
**Electronic still-picture imaging —
Removable memory —**

**Part 1:
Basic removable-memory model**

*Imagerie de prises de vue électroniques — Mémoire amovible —
Partie 1: Modèle de mémoire amovible de base*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees 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 shall not be held responsible for identifying any or all such patent rights.

ISO 12234-1 was prepared by Technical Committee ISO/TC 42, *Photography*.

This third edition cancels and replaces the second edition (ISO 12234-1:2007), which has been technically revised.

ISO 12234 consists of the following parts, under the general title *Electronic still-picture imaging — Removable memory*:

- *Part 1: Basic removable-memory model*
- *Part 2: TIFF/EP image data format*

Introduction

ISO 12234 addresses removable memory requirements for electronic still-picture cameras. Unlike a traditional photographic system, an electronic photography system divides the imaging chain into discrete components separately devoted to image acquisition, storage, transmission, processing and display. Since the components can be made by different manufacturers, there is a need to specify a standard format for data interchange among the various components of an electronic imaging system.

This part of ISO 12234 describes data interchange using removable storage media. The purpose of removable storage media is the storage of digitized images on media that is compact, is mechanically rugged, and has low power requirements. The removable storage media is used to transport the digitized image data to other components in the imaging chain.

This part of ISO 12234 further specifies the required information content for a removable memory data format. The information content includes both the image data and data items describing the image. Normative annexes A, B and C describe various conforming formats. The data features supported by each of these formats are also described in Clause 6. The information content further includes a description of the file system which organizes the files containing digitized image data. Informative Annex D describes a conforming file system. The file system features are described in Clause 7.

An implementation is said to be in compliance if, at a minimum, all mandatory elements are present. Recommended features are not required, but will substantially enhance interoperability, performance and/or robustness.

In developing this part of ISO 12234, a structured methodology was followed. A reference model describes the environment as well as the overall architecture in which this part of ISO 12234 is applicable. The architecture separates the software layers (termed the “image data format” and the “file system”) from the hardware technology-dependent layer (termed the “media profile”). An image data format is media independent and contains the image data, image-related data and a means for structuring these data elements. A file system defines the data organization on the storage media used, but it is independent of the media.

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Electronic still-picture imaging — Removable memory —

Part 1: Basic removable-memory model

1 Scope

This part of ISO 12234 specifies a basic removable-memory reference model for digital electronic still-picture cameras. The reference model includes image file formats for storing image data and metadata, file system requirements for storing and retrieving the image files on the removable memory, and media profiles which are specific to a given storage technology. The reference model allows the image data and metadata to be interchanged among the various components of an electronic imaging system by using the removable storage media.

2 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 12234-2, *Electronic still-picture imaging — Removable memory — Part 2: TIFF/EP image data format*

ISO 15444-1, *Information technology — JPEG 2000 image coding system — Part 1*

ISO 15444-2, *Information technology — JPEG 2000 image coding system: Extensions — Part 2*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

file system

software structure which specifies how the data is logically organized on a given storage media

3.2

image data format

structure and content which specify image data and the organization of the image related data in a device-independent manner

3.3

image storage application profile

ISAP

media profile, the file system and the image data format

NOTE The ISAP specifies all the information necessary to completely implement the removable memory.

3.4

media profile

portion of the memory module specification which is specific to a given memory technology, including the form factor, interconnection and access protocol

3.5

memory card

specific type of memory module using non-volatile solid-state memory and having a flat physical form factor

3.6

memory module

physical implementation of the removable memory, containing the image data format combined with a specified physical form factor, interconnect definition and access protocol

3.7

removable memory

storage in a user-removable form factor, which is transportable, intended for the digital storage of image data in electronic still-picture cameras

NOTE The memory media can be read/write, write once, etc., but have to be non-volatile when removed from the camera so as to retain the data.

3.8

sound compression

process of altering the sound data coding in order to reduce the size of a sound file in the electronic still-picture camera

NOTE See also **sound recording** (3.9).

3.9

sound recording

recording of the sound data relative to an image acquired by the electronic still-picture camera

NOTE 1 The sound recording can be made before, during or after the time of the image acquisition.

NOTE 2 A sound recording attached to an electronic still picture is considered an annotation of the image, as distinguished from a sound recording which is attached to and synchronized with motion pictures or video pictures.

4 Reference model

4.1 General considerations

Table 1 summarizes the reference model for this part of ISO 12234. The reference model is a layered model. The implementation of any one layer can be changed without affecting the implementation of any other layer. The reference model describes the types of elements included in each layer.

Table 1 — Reference model for removable storage

Layer	Intent	Examples	Implementation
Application	Content-image data and parameters	Image data	Image data format
Presentation	Define structure of image data and encoding mechanism	Tags	
Session	Define data organization on media	File system for image storage/retrieval	File system
Transport	Communication of data across a channel	Data transmission protocol	Media profile
Network	Conformance layer	Compatibility and interoperability with other systems	
Data link	Assures reliable data read/write Storage media-specific recording information	Card information structure Error correction methods Control for insertion/removal	
Physical	Assure basic compatibility in physical form factor and electrical signals	Form factor, pin alignment, size Electrical interface specification Protocol/command sets	

4.2 Image storage application profiles (ISAP)

The ISAP completely specifies all the information necessary to implement a particular type of removable storage. The image storage application profile consists of three parts:

- the image data format, which describes the structure and content of the image data;
- the file system, which describes how the image files are stored and retrieved;
- the media profile, which describes the media used to store the image files.

4.3 Image data format

The image data format consists of the application and presentation layers. The application layer defines the content of the image data. The presentation layer defines the encoding of the image data. This part of ISO 12234 specifies image data formats that are consistent across implementations and independent of the media used for storage.

The content defined in the application layer includes the image and image-related information, called metadata, such as the date the image was captured. The encoding defined in the presentation layer includes the structures which define the image and the image-related information as digital values. For example, the encoding describes whether the image is stored as strips or tiles, and whether the metadata are stored as numbers or characters. The detailed elements in three allowed image data formats are described in Clause 6.

