INTERNATIONAL STANDARD

ISO/IEC 29109-4

First edition
2010-05-01

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

Part 4: Finger image data

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

Partie 4: Données d'image du doigt

Reference number
ISO/IEC 29109-4:2010(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

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

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

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

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

ISO/IEC 29109 consists of the following parts, under the general title *Information technology — Conformance testing methodology for biometric data interchange formats defined in ISO/IEC 19794*:

— *Part 1: Generalized conformance testing methodology*

— *Part 2: Finger minutiae data*

— *Part 4: Finger image data*

— *Part 5: Face image data*

— *Part 6: Iris image data*

— *Part 8: Finger pattern skeletal data*

— *Part 9: Vascular image data*

— *Part 10: Hand geometry silhouette data*

The following part is under preparation:

— *Part 7: Signature/sign time series data*

Introduction

ISO/IEC 19794-4:2005 specifies a data record interchange format for recording, storing, and transmitting one or more finger images within a common biometric exchange formats framework (CBEFF) data structure. Each image is accompanied by image-specific metadata contained in a header record. This part of ISO/IEC 29109 establishes tests for checking the correctness of the binary record.

The objective of ISO/IEC 19794-4:2005 cannot be completely achieved until biometric products can be tested to determine whether they conform to those specifications. Conforming implementations are a necessary prerequisite for achieving interoperability among implementations; therefore there is a need for a standardized conformance testing methodology, test assertions, and test procedures as applicable to specific modalities addressed by each part of ISO/IEC 19794. The test assertions will cover, as far as practical, the ISO/IEC 19794 requirements (covering the most critical features), so that the conformity results produced by the test suites will reflect the real degree of conformity of the implementations to ISO/IEC 19794 data interchange format records. This is the motivation for the development of this conformance testing methodology.

This part of ISO/IEC 29109 supports those applications that require use of finger image data according to ISO/IEC 19794-4:2005. It defines a testing methodology to ensure conformance of a vendor's application or service to ISO/IEC 19794-4:2005. Thus this part of ISO/IEC 29109 is intended to

— establish elements of the conformance testing methodology framework that are specific to the finger and palm image-based data record requirements of ISO/IEC 19794-4:2005 conformance testing,

— define requirements and guidelines for specifying conformance test suites and related test methods for measuring conformity of products and services to the finger image data record requirements of ISO/IEC 19794-4:2005, and

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

This part of ISO/IEC 29109 is applicable to the development and use of conformity test method specifications, conformity test suites for ISO/IEC 19794-4:2005 records, and conformance testing programs for ISO/IEC 19794-4:2005 conformant products. It is intended primarily for use by testing organizations, but may be applied by developers and users of test method specifications and test method implementations. The table of test assertions (Clause 6.2, Table 2) specifies test assertions for the conformance requirements of ISO/IEC 19794-4:2005.

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

Part 4: Finger image data

1 Scope

This part of ISO/IEC 29109 specifies elements of conformance testing methodology, test assertions, and test procedures as applicable to ISO/IEC 19794-4.

It establishes

— test assertions of the structure of the finger image data format as specified in ISO/IEC 19794-4:2005 (Type A Level 1 as defined in ISO/IEC 29109-1:2009),

— test asssertions of internal consistency by checking the types of values that may be contained within each field (Type A Level 2 as defined in ISO/IEC 29109-1:2009),

— tests of semantic assertions (Type A Level 3 as defined in ISO/IEC 29109-1:2009).

It does not establish

— tests of conformance of CBEFF structures required by ISO/IEC 19794-4:2005,

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

— tests of conformance of systems that do not produce ISO/IEC 19794-4:2005 records.

2 Conformance

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

Implementations of ISO/IEC19794-4:2005 tested according to the methodology specified shall be able to claim conformance only to those biometric data record (BDB) requirements specified in ISO/IEC 19794-4:2005 that are tested by the test methods established by this methodology.

