
**Information technology — MPEG
systems technologies —**

**Part 12:
Image File Format**

Technologies de l'information — Technologies des systèmes MPEG —

Partie 12: Format de fichier d'image

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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.

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 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 or www.iec.ch/members_experts/refdocs).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see <https://patents.iec.ch>).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 23008-12:2017), which has been technically revised. It also incorporates the Amendments ISO/IEC 23008-12:2017/Amd.1:2020, ISO/IEC 23008-12:2017/DAMD.2:2019 and the Technical Corrigendum ISO/IEC 23008-12:2017/Cor.1:2020.

The main changes are as follows:

- addition of [Annexes L](#) to [N](#);
- support for predictive image coding, bursts, bracketing and region annotations.

A list of all parts in the ISO/IEC 23008 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

Introduction

The Image File Format is designed to enable the interchange of images and image sequences, as well as their associated metadata. It forms part of a family of specifications that are box-structured, and is built using tools defined in the ISO base media file format. This document specifies both structural brands that can be used with any codec and brands specific to High Efficiency Video Coding (HEVC). The file format specified in this document is referred to as the High Efficiency Image File Format (HEIF). It is suggested that HEIF be pronounced "heaff" (like heath with an ff ending). When the requirements of the HEVC-specific brands are applied, the file format can be referred to as the HEVC Image File Format.

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this document may involve the use of a patent.

ISO and IEC take no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured ISO and IEC that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO and IEC. Information may be obtained from the patent database available at www.iso.org/patents.

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This document is organized as follows:

- [Clause 5](#) specifies general requirements on files and file readers conforming to the Image File Format.
- [Clause 6](#) specifies the file structures for the storage of a single image and an image collection. Additionally, general requirements that shall be supported in all files using the Image File Format for the storage of a single image or an image collection are specified.
- [Clause 7](#) specifies the file structures for the storage of image sequences. Additionally, general requirements that shall be supported in all files using the Image File Format for the storage of image sequences are specified.
- [Clause 8](#) specifies the metadata structures for a single image, an image collection, and image sequences.
- [Clause 9](#) specifies enhancements to the ISO base media file format.
- [Clause 10](#) specifies structural brands for a single image and an image collection, as well as image sequences. Requirements on both files and file readers are specified.
- [Annex A](#) specifies the format for storing Exif, XMP, and MPEG-7 metadata in files conforming to the Image File Format.
- [Annex B](#) specifies the format for encapsulating HEVC-coded images, image collections, and image sequences according to the Image File Format. [Annex B](#) also specifies HEVC-specific brands for a single image and an image collection as well as image sequences. Requirements on both files and file readers are specified.
- [Annex C](#) and [Annex D](#) specify the MIME type registration for a single image or an image collection, and image sequences, respectively, for the structural and HEVC-specific brands.
- [Annex E](#) specifies the format for encapsulating AVC-coded images, image collections, and image sequences according to the Image File Format.

- [Annex F](#) and [Annex G](#) specify the MIME type registration for a single image or an image collection, and image sequences, respectively, for the AVC-specific brands.
- [Annex H](#) specifies the format for encapsulating JPEG-coded images, image collections, and image sequences according to the Image File Format.
- [Annex I](#) outlines guidelines on defining new image formats and brands.
- [Annex J](#) contains informative examples of single image and image collection file structures conforming to the Image File Format.
- [Annex K](#) provides guidelines for a player operation for progressive refinement and file structures enabling progressive refinement.
- [Annex L](#) specifies the format for encapsulating VVC-coded images, image collections, and image sequences according to the Image File Format. [Annex L](#) also specifies VVC-specific brands for a single image and an image collection as well as image sequences. Requirements on both files and file readers are specified.
- [Annex M](#) specifies the format for encapsulating EVC-coded images, image collections, and image sequences according to the Image File Format. [Annex M](#) also specifies EVC-specific brands for a single image and an image collection as well as image sequences. Requirements on both files and file readers are specified.
- [Annex N](#) contains considerations on privacy and security relating to the use of the Image File Format.

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Information technology — MPEG systems technologies —

Part 12: Image File Format

1 Scope

This document specifies the Image File Format, an interoperable storage format for a single image, a collection of images, and sequences of images.