The image data formats described in this part of ISO 12234 provide an explicit binding between the content in the application layer and the encoding method given in the presentation layer.

4.4 File system

The file system definition includes the information required for the session layer. It defines the data organization on the storage media used.

4.5 Media profiles

Many different removable memory types are used in digital electronic still-picture cameras. The storage technologies include various solid state memory cards, magnetic hard drives and optical discs. Each of these removable memory types can be described by an appropriate media profile.

The media profile definition includes the information required for the transport, network, data link and physical layers.

The transport layer defines the protocol for how these data are transported between the digital electronic still-picture camera and the removable memory.

The network layer describes the conformance requirements needed to maintain compatibility and interoperability with other systems.

The data link layer describes the mechanisms for assuring reliable communications, and the specifications for reading, writing, erasing, removing and inserting specific types of media.

The physical layer ensures the basic compatibility of the physical and electrical interface. It defines the physical form factor, connector specifications and electrical interface specifications.

5 Required characteristics for image storage application profiles

5.1 General

The characteristics required for suitable image data formats and media profiles are specified in 5.2 to 5.8. These criteria were used in the development of this part of ISO 12234 and will be used in developing its future editions.

5.2 Interoperability

This part of ISO 12234 fosters interoperability between systems manufactured by different vendors. Here interoperability permits

- a) storage of image data on a removable medium,
- b) removal of that media from a digital electronic still-picture camera,
- c) insertion of that media into a second system, and
- d) transfer of the image data to the second device.

5.3 Flexibility

This reference model permits flexibility across applications requiring different levels of feature sets. Some image formats allow default values for specific data elements in order to simplify the implementation.

5.4 Extensibility

This reference model allows for various extensions to provide the possibility of incorporating new features. Some image data formats include the capability for private extensions to meet special needs. In future revisions of this part of ISO 12234, new features may be added to the present image data formats. In addition, new media profiles or image data formats may be included.

5.5 Ease of implementation

This reference model allows easy and unambiguous implementation. In particular, many electronic still-picture cameras have limited processing power and even many of the hosts reading the data may have limited processing power. Hence, the standard format requires minimal encoding and decoding of the image data.

5.6 Platform independence

Because it will be necessary to exchange data between different hardware platforms running under different operating systems, this reference model is platform independent. In particular, the data and data structures presented to the application are platform independent.

5.7 Multiple physical media types

This reference model supports multiple physical media types. Media based on various different storage technologies, e.g. solid state EEPROM and rotating magnetic disc storage, are supported for use as removable storage media in electronic still-picture cameras.

5.8 Elimination of redundancy

Information should appear once and only once within the image data format. This prevents conflicts if the data are entered in two different places and happen to be inconsistent. If a type of information appears in multiple places, the data written needs to be consistent, e.g. by assigning equivalent values. This applies both to explicitly entered data and to data implicitly derived from other fields.

6 Image data format specification

6.1 General considerations

The image data format corresponds to the application and presentation layers of the reference model, and is independent of the storage media used. The image data formats described in normative Annexes A, B and C are intended for use as image interchange formats for photographic images within the scope of the reference model. It is recognized that images from sources other than electronic still-picture cameras may use different image data formats.

6.2 Application layer for image data

The application layer defines what image data may be present in the information to be exchanged between systems. The data defined here determines what information is available to a host system about the image, the picture-taking conditions, the camera system which took the image and any annotations to help describe the image for the user. Table 2 represents a list of image data features that should be included in an image data format.

6.3 Presentation layer

The presentation layer defines what data may be present in the information to be exchanged between systems. The data defined here describe the organization of data in the format. It is media independent.

6.4 Image data formats

It is recognized that different applications require different levels of support. Some applications are highly standardized with many of the data elements assuming default values, while other applications require more flexibility. To accommodate different applications, three different image formats, TIFF/EP, Exif and JPEG 2000, are allowed. The image data formats differ in their required elements and degree of flexibility. When used, the TIFF/EP image data format (see Annex A) shall be implemented in accordance with ISO 12234-2. The Exif image format is described in Annex B. The JPEG 2000 image format is described in Annex C. When used, the JPEG 2000 image data format (see Annex C) shall be implemented in accordance with ISO 15444-1 and ISO 15444-2. The DCF file system is described in Annex D. Reference [8] describes the development and structure of these image formats and this file system.

Table 2 summarizes the image data features supported by the allowed image data formats. Each is supported by a specific file system. For each image data format, the support for the feature can be mandatory, recommended, optional or not used. Further information concerning implementation of each format is contained in normative Annexes A, B, and C.

Different requirements are imposed on writing, reading and editing devices by the image data format. The writing device should support all mandatory features, but need not support features listed as recommended or optional. The reading device should support all mandatory features, and also should support optional or recommended features at least to the extent of allowing the image to be interpreted without corrupting the data. Therefore, a reader may ignore recommended or optional features as long as it is done in a safe manner. If an editor ignores some features, it is required that the ignored features be passed along unchanged as part of the data file, rather than truncating or eliminating them. This permits the previously ignored features to be interpreted by a subsequent reader.

Table 2 — Image data feature descriptions and requirements, with field names and codes

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPG 2000 element, applicability
1	Camera information				
	Camera Make	Manufacturer of the camera that captured the image (ASCII)	M 271, Make	M 271, Make	M /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_INFO /-MANUFACTURER
	Camera Model	Model number of the camera that captured the image (ASCII)	M 272, Model	M 272, Model	M /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_INFO /MODEL
	Camera Serial Number	The serial number of the camera used to capture the image (ASCII)	NU	NU	O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_INFO /SERIAL
	Camera Version	The version of the camera model used to capture the image (ASCII)	NU	NU	M /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_INFO /VERSION
	Lens Make	Manufacturer of the lens that captured the image (ASCII)	NU	NU	O /IMAGE_CREATION /CAMERA_- CAPTURE /LENS_INFO /-MANUFACTURER
6	Lens Model	Model number of the lens that captured the image (ASCII)	NU	NU	O /IMAGE_CREATION /CAMERA_- CAPTURE /LENS_INFO /MODEL