Implementations of ISO/IEC 19794-4:2005 do not necessarily need to conform to all possible aspects of ISO/IEC 19794-4:2005, but only to those ISO/IEC 19794-4:2005 requirements that are claimed to be supported by the implementation in an implementation conformance statement (ICS), filled out in accordance with Clause 8 of ISO/IEC 29109-1:2009 and Table 1 of this part of ISO/IEC 29109.

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 19794-4:2005, *Information technology — Biometric data interchange formats — Part 4: Finger image data*

ISO/IEC 29109-1:2009, *Information technology — Conformance testing methodology for biometric data interchange formats defined in ISO/IEC 19794 — Part 1: Generalized conformance testing methodology*

4 Terms and definitions

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

5 Symbols and abbreviated terms

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

6 Conformance testing methodology

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

6.1 Table of requirements in the base standard

The normative requirements of ISO/IEC 19794-4:2005 are listed in Table 1. The supplier of the IUT can explain which optional components of the standard are supported and the testing laboratory can note the results of the test.

Table 1 — Requirements of the base standard (ISO/IEC 19794-4:2005)

Require-ment identifier	Reference in base standard	Requirement summary	Level	Status	IUT support	Supported range	Test result
R-1	4.15	Information contained in a transaction shall be applicable to a single subject.	3C	O-1		N/A	N/A
R-2	6.1	Each item of information, field, or logical record shall contain one or more bytes of data.	3C	O-1		N/A	N/A
R-3	6.1	The order for transmission shall also be the most significant byte first and least significant byte last.	3C	O-1		N/A	N/A
R-4	6.1	Within a byte, the order of transmission shall be the most significant bit first and the least significant bit last.	3C	O-1		N/A	N/A
R-5	6.2	Each image as presented in accordance with this format standard shall appear to have been captured in an upright position and approximately centered horizontally in the field of view.	3C	O-1		N/A	N/A

Table 1 (*continued*)

Require-ment identifier	Reference in base standard	Requirement summary	Level	Status	IUT support	Supported range	Test result
R-6	6.2	The recorded image data shall appear to be the result of a scanning of a conventional inked impression of a fingerprint.	3C	O-1		N/A	N/A
R-7	6.2	The scanning sequence (and recorded data) shall appear to have been from left-to-right, progressing from top-to-bottom of the fingerprint or palm print.	3C	O-1		N/A	N/A
R-8	6.2	For the purpose of describing the position of each pixel within an image to be exchanged, a pair of reference axes shall be used.	3C	O-1		N/A	N/A
R-9	6.2	The origin of the axes, pixel location (0,0), shall be located at the upper left-hand corner of each image.	3C	O-1		N/A	N/A
R-10	6.2	The x-coordinate (horizontal) position shall increase positively from the origin to the right side of the image.	3C	O-1		N/A	N/A
R-11	6.2	The y-coordinate (vertical) position shall increase positively from the origin to the bottom of the image.	3C	O-1		N/A	N/A
R-12	7.2	For all quality levels, the finger image shall be represented using square pixels, in which the horizontal and vertical dimensions of the pixels are equal.	3C	O-1		N/A	N/A
R-13	7.3	The grayscale precision of the pixel data shall be specified in terms of the pixel depth or the number of bits used to represent the grayscale value of a pixel.	3C	O-1		N/A	N/A
R-14	7.3	For grayscale data, the minimum value that can be assigned to a “black” pixel shall be zero.	3C	O-1		N/A	N/A
R-15	7.3	The maximum value that can be assigned to a “white” pixel shall be the grayscale value with all of its bits of precision set to “1”.	3C	O-1		N/A	N/A
R-16	7.4	The image data portion of a record for an uncompressed grayscale image shall contain a set of raw pixel information.	3C	O-1		N/A	N/A
R-17	7.4	Using a pixel depth of 8 bits (256 grayscale levels) each pixel shall be contained in a single byte.	2	M			
R-18	7.4	Increased precision for pixel values greater than 255 shall use two unsigned bytes to hold up to sixteen-bit pixels with values in the range of 0-65635.	3C	O-1		N/A	N/A
R-19	7.4, Tables 2 and 3	The encoding of a compressed grayscale image shall be the output of the appropriate grayscale compression algorithm specified.	2	M		N/A	

