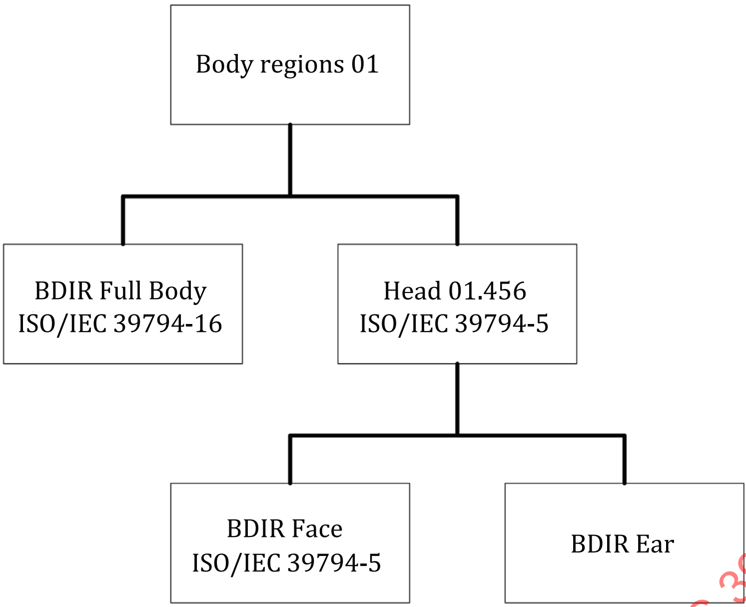


Figure 13 — Full body root node and child elements

Full body imaging systems produce 2D images or 3D models for human examination and for automated full body verification and identification. Instead of using representations as isolated entities, a more organized way is to utilize the body tree structure. In this context an image should be perceived as any descriptive data set describing a human body or part of the body.

A few well-established databases for identification of missing persons and unknown bodies have been deployed by the international and national police authorities. There are several widely used data models such as INTERPOL DVI for disaster victim identification (Figure 14) and VERMI-UTOT (VUTOT) of the German Federal Criminal Police. Such databases contain both biometric and non-biometric data.

Figure 14 — INTERPOL DVI document structure

Machine learning applications are able to produce landmark points and biometric feature vectors constructed from a biometric data set. Feature vectors only remotely resemble conventional images. The use of a convolutional neural network (CNN) helps to reduce identification errors[46]. Local processing using neural network is always possible using local feature vector or tensor formats. However, full body image output data or gait image sequence output data for information interchange using ASN.1 or XML shall follow the format specifications given in this document. For information interchange the image format shall conform to one of the encodings given in 6.2.

Figure 15 illustrates a simplified diagram of a fully connected neural network. Three input nodes form the input layer, eight hidden nodes form two hidden layers of four neurons, and one node forms the regression output layer. More than one output layer is needed for classification.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

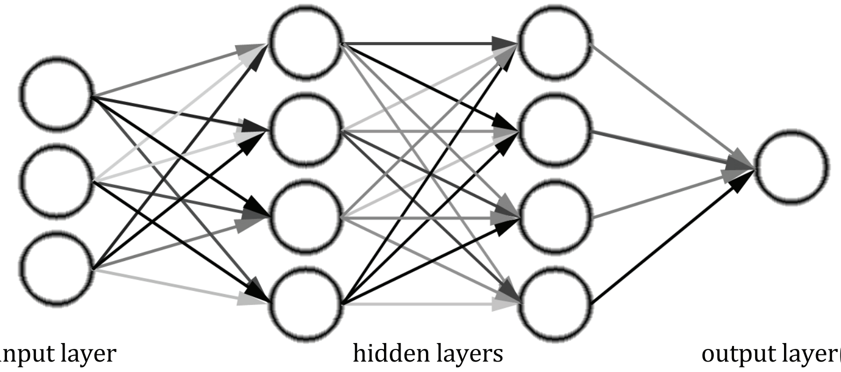
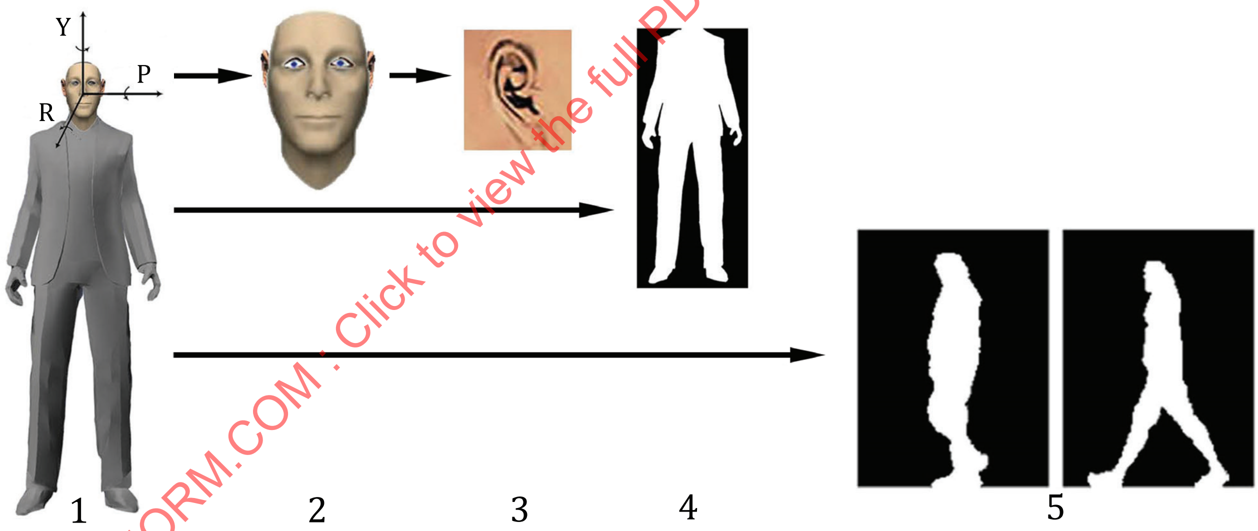


Figure 15 — Typical simplified neural network architectural diagram

The CNN in machine learning applications facilitate advances not only in full body image classification and modelling, but also in decomposing a human full body image into semantic body regions and clothes [46]. Advanced neural network architectures can recognize human faces or body features with any view in a certain viewing angle range, e.g. from left 30° to the right 30° of yaw angle rotation. To recognize targeted subject features of a specific view, the selected architecture can require the use of parallel view specific neural networks instead of a single neural network.

Figure 16 illustrates the possibilities offered by full body images and videos, which provide a wide selection of biometric features for various processes.



Key

1 pose
2 face
3 ear
4 appearance
5 gait
P pitch around the side-to-side x axis
Y yaw around the vertical y axis
R roll around the front-to-back z axis

Figure 16 — Full body features for various processes

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Standard poses, element structures and data formats help the parsing of the body tree data into body part representations. Parsing can be done using methods and algorithms which process the human body as an assembly of parts. Segmentation can be used as a pre-processing step.

7.1.3 Anthropometric data models

Anthropometry means, literally, the measurement of people.

Biometric or anthropometric applications can be roughly divided into three different categories:

— internal human body structure reconstruction;

— human body surface reconstruction;

— human body motion analysis.

Table 8 — Cross-reference table for different data models

Model scope	Process scope	Model name
Internal human body structure reconstruction	body tree based standard selection, personal data reference	MeSH
Human body surface reconstruction	personal data reference	Anthropometric landmarks, CAESAR
Human body surface reconstruction	3D modelling landmarks	MPEG-4
Human body motion analysis	gait recognition landmarks	MPEG-4

Internal human body structure recovering based on MeSH allows 3D reconstruction of anatomical parts for biometric standards related process and application selection. Human body surface reconstruction modelling is required to describe landmark locations on the body.

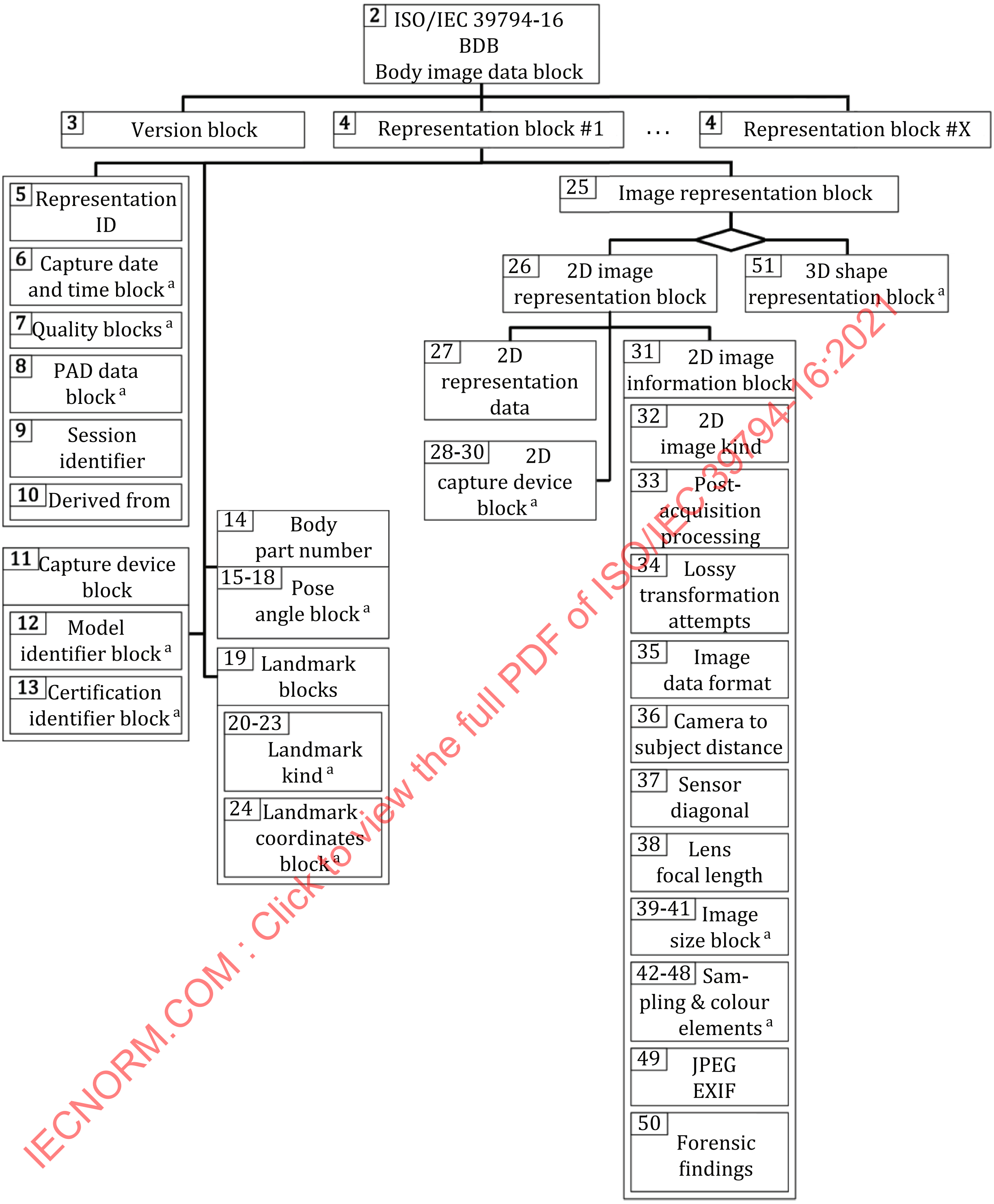
The MPEG-4 face/body animation parameters (FAP/BAP) are used to animate face/body models. Human body motion recognition may also be achieved by analyzing the extracted 3D pose parameters. Smart surveillance systems, capable of more than single-motion detection, can take advantage of the 3D human motion analysis by incorporating specific knowledge about human shape and appearance, in order to decrease false alarms. High-level analysis is able to distinguish between simple authorized and non-authorized activities.

7.1.4 Structure overview

The order of the abstract data elements in 7.2 and beyond is derived from traversing the tree in Figure 17 from left to right, depth first. A more formal description of the structure is given in A.1 for ASN.1 and in A.2 for the XML encoding of these abstract data elements.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved



IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Key

a Elements which can be divided in sub-elements, not shown in this figure.

◇ exclusive Or (XOR), one, and only one, option shall be chosen

[n] denotes that this element is defined in sublause 7.n

Figure 17 — ISO/IEC 39794-16 body image data block

7.1.5 Data conventions

All numeric values are unsigned integer quantities, unless otherwise specified.

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.

The absence of an optional element means that the encoder does not provide any statement about the value of the element.

In application profiles that require the presence of an otherwise optional data element, the abstract value "unknown" shall be used if the value of this data element is unknown.

7.2 Body image data block

Abstract values: None

Contents: Each BDB shall pertain to a single subject and shall contain one or more representations of a human body and/or human body-related information. Together with version block, each BDB can contain one or more image representations. The record structure is depicted in Figure 18.

NOTE The full-body image data block is structurally similar to the face image data block defined in ISO/IEC 39794-5. "BodyImageData" is used exceptionally instead of "BodyImageDataBlock" to reflect the title of the corresponding part of ISO/IEC 39794 in the textual encoding for body image data.

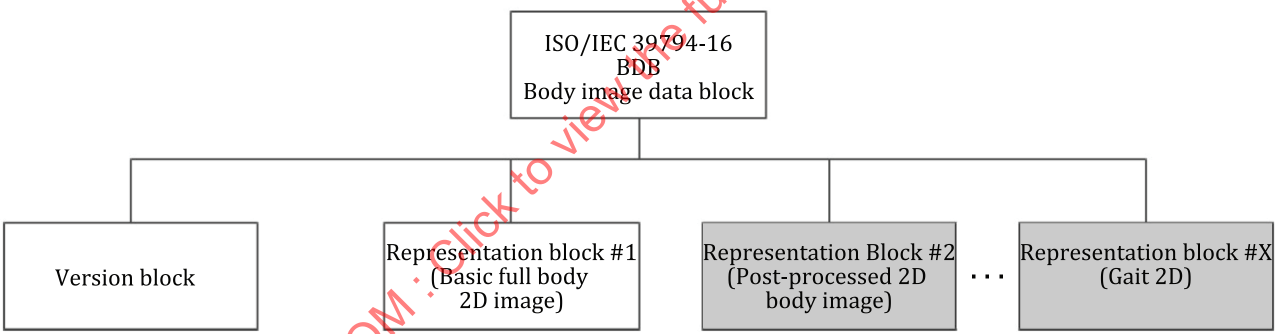


Figure 18 — Example of embedding multiple representations in the same body image data block

When referring to the objects of a record, they are grouped into three data structures (field, block and record). A field denotes the elementary one to store data. There are two kinds of fields: simple and combined field. A simple field contains only one simple data object and a combined field contains one or more fields which may be simple or combined. One or more data fields can be grouped together into a data block. The part consisting of several uniquely named components (data fields and blocks) forms a data record. The whole-body image structure is illustrated in Figure 17.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

7.3 Version block

Abstract values: The abstract values for the versions are defined in ISO/IEC 39794-1.

Contents: The version block element shall indicate the version number of the extensible biometric data interchange format, as specified in ISO/IEC 39794-1.

The generation number of this document shall be 3. The year shall be the year of the publication of this document.

If a BDB contains representations encoded using different versions of an extensible biometric data interchange format, then the version number of the most recent version of the encoding versions shall be used.

7.4 Representation block

Abstract values: None

Contents: A representation block consists of representation blocks, a unique representation ID characterizing this representation block, a capture date/time block element, quality blocks, PAD data block, a session identifier, an identifier to define a relationship to another record, called derived from, capture device information, body part number, pose angle block, and the landmark point block. The structure of these elements is shown in Figure 17.

Multiple body image representations of the same biometric data subject may be described in the same body image data block. This is accomplished by including multiple image representation blocks. 2D image representation blocks containing 2D data may be combined with 3D shape representation blocks containing 3D data.

EXAMPLE The structure of a possible storage of 2D and 3D representations is illustrated in Figure 17.

7.5 Representation ID

Abstract values: Integer

Contents: This element shall obtain a unique identifier for the image representation block. Each two representations in a record shall have different identifiers.

7.6 Capture date/time block

Abstract values: See capture date/time block in ISO/IEC 39794-1.

Contents: The capture date/time block shall indicate when the capture of this representation started in UTC.

7.7 Quality blocks

Abstract values: See quality block in ISO/IEC 39794-1.

Contents: This element contains information on the biometric sample quality.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

7.8 PAD data block

Abstract values: See PAD data block in ISO/IEC 39794-1.

Contents: This element shall convey the mechanism used in biometric presentation attack detection and the results of the presentation attack detection mechanism.

7.9 Session identifier

Abstract values: Integer

Contents: This element shall map the representation to the photo session where the body image was recorded.

7.10 Derived from

Abstract values: Integer

Contents: The derived from element shall denote interdependencies when multiple representations are stored in the interchange record. This may be set where post-processing has been used, but also for other image types. The value shall be the representation ID number of the original representation.

EXAMPLE There are two representations in the overall record. Their identifiers are 1 and 2. The first representation has been post-processed and resulted in the second representation. Then, the second representation shall have the derived from element set to 1.

7.11 Capture device block

Abstract values: See capture device block in ISO/IEC 39794-1.

Contents: The capture device block contains information on the capture device model in the model identifier block and on the certification in the certification identifier block.

7.12 Model identifier block

Abstract values: See model identifier block in ISO/IEC 39794-1.

Contents: The model identifier block shall identify the biometric organisation that owns the product that created the BDB. It shall carry a CBEFF biometric organisation identifier (registered by IBIA or other approved registration authority). Additionally, it shall identify the product type that created the BDB. It shall be assigned by the registered product owner or other approved registration authority.

7.13 Certification identifier block

Abstract values: See certification identifier block in ISO/IEC 39794-1.

Contents: Certification schemes are published following the ISO/IEC standard procedures when certification identifiers are available for this document.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

7.14 Body part number

Abstract values: For the structure see Table 9.

Contents: The body part number element contains a MeSH conformant description of the body part or behaviour number in seven digits. The least significant digit in the seven-digit body part number is set to 0 as a default, 1 for left side, and 2 for right side body part.

The parent node is always available if it is not possible to pinpoint the exact body part. The highest point of the body tree is body regions. Unknown body parts are marked with a number zero.

MeSH main headings are listed by a tree number system that places the headings in a hierarchical arrangement. The U.S. National Library of Medicine is the creator, maintainer, and provider of the data. The truncated MeSH tree list with headings in Table 9 for full body image data is based on the MeSH Tree List published in 2017.

Table 9 — Truncated MeSH tree list with headings

Abstract value	Tree number	Body part number	Term
unknown	A00	0000000	Unknown
bodyRegions	A01	0018290	Body regions
breast	A01.236	0019400	Breast
amputationStumps	A01.378.100	0006720	Amputation stumps
buttocks	A01.378.610.100	0020810	Buttocks
foot	A01.378.610.250	0055280	Foot
hip	A01.378.610.400	0066150	Hip
knee	A01.378.610.450	0077170	Knee
leg	A01.378.610.500	0078660	Leg
thigh	A01.378.610.750	0138480	Thigh
arm	A01.378.800.075	0011320	Arm
elbow	A01.378.800.420	0045500	Elbow
forearm	A01.378.800.585	0055420	Forearm
hand	A01.378.800.667	0062250	Hand
fingers	A01.378.800.667.430	0053850	Fingers
shoulder	A01.378.800.750	0127820	Shoulder
head	A01.456	0062570	Head
ear	A01.456.313	0044230	Ear
face	A01.456.505	0051450	Face
eye	A01.456.505.420	0051230	Eye
scalp	A01.456.810	0125350	Scalp
neck	A01.598	0093330	Neck
torso	A01.923	0607260	Torso
back	A01.923.176	0014150	Back
pelvis	A01.923.600	0103880	Pelvis
transplants	A01.941	0197370	Transplants
skeleton	A02.835	0128630	Skeleton
skull	A02.835.232.781	0128860	Skull
intestines	A03.556.124	0074220	Intestines

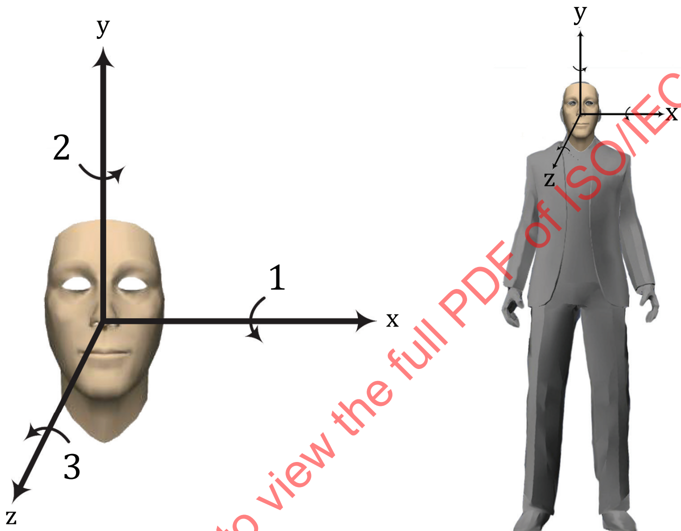
IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Table 9 *(continued)*

Abstract value	Tree number	Body part number	Term
mouth	A03.556.500	0090550	Mouth
nose	A04.531	0096660	Nose
heart	A07.541	0006321	Heart
brain	A08.186.211	0019210	Brain
eye	A09.371	0051230	Eye
iris	A09.371.060.450	0074980	Iris
retina	A09.371.729	0121600	Retina
gait	G11.427.410.568.900.750	0005684	Gait

7.15 Pose angle block



Key

y yaw angle (Y)
x pitch angle (P)
z roll angle (R)

Figure 19 — The definition of pose angles with respect to the frontal view of the subject

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Abstract values: The pose angle block contains angle data for yaw, pitch, and roll.

Contents: The pose angle block element shall represent the estimated or measured pose of the subject in the image.

The angles encoded in this element are:

Yaw angle block (Y): Rotation about the vertical (y) axis. The yaw angle Y is the rotation in degrees about the y-axis (vertical axis) shown in Figure 19. Frontal poses have a yaw angle of 0°. Positive angles represent faces looking to their left (a counter-clockwise rotation around the y-axis).

Pitch angle block (P): Rotation about the horizontal side-to-side x-axis. The pitch angle P is the rotation in degrees about the x-axis (horizontal axis) shown in Figure 19. Frontal poses have a pitch angle of 0°. Positive angles represent faces looking down (a counter-clockwise rotation around the x-axis).

Roll angle block (R): Rotation about the horizontal back to front z-axis. The roll angle R is the rotation in degrees about the z-axis (the horizontal axis from front to back) shown in Figure 19. Frontal poses have a roll angle of 0°. Positive angles represent faces tilted toward their right shoulder (counter-clockwise rotation around the z-axis). A roll angle of 0° denotes that the left and right eye centres have identical y coordinates. The angles are defined relative to the frontal pose of the subject, which has angles (Y=P=R=0) as shown in Figure 19. The frontal pose is defined by the Frankfurt Horizon 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. Examples are shown in Figure 20.

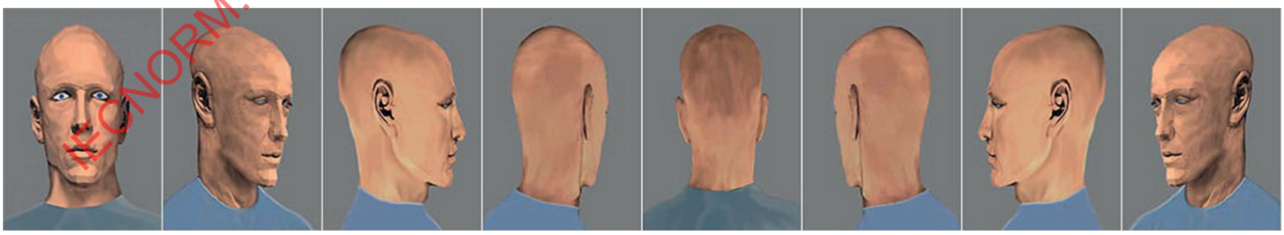
As the order of the successive rotation around the different axes does matter, the encoded rotation angle shall correspond to an order of execution starting from the frontal view. This order shall be given by roll (about the front axis), then pitch (about the horizontal axis) and finally yaw (about the vertical axis). The (first executed) roll transformation is always in the image xy plane.

From the point of view of executing a transformation from the observed view to a frontal view, the transformation order is therefore be in the opposite order: yaw, pitch and then roll.

NOTE 1 The encoded angle is from the frontal view to the observed view.

NOTE 2 The conversion to integer is specified in 7.1.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021



NOTE From left (0,0,0), (+45,0,0), (+90,0,0), (+135,0,0), (+180,0,0), (-135,0,0), (-90,0,0), (-45,0,0).

Figure 20 — Examples of pose angles applied for full body images in the same way as for face images.

© ISO/IEC 2021 – All rights reserved

7.15.1 Yaw angle, *Y*

Abstract values: The minimum value is -180, the maximum value is 180. See ISO/IEC 39794-5.

Contents: The yaw angle, *Y*, is the rotation in degrees about the y-axis (vertical axis) shown in Figure 19. Frontal poses have a yaw angle of 0°. Positive angles represent faces looking to their left (a counter-clockwise rotation around the y-axis).

7.15.2 Pitch angle, *P*

Abstract values: The minimum value is -180, the maximum value is 180. See ISO/IEC 39794-5.

Contents: The pitch angle, *P*, is the rotation in degrees about the x-axis (horizontal axis) shown in Figure 19. Frontal poses have a pitch angle of 0°. Positive angles represent faces looking down (a counter-clockwise rotation around the x-axis).

7.15.3 Roll angle, *R*

Abstract values: The minimum value is -180, the maximum value is 180. See ISO/IEC 39794-5.

Contents: The roll angle, *R*, is the rotation in degrees about the z-axis (the horizontal axis from front to back) shown in Figure 19. Frontal poses have a roll angle of 0°. Positive angles represent faces tilted toward their right shoulder (counter-clockwise rotation around the z-axis). A roll angle of 0° denotes that the left and right eye centres have identical y coordinates.

7.16 Angle data block

Abstract values: Angle value and angle uncertainty.

Contents: The angle data block element contains an angle value and its corresponding angle uncertainty.

7.17 Angle value

Abstract values: Integer, the minimum value is -180, the maximum value is 180.

