

INTERNATIONAL STANDARD

ISO/IEC 19794-5

First edition
2005-06-15

Corrected version
2016-09-01

Information technology — Biometric data interchange formats —

Part 5: Face image data

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

Partie 5: Données d'image de la face

Reference number
ISO/IEC 19794-5:2005(E)





COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2005, Published in Switzerland

All rights reserved. Unless otherwise specified, 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
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	viii
Introduction.....	ix
1 Scope	1
2 Compliance	2
3 Normative references	2
4 Terms and definitions	3
5 The Face Image Record Format	6
5.1 Overview	6
5.2 Data Conventions	9
5.2.1 Byte ordering	9
5.2.2 Numeric values	9
5.2.3 Conversion to integer	9
5.2.4 Unspecified field value.....	9
5.2.5 Unknown field value	9
5.3 The CBEFF Header	9
5.4 The Facial Record Header	10
5.4.1 Format Identifier	10
5.4.2 Version Number	10
5.4.3 Length of Record	10
5.4.4 Number of Facial Images	10
5.5 The Facial Information Block	10
5.5.1 Facial Record Data Length	11
5.5.2 Number of Feature Points.....	11
5.5.3 Gender	11
5.5.4 Eye Colour	11
5.5.5 Hair Colour	12
5.5.6 Property Mask	12
5.5.7 Expression	13
5.5.8 Pose Angle	13
5.5.9 Pose Angle Uncertainty	15
5.6 The Landmark Point Block	15
5.6.1 Landmark Point Type	16
5.6.2 Landmark Point Code	16
5.6.3 MPEG4 Feature Points	16
5.6.4 Eye and nostril Landmark Points.....	17
5.6.5 Anthropometric Landmarks	18
5.6.6 Anthropometric 3D landmark	21
5.6.7 Z Coordinate.....	21
5.7 The Image Information Block	22
5.7.1 Face Image Type.....	22
5.7.2 Image Data Type	23
5.7.3 Width.....	23
5.7.4 Height.....	23
5.7.5 Image Colour Space	23
5.7.6 Source Type	23
5.7.7 Device Type.....	24
5.7.8 Quality.....	24
5.8 The Image Data Block	24
5.8.1 Data structure	24
5.9 The 3D Information Block.....	24

5.9.1	Length of 3D Data Representation	25
5.9.2	Coordinate System Type	25
5.9.3	Texture Projection Matrix	27
5.9.4	ScaleX, ScaleY, ScaleZ, OffsetX, OffsetY, OffsetZ	27
5.9.5	3D Representation Type	28
5.9.6	3D Supplemental Data	28
5.9.7	3D Source Type	28
5.9.8	3D Device Type	29
5.9.9	3D to 2D Image Temporal Synchronicity	29
5.9.10	3D to 2D Texture Temporal Synchronicity	29
5.9.11	3D Acquisition Time	30
5.9.12	2D Texture Acquisition Time	30
5.9.13	Texture Map Type	30
5.9.14	Texture Map Spectrum	31
5.10	The 3D Data Block	31
5.10.1	Range Image Bit Depth	31
5.10.2	Range Image	32
5.10.3	3D Point Map Width and Height	32
5.10.4	3D Point Map	32
5.10.5	Vertex Data	32
5.10.6	Triangle Data	33
5.10.7	Error Map	33
5.10.8	Texture Map	33
6	The Basic Face Image Type	34
6.1	Inheritance requirements for the Basic Face Image Type	34
6.2	Image data encoding requirements for the Basic Face Image Type	34
6.3	Image data compression requirements for the Basic Face Image Type	34
6.4	Format requirements for the Basic Face Image Type	34
6.4.1	Facial Header	34
6.4.2	Facial Information	34
6.4.3	Image Information	34
7	The Frontal Face Image Type	34
7.1	Inheritance requirements for the Frontal Face Image Type	34
7.2	Scene requirements for the Frontal Image Type	35
7.2.1	Purpose	35
7.2.2	Pose	35
7.2.3	Expression	35
7.2.4	Assistance in positioning the face	36
7.2.5	Shoulders	36
7.2.6	Backgrounds	36
7.2.7	Subject and scene lighting	36
7.2.8	Shadows over the face	36
7.2.9	Shadows in eye sockets	36
7.2.10	Hot spots	36
7.2.11	Eye glasses	36
7.2.12	Eye patches	36
7.3	Photographic Requirements for the Frontal Image Type	37
7.3.1	Purpose	37
7.3.2	No over or under exposure	37
7.3.3	Focus and depth of field	37
7.3.4	Unnatural colour	37
7.3.5	Colour or greyscale enhancement	37
7.3.6	Radial distortion of the camera lens	37
7.4	Digital requirements for the Frontal Image Type	37
7.4.1	Geometry	37
7.4.2	Colour profile	38
7.4.3	Video interlacing	38
7.5	Format requirements for the Frontal Image Type	38
7.5.1	Inheritance requirements	38

