



BSI Standards Publication

Digital imaging — Image storage

Part 1: Reference model

National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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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.

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

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html. This document was prepared by Technical Committee ISO/TC 42, *Photography*.

This fourth edition cancels and replaces the third edition (ISO 12234-1:2012), which has been technically revised.

The main changes are as follows:

- [subclauses 6.4.2](#) and [6.4.3](#) replace subclause 6.6 in the previous edition;
- [Table 2](#) of the previous edition has been divided into [Tables 4, 5](#) and [6](#) according to the feature classifications defined in [Table 2](#) in [6.4.2](#), and each metadata item is given a post processing rank according to [Table 3](#) in [6.4.3](#).

A list of all parts in the ISO 12234 series can be found on the ISO website.

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

Introduction

This document addresses image storage requirements for digital photography systems, devices, and components, including digital cameras. A digital photography system typically divides the imaging chain into discrete components devoted to image acquisition, processing, storage, transmission and display. Since the components can be made by different manufacturers, there is a need to specify a standard format for image data interchange among the various components of the digital photography system.

The initial editions of ISO 12234-1 described image data interchange using only removable storage media, such as removable memory cards, floppy disks, and removable hard drives. The removable storage media was used to transport the digitized image data to other components in the imaging chain. However, many current digital cameras, including the digital cameras incorporated into smartphones and tablet computers, utilize internal non-volatile memory rather than removable memory. Therefore, the title and scope of this document have been broadened to include devices and systems that utilize non-removable image storage technologies.

This document specifies the required information content for storing images in digital photography components, devices and systems. The information content includes both the image data and data items describing the image. [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. [Annex D](#) describes a conforming file system. The file system features are described in [Clause 7](#).

An implementation is considered to be in conformity 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 the earlier editions of ISO 12234, as well as this document, a structured methodology has been followed. A reference model describes the environment as well as the overall system architecture. 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 internal or removable storage media used, but it is independent of the media.

With the permission of Adobe Systems Incorporated, numerous tag names and values used in this document have been copied verbatim from the TIFF 6.0 specification^[5] dated June 3, 1992, specification copyright 1986-1988, 1992 Adobe Systems Incorporated.

Digital imaging — Image storage —

Part 1: Reference model

1 Scope

This document specifies a basic reference model for digital photography systems, including digital cameras. The reference model includes image file formats for storing image data and metadata, file system requirements for storing and retrieving the image files using internal or 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 a digital photography system.

2 Normative references

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

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

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

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

3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 file system

software structure which specifies how the data is logically organized on a given internal or removable 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* (3.1) and the *image data format* (3.2)

Note 1 to entry: The ISAP specifies all the information necessary to completely implement image storage.

3.4

media profile

portion of the memory module specification which is specific to a given memory technology

Note 1 to entry: For removable memory, the media profile includes 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 a removable memory, containing the *image data format* ([3.2](#)) combined with a specified physical form factor, interconnect definition and access protocol

3.7

removable memory

image storage in a user-removable form factor, which is non-volatile, transportable, and used for the storage of digital image data in digital cameras

3.8

sound compression

process of altering the sound data coding in order to reduce the size of a sound file

Note 1 to entry: See also *sound recording* ([3.9](#)).

3.9

sound data recording

recording of the sound data relative to an image acquired by the digital camera

Note 1 to entry: The sound data recording can be made before, during or after the time the image is acquired.

Note 2 to entry: A sound data recording attached to a digital still image is considered an annotation of the image, as distinguished from a sound recording which is attached to and synchronized with a video recording.

4 Reference model

4.1 General considerations

[Table 1](#) summarizes the reference model for this document. 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. The physical layer is applicable only to removable memory.

Table 1 — Reference model

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 storage and retrieval 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 of 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 document 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 document 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

Various types of digital storage may be used in digital cameras. These storage technologies include various internal solid-state memory, removable solid-state memory cards, and magnetic hard drives. Each of these memory types can be described by an appropriate media profile.

The media profile definition includes the information required for the transport, network, and data link layers, and for removable memory, the physical layer as well.

The transport layer defines the protocol for how these data are transported between the digital camera and the 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 images, as well as removing and inserting specific types of media in the case of removable memory.

The physical layer is applicable only to removable memory and 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 [5.7](#). These criteria were used in the development of this document and will be used in developing its future editions.

5.2 Interoperability

This document is intended to foster interoperability between systems manufactured by different vendors. In the case of removable memory, this interoperability permits

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

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, 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 this document, 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 Platform independence

Because it is 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.

5.6 Multiple storage technologies

This reference model supports internal and removable storage media based on various storage technologies, e.g. different types of solid state EEPROM memory cards as well as rotating magnetic disc storage, are supported.

5.7 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 the same 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 [Annexes A, B and C](#) are intended to be used as image interchange formats for photographic images within the scope of the reference model. It is recognized that images from sources other than digital 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 digital camera which captured 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, which is media independent.

6.4 Image data formats

6.4.1 General

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 shall be implemented in accordance with ISO 12234-2 as indicated in [Annex A](#). When used, the Exif image format shall be implemented as described in [Annex B](#). When used, the JPEG 2000 image data format shall be implemented as described in [Annex C](#) and shall conform to ISO/IEC 15444-1 and ISO/IEC 15444-2. The DCF file system is described in [Annex D](#). Reference [9] describes the development and structure of these image formats and this file system.

Following subclauses define image data features for above mentioned image data formats with the definitions of feature classifications and post processing ranks of the features.

6.4.2 Feature classifications

[Table 2](#) classifies the features into three categories according to the type of metadata they record. The classification definitions are essentially identical to the definitions in Reference [7] which provides further details.

Table 2 — Feature classifications

Classification	Definition	Description
Category I	Image structure related features (including image size, colour space information, and the like)	A group of metadata indicating image structure, such as image size (e.g. width, height). This information is necessary during image display, and related metadata need to be updated when image editing occurs.
Category II	Shooting condition related features (including image capture settings)	A group of metadata that record camera setting information during image capture, such as the shutter speed and lens aperture value. This is information related to image capture and should not be updated or deleted unless special circumstances exist.
Category III	Features storing other information	A group of metadata other than those in Category I and II, such as the camera model name, serial number, image capture date and time, image capture location, owner name, and copyrights.

6.4.3 Guidance for persisting metadata

The definitions of ranks for persisting the different types of metadata features listed in [Tables 4, 5](#) and [6](#) are given in [Table 3](#) and the guideline for persisting each metadata item is also listed in [Table 3](#).

[Table 3](#) defines policy-based ranks for persisting the metadata items during post-processing. The ranks are divided into

- a) update (for features to be updated during image editing), and
- b) freeze (for features that do not require updating or deletion).

These ranks are then further subdivided into Update 0 and Update 1 and Freeze 0, Freeze 1, and Freeze 2, respectively, to accommodate cases in which modification or deletion is possible.

The definitions in [Table 3](#) are essentially identical to the definitions in Reference [7], which provides further details.