Contents: The angle value is given by Tait-Bryan angles (in degrees).

7.18 Angle uncertainty

Abstract values: The minimum value of an angle uncertainty variable is 0, the maximum value is 180.

Contents: The angle uncertainty represents the expected degree of uncertainty of the associated pose angle. The more uncertain, the larger the value of the uncertainty. The angle uncertainty allows storing an uncertainty or tolearance value for an angle. The true angle should be in a range of angle value +/- angle uncertainty. If the associated pose angle is absent, the angle uncertainty for this angle shall be absent, too.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

7.19 Landmark blocks

Abstract values: None.

Contents: The landmark blocks element specifies the type, code and position of a landmark point in the image. It shall contain at least one landmark point. A landmark point consists of the landmark kind element and the coordinates of the landmark point.

A landmark point can be specified as MPEG-4 feature points in accordance with ISO/IEC 14496-2:2004, Annex C, or as anthropometric landmarks or as CAESAR anthropometric 3D landmark points. The description of the anthropometric landmarks[27] and their relation with the set of MPEG-4 feature points is discussed in Table 11.

7.20 Landmark kind

Abstract values: None.

Contents: The landmark kind shall either be MPEG-4 feature point or anthropometric landmark or CAESAR anthropometric 3D landmark or MPEG-4 body point. The landmark point code shall specify the landmark point that is stored in the landmark point element. The MPEG-4 feature points are extended by the eye and nostril landmark points. CAESAR anthropometric 3D landmarks are used mainly for forensic purposes and MPEG-4 body points for gait identification described in ISO/IEC 39794-17.

References to right and left shall be taken from the perspective of the subject contained within an image. References to right shall mean the right side of the body from the perspective of the subject. References to the left shall mean the left side of the body from the perspective of the subject.

7.21 MPEG-4 feature point

Abstract values: See feature point in ISO/IEC 39794-5.

Contents: The landmark point code associated with a facial feature point is given by ISO/IEC 14496-2:2004, Annex C. Each landmark point can be notated in the form A.B using a major (A) and a minor (B) value.

7.22 Eye and nostril centre landmark point

Abstract values: See eye and nostril centre landmark point in ISO/IEC 39794-5.

Contents: The eye and nostril landmark point is an addition to the MPEG-4 feature point.

7.23 Anthropometric landmark for face and body

7.23.1 Anthropometric landmark for face

Abstract values: See anthropometric landmark in ISO/IEC 39794-5.

Contents: Anthropometric landmarks extend the MPEG-4 feature model with points that are used in forensics and anthropology for subject identification via two face images or image and skull over a long time. They also allow specification of points that are in use by criminal experts and anthropologists[27].

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

7.23.2 CAESAR anthropometric 3D landmark point

Abstract values: See Table 10.

Contents: CAESAR landmark is a CAESAR anthropometric 3D landmark point. This or a similar anthropometric landmark system should be used to pinpoint a specific point on the body when notes are added into the personal data record.

The Civilian American and European Surface Anthropometry Resource (CAESAR) [32] project was a survey of the civilian populations of four countries: United States of America (USA), Canada, The Netherlands, and Italy.

The list and description of the landmarks form a tested set for anthropometric 3D measurements. Code defines the landmark point numerical value referring to the CAESAR point name as shown in Table 10. The CAESAR landmark enumerated code list contains the CAESAR point names.

Anthropometric landmarks denote feature points that are used in forensics and anthropology for recognition of individuals via two images or image and skeleton. They also allow specification of points that are in use by criminal examiners and anthropologists.

Table 10 — CAESAR anthropometric 3D landmarks with Anthropometric and CAESAR point names

Code	CAESAR anatomical name	Anthropo-metric name	CAESAR point name
1	SELLION	Nasion; Sellion	Sellion
2	INFRAORBITALE, RIGHT		Rt. Infraorbitale
3	INFRAORBITALE, LEFT		Lt. Infraorbitale
4	SUPRAMENTON		Supramenton
5	TRAGION, RIGHT	Tragion	Rt. Tragion
6	GONION, RIGHT		Rt. Gonion
7	TRAGION, LEFT	Tragion	Lt. Tragion
8	GONION, LEFT		Lt. Gonion
9	NUCHALE		Nuchale
10	CLAVICALE, RIGHT		Rt. Clavicale
11	SUPRASTERNALE		Suprasternale
12	CLAVICALE, LEFT		Lt. Clavicale
13	THELION/BUSTPOINT, RIGHT		Rt. Thelion/Bustpoint
14	THELION/BUSTPOINT, LEFT		Lt. Thelion/Bustpoint
15	SUBSTERNALE		Substernale
16	TENTH RIB, RIGHT		Rt. 10th Rib
17	ILIAC SPINE, ANTERIOR, SUPERIOR; RIGHT		Rt. ASIS
18	TENTH RIB, LEFT		Lt. 10th Rib
19	ILIAC SPINE, ANTERIOR, SUPERIOR; LEFT		Lt. ASIS
20	ILIOCRISTALE, RIGHT		Rt. Iliocristale
21	TROCHANTERION, RIGHT		Rt. Trochanterion
22	ILIOCRISTALE, LEFT		Lt. Iliocristale
23	TROCHANTERION, LEFT		Lt. Trochanterion
24	CERVICALE	Cervicale	Cervicale
25	TENTH RIB, MIDSPINE		10th Rib Midspine
26	ILIAC SPINE, POSTERIOR, SUPERIOR; RIGHT		Rt. PSIS

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

Table 10 *(continued)*

Code	CAESAR anatomical name	Anthropo-metric name	CAESAR point name
27	ILIAC SPINE, POSTERIOR, SUPERIOR; LEFT		Lt. PSIS
28	WAIST, PREFERRED, POSTERIOR		Waist, Preferred, Post.
29	ACROMION, RIGHT	Acromion	Rt. Acromion
30	AXILLA POINT, ANTERIOR; RIGHT		Rt. Axilla, Ant
31	RADIAL STYLOID, RIGHT		Rt. Radial Styloid
32	AXILLA POINT, POSTERIOR; RIGHT		Rt. Axilla, Post.
33	OLECRANON, RIGHT		Rt. Olecranon
34	HUMERAL EPICONDYLE, LATERAL;RIGHT		Rt. Humeral Lateral Epicn
35	HUMERAL EPICONDYLE, MEDIAL; RIGHT		Rt. Humeral Medial Epicn
36	RADIALE, RIGHT		Rt. Radiale
37	METACARPAL-PHALANGEAL II, RIGHT		Rt. Metacarpal Phal. II
38	DACTYLION, RIGHT		Rt. Dactylion
39	ULNAR STYLOID, RIGHT		Rt. Ulnar Styloid
40	METACARPAL-PHALANGEAL V, RIGHT		Rt. Metacarpal-Phal. V
41	ACROMION, LEFT	Acromion	Lt. Acromion
42	AXILLA POINT, ANTERIOR; LEFT		Lt. Axilla, Ant
43	RADIAL STYLOID, LEFT		Lt. Radial Styloid
44	AXILLA POINT, POSTERIOR; LEFT		Lt. Axilla, Post.
45	OLECRANON, LEFT		Lt. Olecranon
46	HUMERAL EPICONDYLE, LATERAL; LEFT		Lt. Humeral Lateral Epicn
47	HUMERAL EPICONDYLE, MEDIAL; LEFT		Lt. Humeral Medial Epicn
48	RADIALE, LEFT		Lt. Radiale
49	METACARPAL-PHALANGEAL II, LEFT		Lt. Metacarpal-Phal. II
50	DACTYLION, LEFT		Lt. Dactylion
51	ULNAR STYLOID, LEFT		Lt. Ulnar Styloid
52	METACARPAL-PHALANGEAL V, LEFT		Lt. Metacarpal-Phal. V
53	KNEE CREASE, RIGHT		Rt. Knee Crease
54	FEMORAL EPICONDYLE, LATERAL; RIGHT		Rt. Femoral Lateral Epicn
55	FEMORAL EPICONDYLE, MEDIAL; RIGHT		Rt. Femoral Medial Epicn
56	METATARSAL-PHALANGEAL V, RIGHT		Rt. Metatarsal-Phal. V
57	MALLEOLUS, LATERAL; RIGHT		Rt. Lateral Malleolus
58	MALLEOLUS, MEDIAL; RIGHT		Rt. Medial Malleolus
59	SPHYRION, RIGHT		Rt. Sphyrion
60	METATARSAL-PHALANGEAL I, RIGHT		Rt. Metatarsal-Phal. I
61	CALCANEUS, POSTERIOR; RIGHT		Rt. Calcaneous, Post.
62	DIGIT II, RIGHT		Rt. Digit II
63	KNEE CREASE, LEFT		Lt. Knee Crease
64	FEMORAL EPICONDYLE, LATERAL; LEFT		Lt. Femoral Lateral Epicn
65	FEMORAL EPICONDYLE, MEDIAL; LEFT		Lt. Femoral Medial Epicn
66	METATARSAL-PHALANGEAL V, LEFT		Lt. Metatarsal-Phal. V
67	MALLEOLUS, LATERAL; LEFT		Lt. Lateral Malleolus
68	MALLEOLUS, MEDIAL; LEFT		Lt. Medial Malleolus
69	SPHYRION, LEFT		Lt. Sphyrion

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Table 10 *(continued)*

Code	CAESAR anatomical name	Anthropo-metric name	CAESAR point name
70	METATARSAL-PHALANGEAL I, LEFT		Lt. Metatarsal-Phal. I
71	CALCANEUS, POSTERIOR; LEFT		Lt. Calcaneous, Post.
72	DIGIT II, LEFT		Lt. Digit II
73	CROTCH *(Calculated Point only)*		Crotch
74	BUTT BLOCK		Functional Butt Block

Figure 21 illustrates some key CAESAR landmark points, which are used when notes are added into the personal data record.

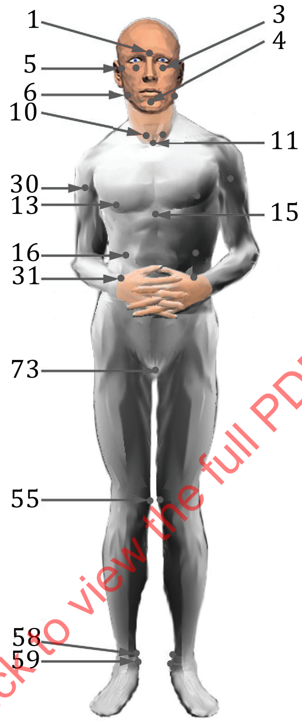


Figure 21 — Frontal view of the CAESAR landmarks

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

7.23.3 MPEG-4 body point

Abstract values: None.

Contents: Figure 22 and Table 11 denote the Landmark point codes associated with body points as indicated by ISO/IEC 14496-2:2004, Annex C. Landmark point x, y, and z values are coordinate values for a model human indicating the default human body landmark point locations. The x and y values are used for frontal full body image landmark points and the z and y values for the later full body pose landmark points. For 3D model construction all landmark point values (x, y and z) are in use.

For a schematic visualization, a simplified stick figure representing the human skeleton can be automatically recovered from the values of body point spatial coordinates. In turn this should be used in gait identification for applications in video surveillance. See ISO/IEC 39794-17 for details.

Figure 22 illustrates the MPEG-4 body landmark key point locations and names. The only requirement for the definition of the skeletal hierarchy is that a humanoid root, i.e. body centre point, is defined.

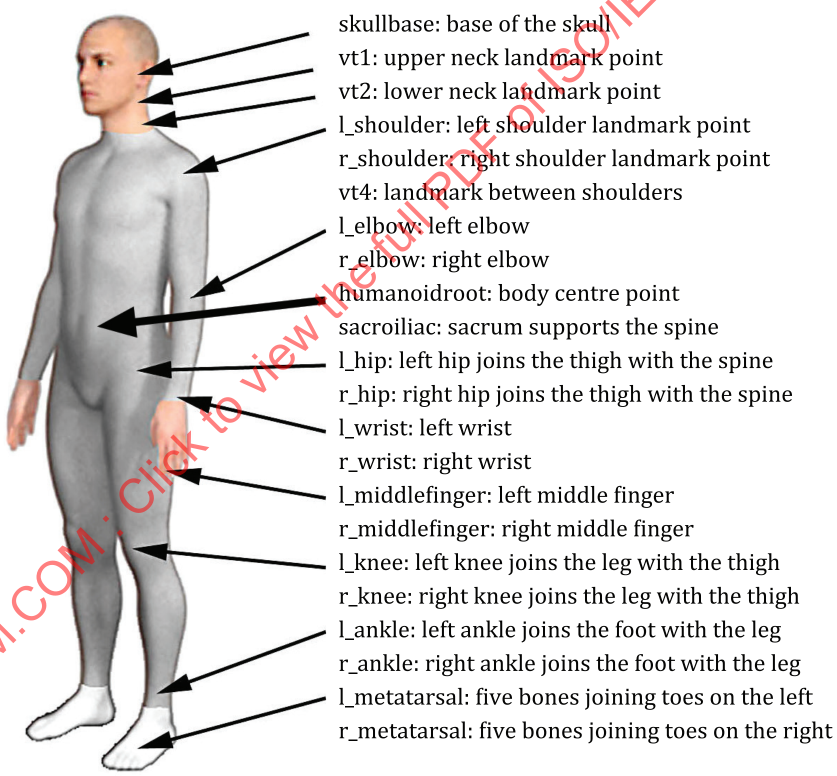


Figure 22 — MPEG-4 body landmark point names

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Table 11 — MPEG-4 Body point values

Point identifier	MPEG-4	How to point
unknown	0	unknown point
skullbase	1	base of the skull
vt1	2	upper neck landmark point
vt2	3	lower neck landmark point
l-shoulder	4	shoulder landmark point

© ISO/IEC 2021 – All rights reserved

Table 11 *(continued)*

Point identifier	MPEG-4	How to point
r-shoulder	5	shoulder landmark point
vt4	6	landmark between shoulders
l-elbow	7	elbow
r-elbow	8	elbow
humanoidroot	9	body centre point
sacroiliac	10	sacrum supports the spine
l-hip	11	hip joins the thigh with the spine
r-hip	12	hip joins the thigh with the spine
l-wrist	13	wrist
r-wrist	14	wrist
l-middlefinger	15	middle finger
r-middlefinger	16	middle finger
l-knee	17	knee joins the leg with the thigh
r-knee	18	knee joins the leg with the thigh
l-ankle	19	ankle joins the foot with the leg
r-ankle	20	ankle joins the foot with the leg
l-metatarsal	21	five long bones joining toes on the left
r-metatarsal	22	five long bones joining toes on the right

7.24 Landmark coordinates block

Abstract values: None.

Contents: The landmark coordinates block shall contain the coordinates of the associated landmark in the 2D Cartesian coordinate system (in case of 2D image representation block existence) or in a 3D Cartesian coordinate system (in case of 3D image representation block existence).

In case of 2D image representation block existence, the Z coordinate of the Cartesian coordinate system is not used. This element shall contain the horizontal and vertical position of the associated Landmark point. They are measured in pixels with values from 0 to Width-1 and Height-1. The Coordinate texture image block consists of the two integer values, uInPixel and vInPixel. In case of the 3D shape representation block existence, the X, Y, Z coordinates are mandatory and defined in the 3D Cartesian coordinate space. The X, Y, Z coordinates are positive non-negative integers. The landmarks are converted to metric Cartesian coordinates using the Cartesian scales and offsets block as defined in ISO/IEC 39794-5. The error of Z coordinate of anthropometric landmark location should be no greater than 3 mm. The point shall withstand from the nearest point on the surface no further than 3 mm.

7.25 Image representation block

Abstract values: Either 2D image representation block, or 3D shape representation block.

Contents: The image representation block contains the image data and metadata. It is either a 2D image representation block or a 3D shape representation block.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

7.26 2D image representation block

Abstract values: None.

Contents: The 2D image representation block element contains the 2D representation data, the 2D capture device block, and the 2D image information block.

7.27 2D representation data

Abstract values: Octet string.

Contents: The 2D representation data element shall contain the image data encoded by the JPEG or JPEG2000 or PNG or MPEG-4 or MP4 or DICOM standards, in accordance with the value of the image data format variable.

7.28 2D capture device block

Abstract values: None.

Contents: The 2D capture device block consists of the capture wavelength range block element and the capture device technology element.

7.29 Capture wavelength range block

Abstract values: The possible values are:

- ultrasound
- millimetre
- submillimetre
- far-infrared
- mid-infrared
- near-infrared
- white light
- ultraviolet
- soft X-ray
- hard X-ray
- gamma ray
- neutron
- proton
- positron

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

— magnetics

— quantum

Contents: Many different types of capture devices work in the visible spectrum or outside of the human visible spectrum. The capture wavelength range block element indicates whether the capture device technology uses one of these illuminations.

Table 12 defines the wavelengths and Table 13 sub-atomic and atomic particles.

Table 12 — ISO 21348 definitions of spectral categories

Spectral category	Wavelength range
Gamma rays	0,00001 nm ≤ λ < 0,001 nm, i.e. 1,24 MeV
X-rays	0,001 nm ≤ λ < 10 nm
Ultraviolet	10 nm ≤ λ < 400 nm
Visible	380 nm ≤ λ < 760 nm
Infrared	760 nm ≤ λ < 1 mm
Microwave	1 mm ≤ λ < 1,33 m

Table 13 — Observed sub-atomic (“quantum”) and atomic particles

Particle name	Sub-atomic mass (GeV/C^2)
Gluon	~0
Photon	~0
Electron neutrino	$\sim 1\times10^{-8}$
Muon neutrino	$1{,}7\times10^{-4}$
Electron	$5{,}11\times10^{-4}$
Up quark	3×10^{-3}
Down quark	6×10^{-3}
Tau neutrino	$1{,}6\times10^{-2}$
Strange quark	0,1
Muon	0,106
Proton	0,938
Neutron	0,940
Lambda	1,116
Charm quark	1,3
Omega	1,672
Tau	1,7771
Bottom quark	4,3
W^- Boson	80,4
W^+ Boson	80,4
Z^0 Boson	91,188
Higgs boson	125
Top quark	175

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

NOTE 1 In ISO 5576, the X-ray wavelength range is from 1 nm to 0,0001 nm, i.e. 12,4 MeV. However, Cobalt 60 illuminator is regarded as a gamma radiation source (1,17 MeV and 1,33 MeV spikes due to radionuclide decay).

NOTE 2 Quantum as an illumination value does not necessarily denote the use of quantum sensor as a detector element. It can refer to a probabilistic nature of the illumination source or to quantum imaging.

NOTE 3 The particle sub-atomic mass values are based on the listings by M. Tanabashi et al. (Particle Data Group).

NOTE 4 XSD and ASN.1 values are not the same as in ISO/IEC 39794-5 Capture device illumination element.

7.30 Capture device technology

Abstract values: The possible values are:

- unknown
- static photograph from an unknown source
- static photograph from a digital still-image camera
- static photograph from a scanner
- video frame(s) from an unknown source
- video frame(s) from an analogue video camera
- video frame(s) from a digital video camera
- static photograph from ultrasound imaging
- video frame from ultrasound imaging
- static photograph from millimetre camera
- video frame from millimetre camera
- static photograph from submillimetre camera
- video frame from submillimetre camera
- static photograph from X-ray camera
- video frame from X-ray camera
- static photograph from gamma ray camera
- video frame from gamma ray camera
- static photograph from CT imaging
- video frame from CT imaging

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

— static photograph from MRI

— video frame from MRI

— static photograph from NI

— video frame from NI

— static photograph from pCT imaging

— video frame from pCT imaging

— static photograph from PET imaging

— video frame from PET imaging

— neural network feature vector or tensor

Contents: The capture device technology identifier element shall indicate the class of device technology used to acquire the captured biometric sample.

7.31 2D image information block

Abstract values: None.

Contents: The 2D image information block element is intended to describe digital properties of the 2D representation data, one of these elements is included for each representation included in the record.

The image information element consists of the 2D image type, the post-acquisition processing block element, the image data format, the camera to subject distance, the sensor diagonal, the focal length, the size, the sampling rate block, the image colour space, the reference colour mapping block, the JPEG EXIF, and the forensic findings block elements. The structure of this element is shown in Figure 17.

7.32 2D image kind

Abstract values: See Table 14 for a list of allowed image types and their normative requirements. Other application-specific image types may be added in the future.

Contents: The 2D image kind element shall represent the type of the body image stored in the 2D representation data.

Table 14 — 2D image kinds

Value	Definition and normative requirements
BasicBodyImage2D	Table 15
Post-processedBodyImage2D	Table 15
InterSurImage2D	Table 15
sMTImage2D	Table 15
Gait2D	Table 15
UBM2D	Table 15
NOTE 2D image kind defines either an image or a set of images as in a video recording. Some representation formats are able to contain also 3D and 4D data, e.g. DICOM and MPEG-4.	

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

7.33 Post acquisition processing

Abstract values: The value of this element shall be one or more of the following:

- rotated (in-plane)
- cropped
- down-sampled
- frame interpolated
- white balance adjusted
- multiply compressed
- interpolated
- contrast stretched
- pose corrected
- age progressed
- multi-view image
- super-resolution processed to enhance the resolution
- normalised
- false colour processed to enhance details or add non-visible data
- silhouette processed for gait recognition
- neural network processed
- extension processing

Extension processing is reserved for future body shape probable variation processing, e.g. using general morphometric methods for describing shape variation in a sample consisting of landmarks and multiple outline shapes.

There may be restrictions on the values by the choice of the 2D image kind.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Contents: While the alteration of image data is discouraged, there are cases when no alternative exists. For example:

- camera images taken in vertical camera orientation (i.e. portrait orientation) shall be rotated to show a standing pose prior to biometric comparison;
- legacy database images shall be rotated to show a standing pose prior to biometric comparison;
- based on frontal image artificial non-frontal body images at predetermined non-frontal poses are automatically generated (multi-view images) using an implicit body 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 or identification purposes; and

© ISO/IEC 2021 – All rights reserved

— a short video stream is super-resolved to a single full body or face image for comparison against a watch list.

The post-acquisition processing element allows the specification of the kind of post-processing that has been applied to the original captured image.

On the one hand, a captured image typically needs some post-processing so that the resulting representation conforms to the clauses of this document. On the other hand, these processing steps should be minimal and should not distort the characteristics of the original image.

7.34 Lossy transformation attempts

Abstract values: Unknown, 0, 1, more than 1.

Contents: This element counts the number of previous lossy transformation steps.

7.35 Image data format

Abstract values: The values shall be specified according to Table 15.

Contents: The image data format denotes the encoding type of the 2D representation data including two-, three- and four-dimensional data representations.

For lossless compression JPEG, PNG or JPEG2000 lossless shall be used. For lossless representation of image sets using more than 8 bits per channel JPEG, PNG or JPEG2000 lossless shall be used. For lossy representation of image sets using more than 8 bit per channel JPEG2000 lossy shall be used. For an encoding in Netpbm portable binary the image formats P5 (grey, PGM) and P6 (colour, PPM) shall be used. It is recommended to use standardized MPEG-4 and/or MP4 encoded video recordings for full body image extraction.

NOTE 1 JPEG 2000 is not natively supported by web browsers. In this respect it is like TIFF and PDF.

NOTE 2 Three- or four-dimensional data can be encapsulated in a single DICOM object. MPEG-4 coding using Object Descriptor Framework allows an audio-visual object inclusion in the scene. See ISO/IEC 30137-4.

Table 15 — Image data formats

Value	Specified in
unkown	
jpeg	ISO/IEC 10918-1, ITU-T Rec. T.81
jpeg2000 lossy	ISO/IEC 15444-3, ITU-T Rec. T.802
jpeg2000 lossless	ISO/IEC 15444-1
png	ISO/IEC 15948
pgm	See Reference [34]
ppm	See Reference [34]
mpeg-4 video	AVC/H.264, ISO/IEC 14496-10
mp4 video	ISO/IEC 14496-14
dicom	ISO 12052

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

7.36 Camera to subject distance (CSD)

Abstract values: Integer. See ISO/IEC 39794-5.

Contents: The CSD element contains the camera to subject distance of the photographical setup used for capturing the photo in cm. The maximum CSD to be encoded is 50 000 cm. All larger distances shall be encoded using that maximum value.

7.37 Sensor diagonal

Abstract values: Integer. See sensor diagonal in ISO/IEC 39794-5.

Contents: The sensor diagonal element contains the diagonal length of the camera sensor used for capturing the photo in mm. The maximum sensor diagonal to be encoded is 200 mm. All larger distances shall be encoded using that maximum value.

7.38 Lens focal length

Abstract values: Integer. See lens focal length in ISO/IEC 39794-5.

Contents: The lens focal length element contains the focal length of the camera lens used for capturing the photo in mm. The maximum lens focal length to be encoded is 2000 mm. All larger distances shall be encoded using that maximum value. If a zoom lens is used, this data element shall encode the actual focal length used to capture the image.

7.39 Image size block

Abstract values: None. See image size block in ISO/IEC 39794-5.

Contents: The image size block element consists of the image width and the image height element.

7.40 Image width

Abstract values: Integer. See width in ISO/IEC 39794-5.

Contents: The image width element shall specify the number of pixels of the 2D representation data in the horizontal direction.

7.41 Image height

Abstract values: Integer. See height in ISO/IEC 39794-5.

Contents: The image height element shall specify the number of pixels of the 2D representation data in the vertical direction.

7.42 Sampling rate block

Abstract values: None.

Contents: The sampling rate block element consists of the spatial sampling rate and the temporal sampling rate element.

NOTE In ISO/IEC 39794-5, in the same relative location, this element is called head sizes and contains head width, inter eye distance (IED), eye to mouth distance (EMD), and head length values.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

7.43 Spatial sampling rate

Abstract values: Integer

Contents: For specific application domains, different minimal spatial sampling rates of the interchange data can 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 spatial sampling rate element provides information on the number of pixels in the image across the height of the body.

7.44 Temporal sampling rate

Abstract values: Integer

Contents: The temporal sampling rate element provides information on the imaging frequency as images per ms for a set of images. Value 0 denotes imaging frequencies in the sub-millisecond range. Value equalling to the maximum value of 65535 denotes slow image rates exceeding 65 s.

If the size of the sample set is one, then this element shall be omitted.