7.5.2	Image Information	38
8	The Full Frontal Image Type	39
8.1	Inheritance requirements for the Full Frontal Face Image Type	39
8.2	Scene requirements for the Full Frontal Face Image Type	39
8.3	Photographic requirements for the Full Frontal Face Image Type	39
8.3.1	Introduction	39
8.3.2	Horizontally centred face	40
8.3.3	Vertical position of the face	40
8.3.4	Width of head	40
8.3.5	Length of head	40
8.3.6	Summary of photographic requirements	40
8.4	Digital requirements for the Full Frontal Face Image Type	41
8.4.1	Resolution	41
8.5	Format requirements for the Full Frontal Image Type	41
8.5.1	Inheritance requirements	41
8.5.2	Image Information	41
9	The Token Face Image Type	41
9.1	Inheritance requirements for Token Face Image Type	41
9.2	Digital requirements for the Token Face Image Type	42
9.2.1	Introduction	42
9.2.2	Eye positions	42
9.2.3	Token image geometric format	42
9.2.4	Minimum width Token image	43
9.2.5	Padding	43
9.3	Format requirements for the Token Face Image Type	43
9.3.1	Inheritance requirements	43
9.3.2	Image Information	43
10.	The Basic 3D Image Type	43
10.1	Inheritance Requirements for the Basic 3D Image Type	43
10.2	The Basic 3D Image Type using the 3D Point Map representation	44
10.2.1	Coordinate System Type	44
10.2.2	ScaleX, ScaleY and ScaleZ	44
10.3	The Basic 3D Image Type using the 3D Vertex representation	44
10.3.1	Coordinate System Type	44
10.3.2	ScaleX, ScaleY and ScaleZ	44
11	The Full Frontal 3D Image Type	44
11.1	Inheritance requirements	44
11.2	Coordinate System Type	44
11.3	Pose of the 3D representation	44
11.4	Calibration Texture Projection Accuracy	45
11.5	Requirements on Full Frontal 3D Image Types using the Range Image Representation	45
11.5.1	ScaleX, ScaleY and ScaleZ	45
11.5.2	Face Coverage	45
11.5.3	Non-valid points in 3D data Image	45
11.6	Requirements on Full Frontal 3D Image Types using the 3D Point Map Representation	46
11.7	Requirements on Full Frontal 3D Image Types using the 3D Vertex Representation	46
12	The Token Frontal 3D Image Type	46
12.1	General	46
12.2	Inheritance requirements	46
12.3	Requirements on Token Frontal 3D Image Types using the Range Image Representation	47
12.4	Requirements on Token Frontal 3D Image Types using the 3D Point Map Representation	47
12.5	Requirements on Token Frontal 3D Image Types using the Vertex Representation	47
	Bibliography	48
	Annex A	49
A.1	Best practices for Basic Face Images	49
A.1.1	Purpose	49
A.1.2	Feature Point determination	49