The format defined in this document is built on tools defined in ISO/IEC 14496-12 and enables the interchange, editing, and display of images, as well as the carriage of metadata associated with those images. The Image File Format defines structures used to contain metadata, how to link that metadata to the images, and defines how metadata of certain forms is carried.

This document also specifies brands for the storage of images and image sequences conforming to High Efficiency Video Coding (HEVC), Advanced Video Coding (AVC), JPEG, Versatile Video Coding (VVC) and Essential Video Coding (EVC).

NOTE The storage of HEVC, AVC, VVC and EVC video sequences is out of scope and is provided in ISO/IEC 14496-15.

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/IEC 10918-1, *Information technology — Digital compression and coding of continuous-tone still images — Part 1: Requirements and guidelines*

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding*

ISO/IEC 14496-12, *Information technology — Coding of audio-visual objects — Part 12: ISO base media file format*

ISO/IEC 14496-15, *Information technology — Coding of moving pictures and audio — Part 15: Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format*

ISO/IEC 23008-2, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*

ISO/IEC 23090-3, *Information technology — Coded representation of immersive media — Part 3: Versatile video coding*

ISO/IEC 23094-1, *Information technology — General video coding — Part 1: Essential video coding*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14496-12, ISO/IEC 14496-15 and the following 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/>

3.1.1

alternate group

group of *entities* (3.1.11) that are alternatives to each other and out of which only one should be selected for processing

3.1.2

associated image item

image item (3.1.18) that is associated with the *item property* (3.1.28) through the `ItemPropertiesBox`

3.1.3

auxiliary image

image (3.1.16) that may not be intended to be displayed but provides supplemental information, such as transparency data, complementing a respective *master image* (3.1.29)

3.1.4

coded image

coded representation of an *image* (3.1.16)

3.1.5

coded image item

item (3.1.27) whose data is a *coded image* (3.1.4)

3.1.6

crop-rotate-mirror derived image item

derived image item (3.1.8) of type 'iden' that is not associated with any other types of *essential item properties* (3.1.12) than 'irot', 'clap', and 'imir'. 23008-12:2022

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3.1.7

derived image

representation of an *image* (3.1.16) as an *operation* (3.1.33) on other images

3.1.8

derived image item

item (3.1.27) whose data is a *derived image* (3.1.7)

3.1.9

derived region item

item (3.1.27) whose data is a representation of the shape, position and size of a region within an *image item* (3.1.18), with which it is associated via item reference, as an *operation* (3.1.33) on other *region items* (3.1.39)

3.1.10

descriptive item property

item property (3.1.28) that describes rather than transforms the associated item

3.1.11

entity

item or track

3.1.12

essential item property

item property (3.1.28) that readers are required to process

3.1.13

HEVC image item

image item (3.1.18) of type 'hvc1' or 'lhv1'

3.1.14**hidden image**

image (3.1.16) that is not intended to be displayed

3.1.15**hidden sample**

sample that is not intended to be displayed

3.1.16**image**

one or more arrays of pixels of different colour components described by an *image item* (3.1.18) or a sample

3.1.17**image collection**

set of *images* (3.1.16) stored as *items* (3.1.27) of a single file according to this document

3.1.18**image item**

coded image item (3.1.5) or *derived image item* (3.1.8)

3.1.19**Image File Format**

file format specified by this document

3.1.20**image property**

item property (3.1.28) for an *image item* (3.1.18)

3.1.21**image sequence**

sequence of *coded images* (3.1.4) which may be associated with advisory timing and in which images may use *inter prediction* (3.1.24)

3.1.22**image sequence track**

track that contains an *image sequence* (3.1.21)

3.1.23**input image**

image (3.1.16) that is used as an input for the *operation* (3.1.33) of the *derived image item* (3.1.8)

3.1.24**inter prediction**

prediction derived in a manner that is dependent on data elements (e.g. sample values or motion vectors) of *images* (3.1.16) other than the current image

3.1.25**intra coding**

coding of an *image* (3.1.16) that may use *intra prediction* (3.1.26) and does not use *inter prediction* (3.1.24)

3.1.26**intra prediction**

prediction derived from only data elements (e.g. sample values) of the same decoded image