NOTE In encoding/decoding of MPEG-4 video stream related values, the temporal sampling rate is encoded/decoded to form compatible MPEG-4 time_code and vop_time_increment_resolution values as defined in ISO/IEC 14496-2.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

7.45 Image colour space

Abstract values: See ISO/IEC 39794-5. The value of this element shall be one of the following:

- unknown
- other
- 24 bit RGB
- YUV422
- 8 bit greyscale
- 48 bit RGB
- 16 bit greyscale

Contents: The image colour space element indicates the colour space used in the encoded image information element.

7.46 Reference colour mapping block

Abstract values: None. See reference colour mapping block in ISO/IEC 39794-5.

Contents: Mapping of reference colours is defined in IEC 61966-2-1[19]. This data element contains the name of the applied reference colour schema, defined in IEC 61966-2-1, and a list of reference colour definitions and value pairs.

 © ISO/IEC 2021 – All rights reserved

7.47 Reference colour schema

Abstract values: Octet string. See reference colour schema in ISO/IEC 39794-5.

Contents: This data element contains the name of the applied reference colour schema, defined in IEC 61966-2-1[19].

7.48 Reference colour definition and value block

Abstract values: Octet string. See reference colour definition and value block in ISO/IEC 39794-5.

Contents: This data element contains a pair of elements consisting of a reference colour definition (e.g. "J 14" in the IEC case) and the respective reference colour value in the given full body image.

7.49 JPEG EXIF

Abstract values: Octet string.

Contents: JPEG EXIF is a separate copy of the JPEG image EXIF metadata, which does not include the compressed JPEG image data or uncompressed TIFF format image data. This separate copy is useful in case the 2D representation data is de-identified during post-processing of the original image.

Figure 23 illustrates the basic data structure of compressed data files. These files are recorded in conformance with the JPEG DCT format specified in ISO/IEC 10918-1, with the Application Marker Segment (APP1) inserted. APP1 is recorded immediately after the SOI marker indicating the beginning of the file (see Figure 23). Multiple APP2 segments can be recorded as necessary, starting immediately after APP1. APPn other than APP1 and APP2 or COM segments are not used by EXIF. EXIF readers should be designed to skip over unknown APPn and COM segments.

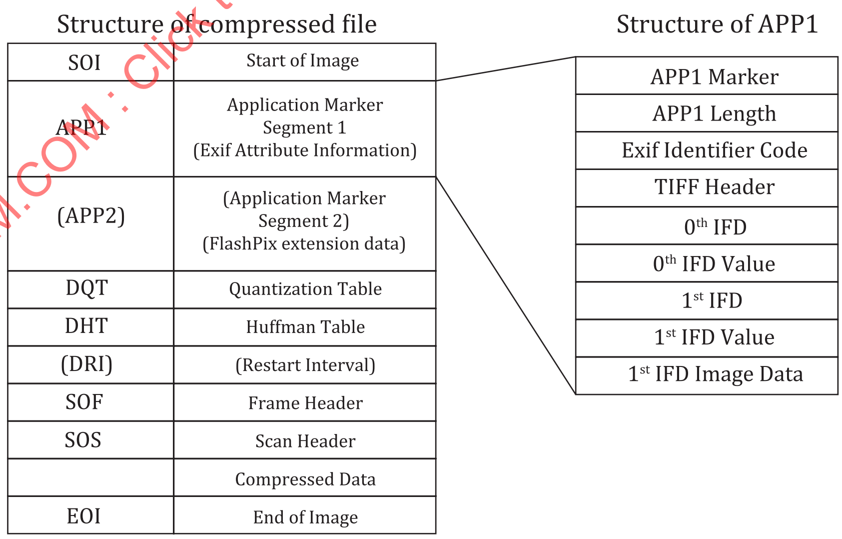


Figure 23 — Basic structure of compressed data files

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

The JFIF minimal file format for the purposes of file interchange is recommended by INTERPOL[28]. JFIF is entirely compatible with the standard JPEG interchange format; the only additional requirement is the mandatory presence of the APP0 marker right after the SOI marker. Note that the JPEG interchange format requires (as does JFIF) all table specifications used in the encoding process to be coded in the bitstream prior to their use.

7.50 Forensic findings block

Abstract values: None.

Contents: The forensic findings block element consists of the forensic observations, the ink to reports, the dynamic range low, the dynamic range high, the dynamic range notes, both the colour fidelity CIELAB a* and the colour fidelity CIELAB b*, the colour fidelity notes, the image sharpness, and the image sharpness notes.

This data element contains the image authentication findings including observations, image error level analysis, and other analysis results. Notes and observations about image quality, i.e. image dynamic range, unnatural colour, and image sharpness, should be added here.

7.50.1 Forensic observations

Abstract values: Octet string.

Contents: This data element contains the image authentication findings including observations, image error level analysis, and other analysis results based on the given full body image.

NOTE Digital evidence, forensic findings and observations related to the case are saved in the forensic observations.

7.50.2 Link to reports

Abstract values: Octet string.

Contents: This data element contains the link to forensic analysis reports and other related reports related to the given full body image.

7.50.3 Dynamic range low

Abstract values: Integer.

Contents: This data element contains the dynamic range lowest value of the given full body image. Using the greyscale density represented by 8 bits, 256 different tones can be assigned to each pixel. The dynamic range of the image shows the amount of unique intensity values as measured using an image processing application. Dynamic range is shown in integer values from 0 to 255 including the limit values.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

7.50.4 Dynamic range high

Abstract values: Integer.

Contents: This data element contains the dynamic range highest value of the given full body image. Using the greyscale density represented by 8 bits, 256 different tones can be assigned to each pixel. The dynamic range of the image shows the amount of unique intensity values as measured using an image processing application. Dynamic range is shown in integer values from 0 to 255 including the limit values.

7.50.5 Dynamic range notes

Abstract values: Octet string.

Contents: This data element contains the dynamic range findings. For example, if the image has a high number of pixels on both ends of the histogram (camel's back) this should be noted.

7.50.6 Colour fidelity CIELAB a*

Abstract values: Integer.

Contents: This data element contains the colour fidelity as measured in terms of colour error using the CIEDE2000 formula (deltaE2000) of a standardized test pattern according to the methodology in Annex E. Measured CIELAB L*a*b* human skin tone a* value shall be positive in cases where the skin tone is natural.

The colour fidelity value for the human skin is shown as an integer value between -100 and 100 including the limit values. The RGB gamut limits the measured values between -50 and 50 including the limit values. Typical skin colour L*a*b* values are between 5-25 for a*.

NOTE If no L*a*b* analysis can be performed, then the fidelity is described using adjectives (e.g. natural, bluish, greenish, reddish, etc.) in the colour fidelity notes element.

7.50.7 Colour fidelity CIELAB b*

Abstract values: Integer.

Contents: This data element contains the colour fidelity as measured in terms of colour error using the CIEDE2000 formula (deltaE2000) of a standardized test pattern according to the methodology in Annex E. Measured CIELAB L*a*b* human skin tone b* value shall be positive in cases where the skin tone is natural.

The colour fidelity value for the human skin is shown as an integer value between -100 and 100 including the limit values. The RGB gamut limits the measured values between -50 and 50 including the limit values. Typical skin colour L*a*b* values are between 5-35 for b*.

NOTE If no L*a*b* analysis can be performed then the fidelity is described using adjectives (e.g. natural, bluish, greenish, reddish, etc.) in the colour fidelity notes element.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

7.50.8 Colour fidelity notes

Abstract values: Octet string.

Contents: This data element contains the colour fidelity notes. If there is no test pattern on the image, then the colour fidelity is determined based on the colour of the subject's skin or other known surfaces. The colour fidelity is described in words using adjectives (e.g. natural, bluish, greenish, reddish, etc.) in the colour fidelity notes element.

7.50.9 Image sharpness

Abstract values: Real.

Contents: This data element contains the 2D image MTF20 analysis result describing the resolution of an image in cy/mm as measured on the target. Resolution is an imaging system's ability to distinguish object detail. The MTF analysis shall be performed using the appropriate target from ISO 12233 according to the methodology in Annex E. The camera original image MTF20 should be at least 0,4 cycles per pixel or 0,6 cy/mm for cameras and 4,7 cy/mm for scanners. Image sharpness is shown in decimal value from 0,0 to 1,0 including the limit values. One cycle corresponds to two pixels, for example 0,6 cycles equals 1,2 pixels, in practice.

NOTE The ASN.1 real value has 2 possible forms: decimal format such as 4.7 using decimal point (.) as a decimal separator or sequence format such as {mantissa 47, base 10, exponent -1}. These two values are identical.

7.50.10 Image sharpness notes

Abstract values: Octet string.

Contents: This data element contains the image sharpness findings. If there is no test pattern or slanted edge fit to be used on the image, then the shrapness of the image is determined by using an image processing application and zooming on the eye of the subject or other known detail. Approximate detail size in mm is marked down as the measurement value. The size of a freckle/mole that should be detectable in face photos is 2 mm to 3 mm. Rulers make good fiducial markers to make measurements on the image.

7.51 3D shape representation block

Abstract values: 3D shape representation block defined in ISO/IEC 39794-5 shall be used when this element is present.

Contents: The structure of the 3D shape representation block element is shown in ISO/IEC 39794-5.

8 Encoding

8.1 Data encoding models

Data encoding languages such as XDR and ASN.1 concern themselves with expressing data structures but leave the semantics up to context hidden in the communication protocol endpoints and in contained data available to higher level protocols. This limits the re-use of this data to applications which are given special knowledge of this context.

ASN.1 binary encoding rules may be used for the efficient encoding and transfer of XML data. A binary XML protocol should reduce message sizes by an order of magnitude over what is currently produced

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

in XML form. If this is not achievable, the text-based alternative (XML) should be used, as it is easier to understand by humans and easier for them to work with.

DER is a restricted variant of BER for producing unequivocal transfer syntax for data structures described by ASN.1. Like DER encodings are valid BER encodings. DER is intended for situations when a unique encoding is needed, such as in cryptography, and ensures that a data structure that needs to be digitally signed produces a unique serialized representation. DER can be considered a canonical form of BER. For example, in BER a boolean value of true can be encoded as any of 255 non-zero byte values, while in DER there is one way to encode a boolean value of true.

XML is a serialization format to encode information for transfer. RDF is a data model for information representation. RDF documents are written in XML. The XML language used by RDF is called RDF/XML. XSD may be converted to an RDF schema. XML to RDF transformation approach, which is based on mappings comprising RDF triple templates that employ simple XPath expressions is described in Reference [43]. In comparison to XML, an RDF element enables a parser to find the subjects, verbs and objects in what follows. RDF assigns meaning to the content where XML is just a syntax.

SPARQL is a recursive acronym for SPARQL Protocol and RDF Query Language. It is an RDF query language, i.e. a semantic query language for databases. SPARQL is able to retrieve and manipulate data stored in RDF format. SPARQL allows for a query to consist of triple patterns, conjunctions, disjunctions, and optional patterns. It was designed to be similar to SQL, a query language for relational databases. In SQL relational database terms, RDF data can also be considered a table with three columns: the subject column, the predicate column, and the object column.

Figure 24 illustrates five layers of data representation. The highest user interface and applications layer is served by other layers.

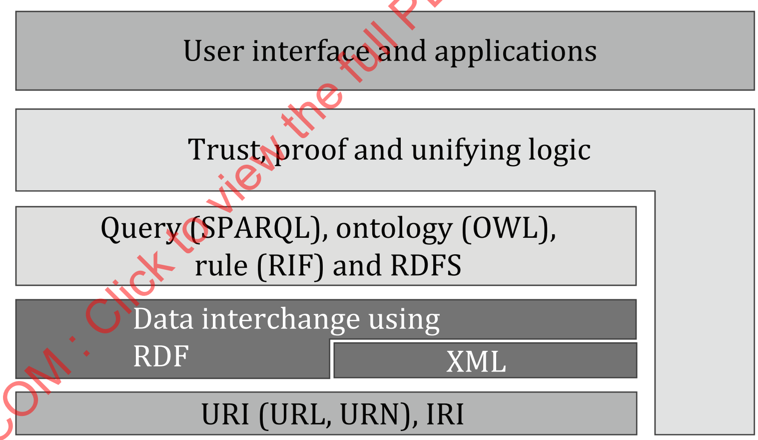


Figure 24 — Data representation layers

RDF is a way of identifying relations between things on the semantic web. XML and RDF are at the core of the Semantic Web.

Figure 25 illustrates how ASN.1 and XML can serve as a definition root for the RDF schema used for RDF transformation of the biometric data.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

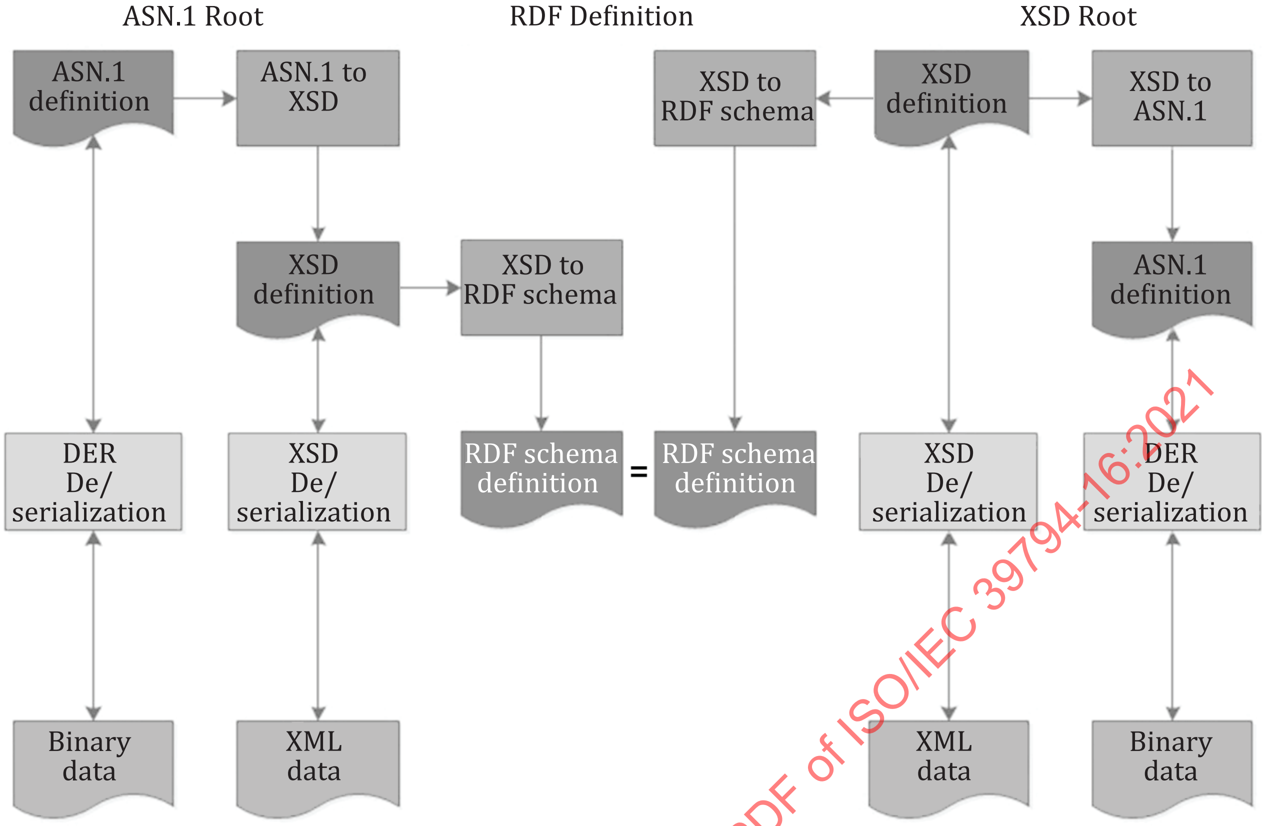


Figure 25 — RDF transformation of the biometric data

RDF's universally grounded entities and relationships provide a mechanism to unify RDBs with other RDBs, as well as static data and other sources. Equal format databases are a natural progression in the development of relational databases. RDF is a standardized method for representing structured data on the internet.

Systems that use RDF are often called Linked Data systems because of RDF emphasis on well-described links between resources. By giving a standardized model for RDB application builders the present problem of poorly compatible biometric databases is alleviated. Without such a linking mechanism, data in a relational database needs to be exported to a text file. This file is imported into a new database to establish the necessary links. This involves several manual steps. XSD to RDF schemas are beyond the scope of this document as are the techniques used to make SPARQL queries.

The RDF mechanism based on well-described links proves promising to link different databases without inventing a new wheel. Multiple biometric data improves and ensures the accuracy of match results of identifying terrorists and criminals. Therefore, the mechanism of RDF is very well-suited for describing and linking different biometric data in the further development of ISO standardization of biometric interchange formats.

A full body image comprises different biometric data categories: text, body image descriptions, DNA, fingerprints, dental notation, etc. Examples to describe multiple biometric and non-biometric data by using RDF is included in B.3.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

8.2 Tagged binary encoding

This sublause specifies the ASN.1 module implementing the abstract data elements specified in Clause 7. It describes the parameters of face image data as they are encoded in ASN.1. These ASN.1 definitions are based on the following design decisions:

— The ASN.1 types as defined in A.1 which encode the abstract data elements of Clause 7 shall conform to the ASN.1 standard ISO/IEC 8824-1 and to ISO/IEC 39794-1 and to ISO/IEC 39794-5.

— The tagged binary encoding of full body image and gait image sequence data shall be obtained by applying the ASN.1 distinguished encoding rules (DER) defined within ISO/IEC 8825-1 to a value of the type BodyImageDataBlock defined in the given ASN.1 module. The DER encoding of each data object has three parts: tag octets that identify the data object, length octets that give the number of subsequent value octets, and the value octets.

— The ISO/IEC 39794 series ASN.1 modules are defined independently. This means that there is no re-use or import of definitions outside the ISO/IEC 39794 series area, in order to avoid interdependencies to other standardization bodies, even if this could be useful (e.g. considering X.509/PKIX definitions).

— Any body image data specific definition is fully included in the ISO/IEC 39794-16 (this document) ASN.1 module. Any re-usable header field that is defined in the ISO/IEC 39794-1 framework is part of the separate ISO/IEC 39794-1 ASN.1 module.

— The entry point for any ISO/IEC 39794 series biometric type definition is BiometricDataBlock, as defined in the ISO/IEC 39794-1 ASN.1 module. This module includes the ASN.1 definition of all modality-specific parts of ISO/IEC 39794. This allows modification or extension of both the generic header information and the supported set of biometric data types in one place without impacting the other parts of ISO/IEC 39794. For example, the ISO/IEC 39794-1 ASN.1 module includes the definitions of face image data, fingerprint image data, iris image data, body image data and gait image sequence data and is extended later on by other biometric modality data. In this case, the ASN.1 definitions of ISO/IEC 39794-16 (this document) and ISO/IEC 39794-17 do not need to be modified.

— Extension markers are included in some data containers or blocks to ensure extensibility and forward/backward compatibility when new parameters need to be added to existing containers/ blocks.

— The latest version of the ASN.1 standard is employed, namely the ISO/IEC 8824 series.

— The distinguished encoding rules (DER) as specified in ISO/IEC 8825-1 are utilized to represent the data in binary format. Other options such as XML Encoding Rules shall not be used.

The ASN.1 module in A.1 can be retrieved from https://standards.iso.org/iso-iec/39794/-16/ed-1/en/.

Additional explanations on the mapping between the specifications in Clause 7 and the ASN.1 module given in A.1 apply:

— The ASN.1 schema does not guarantee that if all elements that could be contained in an element are absent, the whole element is absent too.

— At least one of the elements of the poseAngleBlock element shall be present; otherwise the whole poseAngleBlock element shall be absent. This requirement is not covered by the ASN.1 schema.XML encoding.

A.2 specifies an XSD schema in which the abstract data elements of Clause 7 are constrained by XML types defined within one of the following standards: W3C Recommendations, XML Schema Parts 1 and 2, ISO/IEC 39794-1, ISO/IEC 39794-5, or this document.

Binary data shall only be encoded as base 64 and stored as a text string in an xs:element, which itself has the underlying type of 'xs:base64Binary' e.g. <xs:element name="data" type="xs:base64Binary"/>

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

For avoidance of doubt, other methods of encoding binary data such as xs:hexBinary or proprietary extensions which support binary data encoding (i.e. XOP) are not permitted.

The XML data type "base64Binary" is not supported in SPARQL. Recommendation ITU-T X.694 and identical ISO/IEC 8825-5 define rules for mapping an XSD schema (a schema conforming to the W3C XML Schema specification) to an ASN.1 schema in order to use ASN.1 encoding rules, e.g. DER for the transfer of information defined by the XSD schema.

Additional explanations on the mapping between the specifications in Clause 7 and the XSD given in A.2 apply:

— The XML schema does not guarantee that if all elements that could be contained in an element are absent, the whole element is absent, too.

— If a property in a propertiesBlock element is set to TRUE, this property is present in the image. Otherwise, if it is set to FALSE, the property is absent in the image. If a property is omitted, no statement has been made.

— If an expression in an expressionBlock element is set to TRUE, this expression is present in the image. Otherwise if it is set to FALSE, the expression is absent in the image. If an expression is omitted, no statement has been made.

— The XML schema does not prevent choice between the expressions neutral and smile for the same face image. However, neutral and smile shall not be both true for the same image.

— At least one of the elements of the poseAngleBlock element shall be present; otherwise the whole poseAngleBlock element shall be absent. This requirement is not covered by the XML schema.

The XSD module in A.2 can be retrieved from https://standards.iso.org/iso-iec/39794/-16/ed-1/en/.

Encoding examples are contained in Annex B.

9 Registered BDB format identifiers

The registrations listed in Table 16 have been made in accordance with ISO/IEC 19785 (all parts) to identify the full body image data interchange formats defined in this document. The format owner is ISO/IEC JTC 1/SC 37 with the registered biometric organization identifier 257 (0101_{Hex}).

Table 16 — BDB format identifiers

BDB format identifier	Short name	Full object identifier
46($002E_{Hex}$)	g3-binary-full-body-image	{iso(1) registration-authority(1) cbeff(19785) biometric-organization(0) jtc1-sc37(257) bdbs(0) g3-binary-full-body-image(46)}
47($002F_{Hex}$)	g3-xml-full-body-image	{iso(1) registration-authority(1) cbeff(19785) biometric- organization(0) jtc1-sc37(257) bdbs(0) g3-xml-full-body-image(47)}

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

Annex A
(normative)

Formal definitions

A.1 ASN.1 module tagged binary encoding

This ASN.1 module is available at https://standards.iso.org/iso-iec/39794/-16/ed-1/en/

```
ISO-IEC-39794-16-ed-1-v1 {iso(1) standard(0) iso-iec-39794(39794) part-16(16) ed-1(1)
v1(1) iso-iec-39794-16(0)}

-- Use of ISO/IEC copyright in this Schema is licensed for the purpose of
-- developing, implementing, and using software based on this Schema, subject
-- to the following conditions:
--
-- * Software developed from this Schema must retain the Copyright Notice,
-- this list of conditions and the disclaimer below ("Disclaimer").
--
-- * Neither the name or logo of ISO or of IEC, nor the names of specific
-- contributors, may be used to endorse or promote software derived from
-- this Schema without specific prior written permission.
--
-- * The software developer shall attribute the Schema to ISO/IEC and
-- identify the ISO/IEC standard from which it is taken. Such attribution
-- (e.g., "This software makes use of the Schema from ISO/IEC 39794-5
-- within modifications permitted in the relevant ISO/IEC standard.
-- Please reproduce this note if possible."), may be placed in the
-- software itself or any other reasonable location.
--
-- The Disclaimer is:
-- THE SCHEMA ON WHICH THIS SOFTWARE IS BASED IS PROVIDED BY THE COPYRIGHT
-- HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES,
-- INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY
-- AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL
-- THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT,
-- INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT
-- NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE,
-- DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY
-- THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT
-- (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF
-- THE CODE COMPONENTS, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

DEFINITIONS IMPLICIT TAGS ::= BEGIN

   IMPORTS
         VersionBlock,
         CaptureDateTimeBlock,
         QualityBlocks,
         PADDataBlock
   FROM ISO-IEC-39794-1-ed-1-v1

         CaptureDeviceBlock,
         PoseAngleBlock,
         MPEG4FeaturePoint,
         LandmarkCoordinates,
         AnthropometricLandmark,
         ShapeRepresentation3DBlock,
         LossyTransformationAttempts,
         CameraToSubjectDistance,
         SensorDiagonal,
         LensFocalLength,
         ImageSizeBlock,
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

```
        ImageColourSpace,
        ReferenceColourMappingBlock
  FROM ISO-IEC-39794-5-ed-1-v1;

  BodyImageDataBlock ::= [APPLICATION 16] SEQUENCE {
        versionBlock [0] VersionBlock,
        representationBlocks [1] RepresentationBlocks,
        extensionBlock [2] ExtensionBlock OPTIONAL
  }

 ExtensionBlock ::= SEQUENCE {
   ...
 }

  RepresentationBlocks ::= SEQUENCE OF RepresentationBlock

  RepresentationBlock ::= SEQUENCE {
        representationId [0] INTEGER (0..MAX),
        imageRepresentationBlock [1] ImageRepresentationBlock OPTIONAL,
        captureDateTimeBlock [2] CaptureDateTimeBlock OPTIONAL,
        qualityBlocks [3] QualityBlocks OPTIONAL,
        padDataBlock [4] PADDataBlock OPTIONAL,
        sessionId [5] INTEGER (0..MAX) OPTIONAL,
        derivedFrom [6] INTEGER (0..MAX) OPTIONAL,
        captureDeviceBlock [7] CaptureDeviceBlock OPTIONAL,
        bodyPartNumber [8] INTEGER (0..MAX) OPTIONAL,
        poseAngleBlock [9] PoseAngleBlock OPTIONAL,
        landmarkBlocks [10] LandmarkBlocks OPTIONAL,
        extensionBlock [11] ExtensionBlock OPTIONAL
  }

  LandmarkBlocks ::= SEQUENCE OF LandmarkBlock

  LandmarkBlock ::= SEQUENCE {
        landmarkKind [0] LandmarkKind,
        landmarkCoordinates [1] LandmarkCoordinates OPTIONAL,
        extensionBlock [2] ExtensionBlock OPTIONAL
  }

