# ISO/IEC 19794-5:2005-06 (E)

## Information technology - Biometric data interchange formats - Part 5: Face image data

## 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