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
7	Lens Serial Number	The serial number of the lens used to capture the image (ASCII)	NU	NU	O /IMAGE_CREATION /CAMERA_- CAPTURE /LENS_INFO /SERIAL
8	Lens Version	The version of the lens model used to capture the image (ASCII)	NU	NU	O /IMAGE_CREATION /CAMERA_- CAPTURE /LENS_INFO /VERSION
9	Software Make	Model of the software used to create or process the image (ASCII)	M 305, Software	M 305, Software	R /IMAGE_CREATION /CAMERA_- CAPTURE /SOFTWARE_INFO /MANUFACTURER
10	Software Model	Model of the software used to create or process the image (ASCII)	M 305, Software	M 305, Software	R /IMAGE_CREATION /CAMERA_- CAPTURE /SOFTWARE_INFO /MODEL
11	Software Serial Number	The serial number of the software used to create or process the image (ASCII)	NU	NU	O /IMAGE_CREATION /CAMERA_- CAPTURE /SOFTWARE_INFO /SERIAL
12	Software Version	Version of software used to create the image, or firmware within camera (ASCII)	M 305, Software	M 305, Software	R /IMAGE_CREATION /CAMERA_- CAPTURE /SOFTWARE_INFO /VERSION
13	Accessory	Any accessory used to capture the image	NU	NU	O /IMAGE_CREATION /CAMERA_- CAPTURE /ACCESSORY

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
14	Camera/lens characterization				
	ISO Speed	ISO speed of the camera, as defined in ISO 12232 NOTE: JPEG 2000 files only specify the ISO speed latitude upper limit (R) and the ISO speed latitude lower limit (O)	O 34855, ISO Speed-Ratings	O 34855, ISO Speed-Ratings	R /IMAGE_CREATION /CAMERA_- CAPTURE /DEVICE_ CHARACTER /-ISO_SATURATION O /IMAGE_CREATION /CAMERA_- CAPTURE /DEVICE_ CHARACTER /-ISO_NOISE
15	Focal Length	Focal length of the lens in millimetres	O 37386, FocalLength	O 37386, FocalLength	O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_ SETTINGS /-FOCAL_LENGTH
16	Focal Length in 35 mm film	Focal length of the 35mm film format lens with a corresponding field of view	O 41989, FocalLength In35mmFilm	NU	O /IMAGE_CREATION/ CAMERA_- CAPTURE /CAMERA_ SETTINGS /-FOCAL_LENGTH_ IN_35MM_FILM
17	Spatial Frequency Response (as captured)	Electro-optical spatial frequency response of the camera, as defined in ISO 12233	O 41484, Spatial-Frequency-Response	O 37388, Spatial-Frequency-Response	O /IMAGE_CREATION /CAMERA_- CAPTURE /DEVICE_ CHARACTER /-SPATIAL_FREQ_ RESPONSE
18	Spatial Frequency Response (of the image)	Electro-optical spatial frequency response of the image, as defined in ISO 12233	NU	NU	O /IMAGE_DATA_ CHARACTER /-IMG_SPATIAL_ FREQ_RESPONSE
19	Noise	The rms noise levels of each camera channel at one or more signal levels	NU	O 37389, Noise	NU

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
20	Spectral Sensitivity	The spectral sensitivities of each capture channel	O 34852, Spectral-Sensitivity	O 34852, Spectral-Sensitivity	O /IMAGE_CREATION /CAMERA_- CAPTURE /DEVICE_ CHARACTER /SPECTRAL_ SENSITIVITY
21	Opto-electronic conversion function (OECF), as captured	The relationship between the focal plane or input scene luminances and the digital output levels as captured, as defined in ISO 14524	O 34856, OECF	O 34856, OECF	O /IMAGE_CREATION /CAMERA_- CAPTURE/DEVICE_ CHARACTER/-OECF
22	Opto-electronic conversion function (OECF), of the image	The relationship between the focal plane or input scene luminances and the digital output levels, as defined in ISO 14524	NU	NU	O /IMAGE_DATA_ CHARACTER /-IMG_OECF
23	Focal Plane X Resolution	Number of pixels in the focal plane in the x-direction, per FocalPlane-ResolutionUnit	O 41486, FocalPlane-XResolution	R 37390, FocalPlane-XResolution	O /IMAGE_CREATION /CAMERA_- CAPTURE/DEVICE_ CHARACTER /-FOCAL_PLANE_ RES
24	Focal Plane Y Resolution	Number of pixels in the focal plane in the y-direction, per FocalPlane-ResolutionUnit	O 41487, FocalPlane-YResolution	R 37391, FocalPlane-YResolution	O /IMAGE_CREATION /CAMERA_- CAPTURE/DEVICE_ CHARACTER /-FOCAL_PLANE_ RES
25	Focal Plane Resolution Unit	Measurement unit for focal plane resolution data	O 41488, FocalPlane-ResolutionUnit	R 37392, FocalPlane-Resolution-Unit	O /IMAGE_CREATION /CAMERA_- CAPTURE/DEVICE_ CHARACTER /-FOCAL_PLANE_ RES
26	Max Aperture Value	Minimum f-number the camera can attain, in APEX units	O 37381, MaxAperture-Value	O 37381, MaxAperture-Value	O /IMAGE_CREATION /CAMERA_- CAPTURE/DEVICE_ CHARACTER /-MIN_F_NUMBER