  LandmarkKind ::= SEQUENCE {
        mpeg4FeaturePoint [0] MPEG4FeaturePoint,
        anthropometricLandmark [1] AnthropometricLandmark,
        caesarLandmark [2] CaesarLandmark,
        mpeg4BodyPoint [3] MPEG4BodyPoint,
        extensionBlock [4] ExtensionBlock OPTIONAL
  }

  CaesarLandmarkCode ::= ENUMERATED {
        unknown(0),
        sellion(1),
        rt-Infraorbitale(2),
        lt-Infraorbitale(3),
        supramenton(4),
        rt-Tragion(5),
        rt-Gonion(6),
        lt-Tragion(7),
        lt-Gonion(8),
        nuchale(9),
        rt-Clavicale(10),
        suprasternale(11),
        lt-Clavicale(12),
        rt-ThelionBustpoint(13),
        lt-ThelionBustpoint(14),
        substernale(15),
        rt-10thRib(16),
        rt-ASIS(17),
        lt-10thRib(18),
        lt-ASIS(19),
        rt-Iliocristale(20),
        rt-Trochanterion(21),
        lt-Iliocristale(22),
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

```
        lt-Trochanterion(23),
        cervicale(24),
        ribMidspine10th(25),
        rt-PSIS(26),
        lt-PSIS(27),
        waistPreferredPost(28),
        rt-Acromion(29),
        rt-AxillaAnt(30),
        rt-RadialStyloid(31),
        rt-AxillaPost(32),
        rt-Olecranon(33),
        rt-HumeralLateralEpicn(34),
        rt-HumeralMedialEpicn(35),
        rt-Radiale(36),
        rt-MetacarpalPhal-II(37),
        rt-Dactylion(38),
        rt-UlnarStyloid(39),
        rt-Metacarpal-Phal-V(40),
        lt-Acromion(41),
        lt-AxillaAnt(42),
        lt-RadialStyloid(43),
        lt-AxillaPost(44),
        lt-Olecranon(45),
        lt-HumeralLateralEpicn(46),
        lt-HumeralMedialEpicn(47),
        lt-Radiale(48),
        lt-Metacarpal-Phal-II(49),
        lt-Dactylion(50),
        lt-UlnarStyloid(51),
        lt-Metacarpal-Phal-V(52),
        rt-KneeCrease(53),
        rt-FemoralLateralEpicn(54),
        rt-FemoralMedialEpicn(55),
        rt-Metatarsal-Phal-V(56),
        rt-LateralMalleolus(57),
        rt-MedialMalleolus(58),
        rt-Sphyrion(59),
        rt-Metatarsal-Phal-I(60),
        rt-CalcaneousPost(61),
        rt-DigitII(62),
        lt-KneeCrease(63),
        lt-FemoralLateralEpicn(64),
        lt-FemoralMedialEpicn(65),
        lt-Metatarsal-Phal-V(66),
        lt-LateralMalleolus(67),
        lt-MedialMalleolus(68),
        lt-Sphyrion(69),
        lt-Metatarsal-Phal-I(70),
        lt-CalcaneousPost(71),
        lt-DigitII(72),
        crotch(73),
        functionalButtBlock(74),
        otherPosition(999)
}

CaesarLandmarkExtensionBlock ::= SEQUENCE {
        fallback [0] CaesarLandmarkCode,
        ...
}

CaesarLandmark ::= CHOICE {
        code [0] CaesarLandmarkCode,
        extensionBlock [1] CaesarLandmarkExtensionBlock
}

MPEG4BodyPointCode ::= ENUMERATED {
        unknown(0),
        l-MetatarsalFoot(1),
        r-MetatarsalFoot(2),
        l-Ankle(3),
        r-Ankle(4),
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

```
        l-Knee(5),
        r-Knee(6),
        l-Hip(7),
        r-Hip(8),
        sacroiliacSpine(9),
        bodyCentreRoot(10),
        l-Middle3Finger(11),
        r-Middle3Finger(12),
        l-Wrist(13),
        r-Wrist(14),
        l-Elbow(15),
        r-Elbow(16),
        l-Shoulder(17),
        r-Shoulder(18),
        vt4MidShoulder(19),
        vt2LowerNeck(20),
        vt1UpperNeck(21),
        skullBase(22),
        otherPosition(999)
}

MPEG4BodyPointExtensionBlock ::= SEQUENCE {
        fallback [0] MPEG4BodyPointCode,
    ...
}

MPEG4BodyPoint ::= CHOICE {
        code [0] MPEG4BodyPointCode,
        extensionBlock [1] MPEG4BodyPointExtensionBlock
}

ImageRepresentationBlock ::= CHOICE {
        representation [0] ImageRepresentationBaseBlock,
        extensionBlock [1] ImageRepresentationBlockExtension
}

ImageRepresentationBaseBlock ::= CHOICE {
        imageRepresentation2DBlock [0] ImageRepresentation2DBlock,
        shapeRepresentation3DBlock [1] ShapeRepresentation3DBlock
}

ImageRepresentationBlockExtension ::= SEQUENCE {
        fallback [0] ImageRepresentationBaseBlock,
    ...
}

ImageRepresentation2DBlock ::= SEQUENCE {
        representationData2D [0] OCTET STRING,
        captureDevice2DBlock [1] CaptureDevice2DBlock OPTIONAL,
        imageInformation2DBlock [2] ImageInformation2DBlock OPTIONAL,
        extensionBlock [3] ExtensionBlock OPTIONAL
}

CaptureDevice2DBlock ::= SEQUENCE {
        captureWavelengthRangeBlock [0] CaptureWavelengthRangeBlock OPTIONAL,
        captureDeviceTechnology [1]  CaptureDeviceTechnologyId OPTIONAL,
        extensionBlock [2] ExtensionBlock OPTIONAL
}

CaptureWavelengthRangeBlock ::= SEQUENCE {
        ultrasound [0] BOOLEAN OPTIONAL,
        millimetre [1] BOOLEAN OPTIONAL,
        subMillimetre [2] BOOLEAN OPTIONAL,
        farInfrared [3] BOOLEAN OPTIONAL,
        midInfrared [4] BOOLEAN OPTIONAL,
        nearInfrared [5] BOOLEAN OPTIONAL,
        whiteLight [6] BOOLEAN OPTIONAL,
        ultraviolet [7] BOOLEAN OPTIONAL,
        softX-ray [8] BOOLEAN OPTIONAL,
        hardX-ray [9] BOOLEAN OPTIONAL,
        gammaRay [10] BOOLEAN OPTIONAL,
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

```
        neutron [11] BOOLEAN OPTIONAL,
        proton [12] BOOLEAN OPTIONAL,
        positron [13] BOOLEAN OPTIONAL,
        magnetics [14] BOOLEAN OPTIONAL,
        quantum [15] BOOLEAN OPTIONAL,
        extensionBlock [16] ExtensionBlock OPTIONAL
}

CaptureDeviceTechnologyCode ::= ENUMERATED {
        unknown(0),
        staticPhotographFromUnknownSource(1),
        staticPhotographFromDigitalStillImageCamera(2),
        staticPhotographFromScanner(3),
        videoFrameFromUnknownSource(4),
        videoFrameFromAnalogueVideoCamera(5),
        videoFrameFromDigitalVideoCamera(6),
        staticPhotographFromUltrasoundImaging(7),
        videoFrameFromUltrasoundImaging(8),
        staticPhotographFromMillimetreCamera(9),
        videoFrameFromMillimetreCamera(10),
        staticPhotographFromSubMillimetreCamera(11),
        videoFrameFromSubMillimetreCamera(12),
        staticPhotographFromXRayCamera(13),
        videoFrameFromXRayCamera(14),
        staticPhotographFromGammaRayCamera(15),
        videoFrameFromGammaRayCamera(16),
        staticPhotographFromComputedTomographyImaging(17),
        videoFrameFromComputedTomographyImaging(18),
        staticPhotographFromMagneticResonanceImaging(19),
        videoFrameFromMagneticResonanceImaging(20),
        staticPhotographFromNeutronImaging(21),
        videoFrameFromNeutronImaging(22),
        staticPhotographFromProtonComputedTomography(23),
        videoFrameFromProtonComputedTomography(24),
        staticPhotographFromPositronEmissionTomography(25),
        videoFrameFromPositronEmissionTomography(26),
        staticPhotographFromMagneticsImaging(27),
        videoFrameFromMagneticsImaging(28),
        staticPhotographFromQuantumImaging(29),
        videoFrameFromQuantumImaging(30),
        otherImagingTechnology(999)
}

CaptureDeviceTechnologyExtensionBlock ::= SEQUENCE {
        fallback [0] CaptureDeviceTechnologyCode,
    ...
}

CaptureDeviceTechnologyId ::= CHOICE {
        code [0] CaptureDeviceTechnologyCode,
        extensionBlock [1] CaptureDeviceTechnologyExtensionBlock
}

ImageInformation2DBlock ::= SEQUENCE {
        imageDataFormat [0] ImageDataFormat,
        imageKind2D [1] ImageKind2D OPTIONAL,
        postAcquisitionProcessingBlock [2] PostAcquisitionProcessingBlock OPTIONAL,
        lossyTransformationAttempts [3] LossyTransformationAttempts OPTIONAL,
        cameraToSubjectDistance [4] CameraToSubjectDistance OPTIONAL,
        sensorDiagonal [5] SensorDiagonal OPTIONAL,
        lensFocalLength [6] LensFocalLength OPTIONAL,
        imageSizeBlock [7] ImageSizeBlock OPTIONAL,
        samplingRateBlock [8] SamplingRateBlock OPTIONAL,
        imageColourSpace [9] ImageColourSpace OPTIONAL,
        referenceColourMappingBlock [10] ReferenceColourMappingBlock OPTIONAL,
        jpegExif [11] OCTET STRING OPTIONAL,
        forensicFindingsBlock [12] ForensicFindingsBlock OPTIONAL,
        extensionBlock [13] ExtensionBlock OPTIONAL
}

ImageKind2DCode ::= ENUMERATED {
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

```
        basicBodyImage2D(0),
        post-processedBodyImage2D(1),
        basicBodyImage2DFrom3D(2),
        interSurImage2D(3),
        sMTImage2D(4),
        gait2D(5),
        uBM2D(6)
}

ImageKind2DExtensionBlock ::= SEQUENCE {
        fallback [0] ImageKind2DCode,
    ...
}

ImageKind2D ::= CHOICE {
        code [0] ImageKind2DCode,
        extensionBlock [1] ImageKind2DExtensionBlock
}

PostAcquisitionProcessingBlock ::= SEQUENCE {
        rotated [0] BOOLEAN OPTIONAL,
        cropped [1] BOOLEAN OPTIONAL,
        downsampled [2] BOOLEAN OPTIONAL,
        whiteBalanceAdjusted [3] BOOLEAN OPTIONAL,
        multiplyCompressed [4] BOOLEAN OPTIONAL,
        interpolated [5] BOOLEAN OPTIONAL,
        contrastStretched [6] BOOLEAN OPTIONAL,
        poseCorrected [7] BOOLEAN OPTIONAL,
        multiViewImage [8] BOOLEAN OPTIONAL,
        ageProgressed [9] BOOLEAN OPTIONAL,
        super-resolutionProcessed [10] BOOLEAN OPTIONAL,
        normalised [11] BOOLEAN OPTIONAL,
        falseColourProcessed [12] BOOLEAN OPTIONAL,
        silhouetteProcessed [13] BOOLEAN OPTIONAL,
        neuralNetworkProcessed [14] BOOLEAN OPTIONAL,
        extensionProcessing [15] BOOLEAN OPTIONAL,
        extensionBlock [16] ExtensionBlock OPTIONAL
}

ImageDataFormatCode ::= ENUMERATED {
        unknown(0),
        jpeg(1),
        jpeg2000(2),
        jpeg2000Lossy(3),
        jpeg2000Lossless(4),
        png(5),
        pgm(6),
        ppm(7),
        mpeg4(8),
        mp4(9),
        dicom(10)
}

ImageDataFormatExtensionBlock ::= SEQUENCE {
        fallback [0] ImageDataFormatCode,
    ...
}

ImageDataFormat ::= CHOICE {
        code [0] ImageDataFormatCode,
        extensionBlock [1] ImageDataFormatExtensionBlock
}

SamplingRateBlock ::= SEQUENCE {
        spatialSamplingRate [0]  INTEGER (0..MAX) OPTIONAL,
        temporalSamplingRate [1]  INTEGER (0..MAX) OPTIONAL,
        extensionBlock [2] ExtensionBlock OPTIONAL
}

ForensicFindingsBlock ::= SEQUENCE {
        forensicObservations [0] VisibleString OPTIONAL,
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

```
        linkToReports [1] VisibleString OPTIONAL,
        dynamicRangeLow [2] INTEGER (0..255) OPTIONAL,
        dynamicRangeHigh [3] INTEGER (0..255) OPTIONAL,
        dynamicRangeNotes [4] VisibleString OPTIONAL,
        colourFidelityCieLaba [5] INTEGER (-100..100) OPTIONAL,
        colourFidelityCieLabb [6] INTEGER (-100..100) OPTIONAL,
        colourFidelityNotes [7] VisibleString OPTIONAL,
        imageSharpness [8]  INTEGER (0..MAX) OPTIONAL,
        imageSharpnessNotes [9] VisibleString OPTIONAL,
        extensionBlock [10] ExtensionBlock OPTIONAL
    }

END
```

A.2 XML schema definition for XML encoding

This XML module is available at https://standards.iso.org/iso-iec/39794/-16/ed-1/en/

```
<?xml version="1.0" encoding="utf-8"?>
<!--Use of ISO/IEC copyright in this Schema is licensed for the purpose of developing,
implementing, and using software based on this Schema, subject to the following
conditions:
* Software developed from this Schema must retain the Copyright Notice, this list of
conditions and the disclaimer below ("Disclaimer").
* Neither the name or logo of ISO or of IEC, nor the names of specific contributors, may
be used to endorse or promote software derived from this Schema without specific prior
written permission.
* The software developer shall attribute the Schema to ISO/IEC and identify the ISO/IEC
standard from which it is taken. Such attribution (e.g., "This software makes use of the
Schema from ISO/IEC 39794-5 within modifications permitted in the relevant ISO/IEC
standard. Please reproduce this note if possible."), may be placed in the software itself
or any other reasonable location.
The Disclaimer is:
THE SCHEMA ON WHICH THIS SOFTWARE IS BASED IS PROVIDED BY THE COPYRIGHT HOLDERS AND
CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO,
THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE
DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY
DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT
NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR
PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER
IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY
WAY OUT OF THE USE OF THE CODE COMPONENTS, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH
DAMAGE.-->
<xs:schema
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:vc="http://www.w3.org/2007/XMLSchema-versioning"
  xmlns:cmn="https://standards.iso.org/iso-iec/39794/-1"
  xmlns:fac="https://standards.iso.org/iso-iec/39794/-5"
  xmlns="https://standards.iso.org/iso-iec/39794/-16"
  targetNamespace="https://standards.iso.org/iso-iec/39794/-16"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified">

  <xs:import schemaLocation="iso-iec-39794-1-ed-1-v1.xsd" namespace="https://standards.
iso.org/iso-iec/39794/-1" />
  <xs:import schemaLocation="iso-iec-39794-5-ed-1-v1.xsd" namespace="https://standards.
iso.org/iso-iec/39794/-5" />

  <xs:element name="bodyImageData" type="BodyImageDataBlockType">
    <xs:annotation>
      <xs:documentation>root element</xs:documentation>
    </xs:annotation>
  </xs:element>

  <xs:complexType name="ExtensionBlockType">
    <xs:sequence>
      <xs:any namespace="##other" processContents="lax" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

```
  <xs:complexType name="BodyImageDataBlockType">
    <xs:sequence>
      <xs:element name="versionBlock" type="cmn:VersionBlockType"/>
      <xs:element name="representationBlocks" type="RepresentationBlocksType"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="RepresentationBlocksType">
    <xs:sequence>
      <xs:element name="representationBlock" type="RepresentationBlockType"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="RepresentationBlockType">
    <xs:sequence>
      <xs:element name="representationId" type="xs:unsignedInt"/>
      <xs:element name="imageRepresentationBlock" type="ImageRepresentationBlockType"
minOccurs="0"/>
      <xs:element name="captureDateTimeBlock" type="cmn:CaptureDateTimeBlockType"
minOccurs="0"/>
      <xs:element name="qualityBlocks" type="cmn:QualityBlocksType" minOccurs="0"/>
      <xs:element name="padDataBlock" type="cmn:PADDataBlockType" minOccurs="0"/>
      <xs:element name="sessionId" type="xs:unsignedInt" minOccurs="0"/>
      <xs:element name="derivedFrom" type="xs:unsignedInt" minOccurs="0"/>
      <xs:element name="captureDeviceBlock" type="fac:CaptureDeviceBlockType"
minOccurs="0"/>
      <xs:element name="bodyPartNumber" type="xs:unsignedInt" minOccurs="0"/>
      <xs:element name="poseAngleBlock" type="fac:PoseAngleBlockType" minOccurs="0"/>
      <xs:element name="landmarkBlocks" type="LandmarkBlocksType" minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="LandmarkBlocksType">
    <xs:sequence>
      <xs:element name="landmarkBlock" type="LandmarkBlockType" maxOccurs="unbounded" />
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="LandmarkBlockType">
    <xs:sequence>
      <xs:element name="landmarkKind" type="LandmarkKindType"/>
      <xs:element name="landmarkCoordinates" type="fac:LandmarkCoordinatesType"
minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="LandmarkKindType">
    <xs:sequence>
      <xs:element name="mpeg4FeaturePoint" type="fac:MPEG4FeaturePointType"/>
      <xs:element name="anthropometricLandmark" type="fac:AnthropometricLandmarkType"/>
      <xs:element name="caesarLandmark" type="CaesarLandmarkType"/>
      <xs:element name="mpeg4BodyPoint" type="MPEG4BodyPointType"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="CaesarLandmarkCodeType">
    <xs:choice>
      <xs:element name="unknown" type="xs:int" fixed="0" />
      <xs:element name="sellion" type="xs:int" fixed="1" />
      <xs:element name="rt-Infraorbitale" type="xs:int" fixed="2" />
      <xs:element name="lt-Infraorbitale" type="xs:int" fixed="3" />
      <xs:element name="supramenton" type="xs:int" fixed="4" />
      <xs:element name="rt-Tragion" type="xs:int" fixed="5" />
      <xs:element name="rt-Gonion" type="xs:int" fixed="6" />
      <xs:element name="lt-Tragion" type="xs:int" fixed="7" />
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

```
      <xs:element name="lt-Gonion" type="xs:int" fixed="8" />
      <xs:element name="nuchale" type="xs:int" fixed="9" />
      <xs:element name="rt-Clavicale" type="xs:int" fixed="10" />
      <xs:element name="suprasternale" type="xs:int" fixed="11" />
      <xs:element name="lt-Clavicale" type="xs:int" fixed="12" />
      <xs:element name="rt-ThelionBustpoint" type="xs:int" fixed="13" />
      <xs:element name="lt-ThelionBustpoint" type="xs:int" fixed="14" />
      <xs:element name="substernale" type="xs:int" fixed="15" />
      <xs:element name="rt-10thRib" type="xs:int" fixed="16" />
      <xs:element name="rt-ASIS" type="xs:int" fixed="17" />
      <xs:element name="lt-10thRib" type="xs:int" fixed="18" />
      <xs:element name="lt-ASIS" type="xs:int" fixed="19" />
      <xs:element name="rt-Iliocristale" type="xs:int" fixed="20" />
      <xs:element name="rt-Trochanterion" type="xs:int" fixed="21" />
      <xs:element name="lt-Iliocristale" type="xs:int" fixed="22" />
      <xs:element name="lt-Trochanterion" type="xs:int" fixed="23" />
      <xs:element name="cervicale" type="xs:int" fixed="24" />
      <xs:element name="ribMidspine10th" type="xs:int" fixed="25" />
      <xs:element name="rt-PSIS" type="xs:int" fixed="26" />
      <xs:element name="lt-PSIS" type="xs:int" fixed="27" />
      <xs:element name="waistPreferredPost" type="xs:int" fixed="28" />
      <xs:element name="rt-Acromion" type="xs:int" fixed="29" />
      <xs:element name="rt-AxillaAnt" type="xs:int" fixed="30" />
      <xs:element name="rt-RadialStyloid" type="xs:int" fixed="31" />
      <xs:element name="rt-AxillaPost" type="xs:int" fixed="32" />
      <xs:element name="rt-Olecranon" type="xs:int" fixed="33" />
      <xs:element name="rt-HumeralLateralEpicn" type="xs:int" fixed="34" />
      <xs:element name="rt-HumeralMedialEpicn" type="xs:int" fixed="35" />
      <xs:element name="rt-Radiale" type="xs:int" fixed="36" />
      <xs:element name="rt-MetacarpalPhal-II" type="xs:int" fixed="37" />
      <xs:element name="rt-Dactylion" type="xs:int" fixed="38" />
      <xs:element name="rt-UlnarStyloid" type="xs:int" fixed="39" />
      <xs:element name="rt-Metacarpal-Phal-V" type="xs:int" fixed="40" />
      <xs:element name="lt-Acromion" type="xs:int" fixed="41" />
      <xs:element name="lt-AxillaAnt" type="xs:int" fixed="42" />
      <xs:element name="lt-RadialStyloid" type="xs:int" fixed="43" />
      <xs:element name="lt-AxillaPost" type="xs:int" fixed="44" />
      <xs:element name="lt-Olecranon" type="xs:int" fixed="45" />
      <xs:element name="lt-HumeralLateralEpicn" type="xs:int" fixed="46" />
      <xs:element name="lt-HumeralMedialEpicn" type="xs:int" fixed="47" />
      <xs:element name="lt-Radiale" type="xs:int" fixed="48" />
      <xs:element name="lt-Metacarpal-Phal-II" type="xs:int" fixed="49" />
      <xs:element name="lt-Dactylion" type="xs:int" fixed="50" />
      <xs:element name="lt-UlnarStyloid" type="xs:int" fixed="51" />
      <xs:element name="lt-Metacarpal-Phal-V" type="xs:int" fixed="52" />
      <xs:element name="rt-KneeCrease" type="xs:int" fixed="53" />
      <xs:element name="rt-FemoralLateralEpicn" type="xs:int" fixed="54" />
      <xs:element name="rt-FemoralMedialEpicn" type="xs:int" fixed="55" />
      <xs:element name="rt-Metatarsal-Phal-V" type="xs:int" fixed="56" />
      <xs:element name="rt-LateralMalleolus" type="xs:int" fixed="57" />
      <xs:element name="rt-MedialMalleolus" type="xs:int" fixed="58" />
      <xs:element name="rt-Sphyrion" type="xs:int" fixed="59" />
      <xs:element name="rt-Metatarsal-Phal-I" type="xs:int" fixed="60" />
      <xs:element name="rt-CalcaneousPost" type="xs:int" fixed="61" />
      <xs:element name="rt-DigitII" type="xs:int" fixed="62" />
      <xs:element name="lt-KneeCrease" type="xs:int" fixed="63" />
      <xs:element name="lt-FemoralLateralEpicn" type="xs:int" fixed="64" />
      <xs:element name="lt-FemoralMedialEpicn" type="xs:int" fixed="65" />
      <xs:element name="lt-Metatarsal-Phal-V" type="xs:int" fixed="66" />
      <xs:element name="lt-LateralMalleolus" type="xs:int" fixed="67" />
      <xs:element name="lt-MedialMalleolus" type="xs:int" fixed="68" />
      <xs:element name="lt-Sphyrion" type="xs:int" fixed="69" />
      <xs:element name="lt-Metatarsal-Phal-I" type="xs:int" fixed="70" />
      <xs:element name="lt-CalcaneousPost" type="xs:int" fixed="71" />
      <xs:element name="lt-DigitII" type="xs:int" fixed="72" />
      <xs:element name="crotch" type="xs:int" fixed="73" />
      <xs:element name="functionalButtBlock" type="xs:int" fixed="74" />
      <xs:element name="otherPosition" type="xs:int" fixed="999"  />
    </xs:choice>
  </xs:complexType>
```

© ISO/IEC 2021 – All rights reserved

```
  <xs:complexType name="CaesarLandmarkExtensionBlockType">
    <xs:sequence>
      <xs:element name="fallback" type="CaesarLandmarkCodeType" />
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="CaesarLandmarkType">
    <xs:choice>
      <xs:element name="code" type="CaesarLandmarkCodeType" />
      <xs:element name="extensionBlock" type="CaesarLandmarkExtensionBlockType" />
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="MPEG4BodyPointCodeType">
    <xs:choice>
      <xs:element name="unknown" type="xs:int" fixed="0" />
      <xs:element name="l-MetatarsalFoot" type="xs:int" fixed="1" />
      <xs:element name="r-MetatarsalFoot" type="xs:int" fixed="2" />
      <xs:element name="l-Ankle" type="xs:int" fixed="3" />
      <xs:element name="r-Ankle" type="xs:int" fixed="4" />
      <xs:element name="l-Knee" type="xs:int" fixed="5" />
      <xs:element name="r-Knee" type="xs:int" fixed="6" />
      <xs:element name="l-Hip" type="xs:int" fixed="7" />
      <xs:element name="r-Hip" type="xs:int" fixed="8" />
      <xs:element name="sacroiliacSpine" type="xs:int" fixed="9" />
      <xs:element name="bodyCentreRoot" type="xs:int" fixed="10" />
      <xs:element name="l-Middle3Finger" type="xs:int" fixed="11" />
      <xs:element name="r-Middle3Finger" type="xs:int" fixed="12" />
      <xs:element name="l-Wrist" type="xs:int" fixed="13" />
      <xs:element name="r-Wrist" type="xs:int" fixed="14" />
      <xs:element name="l-Elbow" type="xs:int" fixed="15" />
      <xs:element name="r-Elbow" type="xs:int" fixed="16" />
      <xs:element name="l-Shoulder" type="xs:int" fixed="17" />
      <xs:element name="r-Shoulder" type="xs:int" fixed="18" />
      <xs:element name="vt4MidShoulder" type="xs:int" fixed="19" />
      <xs:element name="vt2LowerNeck" type="xs:int" fixed="20" />
      <xs:element name="vt1UpperNeck" type="xs:int" fixed="21" />
      <xs:element name="skullBase" type="xs:int" fixed="22" />
      <xs:element name="otherPosition" type="xs:int" fixed="999"  />
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="MPEG4BodyPointExtensionBlockType">
    <xs:sequence>
      <xs:element name="fallback" type="MPEG4BodyPointCodeType" />
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="MPEG4BodyPointType">
    <xs:choice>
      <xs:element name="code" type="MPEG4BodyPointCodeType" />
      <xs:element name="extensionBlock" type="MPEG4BodyPointExtensionBlockType" />
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="ImageRepresentationBlockType">
    <xs:choice >
      <xs:element name="representation" type="ImageRepresentationBaseBlockType" />
      <xs:element name="extensionBlock" type="ImageRepresentationBlockExtensionType" />
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="ImageRepresentationBaseBlockType">
    <xs:choice>
      <xs:element name="imageRepresentation2DBlock" type="ImageRepresentation2DBlockT
ype"/>
      <xs:element name="shapeRepresentation3DBlock" type="fac:ShapeRepresentation3DBlockT
ype"/>
    </xs:choice>
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