A.2	Best practices for Frontal Images	49
A.2.1	Purpose.....	49
A.2.2	Pose.....	49
A.2.3	Expression.....	49
A.2.4	Assistance in positioning the face.....	49
A.2.5	Background.....	50
A.2.5.1	Background segmentation.....	50
A.2.5.2	Background shadows.....	50
A.2.5.3	Background uniformity.....	50
A.2.5.4	Background examples.....	50
A.2.6	Focus and depth of field.....	50
A.2.7	No unnatural colour.....	50
A.2.8	Colour calibration.....	50
A.2.9	Radial distortion of the camera lens.....	50
A.3	Best practices for Full Frontal Images	51
A.3.1	Digital attributes of Full Frontal Images.....	51
A.3.1.1	Photo resolution.....	51
A.3.2	Best practices for use of Full Frontal Images on Travel Documents.....	51
A.3.2.1	Width to height ratio of the image.....	51
A.3.2.2	Head size relative to the image size.....	51
A.3.2.3	Summary of best practice photographic recommendations.....	51
A.3.2.4	Sample images and sample photograph taking guidelines for travel documents.....	53
A.3.3	Full Frontal Image compression.....	56
A.3.3.1	Compression – no region of interest.....	56
A.3.3.2	Recommendations for maximum compression and file sizes for JPEG and JPEG2000.....	57
A.3.4	Full Frontal Image compression using region of interest.....	57
A.3.4.1	Discussion.....	57
A.3.4.2	Inner and outer regions, Full Image.....	58
A.4	Best practices for Token Images	58
A.4.1	Token image sizes.....	58
A.4.2	Creation of a Token Image.....	59
A.4.3	Best practices for digital attributes of Token Images.....	59
A.4.4	Token Image compression.....	60
A.4.4.1	Compression – no region of interest.....	60
A.4.4.2	Recommendations for maximum compression and file sizes for JPEG and JPEG2000 Token Images.....	61
A.4.5	Token Image compression using region of interest.....	61
A.4.5.1	Discussion.....	61
A.4.6	Inner and outer regions for the Token Image for the purpose of compression.....	62
A.5	Experimental study on the enrolment of full frontal images for travel documents	62
A.5.1	Software and data used for the analysis.....	62
A.5.2	Experimental results.....	63
A.5.2.1	Inter-eye distance.....	63
A.5.2.2	Relative horizontal position of the face.....	64
A.5.2.3	Relative vertical position of the face.....	64
A.5.2.4	Head Image Width Ratio.....	65
A.5.2.5	Head Image Height Ratio.....	66
A.5.3	Error Discussion.....	67
A.5.4	Summary.....	67
A.6	Study on the effects of inter-eye distance and roll on biometric comparison performance	68
A.6.1	Inter-eye distance.....	68
A.6.2	Pose.....	69
A.7	Best Practices for the Full Frontal 3D Image Type	70
A.7.1	Best Practices for the 2D part of the Full Frontal 3D Image Type.....	70
A.7.2	Compatibility considerations.....	70
A.7.3	Pose of the 3D representation.....	70
A.7.4	3D to 2D Image Temporal Synchronicity.....	71
A.7.5	3D Acquisition Time.....	71
A.7.6	Best Practices for Full Frontal 3D Image Types using the Range Image Representation.....	71
A.7.6.1	ScaleX, ScaleY and ScaleZ.....	71