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
27	Sensor Configuration	Image sensor configuration used to capture the image	O 41495, Sensing-Method	M 37399, Sensing-Method	O /IMAGE_CREATION /CAMERA_- CAPTURE/DEVICE_ CHARACTER /SENSOR_ TECHNOLOGY
28	CFA Pattern at time of capture	Colour filter array pattern on sensor at time of capture	O 41730, CFAPattern	O if Photometric- Interpretation not = 32803, NU otherwise 33422, CFAPattern	O /IMAGE_CREATION /CAMERA_- CAPTURE/DEVICE_ CHARACTER /CFA_PATTERN
29	CFA Pattern of image	Colour filter array pattern of image	NU	M if Photometric- Interpretation = 32803, NU otherwise 33422, CFAPattern	O /IMAGE_DATA_ CHARACTER /-IMG_CFA_ PATTERN
30	CFA Pattern Dimensions	Colour filter array pattern dimensions	NU	M if Photometric- Interpretation = 32803, O otherwise 33421, CFAPattern	NU
31	Image annotation				
	Date Time Original	Date and time of image capture	O/M ^d 36867, DateTime Original	R 36867, DateTime Original	O /CONTENT_ DESCRIPTION /-CAPTURE_TIME
32	Time Zone Offset	Date Time Original Time Zone Offset	NU	R 34858, TimeZone-Offset	NU
33	DateTime Digitized	Date and time of image digitized	O/M ^d 36868, DateTime-Digitized	NU	O /IMAGE_CREATION /GENERAL_- CREATION_INFO /CREATION_TIME
34	DateTime-Last-Modified	Date and time of last modification to image file	R 306, DateTime	M 306, DateTime	O /IPR.IPR_DATES /IPR_DATE@- DESCRIPTION = " Last Modified"
35	Image Description	Description of image, e.g. title or subject (ASCII)	R 270, Image-Description	M 270, Image-Description	O /CONTENT_ DESCRIPTION /-CAPTION

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
36	User Comments	Additional user annotation field of undefined character type	O 37510, User- Comment	NU	NU
37	Image Number	Index number assigned to image (ASCII)	NU	O 37393, Image-Number	NU
38	Artist	Identifier for creator of image (ASCII)	O 315, Artist	O 315, Artist	O /IMAGE_CREATION /GENERAL_ CREATION_INFO /IMAGE_-CREATOR
39	Copyright	Image copyright holder (ASCII)	O 33432, Copyright	M 33432, Copyright	O /IPR/
40	Security Classification	Identifier specifying the security classification given to the image	NU	O 37394, Security- Classification	O /IPR/
41	GPS Info	The position of the camera at image capture	O 34853, GPSInfo	O 34853, GPSInfo	NU
42	IPTC/NAA	IPTC/NAA information	NU	O 33723, IPTC/NAA	NU
43	Image History	Text describing the history of modifications to the image (ASCII)	NU	O 37395, Image-History	O /HISTORY/
44	Processing Summary	History metadata elements defined in ISO 15444-2:2004 Annex N.6.3	NU	NU	M /PROCESSING_ SUMMARY/
45	Subject Location	Location and area of the main subject in the image	O 41492, Subject-Location 37396, SubjectArea	O 37396, Subject-Location	O /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /SUBJECT_ POSITION
46	Image- UniqueID	Unique identifier assigned to the image	O 42016, ImageUnique-ID	NU	O /BASIC_IMAGE_ PARAM /BASIC_ IMAGE_INFO /IMAGE_ID
47	Related SoundFile	Audio file associated with the image	O 40964	NU	NU

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
48		Image information			
	Thumbnail	Differentiate image (full resolution) and thumbnail image (reduced resolution) data	O/M ^d Primary image in IFD0 thumbnail in IFD1	M 254, NewSub-FileType	NU NOTE: JPEG 2000 provides a multi-resolution image representation
49	Interlace Scan	Field number of multi-field images	NU	O 34857, Interlace	NU
50	Image Width	Number of pixel columns	M ^e 256, ImageWidth	M 256, ImageWidth	M Specified in the Image Header box
51	Image Height	Number of pixel rows	M ^e 257, ImageLength	M 257, Image-Length	M Specified in the Image Header box
52	Aspect Ratio (Pixel)	Ratio of XResolution to YResolution ^f	M ^f	M ^f	O Elements used specified in the Resolution box.
53	Aspect Ratio (Image)	Ratio of XResolution/ImageWidth to YResolution/ImageLength ^g	M ^g	M ^g	O Elements used specified in the Resolution box and Image Header box.
54	PixelX Dimension	Valid image width in the x-direction	M ^h 40962	NU	NU
55	PixelY Dimension	Valid image width in the y-direction	M ^h 40963	NU	NU
56	X Resolution	Number of pixels per output distance unit in the ImageWidth direction	M 282, XResolution	M 282, XResolution	O Specified in the Resolution box
57	Y Resolution	Number of pixels per output distance unit in the ImageLength direction	M 283, YResolution	M 283, YResolution	O Specified in the Resolution box
58	Resolution Unit	Physical units for output distance data	M 296, Resolution-Unit	M 296, Resolution-Unit	NU
59	Orientation	Orientation of the current image relative to the horizontal rows and vertical columns of the originally captured image	R 274, Orientation	O 274, Orientation	R /IMAGE_CREATION /CAMERA_CAPTURE /CAMERA_SETTINGS /ORIENTATION

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
60	Samples Per Pixel	Number of components (samples) stored for each pixel	M ^d 277, Samples-PerPixel	M 277, Samples-PerPixel	M Specified in the Image Header box
61	Bits Per Sample	Number of bits used to store each sample or component	M ^d 258, BitsPer-Sample	M 258, BitsPer-Sample	M Specified in the Image Header box or Bits Per Sample box if it's not constant across all components.
62	Original Compressed Bits Per Pixel	Setting of bit rate at the time of capture compression	NU	NU	O /IMAGE_CREATION /CAMERA_CAPTURE /CAMERA_SETTINGS /COMPRESSED_BITS_PER_PIXEL
63	Compressed Bits Per Pixel	Setting of bit rate at the time of last image compression	O ^h 37122, Compressed-BitsPerPixel	O ^h 37122, Compressed-BitsPerPixel	O /IMAGE_DATA_CHARACTERIZATION/IMG_COMPRESSED_BITS_PER_PIXEL
64	Compression	Type of image compression method (none, JPEG, DPCM, etc.) applied to the image data	M ^h Only thumbnail 259, Compression	M 259, Com-pression	Indicated in codestream ⁱ
65	JPEG Interchange Format		M ^h 513	M ^h 513	NU
66	JPEG Interchange Format Length		M ^h 514	M ^h 514	NU
67	JPEG Tables (DQT, DHT)	Tables to aid in decoding compressed image data, e.g. Huffman tables	M ^h JPEG Marker	O 347, JPEGTables	NU
68	Planar Configuration	Storage pattern of the colour components in the image data (Interleaving pattern)	M ^e 284, Planar-Configuration	M 284, Planar-Configuration	NU ^j
69	Strip Offsets	Offsets with respect to the beginning of the file to each strip of image data	M ^e 273, StripOffsets	M ^k 273, StripOffsets	NU ^j
70	Rows per Strip	Number of rows per strip within the image	M ^e 278, RowsPerStrip	M ^k 278, RowsPerStrip	NU ^j