```
  </xs:complexType>

  <xs:complexType name="ImageRepresentationBlockExtensionType">
    <xs:sequence>
      <xs:element name="fallback" type="ImageRepresentationBaseBlockType" />
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="ImageRepresentation2DBlockType">
    <xs:sequence>
      <xs:element name="representationData2D" type="xs:base64Binary"/>
      <xs:element name="captureDevice2DBlock" type="CaptureDevice2DBlockType"
minOccurs="0"/>
      <xs:element name="imageInformation2DBlock" type="ImageInformation2DBlockType"
minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="CaptureDevice2DBlockType">
    <xs:sequence>
      <xs:element name="captureWavelengthRangeBlock" type="CaptureWavelengthRangeBlockT
ype" minOccurs="0"/>
      <xs:element name="captureDeviceTechnology" type="CaptureDeviceTechnologyIdType"
minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="CaptureWavelengthRangeBlockType">
    <xs:sequence>
      <xs:element name="ultrasound" type="xs:boolean" minOccurs="0"/>
      <xs:element name="millimetre" type="xs:boolean" minOccurs="0"/>
      <xs:element name="subMillimetre" type="xs:boolean" minOccurs="0"/>
      <xs:element name="farInfrared" type="xs:boolean" minOccurs="0"/>
      <xs:element name="midInfrared" type="xs:boolean" minOccurs="0"/>
      <xs:element name="nearInfrared" type="xs:boolean" minOccurs="0"/>
      <xs:element name="whiteLight" type="xs:boolean" minOccurs="0"/>
      <xs:element name="ultraviolet" type="xs:boolean" minOccurs="0"/>
      <xs:element name="softX-ray" type="xs:boolean" minOccurs="0"/>
      <xs:element name="hardX-ray" type="xs:boolean" minOccurs="0"/>
      <xs:element name="gammaRay" type="xs:boolean" minOccurs="0"/>
      <xs:element name="neutron" type="xs:boolean" minOccurs="0"/>
      <xs:element name="proton" type="xs:boolean" minOccurs="0"/>
      <xs:element name="positron" type="xs:boolean" minOccurs="0"/>
      <xs:element name="magnetics" type="xs:boolean" minOccurs="0"/>
      <xs:element name="quantum" type="xs:boolean" minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="CaptureDeviceTechnologyCodeType">
    <xs:choice>
      <xs:element name="unknown" type="xs:int" fixed="0" />
      <xs:element name="staticPhotographFromUnknownSource" type="xs:int" fixed="1" />
      <xs:element name="staticPhotographFromDigitalStillImageCamera" type="xs:int"
fixed="2" />
      <xs:element name="staticPhotographFromScanner" type="xs:int" fixed="3" />
      <xs:element name="videoFrameFromUnknownSource" type="xs:int" fixed="4" />
      <xs:element name="videoFrameFromAnalogueVideoCamera" type="xs:int" fixed="5" />
      <xs:element name="videoFrameFromDigitalVideoCamera" type="xs:int" fixed="6" />
      <xs:element name="staticPhotographFromUltrasoundImaging" type="xs:int" fixed="7" />
      <xs:element name="videoFrameFromUltrasoundImaging" type="xs:int" fixed="8" />
      <xs:element name="staticPhotographFromMillimetreCamera" type="xs:int" fixed="9" />
      <xs:element name="videoFrameFromMillimetreCamera" type="xs:int" fixed="10" />
      <xs:element name="staticPhotographFromSubMillimetreCamera" type="xs:int" fixed="11"
/>
      <xs:element name="videoFrameFromSubMillimetreCamera" type="xs:int" fixed="12" />
      <xs:element name="staticPhotographFromXRayCamera" type="xs:int" fixed="13" />
      <xs:element name="videoFrameFromXRayCamera" type="xs:int" fixed="14" />
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

```
      <xs:element name="staticPhotographFromGammaRayCamera" type="xs:int" fixed="15" />
      <xs:element name="videoFrameFromGammaRayCamera" type="xs:int" fixed="16" />
      <xs:element name="staticPhotographFromComputedTomographyImaging" type="xs:int"
fixed="17" />
      <xs:element name="videoFrameFromComputedTomographyImaging" type="xs:int" fixed="18"
/>
      <xs:element name="staticPhotographFromMagneticResonanceImaging" type="xs:int"
fixed="19" />
      <xs:element name="videoFrameFromMagneticResonanceImaging" type="xs:int" fixed="20"
/>
      <xs:element name="staticPhotographFromNeutronImaging" type="xs:int" fixed="21" />
      <xs:element name="videoFrameFromNeutronImaging" type="xs:int" fixed="22" />
      <xs:element name="staticPhotographFromProtonComputedTomography" type="xs:int"
fixed="23" />
      <xs:element name="videoFrameFromProtonComputedTomography" type="xs:int" fixed="24"
/>
      <xs:element name="staticPhotographFromPositronEmissionTomography" type="xs:int"
fixed="25" />
      <xs:element name="videoFrameFromPositronEmissionTomography" type="xs:int" fixed="26"
/>
      <xs:element name="staticPhotographFromMagneticsImaging" type="xs:int" fixed="27" />
      <xs:element name="videoFrameFromMagneticsImaging" type="xs:int" fixed="28" />
      <xs:element name="staticPhotographFromQuantumImaging" type="xs:int" fixed="29" />
      <xs:element name="videoFrameFromQuantumImaging" type="xs:int" fixed="30" />
      <xs:element name="otherImagingTechnology" type="xs:int" fixed="999"  />
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="CaptureDeviceTechnologyExtensionBlockType">
    <xs:sequence>
      <xs:element name="fallback" type="CaptureDeviceTechnologyCodeType" />
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="CaptureDeviceTechnologyIdType">
    <xs:choice>
      <xs:element name="code" type="CaptureDeviceTechnologyCodeType" />
      <xs:element name="extensionBlock" type="CaptureDeviceTechnologyExtensionBlockType"
/>
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="ImageInformation2DBlockType">
    <xs:sequence>
      <xs:element name="imageDataFormat" type="ImageDataFormatType"/>
      <xs:element name="imageKind2D" type="ImageKind2DType" minOccurs="0"/>
      <xs:element name="postAcquisitionProcessingBlock" type="PostAcquisitionProcessingBlo
ckType" minOccurs="0"/>
      <xs:element name="lossyTransformationAttempts" type="fac:LossyTransformationAttempts
Type" minOccurs="0"/>
      <xs:element name="cameraToSubjectDistance" type="fac:CameraToSubjectDistanceType"
minOccurs="0"/>
      <xs:element name="sensorDiagonal" type="fac:SensorDiagonalType" minOccurs="0"/>
      <xs:element name="lensFocalLength" type="fac:LensFocalLengthType" minOccurs="0" />
      <xs:element name="imageSizeBlock" type="fac:ImageSizeBlockType" minOccurs="0"/>
      <xs:element name="samplingRateBlock" type="SamplingRateBlockType" minOccurs="0"/>
      <xs:element name="imageColourSpace" type="fac:ImageColourSpaceType" minOccurs="0"/>
      <xs:element name="referenceColourMappingBlock" type="fac:ReferenceColourMappingBlock
Type" minOccurs="0"/>
      <xs:element name="jpegExif" type="xs:base64Binary" minOccurs="0"/>
      <xs:element name="forensicFindingsBlock" type="ForensicFindingsBlockType"
minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="ImageKind2DCodeType">
    <xs:choice>
      <xs:element name="basicBodyImage2D" type="xs:int" fixed="0" />
     <xs:element name="post-processedBodyImage2D" type="xs:int" fixed="1" />
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

```
    <xs:element name="basicBodyImage2DFrom3D" type="xs:int" fixed="2" />
    <xs:element name="interSurImage2D" type="xs:int" fixed="3" />
    <xs:element name="sMTImage2D" type="xs:int" fixed="4" />
    <xs:element name="gait2D" type="xs:int" fixed="5" />
    <xs:element name="uBM2D" type="xs:int" fixed="6" />
  </xs:choice>
</xs:complexType>

<xs:complexType name="ImageKind2DExtensionBlockType">
  <xs:sequence>
    <xs:element name="fallback" type="ImageKind2DCodeType" />
    <xs:any namespace="##other" processContents="lax"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="ImageKind2DType">
  <xs:choice>
    <xs:element name="code" type="ImageKind2DCodeType" />
    <xs:element name="extensionBlock" type="ImageKind2DExtensionBlockType" />
  </xs:choice>
</xs:complexType>

<xs:complexType name="PostAcquisitionProcessingBlockType">
  <xs:sequence>
    <xs:element name="rotated" type="xs:boolean" minOccurs="0"/>
    <xs:element name="cropped" type="xs:boolean" minOccurs="0"/>
    <xs:element name="downsampled" type="xs:boolean" minOccurs="0"/>
    <xs:element name="whiteBalanceAdjusted" type="xs:boolean" minOccurs="0"/>
    <xs:element name="multiplyCompressed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="interpolated" type="xs:boolean" minOccurs="0"/>
    <xs:element name="contrastStretched" type="xs:boolean" minOccurs="0"/>
    <xs:element name="poseCorrected" type="xs:boolean" minOccurs="0"/>
    <xs:element name="multiViewImage" type="xs:boolean" minOccurs="0"/>
    <xs:element name="ageProgressed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="super-resolutionProcessed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="normalised" type="xs:boolean" minOccurs="0"/>
    <xs:element name="falseColourProcessed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="silhouetteProcessed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="neuralNetworkProcessed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="extensionProcessing" type="xs:boolean" minOccurs="0"/>
    <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="ImageDataFormatCodeType">
  <xs:choice>
    <xs:element name="unknown" type="xs:int" fixed="0" />
    <xs:element name="jpeg" type="xs:int" fixed="1" />
    <xs:element name="jpeg2000" type="xs:int" fixed="2" />
    <xs:element name="jpeg2000Lossy" type="xs:int" fixed="3" />
    <xs:element name="jpeg2000Lossless" type="xs:int" fixed="4" />
    <xs:element name="png" type="xs:int" fixed="5" />
    <xs:element name="pgm" type="xs:int" fixed="6" />
    <xs:element name="ppm" type="xs:int" fixed="7" />
    <xs:element name="mpeg4" type="xs:int" fixed="8" />
    <xs:element name="mp4" type="xs:int" fixed="9" />
    <xs:element name="dicom" type="xs:int" fixed="10" />
  </xs:choice>
</xs:complexType>

<xs:complexType name="ImageDataFormatExtensionBlockType">
  <xs:sequence>
    <xs:element name="fallback" type="ImageDataFormatCodeType" />
    <xs:any namespace="##other" processContents="lax"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="ImageDataFormatType">
  <xs:choice>
    <xs:element name="code" type="ImageDataFormatCodeType" />
    <xs:element name="extensionBlock" type="ImageDataFormatExtensionBlockType" />
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

```
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="SamplingRateBlockType">
    <xs:sequence>
      <xs:element name="spatialSamplingRate" type="xs:integer" minOccurs="0"/>
      <xs:element name="temporalSamplingRate" type="xs:integer" minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="ForensicFindingsBlockType">
    <xs:sequence>
      <xs:element name="forensicObservations" type="xs:string" minOccurs="0"/>
      <xs:element name="linkToReports" type="xs:string" minOccurs="0"/>
      <xs:element name="dynamicRangeLow" minOccurs="0">
        <xs:simpleType>
          <xs:restriction base="xs:integer">
            <xs:minInclusive value="0"/>
            <xs:maxInclusive value="255"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
      <xs:element name="dynamicRangeHigh" minOccurs="0">
        <xs:simpleType>
          <xs:restriction base="xs:integer">
            <xs:minInclusive value="0"/>
            <xs:maxInclusive value="255"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
      <xs:element name="dynamicRangeNotes" type="xs:string" minOccurs="0"/>
      <xs:element name="colourFidelityCieLaba" minOccurs="0">
        <xs:simpleType>
          <xs:restriction base="xs:integer">
            <xs:minInclusive value="-100"/>
            <xs:maxInclusive value="100"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
      <xs:element name="colourFidelityCieLabb" minOccurs="0">
        <xs:simpleType>
          <xs:restriction base="xs:integer">
            <xs:minInclusive value="-100"/>
            <xs:maxInclusive value="100"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
      <xs:element name="colourFidelityNotes" type="xs:string" minOccurs="0"/>
      <xs:element name="imageSharpness" type="xs:decimal" minOccurs="0"/>
      <xs:element name="imageSharpnessNotes" type="xs:string" minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

</xs:schema>
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

Annex B
(informative)

Encoding examples

B.1 Binary encoding example

B.1.1 General

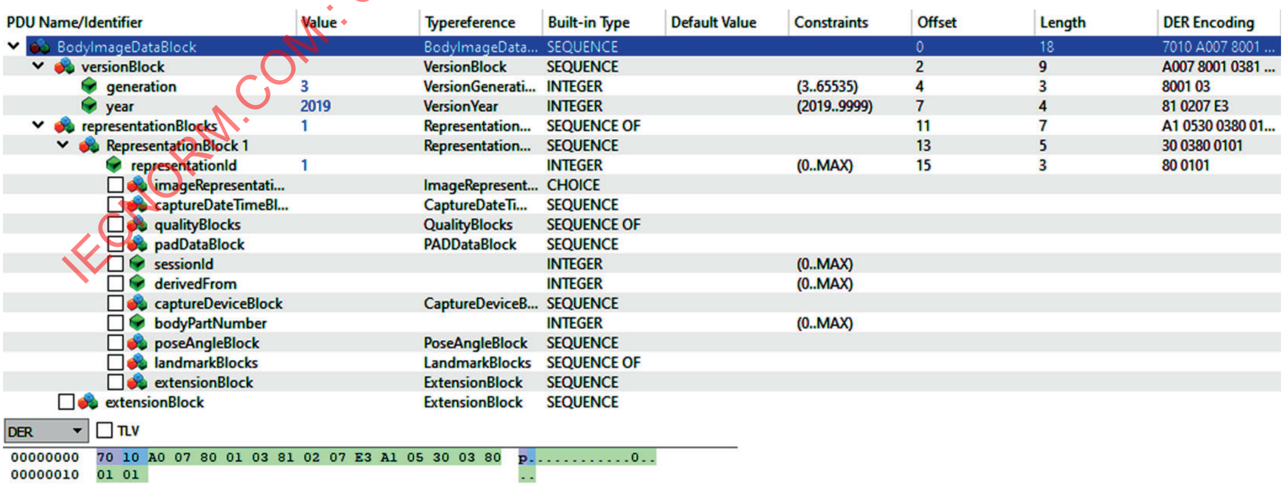
The body image data blocks used in these encoding examples are of type BodyImageDataBlock, which is defined in the ASN.1 module in A.1. Data is encoded in DER. DER is a subset of BER providing for exactly one way to encode an ASN.1 value. DER is intended for situations where a unique encoding is needed, such as in cryptography, and ensures that a data structure that needs to be digitally signed produces a unique serialized representation.

B.1.2 Binary encoding example using mandatory data fields

The first example contains only the mandatory elements and an empty imageRepresentationBlock2D. Its value is formally described below using ASN.1 value notation:

```
value1 BodyImageDataBlock ::= {
  versionBlock {
    generation 3,
    year 2019
  },
  representationBlocks {
    {
      representationId 1
    }
  }
}
```

Figure B.1 shows the mandatory elements and the DER hexadecimal view at the bottom of the figure on green background.



PDU Name/Identifier	Value	Typereference	Built-in Type	Default Value	Constraints	Offset	Length	DER Encoding
BodyImageDataBlock		BodyImageData...	SEQUENCE			0	18	7010 A007 8001 ...
versionBlock		VersionBlock	SEQUENCE			2	9	A007 8001 0381 ...
generation	3	VersionGenerati...	INTEGER		(3..65535)	4	3	8001 03
year	2019	VersionYear	INTEGER		(2019..9999)	7	4	81 0207 E3
representationBlocks	1	Representation...	SEQUENCE OF			11	7	A1 0530 0380 01...
RepresentationBlock 1		Representation...	SEQUENCE			13	5	30 0380 0101
representationId	1		INTEGER		(0..MAX)	15	3	80 0101
imageRepresentati...		ImageRepresent...	CHOICE					
captureDateTimeBl...		CaptureDateTi...	SEQUENCE					
qualityBlocks		QualityBlocks	SEQUENCE OF					
padDataBlock		PADDataBlock	SEQUENCE					
sessionId			INTEGER		(0..MAX)			
derivedFrom			INTEGER		(0..MAX)			
captureDeviceBlock		CaptureDeviceB...	SEQUENCE					
bodyPartNumber			INTEGER		(0..MAX)			
poseAngleBlock		PoseAngleBlock	SEQUENCE					
landmarkBlocks		LandmarkBlocks	SEQUENCE OF					
extensionBlock		ExtensionBlock	SEQUENCE					
extensionBlock		ExtensionBlock	SEQUENCE					

DER TLV

```
00000000  70 10 A0 07 80 01 03 81 02 07 E3 A1 05 30 03 80  p...........0..
00000010  01 01                                            ..
```

Figure B.1 — ASN.1 mandatory elements for BodyImageDataBlock

Example encodings can be retrieved from https://standards.iso.org/iso-iec/39794/-16/ed-1/en/

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

B.1.3 Binary encoding example using most common data entry fields

The second example contains typical optional elements and an empty *representationData2D*. See ISO/IEC 39794-5 for image representation using a small face image.

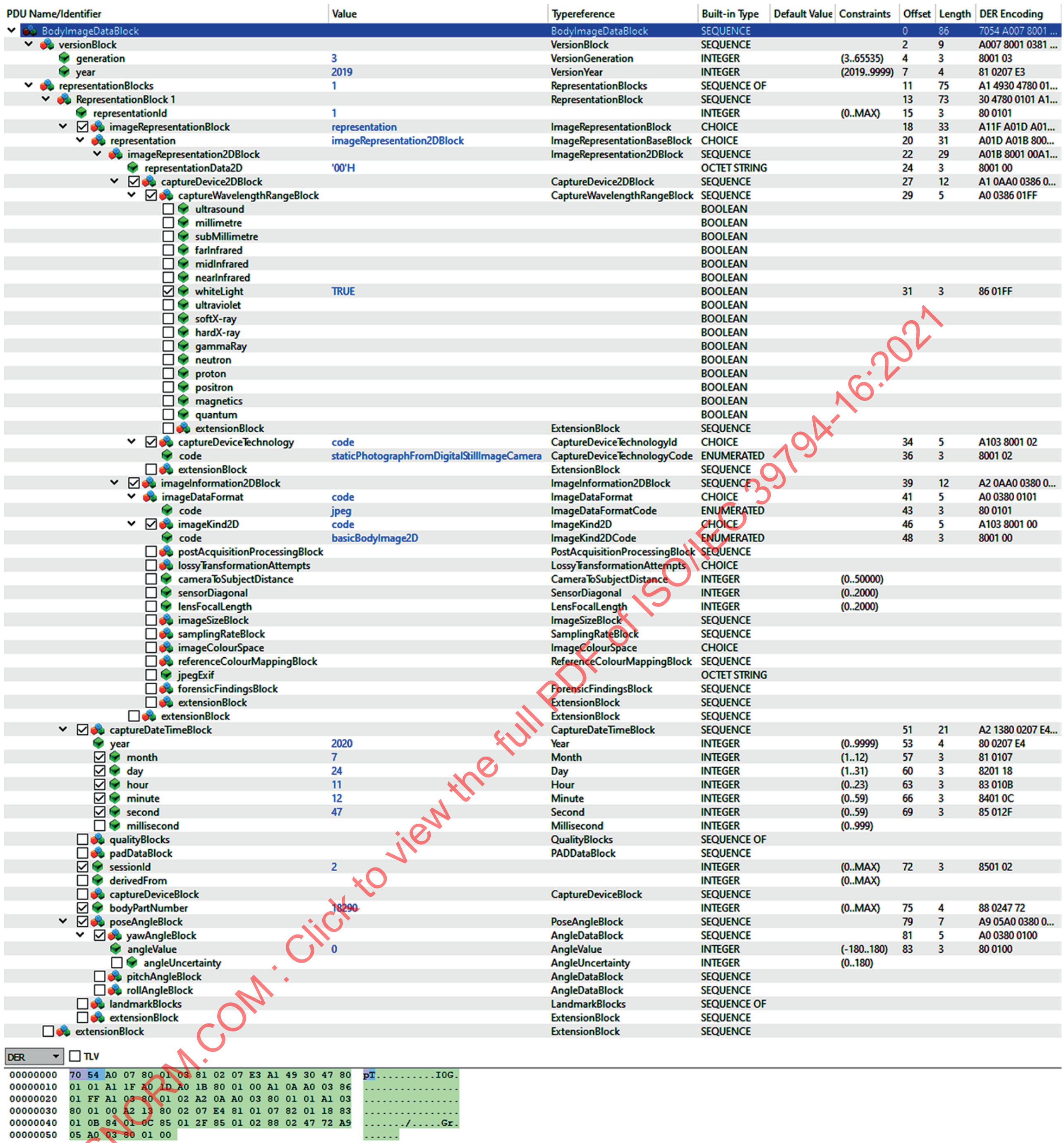
Typical example values are formally described below using ASN.1 value notation:

```
value1 BodyImageDataBlock ::= {
  versionBlock {
    generation 3,
    year 2019
  },
  representationBlocks {
    {
      representationId 1,
      imageRepresentationBlock representation : imageRepresentation2DBlock : {
        representationData2D '00'H,
        captureDevice2DBlock {
          captureWavelengthRangeBlock {
            whiteLight TRUE
          },
          captureDeviceTechnology code : staticPhotographFromDigitalStillImageCamera
        },
        imageInformation2DBlock {
          imageDataFormat code : jpeg,
          imageKind2D code : basicBodyImage2D
        }
      },
      captureDateTimeBlock {
        year 2020,
        month 7,
        day 24,
        hour 11,
        minute 12,
        second 47
      },
      sessionId 2,
      bodyPartNumber 18290,
      poseAngleBlock {
        yawAngleBlock {
          angleValue 0
        }
      }
    }
  }
}
```

Figure B.2 shows typical elements and the DER hexadecimal view at the bottom of the figure on green background.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved



PDU Name/Identifier	Value	Typereference	Built-in Type	Default Value	Constraints	Offset	Length	DER Encoding
BodyImageDataBlock		BodyImageDataBlock	SEQUENCE			0	86	7054 A007 8001 ...
versionBlock		VersionBlock	SEQUENCE			2	9	A007 8001 0381 ...
generation	3	VersionGeneration	INTEGER		(3..65535)	4	3	8001 03
year	2019	VersionYear	INTEGER		(2019..9999)	7	4	81 0207 E3
representationBlocks	1	RepresentationBlocks	SEQUENCE OF			11	75	A1 4930 4780 01...
RepresentationBlock 1		RepresentationBlock	SEQUENCE			13	73	30 4780 0101 A1...
representationId	1		INTEGER		(0..MAX)	15	3	80 0101
imageRepresentationBlock	representation	ImageRepresentationBlock	CHOICE			18	33	A11F A01D A01...
representation	imageRepresentation2DBlock	ImageRepresentationBaseBlock	CHOICE			20	31	A01D A01B 800...
imageRepresentation2DBlock		ImageRepresentation2DBlock	SEQUENCE			22	29	A01B 8001 00A1...
representationData2D	'00'H		OCTET STRING			24	3	8001 00
captureDevice2DBlock		CaptureDevice2DBlock	SEQUENCE			27	12	A1 0AA0 0386 0...
captureWavelengthRangeBlock		CaptureWavelengthRangeBlock	SEQUENCE			29	5	A0 0386 01FF
ultrasound			BOOLEAN					
millimetre			BOOLEAN					
subMillimetre			BOOLEAN					
farInfrared			BOOLEAN					
midInfrared			BOOLEAN					
nearInfrared			BOOLEAN					
whiteLight	TRUE		BOOLEAN			31	3	86 01FF
ultraviolet			BOOLEAN					
softX-ray			BOOLEAN					
hardX-ray			BOOLEAN					
gammaRay			BOOLEAN					
neutron			BOOLEAN					
proton			BOOLEAN					
positron			BOOLEAN					
magnetics			BOOLEAN					
quantum			BOOLEAN					
extensionBlock		ExtensionBlock	SEQUENCE					
captureDeviceTechnology	code	CaptureDeviceTechnologyId	CHOICE			34	5	A103 8001 02
code	staticPhotographFromDigitalStillImageCamera	CaptureDeviceTechnologyCode	ENUMERATED			36	3	8001 02
extensionBlock		ExtensionBlock	SEQUENCE					
imageInformation2DBlock		ImageInformation2DBlock	SEQUENCE			39	12	A2 0AA0 0380 0...
imageDataFormat	code	ImageDataFormat	CHOICE			41	5	A0 0380 0101
code	jpeg	ImageDataFormatCode	ENUMERATED			43	3	80 0101
imageKind2D	code	ImageKind2D	CHOICE			46	5	A103 8001 00
code	basicBodyImage2D	ImageKind2DCode	ENUMERATED			48	3	8001 00
postAcquisitionProcessingBlock		PostAcquisitionProcessingBlock	SEQUENCE					
lossyTransformationAttempts		LossyTransformationAttempts	CHOICE					
cameraToSubjectDistance		CameraToSubjectDistance	INTEGER		(0..50000)			
sensorDiagonal		SensorDiagonal	INTEGER		(0..2000)			
lensFocalLength		LensFocalLength	INTEGER		(0..2000)			
imageSizeBlock		ImageSizeBlock	SEQUENCE					
samplingRateBlock		SamplingRateBlock	SEQUENCE					
imageColourSpace		ImageColourSpace	CHOICE					
referenceColourMappingBlock		ReferenceColourMappingBlock	SEQUENCE					
jpegExif			OCTET STRING					
forensicFindingsBlock		ForensicFindingsBlock	SEQUENCE					
extensionBlock		ExtensionBlock	SEQUENCE					
extensionBlock		ExtensionBlock	SEQUENCE					
captureDateTimeBlock		CaptureDateTimeBlock	SEQUENCE			51	21	A2 1380 0207 E4...
year	2020	Year	INTEGER		(0..9999)	53	4	80 0207 E4
month	7	Month	INTEGER		(1..12)	57	3	81 0107
day	24	Day	INTEGER		(1..31)	60	3	8201 18
hour	11	Hour	INTEGER		(0..23)	63	3	83 010B
minute	12	Minute	INTEGER		(0..59)	66	3	8401 0C
second	47	Second	INTEGER		(0..59)	69	3	85 012F
millisecond		Millisecond	INTEGER		(0..999)			
qualityBlocks		QualityBlocks	SEQUENCE OF					
padDataBlock		PADDataBlock	SEQUENCE					
sessionId	2		INTEGER		(0..MAX)	72	3	8501 02
derivedFrom			INTEGER		(0..MAX)			
captureDeviceBlock		CaptureDeviceBlock	SEQUENCE					
bodyPartNumber	18290		INTEGER		(0..MAX)	75	4	88 0247 72
poseAngleBlock		PoseAngleBlock	SEQUENCE			79	7	A9 05A0 0380 0...
yawAngleBlock		AngleDataBlock	SEQUENCE			81	5	A0 0380 0100
angleValue	0	AngleValue	INTEGER		(-180..180)	83	3	80 0100
angleUncertainty		AngleUncertainty	INTEGER		(0..180)			
pitchAngleBlock		AngleDataBlock	SEQUENCE					
rollAngleBlock		AngleDataBlock	SEQUENCE					
landmarkBlocks		LandmarkBlocks	SEQUENCE OF					
extensionBlock		ExtensionBlock	SEQUENCE					
extensionBlock		ExtensionBlock	SEQUENCE					

DER ☐ TLV

```
00000000  70 54 A0 07 80 01 03 81 02 07 E3 A1 49 30 47 80   pT..........IOG.
00000010  01 01 A1 1F A0 1D A0 1B 80 01 00 A1 0A A0 03 86   ................
00000020  01 FF A1 03 80 01 02 A2 0A A0 03 80 01 01 A1 03   ................
00000030  80 01 00 A2 13 80 02 07 E4 81 01 07 82 01 18 83   ................
00000040  01 0B 84 01 0C 85 01 2F 85 01 02 88 02 47 72 A9   ......./.....Gr.
00000050  05 A0 03 80 01 00                                 ......
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

NOTE This data encoding example contains some of the most common entry fields showing typical placeholder test values as an example.