Table 1 (*continued*)

Require-ment identifier	Reference in base standard	Requirement summary	Level	Status	IUT support	Supported range	Test result
R-20	7.4	Upon decompression the grayscale value for each pixel shall be represented in the same manner as pixels in an uncompressed image.	3C	O-1		N/A	N/A
R-21	7.5	The image grayscale shall be encoded using the agreed precision necessary to meet the dynamic range requirement for a specific application.	3C	O-1		N/A	N/A
R-22	7.6	Grayscale fingerprint image areas to be captured shall be acquired by an image capture device operating at a specific scanning resolution.	3C	O-1		N/A	N/A
R-23	8.1	Each record shall pertain to a single subject.	3C	O-1		N/A	N/A
R-24	8.1	Each record shall contain an image record (consisting of one or more views) for each of one or more fingers, multiple fingers (single image records), or palms.	3C	O-1		N/A	N/A
R-25	8.1	The biometric data record specified in this standard shall be embedded in a CBEFF-compliant structure in the CBEFF biometric data block (BDB).	N/A	N/A		N/A	N/A
R-26	8.1	The CBEFF BDB_biometric organization shall be assigned by the International Biometric Industry Association (IBIA) to JTC 1 SC 37 shall be used.	N/A	N/A		N/A	N/A
R-27	8.1	This code shall be included in the CBEFF Header.	N/A	N/A		N/A	N/A
R-28	8.1	The associated sixteen-bit CBEFF BDB_format code shall have a value of 0x0007. The BDB_PID recorded shall be defined by CBEFF.	N/A	N/A		N/A	N/A
R-28	8.1	The BDB_PID recorded shall be defined by CBEFF.	N/A	N/A		N/A	N/A
R-30	8.2.2, Table 2	The Format identifier for the finger image standard record shall consist of the three ASCII characters "FIR" followed by the null character (0x0).	1	M		N/A	
R-31	8.2.3, Table 2	The number for the version of this standard used for constructing the image record shall be placed in four bytes.	1	M		N/A	
R-32	8.2.3, Table 2	This version number shall consist of three ASCII numerals followed by a zero byte as a null string terminator.	1	M		N/A	
R-33	8.2.3, Table 2	Upon approval of this specification, the version number shall be “010” –. Version 1 revision 0.	1	M		N/A	
R-34	8.2.4, Table 2	The combined length in bytes for the entire record shall be recorded in these six bytes.	1	M			

Table 1 (*continued*)

Require-ment identifier	Reference in base standard	Requirement summary	Level	Status	IUT support	Supported range	Test result
R-35	8.2.4, Table 2	This count [the value of the record length] shall be the sum of the lengths of all finger records (including all finger headers), the views for each finger, multiple finger record, and palms.	2	M			
R-36	8.2.5, Table 2	Capture device ID.	1, 3B	M			
R-37	8.2.6, Tables 1 and 2	This two-byte field shall specify the image acquisition setting level chosen from Table 1.	1,2	M			
R-38	8.2.6	The value used shall indicate the level at which all of the minimum acquisition parameters were satisfied during the image.	3C	O-1		N/A	N/A
R-39	8.2.7, Table 2	The number of finger or palm images included in the record shall be recorded in one byte.	1,2	M			
R-40	8.2.8, Table 2	This field shall specify the units used to describe the scanning and image resolutions of the image.	1,2 3C	M O-1			
R-41	8.2.9, Tables 1 and 2	This 2-byte field shall specify the rounded scanning resolution used in the horizontal direction.	2 3C	M O-1			
R-42	8.2.10, Tables 1 and 2	This 2-byte field shall specify the rounded scanning resolution used in the vertical direction.	2 3C	M O-1			
R-43	8.2.11, Table 2	This 2-byte field shall specify the rounded image resolution used in the horizontal direction.	2	M			
R-44	8.2.12, Table 2	This 2-byte field shall specify the rounded image resolution used in the vertical direction.	2	M			
R-45	8.2.13, Tables 1 and 2	This 1-byte field shall contain the number of bits used to represent a pixel.	2	M			
R-46	8.2.13, Tables 1 and 2	This field (pixel depth) shall contain an entry of ‘0x1’ to ‘0x10’.	1	M			
R-47	8.2.14, Tables 2 and 3	This 1-byte field shall specify the method used to record the uncompressed or compressed grayscale images.	1,2	M			
R-48	8.2.14	When using the unpacked option for grayscale pixels greater than eight bits, each pixel shall be recorded in a pair of bytes right justified.	3C	O-1		N/A	N/A
R-49	8.2.14, Tables 2 and 3	Compression ratio for lossy compression of 8-bit, 19.69 ppmm (500 ppi) grayscale images shall be limited to a 15:1.	2	M			