A.7.6.2	Non-valid points in Range Image.....	71
A.7.7	Best Practices for the Full Frontal 3D Image Types using the 3D Point Map Representation.....	71
A.7.7.1	3D Point Map Width and Height	71
A.7.7.2	Face coverage.....	71
A.7.8	Best Practices for Full Frontal 3D Image Types using the 3D Vertex Representation.....	71
A.7.8.1	Face coverage.....	71
A.8	Best Practices for Token Frontal 3D Images	72
A.8.1	Best Practices for the 2D part of the Token Frontal 3D Image	72
A.8.2	Compatibility considerations	72
A.8.3	Pose of the 3D representation.....	72
A.8.4	3D to 2D Image Temporal Synchronicity	72
A.8.5	3D Acquisition Time	72
A.8.6	Best Practices for Token Frontal 3D Image Types using the Range Image Representation	72
A.8.7	Best Practices for Token Frontal 3D Image Types using the 3D Point Map Image Representation.....	72
A.8.8	Best Practices for Token Frontal 3D Image Types using the Vertex Representation	72
A.9	Summary of mandatory and best practices for the 3D Image Types.....	72
Annex B	75
B.1	Scope	75
B.2	Photography recommendations	75
B.2.1	General	75
B.2.2	Recommendations for a photo studio or store	75
B.2.3	Recommendations for photo booths	79
B.2.4	Recommendations for a registration office environment	83
B.3	Guidelines for printing	84
B.3.1	General	84
B.3.2	Spatial and tonal resolution trade-offs.....	85
B.3.3	Recommended printing quality.....	85
B.3.4	Use of a photo template.....	86
B.4	Guidelines for scanning.....	86
B.4.1	General	86
B.4.2	Sampling frequency and quantization levels	87
B.4.3	Spatial resolution	87
B.4.4	Output colour space.....	87
B.4.5	Saturation	87
B.4.6	Image compression.....	87
B.5	Face image quality assessment software.....	87
B.6	Tables of the recommendations	89
B.6.1	General	89
B.6.2	Scene setting	89
B.6.3	Photographing	91
B.6.4	After photographing.....	91
B.6.5	Photographic quality.....	92
B.7	Experimental data.....	93
B.7.1	Experimental results of face recognition in a photo studio and photo booth	93
B.8	Photographic examples	94
B.8.1	General	94
B.8.2	Photographic examples at a photo studio.....	94
B.8.3	Photographic examples at a photo booth.....	99
Annex C	104

Foreword

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

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

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

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

This consolidated reprint of ISO/IEC 19794-5:2005 was prepared by Joint Technical Committee ISO/IEC JTC1, *Information Technology*, Subcommittee SC 37, *Biometrics*.

This consolidated reprint of ISO/IEC 19794-5:2005 contains the original content of ISO/IEC 19794-5:2005 and incorporates the Amendments ISO/IEC 19794-5:2005/Amd 1:2007 and ISO/IEC 19794-5:2005/Amd 2:2009 and the Technical Corrigenda ISO/IEC 19794-5:2005/Cor 1:2008, ISO/IEC 19794-5:2005/Cor 2:2008, ISO/IEC 19794-5:2005/Cor 3:2013, ISO/IEC 19794-5:2005/Cor 4:2015, and the unpublished draft of ISO/IEC 19794-5:2005/Cor 5.

Introduction

Face images, also commonly referred to as displayed portraits, have been used for many decades to verify identity of persons. In recent years, digital face images are used in many applications including human examination as well as computer automated face recognition. Although photographic formats have been standardized in some cases such as passport and driver license, it is also demanded to define a standard data format of digital face images to allow interoperability among vendors.

This document is intended to provide a face image format for face recognition applications requiring exchange of face image data. The typical applications are:

- Human examination of facial images with sufficient resolution to allow a human examiner to ascertain small features such as moles and scars that might be used to verify identity;
- Human verification of identify by comparison of persons against facial images;
- Computer automated face identification (one-to-many searching);
- Computer automated face verification (one-to-one matching).

To enable many applications on variety of devices, including devices that have the limited resources required for data storage, and to improve face recognition accuracy, this document specifies not only a data format, but also scene constraints (lighting, pose, expression, etc.), photographic properties (positioning, camera focus, etc.), digital image attributes (image resolution, image size, etc.).

Several image types are introduced to define categories that satisfy requirements of some applications. Each requirement is specified for each image type.

The record format specified in this document is designed to be embedded in a CBEFF-compliant structure specified in the multi-part Standard ISO/IEC 19785. The embedment in the CBEFF structure is described in ISO/IEC 19794-1:2006.

Information technology – Biometric data interchange formats – Face image data

1 Scope

This document specifies

- A record format for storing, recording, and transmitting the information from one or more facial images within a CBEFF data structure,
- Scene constraints of the facial images,
- Photographic properties of the facial images,
- Digital image attributes of the facial images.