Figure B.2 — ASN.1 typical elements and the DER encoding on green background

An example encoding can be retrieved from https://standards.iso.org/iso-iec/39794/-16/ed-1/en/

B.1.4 Binary encoding for submillimetre camera example

The third example contains an alternative set of optional elements. Data entry alternatives are better shown in Figure B.3.

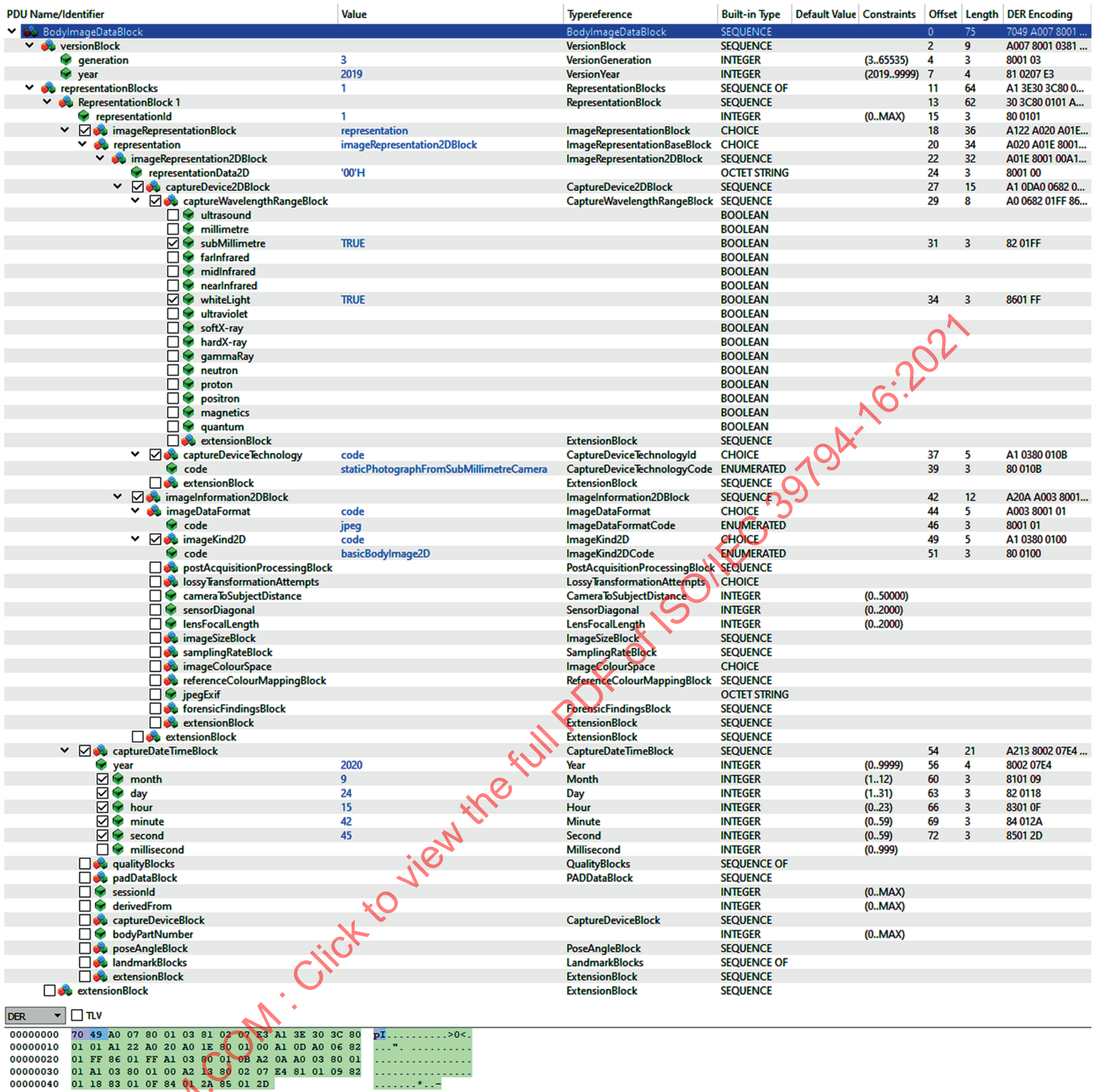
© ISO/IEC 2021 – All rights reserved

```
value1 BodyImageDataBlock ::= {
  versionBlock {
    generation 3,
    year 2019
  },
  representationBlocks {
    {
      representationId 1,
      imageRepresentationBlock representation : imageRepresentation2DBlock : {
        representationData2D '00'H,
        captureDevice2DBlock {
          captureWavelengthRangeBlock {
            subMillimetre TRUE,
            whiteLight TRUE
          },
          captureDeviceTechnology code : staticPhotographFromSubMillimetreCamera
        },
        imageInformation2DBlock {
          imageDataFormat code : jpeg,
          imageKind2D code : basicBodyImage2D
        }
      },
      captureDateTimeBlock {
        year 2020,
        month 9,
        day 24,
        hour 15,
        minute 42,
        second 45
      }
    }
  }
}
```

Figure B.3 shows an example of the submillimetre camera elements and the DER hexadecimal view at the bottom of the figure on green background.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved



PDU Name/Identifier	Value	Typereference	Built-in Type	Default Value	Constraints	Offset	Length	DER Encoding
BodyImageDataBlock		BodyImageDataBlock	SEQUENCE			0	75	7049 A007 8001 ...
versionBlock		VersionBlock	SEQUENCE			2	9	A007 8001 0381 ...
generation	3	VersionGeneration	INTEGER		(3..65535)	4	3	8001 03
year	2019	VersionYear	INTEGER		(2019..9999)	7	4	81 0207 E3
representationBlocks	1	RepresentationBlocks	SEQUENCE OF			11	64	A1 3E30 3C80 0...
RepresentationBlock 1		RepresentationBlock	SEQUENCE			13	62	30 3C80 0101 A...
representationId	1		INTEGER		(0..MAX)	15	3	80 0101
imageRepresentationBlock	representation	ImageRepresentationBlock	CHOICE			18	36	A122 A020 A01E...
representation	imageRepresentation2DBlock	ImageRepresentationBaseBlock	CHOICE			20	34	A020 A01E 8001...
imageRepresentation2DBlock		ImageRepresentation2DBlock	SEQUENCE			22	32	A01E 8001 00A1...
representationData2D	'00'H		OCTET STRING			24	3	8001 00
captureDevice2DBlock		CaptureDevice2DBlock	SEQUENCE			27	15	A1 0DA0 0682 0...
captureWavelengthRangeBlock		CaptureWavelengthRangeBlock	SEQUENCE			29	8	A0 0682 01FF 86...
ultrasound			BOOLEAN					
millimetre			BOOLEAN					
subMillimetre	TRUE		BOOLEAN			31	3	82 01FF
farInfrared			BOOLEAN					
midInfrared			BOOLEAN					
nearInfrared			BOOLEAN					
whiteLight	TRUE		BOOLEAN			34	3	8601 FF
ultraviolet			BOOLEAN					
softX-ray			BOOLEAN					
hardX-ray			BOOLEAN					
gammaRay			BOOLEAN					
neutron			BOOLEAN					
proton			BOOLEAN					
positron			BOOLEAN					
magnetics			BOOLEAN					
quantum			BOOLEAN					
extensionBlock		ExtensionBlock	SEQUENCE					
captureDeviceTechnology	code	CaptureDeviceTechnologyId	CHOICE			37	5	A1 0380 010B
code	staticPhotographFromSubMillimetreCamera	CaptureDeviceTechnologyCode	ENUMERATED			39	3	80 010B
extensionBlock		ExtensionBlock	SEQUENCE					
imageInformation2DBlock		ImageInformation2DBlock	SEQUENCE			42	12	A20A A003 8001...
imageDataFormat	code	ImageDataFormat	CHOICE			44	5	A003 8001 01
code	jpeg	ImageDataFormatCode	ENUMERATED			46	3	8001 01
imageKind2D	code	ImageKind2D	CHOICE			49	5	A1 0380 0100
code	basicBodyImage2D	ImageKind2DCode	ENUMERATED			51	3	80 0100
postAcquisitionProcessingBlock		PostAcquisitionProcessingBlock	SEQUENCE					
lossyTransformationAttempts		LossyTransformationAttempts	CHOICE					
cameraToSubjectDistance		CameraToSubjectDistance	INTEGER		(0..50000)			
sensorDiagonal		SensorDiagonal	INTEGER		(0..2000)			
lensFocalLength		LensFocalLength	INTEGER		(0..2000)			
imageSizeBlock		ImageSizeBlock	SEQUENCE					
samplingRateBlock		SamplingRateBlock	SEQUENCE					
imageColourSpace		ImageColourSpace	CHOICE					
referenceColourMappingBlock		ReferenceColourMappingBlock	SEQUENCE					
jpegExif			OCTET STRING					
forensicFindingsBlock		ForensicFindingsBlock	SEQUENCE					
extensionBlock		ExtensionBlock	SEQUENCE					
extensionBlock		ExtensionBlock	SEQUENCE					
captureDateTimeBlock		CaptureDateTimeBlock	SEQUENCE			54	21	A213 8002 07E4 ...
year	2020	Year	INTEGER		(0..9999)	56	4	8002 07E4
month	9	Month	INTEGER		(1..12)	60	3	8101 09
day	24	Day	INTEGER		(1..31)	63	3	82 0118
hour	15	Hour	INTEGER		(0..23)	66	3	8301 0F
minute	42	Minute	INTEGER		(0..59)	69	3	84 012A
second	45	Second	INTEGER		(0..59)	72	3	8501 2D
millisecond		Millisecond	INTEGER		(0..999)			
qualityBlocks		QualityBlocks	SEQUENCE OF					
padDataBlock		PADDataBlock	SEQUENCE					
sessionId			INTEGER		(0..MAX)			
derivedFrom			INTEGER		(0..MAX)			
captureDeviceBlock		CaptureDeviceBlock	SEQUENCE					
bodyPartNumber			INTEGER		(0..MAX)			
poseAngleBlock		PoseAngleBlock	SEQUENCE					
landmarkBlocks		LandmarkBlocks	SEQUENCE OF					
extensionBlock		ExtensionBlock	SEQUENCE					
extensionBlock		ExtensionBlock	SEQUENCE					

DER ☐ TLV


```
00000000  70 49 A0 07 80 01 03 81 02 07 E3 A1 3E 30 3C 80   pI..........>0<.
00000010  01 01 A1 22 A0 20 A0 1E 80 01 00 A1 0D A0 06 82   ...". ..........
00000020  01 FF 86 01 FF A1 03 80 01 0B A2 0A A0 03 80 01   ................
00000030  01 A1 03 80 01 00 A2 13 80 02 07 E4 81 01 09 82   ................
00000040  01 18 83 01 0F 84 01 2A 85 01 2D                  .......*..-
```


Figure B.3 — Hierarchical display of a submillimetre camera ASN.1 example

B.1.5 ASN.1 extensibility

In ASN.1 schemas, three dots (...) are the extension markers. In the majority of cases it is sufficient for "older" versions to ignore the extension values received from "newer" versions because they typically do not know what to do with them. Type extensibility has no effect on the size of BER encodings.

B.2 XML encoding example

B.2.1 General

The body image data blocks used in these encoding examples are of type BodyImageDataBlockType, which is defined in the XSD module in A.2.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Figure B.4 illustrates the dependencies of the ISO/IEC 39794-16 (this document) XSD in relation to other related XSD files.

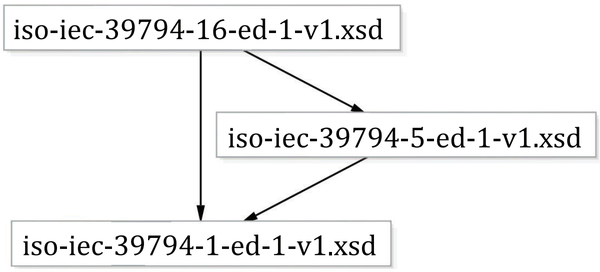


Figure B.4 — XSD dependencies

Figure B.5 illustrates the modular structure based on the main elements for the ISO/IEC 39794-16 (this document) XSD.

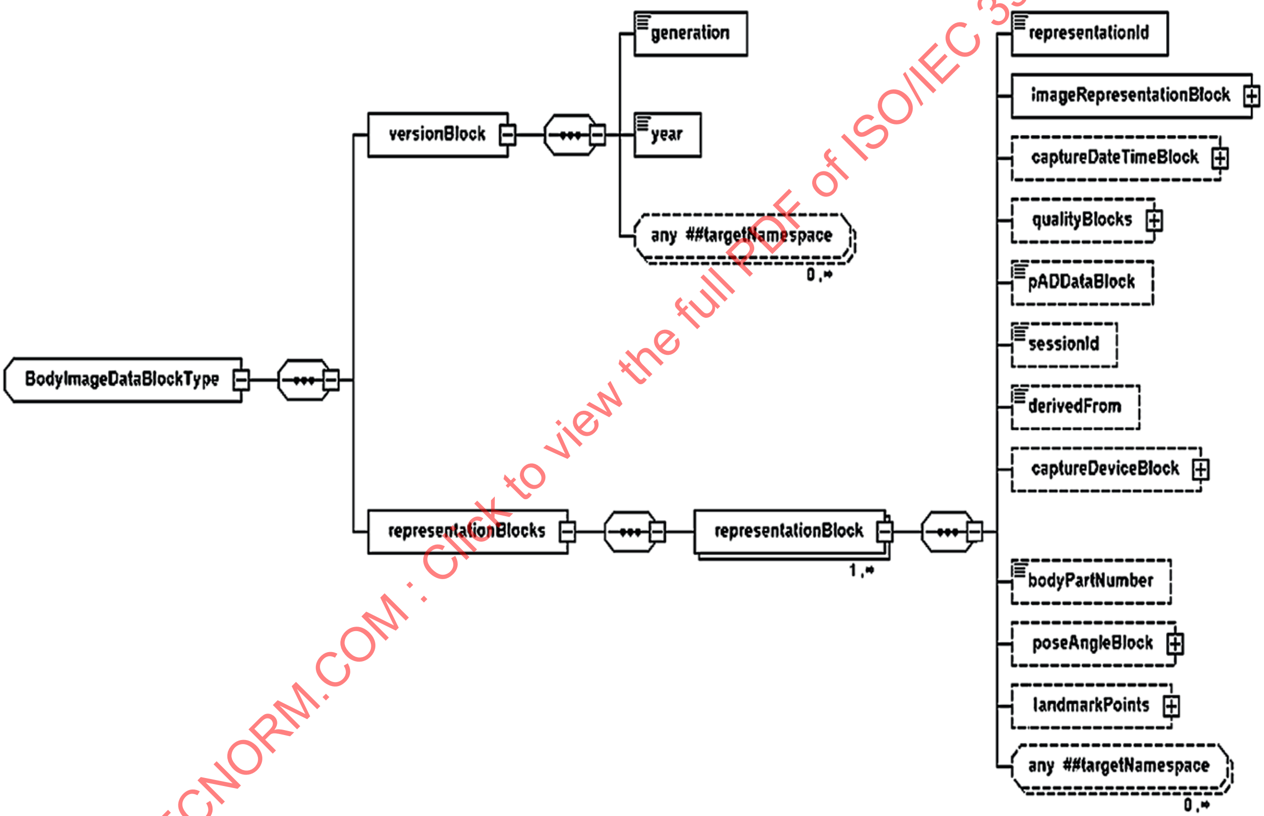


Figure B.5 — XSD modular structure

NOTE Element names in Figure B.5 are the same as in the XSD of this document and in the examples containing the image data encoding in subclause B.2.

Examples containing the image data encoding can be retrieved from https://standards.iso.org/iso-iec/39794/-16/ed-1/en/

B.2.2 XML encoding example using mandatory data fields

The first XML example contains only the mandatory data. This example structure is compatible with the ISO/IEC 39794-5 data structure and data content.

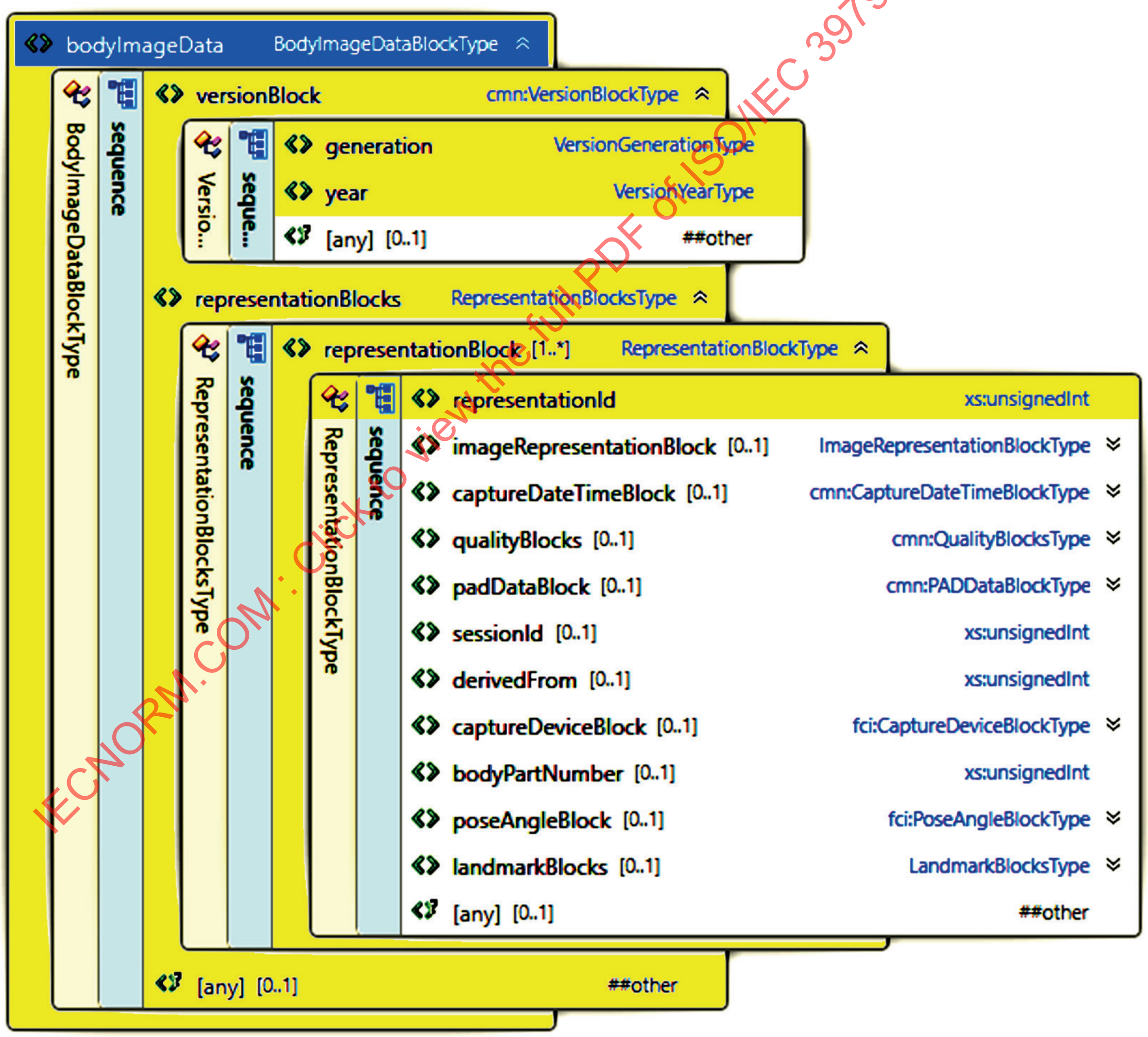
IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

A mandatory XML data sample is described in this subclause using XML notation:

```
<?xml version="1.0" encoding="utf-8"?>
<!-- 39794-16 mandatory sample -->
<bim:bodyImageData xmlns:cmn="https://standards.iso.org/iso-iec/39794/-1"
xmlns:fac="https://standards.iso.org/iso-iec/39794/-5" xmlns:bim="https://standards.iso.
org/iso-iec/39794/-16">
    <bim:versionBlock>
      <cmn:generation>3</cmn:generation>
      <cmn:year>2019</cmn:year>
    </bim:versionBlock>
    <bim:representationBlocks>
      <bim:representationBlock>
        <bim:representationId>1</bim:representationId>
      </bim:representationBlock>
    </bim:representationBlocks>
</bim:bodyImageData>
```

Figure B.6 illustrates the mandatory XML elements in graphical form for this document. The mandatory elements are on a yellow background.



IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Figure B.6 — Mandatory XML elements

B.2.3 XML encoding example using most common data entry fields

The second example contains typical optional elements and an empty *representationData2D*. The data example structure is compatible with the ISO/IEC 39794-5 data structure and data content taking into acoount the specific definitions in this document.

A typical XML data sample with empty ($_{Hex}$ 00) image is described in this subclause using XML notation.