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
71	Strip Byte Counts	Number of bytes in each strip after compression	M ^e 279, StripByte-Counts	M ^k 279, StripByte-Counts	NU ^j
72	Tile Offsets	Offsets with respect to the beginning of the file to each tile of image data	NU	M ^k 324, TileOffsets	NU ^j
73	Tile Width	Number of columns in each image tile	NU	M ^k 322, TileWidth	NU ^j
74	Tile Length	Number of rows in each image tile	NU	M ^k 323, TileLength	NU ^j
75	Tile Byte Counts	Number of bytes in each image tile	NU	M ^k 325, TileByte-Counts	NU ^j
76	Photo-metric Interpretation	Image colour space type: RGB, YCbCr, etc.	M ^e 262, Photometric-Interpretation	M 262, Photometric-Interpretation	NU ^j
77	Components Configuration	Order of the image data colour components for each pixel within an image	M ^h 37121	M 262, Photometric-Interpretation Note, Photometric-Interpretation includes this information.	NU ^j
78	YCbCr Sub-sampling	Subsampling factors for the chrominance components	M ⁱ 530, YCbCrSub-Sampling	M ⁱ 530, YCbCrSub-Sampling	Specified within the codestream: CSsiz parameter of the SIZ marker segment. The subsampling might not be tied specifically to YCrCb, the use of component transform is specified in Ssiz ⁱ parameter in SIZ.
79	YCbCr Positioning	Position of subsampled chrominance components relative to luminance samples	M ⁱ 531, YCbCr-Positioning	M ⁱ 531, YCbCr-Positioning	Specified within the codestream: XRsiz ⁱ and YRsiz ⁱ parameters in the SIZ marker segment
80	Camera settings				
	Light Source	Lighting type detected in the scene and used for white balance at time of capture (Daylight, Tungsten, Fluorescent, Flash, etc.)	O 37384, LightSource	O 37384, LightSource	O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_ SETTINGS /SCENE_ ILLUMINANT

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
81	Light Source CCT	Light Source correlated colour temperature	NU	NU	O /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /COLOR_TEMP
82	Adopted White	Adopted white used for image white balance	NU	NU	O /IMAGE_DATA_ CHARACTE- RIZATION/IMG_ SCENE_ ILLUMINANT
83	Adopted White CCT	Adopted white correlated colour temperature	NU	NU	O /IMAGE_DATA_ CHARACTERIZATION/ IMG_COLOR_TEMP
84	f-number (Aperture)	Focal length of lens/ diameter of lens opening	O 33437, FNumber	O 33437, FNumber	R /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /F_NUMBER
85	Aperture Value (APEX)	Lens aperture value in APEX units	O 37378, Aperture-Value	O 37378, Aperture-Value	NU
86	Exposure Time	Time in seconds for exposure	O 33434, Exposure-Time	O 33434, Exposure-Time	R /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /EXP_TIME
87	Time Value (APEX)	The exposure time or shutter speed value, in APEX units	O 37377, Shutter-SpeedValue	O 37377, Shutter-SpeedValue	NU
88	Self Timer Mode	Seconds of self-timer delay	NU	O 34859, SelfTimer-Mode	NU
89	Exposure Index Used	Actual exposure index used by the camera to capture the image	NU	O 37397, Exposure-Index	O /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /EXPOSURE_INDEX

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
90	Exposure Index Set	Exposure index set on the camera by the user as the "ISO", or used by the camera if set in "auto ISO"	O 41493, Exposure-Index	NU	NU
91	Exposure Bias	Actual camera exposure bias relative to the user set EI, in APEX units NOTE 1: This can be different from user set exposure bias. NOTE 2: It is not necessarily related to image lightness, which might be adjusted in processing.	O 37380, ExposureBias Value	O 37380, ExposureBias Value	O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_ SETTINGS /EXPOSURE_BIAS
92	Metering Mode	Method used for exposure metering	O 37383, Metering-Mode	O 37383, Metering-Mode	O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_ SETTINGS /METERING_MODE
93	Exposure Program	Type of exposure program used	O 34850, Exposure-Program	O 34850, Exposure-Program	O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_ SETTINGS /EXP_PROGRAM
94	Brightness Value	Measured scene brightness in APEX units	O 37379, Brightness-Value	O 37379, Brightness-Value	R /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_ SETTINGS /BRIGHTNESS
95	Subject Distance	Distance of the camera from the subject on which the camera is focused in the scene	O 37382, Subject-Distance	O 37382, Subject-Distance	O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_ SETTINGS /SUBJECT_ DISTANCE

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
96	Flash	State of flash during image capture: on, off, fill or backlight	R 37385, Flash	O 37385, Flash	R /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS/FLASH
97	Flash Energy	Defined in ISO 15444-2:2004, N.6.1.7	O 41483, FlashEnergy	O 37387, FlashEnergy	O /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /FLASH_ENERGY
98	Flash Return	Defined in ISO 15444-2:2004, N.6.1.7	NU	NU	R /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /FLASH_RETURN
99	Back Light	Defined in ISO 15444-2:2004, N.6.1.7	NU	NU	R /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /BACK_LIGHT
100	Exposure-Mode	The exposure mode (Auto, Manual, Bracketed) set at image capture	O 41986, ExposureMode	NU	R /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS/FLASH
101	White-Balance	Indicates the white balance determination mode set at capture (auto, preset, manual)	O 41987, WhiteBalance	NU	R /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /WHITE_BALANCE
102	Digital-Zoom Ratio	The digital zoom ratio selected at image capture	O 41988, DigitalZoom-Ratio	NU	O /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /DIGITAL_ZOOM_RATIO