Table 1 (*continued*)

Require-ment identifier	Reference in base standard	Requirement summary	Level	Status	IUT support	Supported range	Test result
R-50	8.2.14, Tables 2 and 3	WSQ shall not be used to compress images scanned at 39.37 ppmm (1000 ppi).	2	M			
R-51	8.2.14, Tables 2 and 3	Fingerprint/palmprint images scanned at 39.37 ppmm (1 000 ppi), if compressed, shall be compressed using the JPEG 2000 algorithm as described in the ISO 15444.	2	M			
R-52	8.2.14, Tables 2 and 3	NOTE The recommendation is that JPEG 2000 compression be limited to 15:1 for 39.37 ppmm (1000 ppi) images. Images scanned at 19.69 ppmm (500 ppi), if compressed should use WSQ compression and the compression ratio shall be limited to 15:1; above 19.69 ppmm (500 ppi), JPEG 2000 compression is recommended.	2	M			
R-53	8.2.15, Table 2	Two bytes are reserved for future revisions of this part of the ISO/IEC 19794 standard. For this version of the standard this field shall be set to all '0x0'.	1	M			
R-54	8.3.1	A finger header shall start each section of finger data providing information for that view of a single finger image, multi-finger image, or palm.	3C	O-1		N/A	N/A
R-55	8.3.1	For each such image there shall be one finger header record accompanying the view of the image data.	1	M		N/A	N/A
R-56	8.3.1, Table 4	The finger header shall occupy a total of 14 bytes as described below.	1	M			
R-57	8.3.1	The compressed or uncompressed image data for that image view shall immediately follow the header portion.	3C	O-1		N/A	N/A
R-58	8.3.2, Table 4	This four-byte field shall contain the length in bytes of the finger/palm segment.	2	M			
R-59	8.3.3, Tables 4, 5, 6	This 1-byte field shall contain the finger position.	1	M			
R-60	8.3.4, Table 4	This one byte field shall contain the total number of specific views available for this finger.	1,2	M			
R-61	8.3.5, Table 4	This one byte field shall contain the specific image view number associated with the finger.	2	M			
R-62	8.3.6, Table 4	The quality of the overall scanned finger/palm image shall be between 0 and 100 and recorded in one byte.	1	M			

Table 1 (*continued*)