3.1.27**item**

data that does not require timed processing, as opposed to sample data, and is described by the boxes contained in a `MetaBox`

3.1.28

item property

descriptive or transformative information about an *item* (3.1.27) as stored in the item properties array

3.1.29

master image

image that is stored as an *item* (3.1.27) and is not an *auxiliary image* (3.1.3) or a thumbnail image

3.1.30

master image sequence

sequence of images that is stored as an *image sequence track* (3.1.22) and is not an *auxiliary image* (3.1.3) sequence or a thumbnail *image sequence* (3.1.21)

3.1.31

metadata item

item (3.1.27) containing metadata that may for example describe an *image item* (3.1.18)

Note 1 to entry: ISO/IEC 14496-12 uses the terms item and metadata item interchangeably to refer to an item of any type. This document overrides the metadata item definition of the ISO base media file format.

3.1.32

non-essential item property

item property (3.1.28) that readers are allowed to ignore

3.1.33

operation

for a *derived image item* (3.1.8), manipulation, identified by the item type, that produces a *reconstructed image* (3.1.37) from a set of *input images* (3.1.23). For a *derived region item* (3.1.9), manipulation, identified by the item type, that produces the shape, position and size of regions of an *image* (3.1.16) from a set of regions from input *region items* (3.1.39).

3.1.34

output image /standards.iteh.ai/catalog/standards/sist/e017cc88-abb6-45bc-99ec-fce82bfcdc44/iso-image (3.1.16) that results when the reconstructed image of the *image item* (3.1.18) is transformed according to the *transformative item properties* (3.1.42) of the image item

3.1.35

pre-derived coded image

coded image (3.1.4) that has been derived from one or more other images

3.1.36

predictively coded image item

image item (3.1.18) that has a decoding dependency to one or more other *coded image items* (3.1.5)

3.1.37

reconstructed image

image (3.1.16) that results when the *coded image item* (3.1.5) is decoded or when the *operation* (3.1.33) of the *derived image item* (3.1.8), if any, is applied

3.1.38

reference image

image (3.1.16) that may be used as a reference for *inter prediction* (3.1.24) of another image

3.1.39

region item

item (3.1.27) whose data defines the shape, position and size of a region within an *image item* (3.1.18) with which it is associated via item reference

3.1.40**source image item**

image item (3.1.18) referred to by the 'dimg' item reference from the *derived image item* (3.1.8) or from another derived image item that is a source image item for the derived image item

Note 1 to entry: In other words, an image item is a source image item for a derived image item when it is required for deriving the output image of the derived image item.

Note 2 to entry: The definition of the source image item is recursive: an image item is a source image item for a particular derived image item, when the output image of the image item is used as an input image for any derived image item in the 'dimg'-item-reference-linked chain of derived image items ending at that particular derived image item, inclusive.

3.1.41**time-parallel sample**

sample in the reference track that has the same or, when a sample with the same decoding time is not available, the closest preceding decoding time relative to that of the particular sample in the particular track

3.1.42**transformative item property**

item property (3.1.28) that transforms the reconstructed representation of the item content

Note 1 to entry: A transformative item property may for example specify rotation by 90, 180, or 270 degrees of a reconstructed image of an image item.

3.1.43**unique ID**

identifier for either an item, an entity group or a track that fulfils the requirements of the 'unif' brand

Note 1 to entry: Requirements on the 'unif' brand are specified in ISO/IEC 14496-12.

3.1.44**visual context**

visual rendering surface such as a screen buffer, which may already contain visual material, and onto which an *image* (3.1.16) can be rendered

3.2 Abbreviated terms

ASCII	American Standard Code for Information Interchange
AVC	Advanced Video Coding (Rec. ITU-T H.264 ISO/IEC 14496-10)
DCF	Design rule for Camera File system (JEITA CP-3461)
EVC	Essential Video Coding (ISO/IEC 23094-1)
Exif	Exchangeable Image File Format (JEITA CP-3451)
HDR	high dynamic range
HEIF	High Efficiency Image File Format (this document: ISO/IEC 23008-12)
HEVC	High Efficiency Video Coding (Rec. ITU-T H.265 ISO/IEC 23008-2)
MD5	Message Digest algorithm 5
MIME	Multi-purpose Internet Mail Extensions
NAL	network abstraction layer