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
103	Scene Capture Type	The type of scene intended to be captured	R 41990, Scene Capture-Type	NU	O /BASIC_IMAGE_PARAM/-GENERAL_CREATION_INFO /SCENE_TYPE
104	FileSource	Indicates image was recorded by a digital camera	O 41728	NU	NU
105	SceneType	Indicates image was directly photographed	O 41729	NU	NU
106	GainControl	The degree of overall camera gain adjustment at image capture	O 41991, GainControl	NU	O /IMAGE_CREATION /CAMERA_-CAPTURE /CAMERA_SETTINGS /GAIN_CONTROL
107	Contrast	The direction of the contrast processing selected and applied at image capture	O 41992, Contrast	NU	O /IMAGE_CREATION /CAMERA_-CAPTURE /CAMERA_SETTINGS /CONTRAST
108	Saturation	The direction of saturation processing selected and applied at image capture	O 41993, Saturation	NU	O /IMAGE_CREATION /CAMERA_-CAPTURE /CAMERA_SETTINGS /SATURATION
109	Sharpness	The direction of sharpness processing selected and applied at image capture	O 41994, Sharpness	NU	O /IMAGE_CREATION /CAMERA_-CAPTURE /CAMERA_SETTINGS /SHARPNESS
110	Custom-Rendered	Indicates that the image is colour rendered as desired and should not be automatically enhanced	O 41985, Custom-Rendered	NU	O /IMAGE_CREATION /CAMERA_-CAPTURE /CAMERA_SETTINGS /CUSTOM_RENDERED

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
111	Device- Setting- Description	Summary of the picture-taking conditions for a reading system	O 41995, DeviceSetting- Description	NU	O /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS/ DEVICE_ SETTING_ DESCRIPTION
112	Subject- Distance- Range	The distance range (Macro, Close, or Distant view) to the subject	O 41996, SubjectDistance- Range	NU	O /IMAGE_CREATION /CAMERA_ CAPTURE /CAMERA_ SETTINGS /SUBJECT_ DISTANCE_RANGE
113	Battery Level	The level of the camera battery when the image was captured	NU	O 33423	NU
114	Reference Black White (Polarity)	Minimum and maximum code values used to specify the encoding black and white in the image for each component	O 532, Reference- BlackWhite	M when Photometric- Interpretation = 6, NU otherwise 532, Reference- BlackWhite	NU (*8)
115	Gamma (up to 3)	Exponents for each colour component, for the case where the transfer function can be represented using a function with only an exponent (VALUES)	O/M ^j 42240, Gamma	NU	NU (*8)
116	Transfer Function	Per-component lookup tables that relate encoded values to intended output relative radiance	R 301	NU	NU (*8)
117	Primary Chroma- ticities	Encoding RGB primary chromaticities (VALUES)	O/M ^j 319, Primary- Chromaticities	NU	NU (*8)
118	White chromaticity	Encoding white chromaticity	O/M ^j 318	NU	NU (*8)
119	Colour Encoding	The standard colour encoding used to encode the image data	M 40961, ColorSpace	NU	NU (*8)

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
120	YCbCr Coefficients	Coefficients of colour space conversion from RGB to YCbCr	M 529, YCbCr-Coefficients	M when Photometric- Interpretation = 6, NU otherwise 529, YCbCr-Coefficients	NU (*8)
121	ICC profile	ICC profile	NU	R 34675, InterColor- Profile	NU (*8)
122	Format profile				
	Format Used	Format description	M TIFF header JPEG marker	M TIFF header	M File Type box
123	Version and Standard Identifier	Current version of format used	M 36864, ExifVersion	M 37398 TIFF/EP StandardID	M File Type box and O /BASIC_IMAGE_ PARAM/BASIC_ IMAGE_INFO/FILE_ FORMAT/-VERSION
124	SubIFDs	Pointer to thumbnail image	NU	330:	NU
125	Exif IFD Pointer	Location of Exif related metadata	34665:	NU	NU
126	Byte Order	Meaning of first byte accessed, i.e. whether MSB or LSB	M TIFF header	M TIFF header	NU
127	Control Parameters	Control values used in relating files to one another	NU/O ^d DCF - File number match indicates same DCF object	NU	NU
128	Vendor Unique	Information unique to a particular vendor	O 37500, MakerNote	O TIFF private tags	Provided using proprietary +metadata in file is facilitated through the use of the COMMENT element. O /IMAGE_CREATION /CAMERA_- CAPTURE /CAMERA_INFO /-MANUFACTURER /COMMENT
129	Interoperability				
	Interoperability Index	Name of interoperability rule	O/M ^d 1, Interoperability- Index	NU	NU

Table 2 (continued)

Feature name		Description	Exif ^a Tag code, applicability ^d	TIFF/EP ^b Tag code, applicability	JPEG 2000 Part 1 and 2 ^c JPEG 2000 element, applicability
130	Interoperability IFD Pointer	Pointer to interoperability information	O/M ^d 40965		
NOTE The status for a particular information field for the image data formats described in Annexes A, B, C and D may fall into one of the following categories. Mandatory (M): These features shall be present. Recommended (R): These features are not required, but their implementation is strongly advised. Optional (O): These features may be present but are not required. If not present there are no defaults to be assumed. Readers are required to respond gracefully to optional information fields. Writers are not required to implement optional features. (O/M): These features are optional for an Exif file, unless the Exif file is used with DCF as a DCF basic or optional file, in which case these features are mandatory. See Annex D for details. Not used (NU): These features are not applicable and are not present in the given profile. ^a See Annex B. ^b See Annex A. ^c See Annex C. ^d When an Exif file is used with DCF as a DCF basic or optional file, some optional features are mandatory as indicated in this table. See Annex D for details. ^e Tag not used with JPEG compressed image, because the same information is contained in the JPEG marker. ^f The aspect ratio, γ, expressed in pixels, is equal to the ratio of the X resolution, R_X, to the Y resolution, R_Y as follows: $\gamma = \frac{R_X}{R_Y}$ ^g The aspect ratio of the image, β, is equal to the ratio of the X resolution to the image width, w_i with respect to the ratio of the Y resolution to the image length, l_i. $\beta = \frac{R_X/w_i}{R_Y/l_i}$ ^h Tag used only for JPEG compressed image. ⁱ JPEG 2000 supports lossless and lossy compression. ^j The element specified is encapsulated in a different form in the colour specification box; therefore this element is not specifically applicable. For colour architecture details, see ISO/IEC 15444-1:2004, Annex I.3 Greyscale/Colour/Palettized/multi-component specification. ^k Tags shall refer either to strips, or to tiles, but not both. ^l All M tags shall be present for YCC images, but not for RGB images. ^j Tags shall be present only for DCF optional file but not for DCF basic file when an Exif file is used with DCF.					