Require-ment identifier	Reference in base standard	Requirement summary	Level	Status	IUT support	Supported range	Test result
R-63	8.3.6	A value of 0 shall represent the lowest possible quality and the value of 100 shall represent the highest possible quality.	3C	O-1			N/A
R-64	8.3.7	The impression type of the finger or palm image shall be recorded in this one byte field.	3C	O-1		N/A	N/A
R-65	8.3.7, Table 4	The codes for this byte shall be as defined as contained in Tables 5 and 18 the NSI/NIST-ITL 1-2000 standard, “Data Format for the Interchange of Fingerprint, Facial, & Scar Mark & Tattoo (SMT) Information”.	1	M			
R-66	8.3.8, Table 4	This two-byte binary field shall be used to specify the number of pixels contained on a single horizontal line of the transmitted image.	1,2	M			
R-67	8.3.9, Table 4	This two-byte binary field shall be used to specify the number of horizontal lines contained in the transmitted image.	1,2	M			
R-68	Table 4	Reserved field in finger image header.	1	M			
R-69	8.3.10, Table 4	This field shall contain the grayscale image data formatted and recorded in accordance with the image compression algorithm.	2	M			
R-70	Annex A	Image quality specification.	2 or 3C	M-2 or O-2			

Notes for Level 3 requirements:

The following short notes provide more details about why a specific conformance test assertion is not specified for the corresponding requirement(s):

1 Level 3 Assertion is too difficult to test

No method has been defined to test the conformance of the IUT or BDIR for this mandatory requirement of the base standard. For the purposes of this international standard, this requirement is marked as Optional (O-1) until an appropriate test method is established.

2 Image quality specification

If image acquisition level is 31 or 41, capture device is EBTS Appendix F certified and so conformant to all requirements in Annex A. Otherwise, the requirements in Annex A are level 3C and no test method is yet defined to test the conformance of the IUT or BDIR for these mandatory requirements.

6.2 Table of test assertions

The specific test assertions required for conformance testing of ISO/IEC 19794-4:2005 Finger image format for data interchange are listed in Table 2.

Table 2 — ISO/IEC 19794-4:2005 conformance test assertions

Test Number	Section	Requirement ID	Level	Field name	Operator	Operand	Test Note	Status	IUT support	Supported range	Test Result
1.1	Record header	R-30	1	Format identifier	EQ	0x46495200	1	M		N/A	
1.2	Record header	R-30	1	Format identifier	NEQ	0x00524946		M		N/A	
2.1	Record header	R-31, R-32, R-33	1	Version	EQ	0x30313000	1	M		N/A	
2.2	Record header	R-31, R-32, R-33	1	Version	NEQ	0x00303130		M		N/A	
3.1	Record header	R-34	1	Record length	EQ	$47–(2^{48}–1)$		M			
3.2	Record header	R-35	2	Record length	EQ	Total bytes read	2	M		N/A	
3.3	Record header	R-35	2	Record length	EQ	Total bytes expected	2	M		N/A	
4.1	Record header	R-36	1	Capture device type ID	NONE			M		N/A	N/A
4.2	Record header	R-36	3B	Capture device type ID	NONE		14	M		N/A	N/A
5.1	Record header	R-37	1	Image acquisition level	MO	{10, 20, 30, 31, 35, 40, 41}		M			
5.2	Record header	R-37	2	Image acquisition level	C	see note 3	3	M			
6.1	Record header	R-39	1	Number of fingers or palms	EQ	1-255		M			
6.2	Record header	R-39	2	Number of fingers or palms	C	see note 8	8	M		N/A	
7.1	Record header	R-40	1	Scale units	EQ	1-2		M			
7.2	Record header	R-40	2	Scale units	C	see note 3	3	M			
7.3	Record header	R-40	2	Scale units	C	see note 16	16	M			
8	Record header	R-41	2	X scan resolution	C	see note 3	3	M			
9	Record header	R-42	2	Y scan resolution	C	see note 3	3	M			
10.1	Record header	R-43	2	X image resolution	LTE	{X Scan Resolution}		M			
10.2	Record header	R-43	2	X image resolution	C	see note 16	16	M			
11.1	Record header	R-44	2	Y image resolution	LTE	{Y Scan Resolution}		M			
11.2	Record header	R-44	2	Y image resolution	C	see note 16	16	M			
12.1	Record header	R-46	1	Pixel depth	EQ	1 - 16		M			

Table 2 (*continued*)