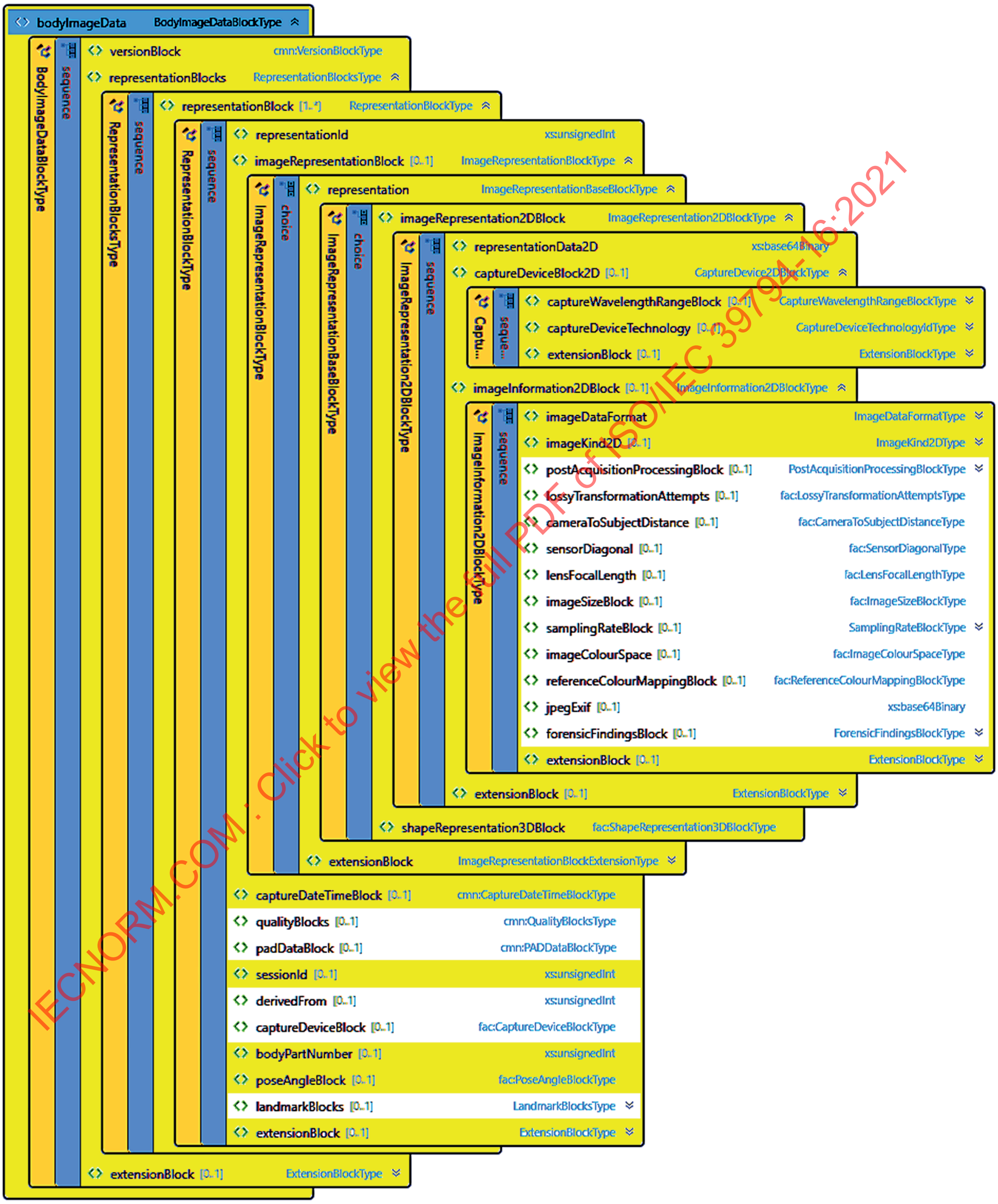
```
<?xml version="1.0" encoding="utf-8"?>
<!-- 39794-16 typical with image sample -->
<bim:bodyImageData xmlns:cmn="https://standards.iso.org/iso-iec/39794/-1"
xmlns:fac="https://standards.iso.org/iso-iec/39794/-5" xmlns:bim="https://standards.iso.
org/iso-iec/39794/-16">
 <bim:versionBlock>
    <cmn:generation>3</cmn:generation>
    <cmn:year>2019</cmn:year>
  </bim:versionBlock>
  <bim:representationBlocks>
    <bim:representationBlock>
      <bim:representationId>1</bim:representationId>
      <bim:imageRepresentationBlock>
          <bim:representation>
            <bim:imageRepresentation2DBlock>
            <bim:representationData2D>AA==</bim:representationData2D>
              <bim:captureDevice2DBlock>
                <bim:captureWavelengthRangeBlock>
                  <bim:whiteLight>true</bim:whiteLight>
                 </bim:captureWavelengthRangeBlock>
                 <bim:captureDeviceTechnology>
                   <bim:code>

<bim:staticPhotographFromDigitalStillImageCamera>2</
bim:staticPhotographFromDigitalStillImageCamera>
                   </bim:code>
                 </bim:captureDeviceTechnology>
               </bim:captureDevice2DBlock>
               <bim:imageInformation2DBlock>
                 <bim:imageDataFormat>
                   <bim:code>
                    <bim:jpeg>1</bim:jpeg>
                  </bim:code>
                </bim:imageDataFormat>
                <bim:imageKind2D>
                 <bim:code>
                   <bim:basicBodyImage2D>0</bim:basicBodyImage2D>
                 </bim:code>
               </bim:imageKind2D>
             </bim:imageInformation2DBlock>
            </bim:imageRepresentation2DBlock>
        </bim:representation>
      </bim:imageRepresentationBlock>
      <bim:captureDateTimeBlock>
        <cmn:year>2020</cmn:year>
        <cmn:month>7</cmn:month>
        <cmn:day>24</cmn:day>
        <cmn:hour>11</cmn:hour>
        <cmn:minute>12</cmn:minute>
        <cmn:second>47</cmn:second>
      </bim:captureDateTimeBlock>
      <bim:sessionId>2</bim:sessionId>
      <bim:bodyPartNumber>18290</bim:bodyPartNumber>
        <bim:poseAngleBlock>
            <fac:yawAngleBlock>
                <fac:angleValue>0</fac:angleValue>
            </fac:yawAngleBlock>
        </bim:poseAngleBlock>
    </bim:representationBlock>
  </bim:representationBlocks>
</bim:bodyImageData>
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

The structure of the ISO/IEC 39794-16 (this document) XSD element hierarchical strucuture is perhaps easiest to see by looking at the most often used elements.

Figure B.7 illustrates a typical extensible full body BDB containing the data shown highlighted with a yellow background.



IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Figure B.7 — Typical XML elements

Note that in this example the sessionId is not used if the representationId contains both the session identification and the representation identification information.

© ISO/IEC 2021 – All rights reserved

B.2.4 XML encoding for submillimetre camera example

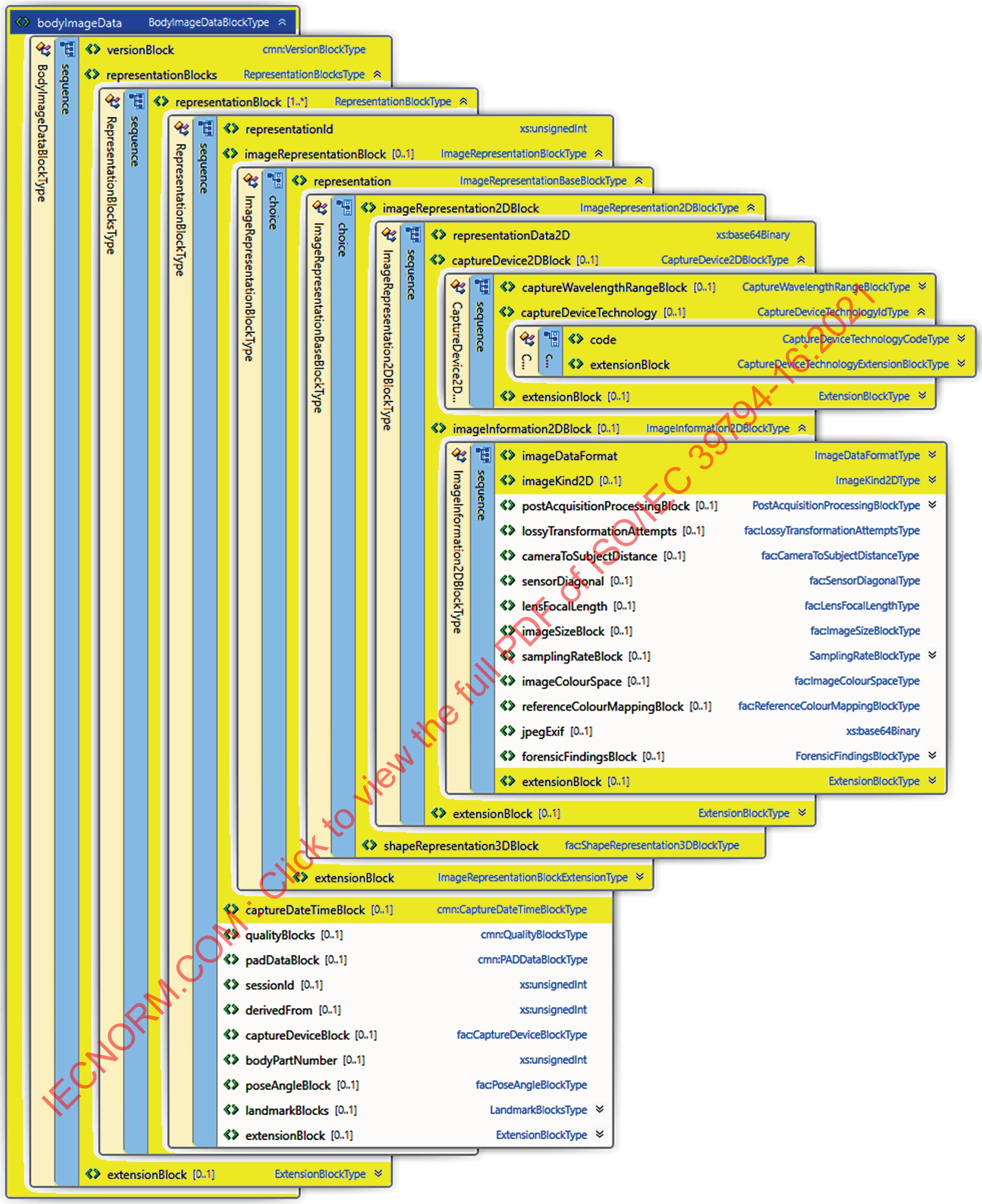
The third example contains an alternative set of optional elements. See also Figure B.8.


```
<?xml version="1.0" encoding="utf-8"?>
<!-- 39794-16 typical with image sample -->
<bim:bodyImageData xmlns:cmn="https://standards.iso.org/iso-iec/39794/-1"
xmlns:fac="https://standards.iso.org/iso-iec/39794/-5" xmlns:bim="https://standards.iso.
org/iso-iec/39794/-16">
  <bim:versionBlock>
    <cmn:generation>3</cmn:generation>
    <cmn:year>2019</cmn:year>
  </bim:versionBlock>
  <bim:representationBlocks>
    <bim:representationBlock>
      <bim:representationId>1</bim:representationId>
      <bim:imageRepresentationBlock>
       <bim:representation>
        <bim:imageRepresentation2DBlock>
          <bim:representationData2D>AA==</bim:representationData2D>
          <bim:captureDevice2DBlock>
            <bim:captureWavelengthRangeBlock>
              <bim:subMillimetre>true</bim:subMillimetre>
              <bim:whiteLight>true</bim:whiteLight>
            </bim:captureWavelengthRangeBlock>
            <bim:captureDeviceTechnology>
              <bim:code>

<bim:staticPhotographFromSubMillimetreCamera>11</
bim:staticPhotographFromSubMillimetreCamera>
              </bim:code>
            </bim:captureDeviceTechnology>
          </bim:captureDevice2DBlock>
          <bim:imageInformation2DBlock>
            <bim:imageDataFormat>
              <bim:code>
                <bim:jpeg>1</bim:jpeg>
              </bim:code>
            </bim:imageDataFormat>
            <bim:imageKind2D>
              <bim:code>
                <bim:basicBodyImage2D>0</bim:basicBodyImage2D>
              </bim:code>
            </bim:imageKind2D>
          </bim:imageInformation2DBlock>
        </bim:imageRepresentation2DBlock>
       </bim:representation>
      </bim:imageRepresentationBlock>
      <bim:captureDateTimeBlock>
        <cmn:year>2020</cmn:year>
        <cmn:month>9</cmn:month>
        <cmn:day>24</cmn:day>
        <cmn:hour>15</cmn:hour>
        <cmn:minute>42</cmn:minute>
        <cmn:second>45</cmn:second>
      </bim:captureDateTimeBlock>
    </bim:representationBlock>
  </bim:representationBlocks>
</bim:bodyImageData>
```


Figure B.8 shows an example of the submillimetre camera XML elements, highlighted on the figure with a yellow background.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved



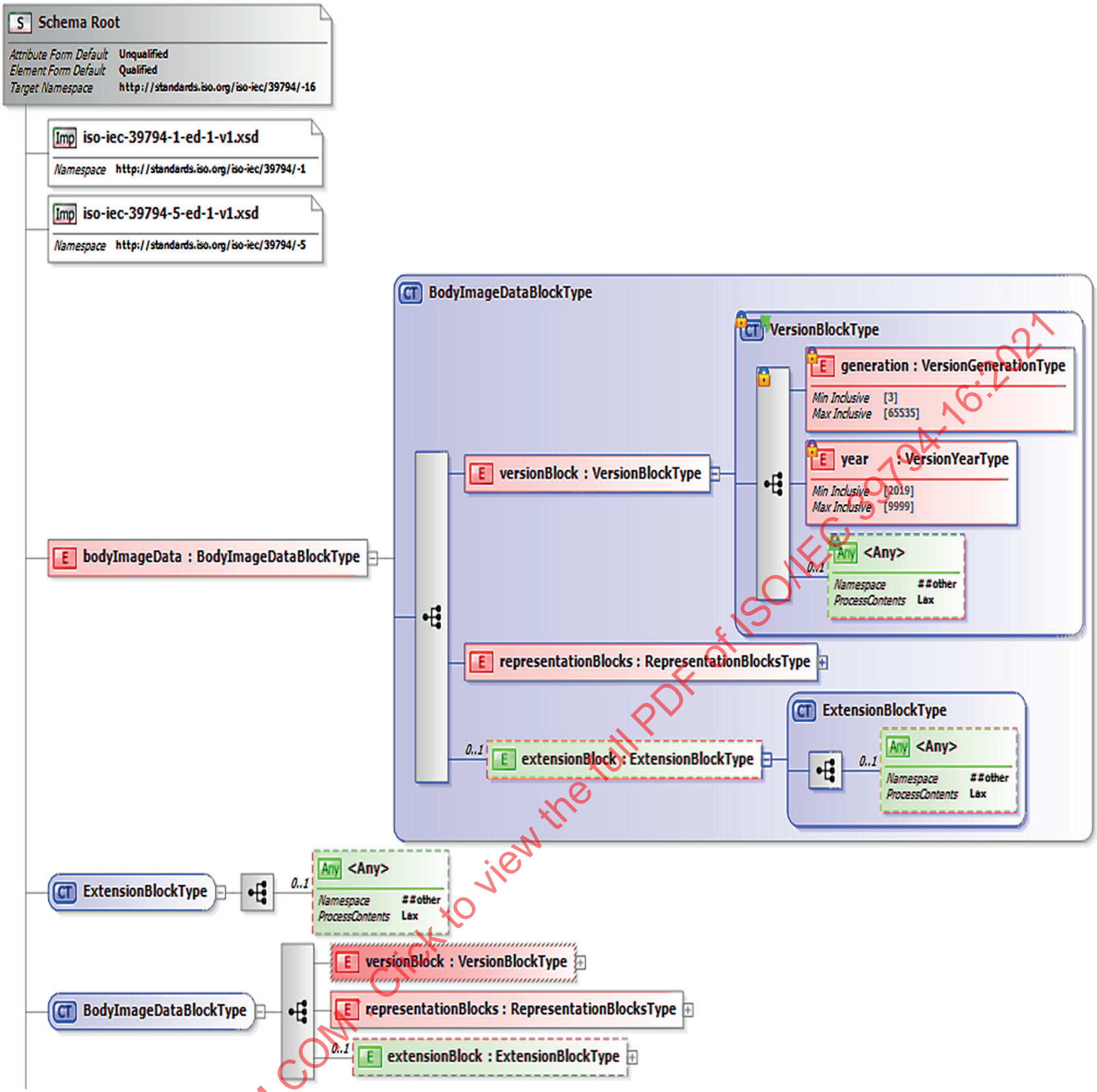
IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Figure B.8 — XML elements for ISO/IEC 39794-16 (this document) submillimetre example

B.2.5 XML extensibility

The extensibility elements are marked with green in Figure B.9.

© ISO/IEC 2021 – All rights reserved



IECNORM.COM Click to view the full PDF of ISO/IEC 39794-16:2021

Figure B.9 — XSD extensibility for ISO/IEC 39794-16 (this document) XSD

The XSD elements of this example are in textual format:

```
<xs:complexType name="PostAcquisitionProcessingBlockType">
  <xs:sequence>
    <xs:element name="rotated" type="xs:boolean" minOccurs="0"/>
    <xs:element name="cropped" type="xs:boolean" minOccurs="0"/>
    <xs:element name="downsampled" type="xs:boolean" minOccurs="0"/>
    <xs:element name="whiteBalanceAdjusted" type="xs:boolean" minOccurs="0"/>
    <xs:element name="multiplyCompressed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="interpolated" type="xs:boolean" minOccurs="0"/>
    <xs:element name="contrastStretched" type="xs:boolean" minOccurs="0"/>
    <xs:element name="poseCorrected" type="xs:boolean" minOccurs="0"/>
    <xs:element name="multiViewImage" type="xs:boolean" minOccurs="0"/>
    <xs:element name="ageProgressed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="super-resolutionProcessed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="normalised" type="xs:boolean" minOccurs="0"/>
    <xs:element name="falseColourProcessed" type="xs:boolean" minOccurs="0"/>
    <xs:element name="silhouetteProcessed" type="xs:boolean" minOccurs="0"/>
```

 © ISO/IEC 2021 – All rights reserved

```
      <xs:element name="neuralNetworkProcessed" type="xs:boolean" minOccurs="0"/>
      <xs:element name="extensionProcessing" type="xs:boolean" minOccurs="0"/>
      <xs:element name="extensionBlock" type="ExtensionBlockType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="ImageDataFormatCodeType">
    <xs:choice>
      <xs:element name="unknown" type="xs:int" fixed="0" />
      <xs:element name="jpeg" type="xs:int" fixed="1" />
      <xs:element name="jpeg2000" type="xs:int" fixed="2" />
      <xs:element name="jpeg2000Lossy" type="xs:int" fixed="3" />
      <xs:element name="jpeg2000Lossless" type="xs:int" fixed="4" />
      <xs:element name="png" type="xs:int" fixed="5" />
      <xs:element name="pgm" type="xs:int" fixed="6" />
      <xs:element name="ppm" type="xs:int" fixed="7" />
      <xs:element name="mpeg4" type="xs:int" fixed="8" />
      <xs:element name="mp4" type="xs:int" fixed="9" />
      <xs:element name="dicom" type="xs:int" fixed="10" />
    </xs:choice>
  </xs:complexType>

  <xs:complexType name="ImageDataFormatExtensionBlockType">
    <xs:sequence>
      <xs:element name="fallback" type="ImageDataFormatCodeType" />
      <xs:any namespace="##other" processContents="lax"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="ImageDataFormatType">
    <xs:choice>
      <xs:element name="code" type="ImageDataFormatCodeType" />
      <xs:element name="extensionBlock" type="ImageDataFormatExtensionBlockType" />
    </xs:choice>
  </xs:complexType>
```

B.3 Examples of using RDF to obtain biometric and non-biometric data

B.3.1 General

The first example contains only the mandatory elements and an empty *imageRepresentationBlock2D*. Its value is formally described below using ASN.1 value notation.

RDF schema is an extension of the basic RDF vocabulary. RDF schema provides mechanisms for describing groups of related resources and the relationships between these resources. RDF Schema is written in RDF using the terms described in the RDF Schema 1.1 W3C Recommendation[31]. When a new RDF schema is written for query, then the written RDF is available for data searching to reach the data. The content of the RDF schema depends on the data requirements and the database structure. Consequently, it is not possible to give a standardized format for the RDF schema, which applies to all eventualities of a biometric and non-biometric data search.

RDF is located in the core part of semantic web standards. As an extension of the existing World Wide Web, the semantic web attempts to make it easier for users to find, share, and combine information. Semantic web leverages the following technologies:

— XML, which provides syntax for RDF;

— OWL, which extends the ability of RDF to encode information;

— RDF, which expresses knowledge; and

— RDF query language SPARQL, which enables query and manipulation of RDF content.

Figure B.10 illustrates how semantic web technologies rely on RDF to find data, on OWL to encode information in order to share the information and on XML to combine data elements for applications. SPARQL is used to manipulate RDF content. Neural networks are used to automate this process.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

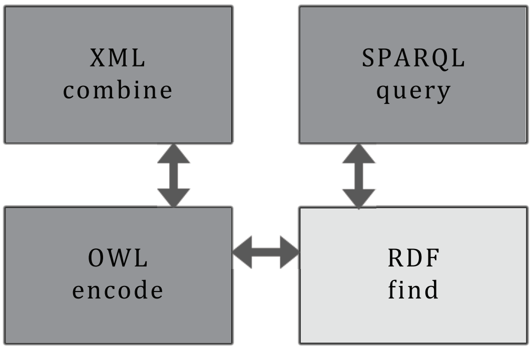


Figure B.10 — Semantic web technology relationships

In police daily work, an extensive amount of raw data exists in real-world situations. It is quite cumbersome to analyze such a huge amount of data by just browsing the data. Even if sufficient time is spent understanding the data, it can not always produce semantically correct results. For example, RDF can be used with a search system using SPARQL Protocol and RDF Query Language.

The system should provide a user interface wherein the officer can type in a search string and the application program interface helps to fetch and display information to the officer. Deriving semantically justified information plays a major role in this context as it helps the officers to understand and work with their ontologies, i.e. representation, naming and categories effectively and particularly use the information to the optimum scale.

B.3.2 Using RDF to obtain DVI-related data

This subclause shows an example of the use of RDF to obtain DVI-related information from an outside source location. The outside source is a non-existent police.org website in this example.

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:db="http://police.org/resource/">
  <rdf:Description rdf:about="http://police.org/resource/DVI_PM">
    <db:Case1234>
      <rdf:Description rdf:about="http://police.org/resource/John_Doe" />
    </db:Case1234>
    <db:Nickname>Handy</db:Nickname>
    <db:Crime>
      <rdf:Description rdf:about="http://police.org/resource/Burglary">
         <db:Category>Home</db:Nickname>
      </rdf:Description>
    </db:Crime>
  </rdf:Description>
</rdf:RDF>
```

B.3.3 RDF example from the State of Washington

This subclause describes a real-life example of Query RDF from the State of Washington. The dataset shown here is called Counties Listed On Intent. The catalogue on Data.gov provides the ability to search and browse datasets, data series, tools and products. The link to the home page is https://catalog.data.gov/dataset.

On the following RDF element list there is a marker (...) showing where part of the original list is cut off. The last element is shown after the ... marker:

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:rdfs="http://
www.w3.org/2000/01/rdf-schema#" xmlns:socrata="http://www.socrata.com/rdf/terms#"
xmlns:dcat="http://www.w3.org/ns/dcat#" xmlns:ods="http://open-data-standards.
github.com/2012/01/open-data-standards#" xmlns:dcterm="http://purl.org/dc/terms/"
xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#" xmlns:skos="http://www.
w3.org/2004/02/skos/core#" xmlns:foaf="http://xmlns.com/foaf/0.1/" xmlns:dsbase="https://
data.wa.gov/resource/" xmlns:ds="https://data.wa.gov/resource/k43v-q6mx/">
<rdf:Description rdf:about="https://data.wa.gov/resource/k43v-q6mx/row-pjyx~iaiy_ttic">
```

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