PPS	picture parameter set
SEI	supplemental enhancement information
SPS	sequence parameter set
TIFF	Tagged Image File Format
URN	Uniform Resource Name
UTF-8	Universal Character Set Transformation Format — 8-bit
VCL	video coding layer
VPS	video parameter set
VVC	Versatile Video Coding (Rec. ITU-T H.266 ISO/IEC 23090-3)
XML	Extensible Markup Language
XMP	Extensible Metadata Platform

4 Overview

This document specifies the following two forms of storage:

- a) the storage of a single coded image or a collection of coded images, possibly with derived images; coded images are normally independently coded except when the 'pred' brand is signalled. In such latter case, coded images may be independently coded or may have been coded with inter prediction;
- b) the storage of image sequences, which can be indicated to be displayed as a timed sequence or by other means, such as a gallery of images, and in which the coded images may be dependent on other coded images in the same sequence.

A file may use both structures, and may also use the structures of the ISO base media file format, enabling a single file to be constructed to meet a variety of needs (e.g. a single image for printing and a record of the image burst that was used to synthesize that image).

In general, the single image support is used for simpler cases, particularly when neither timing nor coding dependency is required. If advisory timing or other tools from the ISO base media file format available for tracks are needed (e.g. sample grouping), then the second approach is needed.

Brands are defined in order to specify what is required to be present in the file, and what reader support is required to decode under that brand (including support for features that are optional for writers). External specifications may also define brands, which may impose additional constraints on the files or the readers. The brands with which a file is compatible are recorded in the file in the usual way using the `FileTypeBox ('ftyp')`.

5 General requirements

5.1 General requirements on files

All files shall conform to the definitions for an object-structured file as defined in ISO/IEC 14496-12:2022, Clause 4.

5.2 General requirements on readers

The following are the requirements for all readers conforming to this document:

- 1) They shall be able to parse object-structured files formatted according to the definitions for an object-structured file as defined in ISO/IEC 14496-12:2022, Clause 4.
- 2) They shall parse the `FileTypeBox` and confirm that one or more brands that they support are included in the list of compatible brands; if there are no such brands, the reader should terminate parsing of the file.
- 3) They shall be able to recognize and discard boxes that are not required to be supported under the specification identified by the brand(s) under which they are operating.

5.3 Multi-purpose files

Files may be identified as compatible with other standards (using brands) than those defined in this document.

NOTE A file identified as compatible with other standards (using brands) contains the boxes specified by those standards.

5.4 Other boxes

In addition to the required boxes (and their required content), other boxes from the ISO base media file format, or other box-structured specifications, may be included as needed.

6 Single image and image collection

6.1 General

Images can be stored as items using the support for untimed data storage, called the `MetaBox` for historical reasons, in the ISO base media file format. A file may contain any number of image items.

[Clause 6](#) specifies requirements for all files using the Image File Format for the storage of a single image or image collection. When a brand specified in [10.2](#) is among the compatible brands of a file, the requirements specified in [Clause 6](#) shall be applied.

6.2 Derivation from the ISO base media file format

A `MetaBox` ('meta'), as specified in ISO/IEC 14496-12, is required at file level. That `MetaBox` shall contain the boxes specified to be mandatorily present by ISO/IEC 14496-12. Additional requirements for the boxes contained in the file-level `MetaBox` are specified in this document. The `MetaBox` containing image items and the metadata items related to the image items for the brands specified in this document shall be included in the file-level `MetaBox` and shall not be included in any `AdditionalMetadataContainerBox`. The file-level `MetaBox` shall identify as its primary item an item that is a coded image or a derived image item. The primary item should be displayed when no other information is available on the preferred displaying method of the image collection. It is recommended not to have a thumbnail image or an auxiliary image as a primary item.

The handler type for the `MetaBox` shall be 'pict'.

All three construction methods specified for the `ItemLocationBox` (by file offset, by offset into the local `ItemDataBox`, and by offset into the data of another item) are permitted by this document, but brands may restrict this. Similarly, the `DataReferenceBox` may indicate the same or another file, but derived specifications may restrict this also. The location for storing the items is specified in the ISO