Test Number	Section	Requirement ID	Level	Field name	Operator	Operand	Test Note	Status	IUT support	Supported range	Test Result
12.2	Record header	R-45	2	Pixel depth	C	see note 3	3	M			
12.3	Record header	R-17	2	Pixel depth	C	see note 17	17	M		N/A	
13.1	Record header	R-19, R-47	1	Image compression algorithm	EQ	0 - 5		M			
13.2	Record header	R-19, R-47	2	Image compression algorithm	C	see note 6	6	M			
13.3	Record header	R-49, R-52	2	Image compression algorithm	C	see note 9	9	M			
13.4	Record header	R-19, R-50, R-51	2	Image compression algorithm	C	see note 10	10	M			
14	Record header	R-53	1	Reserved	EQ	0		M		N/A	
15.1	Finger header	R-55, R-56	1	Data block length	EQ	$14 – (2^{32} – 1)$		M			
15.2	Finger header	R-58	2	Data block length	C	see note 11	11	M		N/A	
16	Finger header	R-59	1	Finger or palm position	MO	{0,1, ...,10, 13,14,15, 20, ..., 36}	4	M			
17.1	Finger header	R-60	1	Count of views	EQ	1-255		M			
17.2	Finger header	R-60	2	Count of views	EQ	Total views read		M		N/A	
18	Finger header	R-61	2	View number	INC	1 - {Count of views}	13	M			
19	Finger header	R-62	1	Finger or palm image quality	EQ	0 - 100	5	M			
20	Finger header	R-65	1	Impression type	MO	{0,1,2,3,7,8,9}		M			
21.1	Finger header	R-66	1	Horizontal line length	EQ	1- 65535		M			
21.2	Finger header	R-66	2	Horizontal line length	C	see note 15	15	M		N/A	
22.1	Finger header	R-67	1	Vertical line length	EQ	1 – 65535		M			
22.2	Finger header	R-67	2	Vertical line length	C	see note 15	15	M		N/A	
23	Finger header	R-68	1	Reserved	EQ	0		M		N/A	
24.1	Finger image data	R-69	1	Image data	LTE	$2^{32} – 1$		M			
24.2	Finger image data	R-47, R-69	2	Image data	C	see notes 6,7	6,7	M			
25	Annex A	R-70	2 or 3C	Image quality specification	C	see note 12	12	M		N/A	

Test Notes:

These are short notes that provide more detail about a specific conformance test assertion or requirement. They use a combination of explanatory text and pseudo code for complex calculations. The pseudo code uses commonly used mathematical notations, rather than the specific logical operators developed for the assertion language.

1. {Format identifier} and {Version} Little-Endian

Test assertions 1.1 and 2.1 will test that these multi-byte fields are equal to their correctly big-endian encoded value. Test assertions 1.2 and 2.2 will test that these multi-byte fields are not equal to the value they would have had if it had been incorrectly encoded using little-endian encoding. The tests for both of these assertions (T1.1 & T1.2 or T2.1 & T2.2) should pass for each field if the fields have been correctly big-endian encoded with the correct value. If a random incorrect value has been used, then the first test (T1.1 or T2.1) should fail but the second test (T1.2 or T2.2) should pass. If the correct values have been used but with the incorrect little-endian encoding, then both tests (T1.1 & T1.2 or T2.1 & T2.2) should fail.

2. {Record length}

The following calculation will be evaluated once the {Image Data Block Length} field for the last finger/palm view has been parsed successfully (not having reached an End-of-File marker prematurely). In the event that an End-of-File marker is reached prematurely this test will be marked as having failed, but no value of {Total Bytes Expected} will be produced. Note that the calculation shown below shows a counter being incremented over each finger /palm and then over each view for that finger / palm. In an actual data record, the views for a given finger / palm do not have to be contiguous, but SUMBYTES must be incremented across the total count of all views for all fingers / palms.

```
SUMBYTES = 32 # i.e. length of General record header

FOR I = 1 TO {Number of fingers / palms}

FOR J = 1 TO {Count of views}

SUMBYTES = SUMBYTES + 14 + {Image data length}

END

END

{Total Bytes Expected} = SUMBYTES

int totalBytesExpected (int numFingersOrPalms; int countOfViews; int imageDataLength)

{

int sumBytes = 32;  # i.e. length of General record header

for (i=0; i<= numFingersOrPalms; i++)

        for (j=1; j<= countOfViews ; j++)

            sumBytes += 14 + imageDataLength

return sumBytes;

}
```