```
    <socrata:rowID>row-pjyx~iaiy_ttic</socrata:rowID>
    <rdfs:member rdf:resource="https://data.wa.gov/resource/k43v-q6mx"/>
    <ds:intent_id>1093811</ds:intent_id>
    <ds:project_id>935287</ds:project_id>
    <ds:county_name>Yakima</ds:county_name></rdf:Description>
<rdf:Description rdf:about="https://data.wa.gov/resource/k43v-q6mx/row-kpva_s8xn_5499">
    <socrata:rowID>row-kpva_s8xn_5499</socrata:rowID>
    <rdfs:member rdf:resource="https://data.wa.gov/resource/k43v-q6mx"/>
    <ds:intent_id>1093810</ds:intent_id>
    <ds:project_id>935286</ds:project_id>
    <ds:county_name>Kitsap</ds:county_name></rdf:Description>
...
<rdf:Description rdf:about="https://data.wa.gov/resource/k43v-q6mx/row-6v3i_7x5f~w9jt">
    <socrata:rowID>row-6v3i_7x5f~w9jt</socrata:rowID>
    <rdfs:member rdf:resource="https://data.wa.gov/resource/k43v-q6mx"/>
    <ds:intent_id>1093176</ds:intent_id>
    <ds:project_id>934987</ds:project_id>
    <ds:county_name>King</ds:county_name></rdf:Description></rdf:RDF>
```


IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Annex C
(normative)

Conformance testing methodology

C.1 General

This annex specifies elements of the conformance testing methodology, test assertions and test procedures as applicable to this document.

Specifically, it establishes:

— test assertions of the structure of the face image data format as specified in this document (Type A Level 1),

— test assertions of internal consistency by checking the types of values that can be contained within each element (Type A Level 2), and

— tests of semantic assertions (Type A Level 3).

This conformance testing methodology does not establish:

— tests of conformance of CBEFF structures required by ISO/IEC 39794-1,

— tests of conformance of the image data to the quality-related specifications,

— 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).

To provide sufficient information about the IUT for the testing laboratory to properly conduct a conformance test and for an appropriate declaration of conformity to be made, the supplier of the IUT shall provide the identification of the supplier and the IUT information in Table C.1 and also complete the columns "IUT support" and "Supported range" in Table C.2 that apply to tested face image extensible BDB format(s). All tables shall be provided to the testing laboratory prior to or at the same time as the IUT is provided to the testing laboratory. W3C maintains a list of tools that can be used to work with XML documents and schemas[30]. ITU-T maintains a list of tools that can be used to work with ASN.1 documents and schemas[21]. Validating documents with the schemas assures all Level 1 conformance issues.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Table C.1 — Identification of the supplier and the IUT

Supplier name and address	
Contact point for queries about the ICS	
Implementation name	
Implementation version	
Any other information necessary for full identification of the implementation	
Registered BDB format identifier of the format to which conformance is claimed	
Are any mandatory requirements of the standard not fully supported (Yes or No)	
Date of statement	

 © ISO/IEC 2021 – All rights reserved

C.2 Requirements and options

Table C.2 lists the syntactic options and semantic conformance requirements specified in this document. The supplier of the IUT can explain which optional components of the standard document are supported and the testing laboratory can note the results of the test. Support is defined as the ability of the used structure to fulfil the requirements automatically without further testing. Support does not mean that the requirement cannot be fulfilled when using the structure. All requirements in Table C.2 can be fulfilled for both ASN.1 and XML.

Table C.2 details the Level 2 conformance tests that a testing organization should perform on an IUT. These Level 2 tests are necessary as the schema validation does not perform these checks. All other Level 1 and Level 2 conformance requirements are tested by schema validation.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Table C.2 — Requirements and options of the data format specification

Provision identifier	Reference in data format specification	Provision summary	Level	Status	Format type applicability		IUT support	Supported range	Test result
					Tagged binary encoding	XML encoding			
P-1	Annex A	A body image data block may contain unknown extensions.	1 and 2	O	Y	Y			
P-2	Annex A	A representation block may contain a capture date/time block.	1 and 2	O	Y	Y			
P-3	Annex A	A representation block may contain quality blocks.	1 and 2	O	Y	Y			
P-4	ISO/IEC 39794-1	A quality block may contain unknown extensions.	1 and 2	O	Y	Y			
P-5	Annex A	A representation block may contain a PAD data block.	1 and 2	O	Y	Y			
P-6	ISO/IEC 39794-1	A PAD data block may contain a PAD decision.	1 and 2	O	Y	Y			
P-7	ISO/IEC 39794-1	A PAD data block may contain PAD score blocks.	1 and 2	O	Y	Y			
P-8	ISO/IEC 39794-1	A PAD data block may contain extended data blocks.	1 and 2	O	Y	Y			
P-9	ISO/IEC 39794-1	A PAD data block may contain a context-of-capture field.	1 and 2	O	Y	Y			
P-10	ISO/IEC 39794-1	A PAD data block may contain a level-of-supervision/surveillance field.	1 and 2	O	Y	Y			
P-11	ISO/IEC 39794-1	A PAD data block may contain a risk level field.	1 and 2	O	Y	Y			
P-12	ISO/IEC 39794-1	A PAD data block may contain a category-of-criteria field.	1 and 2	O	Y	Y			
P-13	ISO/IEC 39794-1	A PAD data block may contain a PAD parameters field.	1 and 2	O	Y	Y			
P-14	ISO/IEC 39794-1	A PAD data block may contain PAD challenges.	1 and 2	O	Y	Y			
P-15	ISO/IEC 39794-1	A PAD data block may contain a PAD capture date/time field.	1 and 2	O	Y	Y			
P-16	Annex A	A representation block may contain a session identifier.	1 and 2	O	Y	Y			
P-17	Annex A	A representation block may contain a derived-from identifier.	1 and 2	O	Y	Y			
P-18	Annex A	A representation block may contain a capture device block.	1 and 2	O	Y	Y			

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Table C.2 *(continued)*

Provision identifier	Reference in data format specification	Provision summary	Level	Status	Format type applicability		IUT support	Supported range	Test result
					Tagged binary encoding	XML encoding			
P-19	Annex A	A capture device block may contain a model identifier block.	1 and 2	O	Y	Y			
P-20	Annex A	A capture device block may contain certification identifier blocks.	1 and 2	O	Y	Y			
P-21	Annex A	A capture device block may contain unknown extensions.	1 and 2	O	Y	Y			
P-22	Annex A	A representation block may contain a personal data block.	1 and 2	O	Y	Y			
P-23	Annex A	A personal data block may contain a case block.	1 and 2	O	Y	Y			
P-24	Annex A	A personal data block may contain an AM block.	1 and 2	O	Y	Y			
P-25	Annex A	A personal data block may contain a PM block.	1 and 2	O	Y	Y			
P-26	Annex A	A personal data block may contain a supporting information block.	1 and 2	O	Y	Y			
P-27	Annex A	A personal data block may contain a data extension block.	1 and 2	O	Y	Y			
P-28	Annex A	A body representation block may contain a body part and a pose angle block.	1 and 2	O	Y	Y			
P-29	Annex A	A pose angle block may contain a yaw angle block.	1 and 2	O	Y	Y			
P-30	Annex A	A yaw angle block may contain an angle value field.	1 and 2	O	Y	Y			
P-31	Annex A	A yaw angle block may contain an angle uncertainty field.	1 and 2	O	Y	Y			
P-32	Annex A	A yaw angle block may contain unknown extensions.	1 and 2	O	Y	Y			
P-33	Annex A	A pose angle block may contain a pitch angle block.	1 and 2	O	Y	Y			
P-34	Annex A	A pitch angle block may contain an angle value field.	1 and 2	O	Y	Y			
P-35	Annex A	A pitch angle block may contain an angle uncertainty field.	1 and 2	O	Y	Y			
P-36	Annex A	A pitch angle block may contain unknown extensions.	1 and 2	O	Y	Y			
P-37	Annex A	A pose angle block may contain a roll angle block.	1 and 2	O	Y	Y			
P-38	Annex A	A roll angle block may contain an angle value field.	1 and 2	O	Y	Y			
P-39	Annex A	A roll angle block may contain an angle uncertainty field.	1 and 2	O	Y	Y			
P-40	Annex A	A roll angle block may contain unknown extensions.	1 and 2	O	Y	Y			
P-41	Annex A	A personal data block may contain unknown extensions.	1 and 2	O	Y	Y			

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

Table C.2 *(continued)*

Provision identifier	Reference in data format specification	Provision summary	Level	Status	Format type applicability		IUT support	Supported range	Test result
					Tagged binary encoding	XML encoding			
P-42	Annex A	A body representation block may contain body landmarks blocks.	1 and 2	O	Y	Y			
P-43	Annex A	A body landmark block may contain a landmark kind value.	1 and 2	O	Y	Y			
P-44	Annex A	A body landmark block may contain a landmark co-ordinates block.	1 and 2	O	Y	Y			
P-45	Annex A	A body landmark co-ordinates block may contain a 2D Cartesian co-ordinates block.	1 and 2	O	Y	Y			
P-46	Annex A	A body landmark co-ordinates block may contain a texture image co-ordinates block.	1 and 2	O	Y	Y			
P-47	ISO/IEC 39794-5	A body landmark co-ordinates block may contain a 3D Cartesian co-ordinates block.	1 and 2	O	Y	Y			
P-48	Annex A	A body landmark co-ordinates block may contain unknown extensions.	1 and 2	O	Y	Y			
P-49	Annex A	A body landmark block may contain unknown extensions.	1 and 2	O	Y	Y			
P-50	Annex A	A body representation block may contain unknown extensions.	1 and 2	O	Y	Y			
P-51	Annex A	A body image representation may contain a 2D image representation block.	1 and 2	O	Y	Y			
P-52	Annex A	A 2D image representation block may contain a 2D capture device block.	1 and 2	O	Y	Y			
P-53	Annex A	A 2D capture device block may contain a capture wavelength range block.	1 and 2	O	Y	Y			
P-54	Annex A	A 2D body capture device capture wavelength range block contains wavelengths given in capture wavelength block element description.	1 and 2	O	Y	Y			
P-57	Annex A	A 2D capture wavelength range block may contain unknown extensions.	1 and 2	O	Y	Y			
P-58	Annex A	A 2D capture device block may contain a 2D capture device technology identifier field.	1 and 2	O	Y	Y			
P-59	Annex A	A 2D capture device block may contain unknown extensions.	1 and 2	O	Y	Y			

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Table C.2 *(continued)*

Provision identifier	Reference in data format specification	Provision summary	Level	Status	Format type applicability		IUT support	Supported range	Test result
					Tagged binary encoding	XML encoding			
P-60	Annex A	A 2D body image information block may contain a 2D body image kind field.	1 and 2	O	Y	Y			
P-61	Annex A	A 2D body image information block may contain a post body acquisition processing block.	1 and 2	O	Y	Y			
P-62	Annex A	A post body acquisition processing block within a 2D image information block may contain a rotated field.	1 and 2	O	Y	Y			
P-63	Annex A	A post body acquisition processing block within a 2D image information block may contain a cropped field.	1 and 2	O	Y	Y			
P-64	Annex A	A post body acquisition processing block within a 2D image information block may contain a down-sampled field.	1 and 2	O	Y	Y			
P-65	Annex A	A post body acquisition processing block within a 2D image information block may contain a white-balance-adjusted field.	1 and 2	O	Y	Y			
P-66	Annex A	A post body acquisition processing block within a 2D image information block may contain a multiply-compressed field.	1 and 2	O	Y	Y			
P-67	Annex A	A post body acquisition processing block within a 2D image information block may contain an interpolated field.	1 and 2	O	Y	Y			
P-68	Annex A	A post body acquisition processing block within a 2D image information block may contain a contrast-stretched field.	1 and 2	O	Y	Y			
P-69	Annex A	A post body acquisition processing block within a 2D image information block may contain a pose-corrected field.	1 and 2	O	Y	Y			
P-70	Annex A	A post body acquisition processing block within a 2D image information block may contain a multi-view image field.	1 and 2	O	Y	Y			
P-71	Annex A	A post body acquisition processing block within a 2D image information block may contain an age-progressed field.	1 and 2	O	Y	Y			
P-72	Annex A	A post body acquisition processing block within a 2D image information block may contain a super-resolution processed field.	1 and 2	O	Y	Y			
P-73	Annex A	A post body acquisition processing block within a 2D image information block may contain a normalised field.	1 and 2	O	Y	Y			

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Table C.2 *(continued)*

Provision identifier	Reference in data format specification	Provision summary	Level	Status	Format type applicability		IUT support	Supported range	Test result
					Tagged binary encoding	XML encoding			
P-74	Annex A	A post body acquisition processing block within a 2D image information block may contain a false colour processed field.	1 and 2	O	Y	Y			
P-75	Annex A	A post body acquisition processing block within a 2D image information block may contain a silhouette processed field.	1 and 2	O	Y	Y			
P-76	Annex A	A post body acquisition processing block within a 2D image information block may contain a neural network processed field.	1 and 2	O	Y	Y			
P-77	Annex A	A post body acquisition processing block within a 2D image information block may contain unknown extensions.	1 and 2	O	Y	Y			
P-78	Annex A	A 2D body image information block may contain a lossy-transformation attempts field.	1 and 2	O	Y	Y			
P-79	Annex A	A 2D body image information block may contain a camera-to-subject distance field.	1 and 2	O	Y	Y			
P-80	Annex A	A 2D body image information block may contain sensor diagonal field.	1 and 2	O	Y	Y			
P-81	Annex A	A 2D body image information block may contain a lens focal length field.	1 and 2	O	Y	Y			
P-82	Annex A	A 2D body image information block may contain an image size block which shall be included only if the 2D image data format is unknown or other or a later version extension code.	1 and 2	O	Y	Y			
P-83	Annex A	An image size block may contain a width field.	1 and 2	O	Y	Y			
P-84	Annex A	An image size block may contain a height field.	1 and 2	O	Y	Y			
P-85	Annex A	A 2D body image information block may contain a sampling rate block.	1 and 2	O	Y	Y			
P-86	Annex A	A sampling rate block may contain spatial and temporal rates.	1 and 2	O	Y	Y			
P-87	Annex A	A sampling rate block may contain unknown extensions.	1 and 2	O	Y	Y			
P-88	Annex A	A 2D body image information block may contain an image colour space field.	1 and 2	O	Y	Y			
P-89	Annex A	A 2D body image information block may contain sampling elements.	1 and 2	O	Y	Y			

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Table C.2 *(continued)*

Provision identifier	Reference in data format specification	Provision summary	Level	Status	Format type applicability		IUT support	Supported range	Test result
					Tagged binary encoding	XML encoding			
P-90	Annex A	A 2D body image information block may contain colour elements.	1 and 2	O	Y	Y			
P-91	Annex A	A 2D body image information block may contain JPEG EXIF data.	1 and 2	O	Y	Y			
P-92	Annex A	A 2D body image information block may contain forensic findings data.	1 and 2	O	Y	Y			
P-93	Annex A	A 2D body image information block may contain unknown extensions.	1 and 2	O	Y	Y			
P-94	Annex A	A 2D body image representation block may contain unknown extensions.	1 and 2	O	Y	Y			
P-95	ISO/IEC 39794-5	A body image representation may contain a 3D shape representation block.	1 and 2	O	Y	Y			

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

IUT support notes

To be filled in by the supplier of IUT on the copy of this table provided to the testing laboratory and to be included in the copy of this table that forms part of the test report.

Test result notes

To be filled in by the testing laboratory if necessary during the execution of the conformance test and to be included in the copy of this table that forms part of the test report.

C.3 Conformance test assertions

Level 1 and 2 requirements and options shall be tested by:

— decoding tagged binary data blocks under test based on the ASN.1 module that specifies the tagged binary data format, or

— validation of XML documents under test against the XML schema definition that specifies the textual data format, respectively.

C.4 Conformance testing for profiles given in Annex D

This subclause specifies conformance testing methodologies for the specific requirements according to the application profiles as given in Annex D.

NOTE Currently, no conformance testing methodologies for the application profiles in Annex D are available for this document.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved

Annex D
(informative)

Application profiles

D.1 Basic body image 2D

D.1.1 General

The basicBodyImage2D profile is used for basic 2D body image capturing.

D.1.2 Capture profiles

For a Level-51 image capture profile, the minimum number of pixels in the digital image shall be 2 400 pixels in the horizontal direction by 3 200 pixels in the vertical direction. Off-the-shelf 8 megapixel digital cameras satisfy this requirement. Most robust mobile phones are capable of taking level 51 or higher-level images. Submillimetre (THz) cameras and scanners have more limited image sizes in pixels due to the terahertz wavelength resolution constraints. THz frames are typically 0,4 kilopixels.

Level 50 image size is compatible with 4K video format as shown in Table D.1. 4K is typically a landscape format when both Level-50 and Level-51/52 has been defined as portrait formats. The 50 and 51 profile levels are intended to allow for examination of up to forensic-level (10 ppmm) detail on a subject's face. The only difference between levels 50 and 51 is that level 50 specifies the "head and shoulders" composition requirements while level 51 specifies the "head only" composition requirements.

Image orientation is generally not a problem as JPEG EXIF metadata shows the camera orientation. MPEG-4 AVC/H.264 (ISO/IEC 14496-10 – MPEG-4 Part 10, Advanced Video Coding) implementations for video coding allow frame extraction for biometric sample comparison processing to take place. MPEG-4 Part 14 or MP4 is a digital multimedia format most commonly used to store video and audio. MPEG-4 Part 14 (formally ISO/IEC 14496-14:2003) is a standard specified as a part of MPEG-4. MP4 is the related container file format.

Table D.1 — Comparison of image formats

Image format name (details)	Resolution	Aspect ratio	Pixels
Level-51/52 (profile)	2400 × 3200	1:1,33 (3:4)	7 680 000
Level-50 (profile)	3300 × 4400	1:1,33 (3:4)	14 520 000
DCI 4K (native resolution)	4096 × 2160	1,90:1 (19:10)	8 847 360

ANSI/NIST has defined best practices for mugshots. These definitions are used as a baseline also for full body images. For an ANSI/NIST Level-50[20] image capture profile, the minimum number of pixels in the digital image shall be 3300 pixels in the horizontal direction by 4400 pixels in the vertical direction. Off-the-shelf 15 (or more) megapixel digital cameras satisfy this requirement.

There are several video surveillance frame formats in use. It is recommended to use HD, 4K or 8K video frame formats given in Table D.2.

Table D.2 — Comparison of video surveillance frame formats

Image format name (details)	Resolution
8K	4320 × 7680
4K	2160 × 3840

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

Table D.2 *(continued)*

Image format name (details)	Resolution
HD (1080p)	1920 × 1080
HD (720p)	1280 × 720
WSVGA screen	1024 × 600
SVGA screen	800 × 600
PAL (576i)	720 × 400
NTSC (486i)	720 × 340
4CIF (576p)	704 × 576
2CIF (288p)	704 × 288
VGA screen	640 × 480
CIF (288p)	352 × 288
QCIF (144p)	176 × 144

Level 50 image size is also compatible with 8K video format as shown in Table D.1 and Figure D.1.

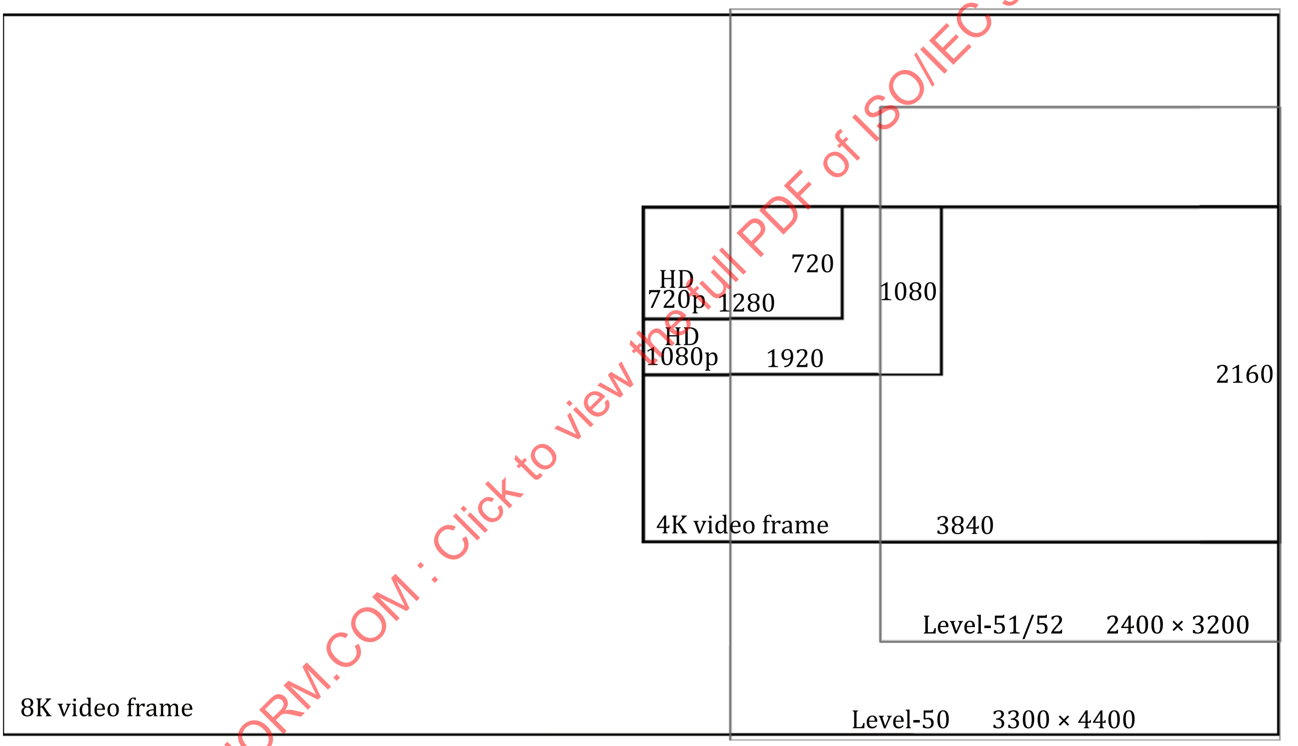


Figure D.1 — Relative frame size comparison between video and full body images

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

D.1.2.1 Camera images taken in white light

In order to assure the required image quality system, installers shall make quality assurance measurements of light conditions and camera system response as defined in Annex E.

The set of photographs shall include at least five photographs of the subject: (frontal, left full body profile, right full body profile, left half body profile and right half body profile).

Gait recognition and full body recognition can be paired to form a multi-mode biometric process in order to improve the performance of a biometric system[38]. If the subject's facial area is not visible or the number of pixels in a video surveillance or other security camera still image is too low then body silhouette can be used for identification or verification purposes.

© ISO/IEC 2021 – All rights reserved

In order to achieve good sample fidelity, there shall be no saturation (e.g. over- or under-exposure) on the measurement target. All RGB channels of the image should have at least 7 bits of intensity variation (i.e. span a range of at least 128 unique values) in the test target patch region of the image. This is required to get as near as possible to an L* level of 50, which in turn ensures a wide sRGB[23] gamut is available for the analysis.

Subject and Scene Lighting: Lighting shall be equally distributed on the subject. There shall be no significant direction of the light from the point of view of the photographer.

Hot spots and specular reflections: Hot spots (i.e. bright regions that result from light shining directly on subject) shall be absent.

D.1.2.2 Body recognition images

High-resolution Level-50 and 4K visual wavelength range still images are suitable even for face image recognition processes. In automated processing, the parsing of the body tree can first be required, which in practice involves the detection of all body parts and forming of a body tree model. In this case, the facial and upper torso are used to get the face image. Some face recognition programs already include this feature.

Images based on submillimetre wavelength radiation show the body excluding clothing which mostly hides the biometric human body. Submillimetre wavelength radiation also called terahertz radiation can pass through clothing, paper, plastic and ceramics. It cannot penetrate liquid water or metal. Because THz is not ionizing and can penetrate some distance through body tissue, it is used as a replacement for medical X-rays. Distances lower than 10 metres are useful for imaging purposes. The full body pose shall be between 60 % and 95 % of the vertical length of the image. The whole-body width shall be visible.

D.1.2.3 Gait recognition images

Gait recognition image sequence profiles are defined in ISO/IEC 39794-17. There are two profiles for gait recognition: *gait2D* for full body gait recognition, and *uBM2D* for upper body movement sequences.

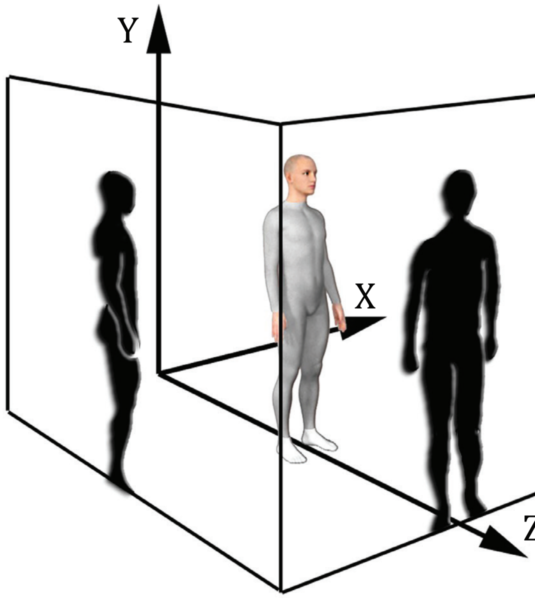
A gait recognition silhouette is the image of an individual represented as a solid shape of a single colour, usually black. The edges of a silhouette match the outline of the subject. Gait recognition walk through video recording is recommended to improve the performance of both gait recognition and full body photometric recognition[42]. Camera may produce silhouette images directly or these images are formed in subsequent post-processing steps.

For example, for the gait feature extraction, width and height of the human silhouette is measured. The dimension of the human silhouette, joint angle, angle velocity and gait velocities from the body segments are calculated as the gait features.

Figure D.2 illustrates the typical viewing angles used in gait recognition camera placement [41]-[42].

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved



NOTE Typical viewing angles for gate recognition are shown in black.

Figure D.2 — Typical viewing angles for gait recognition

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

D.2 Post-processed body image 2D

D.2.1 General

The post-processedBodyImage2D profile is used for 2D post-processed body images. The basic requirement for post-processed images is to fulfil the needs of automatic recognition and human inspection requirements. It is recommended to save also the original camera image and the basic body image with possible JPEG EXIF metadata in order to allow subsequent post-processing steps to take place.

D.2.2 Post-processing

To satisfy the requirements for minimum image size, the normative practice shall be to fill any undefined set of pixels with sRGB middle grey (128, 128, 128). This process does not refer to the filling of the background along the body contour line, which shall be avoided in full body images.

The middle grey is a tone that is perceptually about halfway between black and white on a lightness scale. The use of grey is based on the assumption that the human viewer is less distracted by the image fringe area when grey is used if compared to white or black borders. In the sRGB colour space used widely in monitors and photography, CIELAB middle grey is equivalent to 46,6 % brightness. Middle grey is typically defined as 18 % reflectance in visible light.

D.3 Basic body 2D image from 3D shape

D.3.1 General

The basicBodyImage2DFrom3D profile is used for 3D to 2D converted images. The basic full body 3D shape obeys all normative 3D requirements given in ISO/IEC 39794-5:2019, 7.56 ("3D shape representation block").

 © ISO/IEC 2021 – All rights reserved

D.3.2 3D rendering

Requirements for the post-processing of the full body image depend on the use of the post-processing results. 3D model-based standard views are rendered based on the 3D model and related image maps. The quality of the rendering should be based on the result user requirements. For facial quality rendering see ISO/IEC 39794-5.

D.4 Interrogation and surveillance images 2D

D.4.1 General

The InterSurImage2D profile is used for 2D interrogation and surveillance images. There are several image and video frame formats in use for interrogation and surveillance images and videos. Also, the subject is viewed from different angles depending on the camera setup[41].

This profile does not restrict the quality or cropping of the images. The quality of the imaging should be based on the result-user requirements.

D.4.2 Metadata, encoding and annotation

The basic requirement for interrogation and surveillance images is to fulfil the needs of automatic recognition and human inspection requirements, including lip recognition for lip-reading applications.

Video elements should conform to ISO/IEC 30137-4 when annotation is required.

ISO/IEC 30137-4 establishes requirements on the annotation of video and still imagery of humans, human faces and other body parts. It specifies the following.

— Metadata to be inserted in a video stream.

— Encoding of full and partial spatial and temporal ground truth information for:

  — objects present in a video, and

  — objects absent in a video.

— Procedures for different annotation of known and unknown subjects.

These annotations or a link to annotations is added to the forensic findings.

D.5 Scars, marks and tattoos images 2D

D.5.1 General

The sMTImage2D profile is used for images of scars, body marks and tattoos. Scars, marks and tattoos (SMT) are being increasingly used for suspect and victim identification in forensics and law enforcement agencies as soft biometrics. This can prove controversial from the viewpoint of biometrics because there can be arguments that a tattoo is not a real biometric, and that it is “self expression” or “free speech”. However, tattoos are receiving significant attention because of their visual and demographic characteristics as well as their increasing prevalence. A manual tattoo-matching procedure requires human-assigned class labels as in ANSI/NIST ITL 1-2011[20] and in the related INTERPOL interpretation. This manual procedure makes it time consuming and subjective with limited retrieval performance. It is practically impossible to classify scars and marks on a level where the classification helps in recognition. The use of trained neural networks makes the recognition faster and more reliable. Given that tattoo images are complex and often contain multiple objects with large intra-class variability, it is very difficult to assign a single category in ANSI/NIST ITL 1-2011[20].

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

© ISO/IEC 2021 – All rights reserved

D.5.2 Best practices

The basic requirement for scars, marks and tattoo images is to fulfil the needs of automatic recognition and human inspection requirements. It is recommended to also save the original camera image with possible JPEG EXIF metadata in order to allow subsequent post-processing steps to take place. Minimum requirement for the scars, marks and tattoo images is Level-51/52 and it is recommended to take Level-50 images.

The following recommendations apply to this profile:

— collect at least two photographs;

— take photographs far away and zoomed close-up;

— use a plain background and uniform, diffuse, bright lighting;

— ensure that the scar, mark or tattoo is in focus with good contrast against skin;

— ensure that there are no occlusions or background clutter;

— ensure that the subject's limbs are parallel to the torso;

— minimum distance of 1 m between camera and subject.

Figure D.3 shows the suggested cropping with a yellow dash line. In the second example, the background is not plain and contains texture which may cause errors in the recognition.

a) Example 1 b) Example 2

Figure D.3 — Tattoo image cropping examples

Best practice guidelines for the collection of good quality tattoo images are given in the NIST documentation[26]. The same guidelines apply to the scars and marks collection.

D.6 Gait image sequence 2D

Gait image sequence profile gait2D is defined in ISO/IEC 39794-17.

D.7 Upper body motion image sequence 2D

Upper body motion image sequence profile uBM2D is defined in ISO/IEC 39794-17.

IECNORM.COM : Click to view the full PDF of ISO/IEC 39794-16:2021

 © ISO/IEC 2021 – All rights reserved