6.5 Application layer for sound data

The application layer can define what sound data may be present in the information to be exchanged between the various components of an electronic imaging system. The data defined here determine what information is available to a host system on the sound, the sound conditions and information used to interpret the sound. Sound data recording is defined within the Exif format, but not in TIFF/EP or JPEG 2000.

6.6 Guidance for persisting metadata

The recommendations for persisting the metadata items listed in Table 2 are given in Table 3. In general, the recommendations for each category of metadata are as follows.

Camera information metadata are associated with a specific image capture/creation, and should not be altered, unless it is the intent of the user to create a “new” image. However, software metadata should always be updated to describe the application or device that edited the image. When a new image is created, all the capture/creation metadata should be updated to reflect the new creation, including the creation date/time,

creation device and software. New creation should be at the request of the user and should be indicated through the use of the “save as” (as opposed to “save”) command, or through some other mechanism, the details of which are left to the application.

Camera/lens characterization metadata will frequently be affected by image processing and editing, and appropriate items should be updated when possible. If processing occurs that may render some image characterization metadata items invalid, and it is not possible to update the metadata items appropriately, the appropriate metadata should be deleted.

Annotation metadata are under the control of the user. It should be persisted unless altered by the user. IPR and security metadata are under the control of the copyright owner. It should be persisted unless altered by the copyright owner.

History metadata should be updated whenever the image is modified. The former values for any metadata items that are altered or deleted should be recorded in the History metadata elements, if this is supported by the image format.

Table 3 — Metadata persistence

Feature name		Persistence
Camera information		
1	Camera Make	Persist without modifying
2	Camera Model	Persist without modifying
3	Camera Serial Number	Persist without modifying
4	Camera Version	Persist without modifying
5	Lens Make	Persist without modifying
6	Lens Model	Persist without modifying
7	Lens Serial Number	Persist without modifying
8	Lens Version	Persist without modifying
9	Software Make	Update as appropriate when editing
10	Software Model	Update as appropriate when editing
11	Software Serial Number (Camera)	Update as appropriate when editing
12	Software Version (Camera)	Update as appropriate when editing
13	Accessory	Persist, or modify if altered by user
Camera/lens characterization		
14	ISO Speed	Persist without modifying
15	Focal Length	Persist without modifying
16	Focal Length in 35mm film	Persist without modifying
17	Spatial Frequency Response (as captured)	Persist without modifying
18	Spatial Frequency Response (of the image)	Update as appropriate when editing
19	Noise	Persist without modifying
20	Spectral Sensitivity	Persist without modifying
21	Opto-electronic conversion function (OECF), as captured	Persist without modifying
22	Opto-electronic conversion function (OECF), of the image	Update as appropriate when editing
23	Focal Plane X Resolution	Persist without modifying
24	Focal Plane Y Resolution	Persist without modifying
25	FocalPlane Resolution Unit	Persist without modifying
26	Max Aperture Value	Persist without modifying
27	Sensor Configuration	Persist without modifying

Table 3 (continued)

Feature name		Persistence
28	CFA Pattern at time of capture	Persist without modifying
29	CFA Pattern of image	Persist without modifying
30	CFA Pattern Dimensions	Persist without modifying
Image annotation		
31	Date Time Original	Persist, or modify if altered by user due to incorrect camera clock setting
32	Time Zone Offset	Persist, or modify if altered by user due to incorrect camera clock setting
33	DateTime Digitized	Persist, or modify if altered by user due to incorrect camera clock setting
34	DateTime-Last-Modified	Always update when editing
35	Image Description	Persist, or modify if altered by user
36	User Comments	Persist, or modify if altered by user
37	Image Number	Persist, or modify if altered by user
38	Artist	Persist, or modify if altered by owner
39	Copyright	Persist, or modify if altered by owner
40	Security Classification	Persist, or modify if altered by owner
41	GPS Info	Persist, or modify if altered by user
42	IPTC/NAA	Persist, or modify if altered by user
43	Image History	Persist, and append new history information
44	Processing Summary	Persist, and append new history information
45	Subject Location	Persist or update
46	Image-UniqueID	Persist, or modify if altered by user
47	Related Sound File	Persist or update
Image information		
48	Thumbnail	Persist or update
49	Interlace Scan	Persist or update
50	Image Width	Persist or update
51	Image Height	Persist or update
52	Aspect Ratio (Pixel)	Persist or update
53	Aspect Ratio (Image)	Persist or update
54	Pixel X Dimension	Persist or update
55	Pixel Y Dimension	Persist or update
56	X Resolution	Persist, or modify if altered by user
57	Y Resolution	Persist, or modify if altered by user
58	Resolution Unit	Persist, or modify if altered by user
59	Orientation	Persist, or modify if altered by user
60	Samples Per Pixel	Persist or update
61	Bits Per Sample	Persist or update
62	Original Compressed Bits Per Pixel	Persist without modifying
63	Compressed Bits Per Pixel	Persist or update
64	Compression	Persist or update
65	JPEG Interchange Format	Persist or update
66	JPEG Interchange Format Length	Persist or update
67	JPEG Tables (DQT, DHT)	Persist or update

Table 3 (continued)