3. {Image acquisition level}

The {Image acquisition level} used shall indicate the level of the minimum acquisition parameters were satisfied during the capture of the image (Table 1 of ISO/IEC 19794-4:2005).

IF {Image Acquisition Level} EQ 10 {

{Pixel Depth} >= 1 bit

IF {Scale units} EQ 1 #scale unit is ppi

(X and Y) Scan Resolution >= 125

ESLEIF {Scale units} EQ 2 #scale unit is ppcm

(X and Y) Scan Resolution >= 49

}

IF {Image acquisition level} EQ 20 {

{Pixel Depth} >= 3 bit

IF {Scale units} EQ 1 #scale unit is ppi

(X and Y) Scan resolution >= 250

ESLEIF {Scale units} EQ 2 #scale unit is ppcm

(X and Y) Scan Resolution >= 98

}

IF {Image acquisition level} EQ 30 {

{Pixel depth} >= 8 bit

IF {Scale units} EQ 1 #scale unit is ppi

(X and Y) Scan resolution >= 500

ESLEIF {Scale units} EQ 2 #scale unit is ppcm

(X and Y) Scan resolution >= 197

}

IF {Image acquisition level} EQ 31 {

{Pixel depth} >= 8 bit

IF {Scale units} EQ 1 #scale unit is ppi

(X and Y) Scan resolution >= 500

ESLEIF {Scale units} EQ 2 #scale unit is ppcm

(X and Y) Scan resolution >= 197

}

IF {Image acquisition level} EQ 35 {

{Pixel depth} >= 8 bit

IF {Scale units} EQ 1 #scale unit is ppi

(X and Y) Scan resolution >= 750

ESLEIF {Scale units} EQ 2 #scale unit is ppcm

(X and Y) Scan resolution >= 295

}

IF {Image acquisition level} EQ 40 {

{Pixel depth} >= 8 bit

IF {Scale units} EQ 1 #scale unit is ppi

(X and Y) Scan resolution >= 1000

ESLEIF {Scale units} EQ 2 #scale unit is ppcm

(X and Y) Scan resolution >= 394

}

IF {Image acquisition level} EQ 41 {

{Pixel Depth >= 8 bit}

IF {Scale units} EQ 1 #scale unit is ppi

(X and Y) Scan resolution >= 1000

ESLEIF {Scale units} EQ 2 #scale unit is ppcm

(X and Y) Scan resolution >= 394

}

4. {Finger / Palm position}

Finger and Palm position codes, areas and their maximum dimensions are defined in Tables 5 and 6 of ISO/IEC 19794-4:2005. Codes 0 - 10, 13 - 15 are used for finger images. In Table 4 of ISO/IEC 19794-4:2005, codes 11 and 12 are within the valid values. It is not so according to Clause 8.3.3 of ISO/IEC 19794-4:2005. It is assumed that codes 11 and 12 are reserved. Codes 20-36 are used for palm images.

5. {Finger / Palm image quality}

The {Finger / Palm image quality} range shall be from 0 – 100.

Valid values for {Finger / Palm Image Quality} are recorded differently in Table 4 and Clause 8.3.6 of ISO/IEC 19794-4:2005. According to Table 4, the valid values are 1 - 100. However, Clause 8.3.6 indicates that zero (0) is a valid value, so does its reference document, "ANSI/NCITS 358-2002, BioAPI H-Level Specification Version 1.1". For the purpose of this document, it is assumed that zero (0) is a valid value.