Each requirement is specified for the following *Face Image Types*, respectively.

- **Basic:** This is the fundamental *Face Image Type* that specifies a record format including header and image data. All *Face Image Types* adhere to the properties of this type. No mandatory scene, photographic and digital requirements are specified for this image type.
- **Frontal:** A *Basic Face Image Type* that adheres to additional requirements appropriate for frontal face recognition and/or human examination. Two types of *Frontal Face Image Types* are defined in this document, *Full Frontal* and *Token Frontal* (or simply *Token*).
- **Full Frontal:** A *Face Image Type* that specifies frontal images with sufficient resolution for human examination as well as reliable computer face recognition. This type of *Face Image Type* includes the full head with all hair in most cases, as well as neck and shoulders. This image type is suitable for permanent storage of the face information, and it is applicable to portraits for passport, driver license, and “mug shot” images.
- **Token Frontal:** A *Face Image Type* that specifies frontal images with a specific geometric size and eye positioning based on the width and height of the image. This image type is suitable for minimizing the storage requirements for computer face recognition tasks such as verification while still offering vendor independence and human verification (versus human examination which requires more detail) capabilities.

Table 1 shows the relationships between *Face Image Types* using the notion of inheritance. For example, *Frontal* inherits properties from *Basic*, which means that all normative Clauses that apply to *Basic* also apply to *Frontal*.

Table 1 – Inheritance of Face Image Types

Face Image Type	Inherits from	Normative Clauses	Informative Clauses
Basic	None	1, 2, 3, 4, 5, 6	A.1
Frontal	Basic	7	A.2
Full Frontal	Frontal	8	A.3
Token	Frontal	9	A.4

Figure 1 gives a general overview of the scene, photographic, digitization, and format requirements for the face image types specified in this document. The *Basic Face Image Type* has no scene, photographic, or digital requirements.




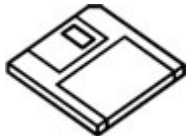





Requirements							
Scene		Photographic		Digital		Format	
 Lighting		 Positioning		 Digital Camera		 Digital Specifications	
 Image and Subject		 Camera Attributes		 Analogue to Digital		 Record Format and Organization	
 Image Scanning							
<i>Clauses:</i> Basic Face None		<i>Clauses:</i> Basic Face None		<i>Clauses:</i> Basic Face None		<i>Clauses:</i> Basic Face 5 6.2 6.3 6.4	
Frontal Face 7.2 Full Frontal Face 8.2		Frontal Face 7.3 Full Frontal Face 8.3		Frontal Face 7.4 Full Frontal Face 8.4 Token Face 9.2		Frontal Face 7.5 Full Frontal Face 8.5 Token Face 9.3	

Figure 1 – Types of imaging requirements specified in this document.

2 Compliance

Conformity with this document requires compliance with the record format specification defined in Clauses 5 and the *Basic Face Image Type* defined in Clause 6. In addition, this document defines additional *Face Image Types*. Compliance with the *Full Frontal Face Image Type* requires compliance with Clauses 5, 6, 7, and 8. Conformity with the *Token Frontal Image Type* requires additional compliance with Clause 5, 6, 7, and 9.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- ISO/IEC 19785 Information technology -- Common Biometric Exchange Formats Framework – Multi-part Standard
- ISO/IEC 19794-1:2006 Information technology — Biometric data interchange formats — Part 1: Framework

- ISO/IEC 10918-1, Information technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines
- ISO/IEC 15444-1, Information technology — JPEG 2000 image coding system: Core coding system
- C-Cube Microsystems, JPEG File Interchange Format (JFIF), Version 1.02
- PIMA 7667:2001, Photography – Electronic Still Picture Imaging – Extended sRGB Color Encoding – e-sRGB
- ICC.1:2001-12, File Format for Color Profiles
- ISO/IEC 14496-2:2004, Information technology - Coding of audio-visual objects - Part 2: Visual (MPEG4)
- ISO/IEC 15948:2004, Information technology — Computer graphics and image processing — Portable Network Graphics (PNG): Functional specification