Feature name		Persistence
68	Planar Configuration	Persist or update
69	Strip Offsets	Persist or update
70	Rows per Strip	Persist or update
71	Strip Byte Counts	Persist or update
72	Tile Offsets	Persist or update
73	Tile Width	Persist or update
74	Tile Length	Persist or update
75	Tile Byte Counts	Persist or update
76	Photometric Interpretation	Persist or update
77	Components Configuration	Persist or update
78	YCbCr Sub-sampling	Persist or update
79	YCbCr Positioning	Persist or update
Camera settings		
80	Light Source	Persist without modifying
81	Light Source CCT	Persist without modifying
82	Adopted White	Persist unless altered by user
83	Adopted White CCT	Persist unless altered by user
84	f-number (Aperture)	Persist without modifying
85	Aperture Value (APEX)	Persist without modifying
86	Exposure Time	Persist without modifying
87	Time Value (APEX)	Persist without modifying
88	Self Timer Mode	Persist without modifying
89	Exposure Index Used	Persist without modifying
90	Exposure Index Set	Persist without modifying
91	Exposure Bias	Persist without modifying
92	Metering Mode	Persist without modifying
93	Exposure Program	Persist without modifying
94	Brightness Value	Persist without modifying
95	Subject Distance	Persist without modifying
96	Flash	Persist without modifying
97	Flash Energy	Persist without modifying
98	Flash Return	Persist without modifying
99	Back Light	Persist without modifying
100	Exposure-Mode	Persist without modifying
101	White-Balance	Persist without modifying
102	DigitalZoomRatio	Persist without modifying
103	Scene Capture Type	Persist unless altered by user
104	File Source	Persist without modifying
105	SceneType	Persist without modifying
106	Gain Control	Persist without modifying
107	Contrast	Persist without modifying
108	Saturation	Persist without modifying
109	Sharpness	Persist without modifying
110	Custom-Rendered	Persist unless altered by user

Table 3 (continued)

Feature name		Persistence
111	Device-Setting-Description	Persist without modifying
112	Subject-Distance-Range	Persist without modifying
113	Battery Level	Persist without modifying
114	Reference Black White (Polarity)	Persist or update
115	Gamma	Persist or update
116	Transfer Function	Persist or update
117	Primary Chromaticities	Persist or update
118	White chromaticity	Persist or update
119	Colour Encoding	Persist or update
120	YCbCr Coefficients	Persist or update
121	ICC profile	Persist or update
Format profile		
122	Format Used	Persist or update
123	Version and Standard Identifier	Persist or update
124	SubIFDs	Persist or update
125	ExifIFD Pointer	Persist or update
126	Byte Order	Persist or update
127	Control Parameters	Persist or update
128	Vendor Unique	Persist or update
Interoperability		
129	Interoperability Index	Persist or update
130	Interoperability IFD Pointer	Persist or update

7 File system requirements

7.1 General considerations

The file system corresponds to the session layer of the reference model, and is also independent of the storage media used. The file system described in Annex D is intended to be used as an image interchange format for photographic images within the scope of the reference model.

CIPA DC-008-2010/JEITA CP-3461B is a suitable example of a complete set of requirements that describes the file system and the basic image format. Table 4 summarizes the set of requirements for the file system.

7.2 Directory structure and name

The primary part of the file system requirements is the directory structure and the names of the directories used to store image files. The structure and naming conventions of the image storage directory shall be strictly defined. These enable the reading/editing devices to find the directories in which the image files are stored.

The definition includes rules defining the tree structure of the directories, where the image storage directories can be located, and rules on directory names, such as the number of characters and the allowed character set. The naming conventions may limit the number of the image storage directories allowed.

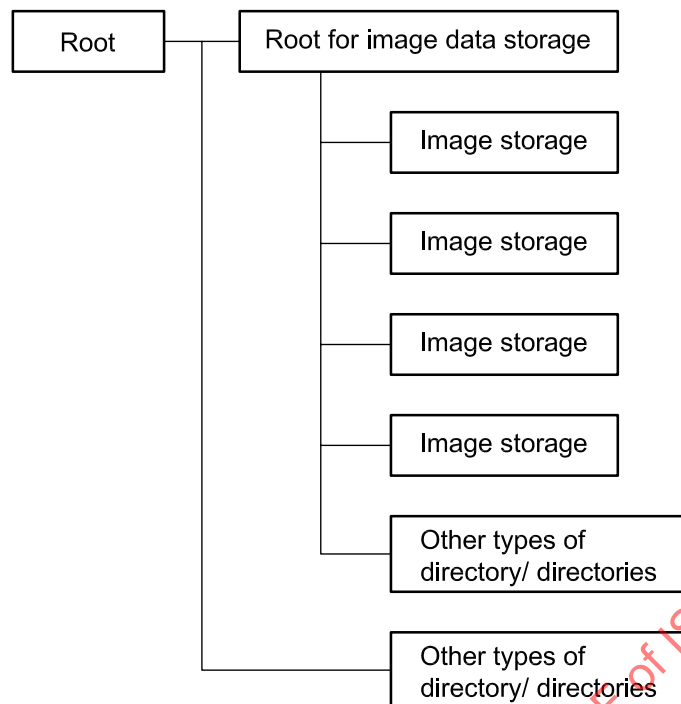


Figure 1 — Typical directory structure

7.3 Object

7.3.1 General

Another part of the file system requirements is the definition of the objects which are stored in the image storage directory. The type, name and file extension of the object shall meet the definition. This enables the reading/editing devices to correctly find objects recorded by the digital still-picture camera and use them according to their attributes.

7.3.2 Object type

The object type is for those objects to be stored in the image storage directory, such as image object and thumbnail image object.

7.3.3 Object file name and file extension

The file name and file extension of a given object type shall meet criteria such as the number of characters, the allowed character set and the predetermined file extension.

These conventions can be used as a machine and human readable object type mark or a beacon of matched file combinations such as matched large and thumbnail images or matched image and audio files.

NOTE A DCF object (see Annex D) defines different concepts, which consist of matched file combinations.

7.4 Interoperability

An interoperability index shall be given to each object file. The index shall clearly show the reading/editing devices if data stored in the removable memory is interoperable with the devices.

The index includes the version number of the file system and the image format used. It further includes the image size (number of pixels) when the reading/editing devices are constrained in terms of maximum image size handled as an interoperability attribute.