6. {Image compression algorithm}

ISO/IEC 19794-4:2005 2005 standard (Clause 8.2.14), Table 3, specifies different types of {Image Compression Algorithm} to be used. A minimum verification for those algorithms is required. {Image Compression Algorithm} codes 0 and 1 do not require any conformance test because they are uncompressed data and there is no specific file format to check.

IF {Image compression algorithm} EQ 2 THEN (WSQ File Format)

First two bytes = 0xFFA0 (SOI – Start Of Image)

IF {Image compression algorithm} EQ 3 THEN (JPEG File Format)

First four bytes of image = 0xFFD8 FFE0 (SOI – Start Of Image)

IF {Image compression algorithm} EQ 4 THEN (JPEG 2000 File Format)

First twelve bytes of image = 0x0000 000C 6A50 2020 0D0A 870A (JPEG2000 Signature box)

IF {Image compression algorithm} EQ 5 THEN (PNG File Format)

First eight bytes = 0x89 50 4E 47 0D 0A 1A 0A (PNG signature)

7. {Image data length}

{Image data length} = {Data block length} – sizeof {Finger header}

{Image data ength} LTE 4294967295 # which is equal to (2^{32}-1)

8. {Number of fingers or palms}

The following calculation checks if there are as many finger or palm image data as the {number of finger of palms} field specifies. The four-byte {Length of finger/palm data block} contains the length in bytes of the finger or palm segment.

```
fingerCounter = 0;

while (fingerCounter <= {Number of fingers or palms}){

    m = {Length of finger/palm data block}

    skip m bytes

    if (End-Of-File) exit(ERROR)

fingerCounter ++

}
```

9. {Image compression algorithm}

compression ratio better than 15:1 is required.

$$\frac{\{\text{Horizontal line length}\} * \{\text{Vertical line length}\} * \{\text{pixel depth}\}}{\text{sizeof}\{\text{imageData}\}} \text{LTE15}$$

where {Lengtht of finger/palm data block} contains sizeof{imageData}.

10. {Image compression algorithm}

IF{Image acquisition level} EQ (40 or 41) THEN

({Image compression algorithm} NEQ 2) AND ({Image compression algorithm} EQ 4)

11. {Length of finger/palm data block}

m = {Length of finger/palm data block}

skip m bytes

if (End-Of-File) exit(ERROR)

Or if sizeof(imageData) is known:

{Length of finger/palm data block} EQ (14 + sizeof(imageData))

Where 14 is the length of finger header.

12. {Image quality specification}

Conformance Test is passed if Image acquisition Level is 31 or 41. Not testable otherwise.

13. {Incremental view number correctness}

As each finger view from the BIR is read, a counter, {Next Finger View}, for the corresponding finger position (if valid) is incremented and compared to {View Number}. The test shall pass if {Next Finger View} is equal to {View Number}.

14. {Capture device ID}

If not zero, examine the validity of this code with the vendor.

15. {Horizontal line length} and {Vertical line length}

For PNG, and WSQ file formats where image file header contains number of pixels in horizontal (X) and vertical (Y) directions, the value of {Horizontal line length} and {Vertical line length} shall be equal to the value in the header. Specifically, PIX_WIDTH and PIX_the HEIGHT of WSQ file header or width and height fields in IHDR image header for a PNG data file shall be equal to {Horizontal line length} and {Vertical line length} respecticvely.

16. {X image resolution}, {Y image resolution}, {Scale unit}

If a JPEG image, these fields shall be equal to image resolution information in the file header. Specifically, {X image resolution} shall be equal to Xdensity field, {Y image resolution} shall be equal to Ydensity field, and {Scan unit} shall be equal to the units filed of the JPEG image header header.

17. {Pixel Depth}

IF {Pixel depth} EQ 8 THEN
{Vertical line length} * {Horizontal line length} EQ {Lengtht of finger/palm data block} -14

where 14 is the length of finger header.

ICS 35.040

Price based on 15 pages