INTERNATIONAL STANDARD

ISO 12639

Second edition
2004-05-15

Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)

Technologie graphique — Échange de données numériques de préimpression — Format de fichier d'image d'étiquette pour la technologie d'image

Reference number
ISO 12639:2004(E)

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

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) 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.

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

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 12639 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO 12639:1998), which has been technically revised to add new capabilities, as well as a new constrained conformity level call Profile 2 (P2) to supplement the previously defined Profile 1 (P1), which is unchanged.

New capabilities include the following:

— expanded LW palette to support up to 65 535 colours;

— support for up to 32 separations;

— new file format “SD” for copydot data with CCITT G4 compression;

— new compression schemes: Flate and JPEG;

— “FP” file format is now defined as normative.

Introduction

The goal of ISO/TC 130 in developing the initial version of ISO 12639 was to enable the interchange of various types of rasterized colour and monochrome image data among electronic digital systems used in prepress image processing, graphic arts design and related document creation and production operations. It was, and is, intended for use as a media-independent means for such interchange, and therefore is applicable to facilitate interchange through a variety of mechanisms such as, but not limited to, network, magnetic and optical media. Both ISO 12639:1998 and this second edition are based on the Adobe TIFF, Version 6.0 file format, and both extend and restrict the technical features of that format.

This second edition of ISO 12639, though based on ISO 12639:1998, specifies new capabilities, as well as a new constrained conformity level called Profile 2 (P2) to supplement the previously defined Profile 1 (P1), which is unchanged. The key added capabilities include a normative final page (FP) format; a new SD file format with optional G4 compression for copydot data; definitive ways to use RGB and CIELAB colour spaces in CT, as well as 16-bit-per-channel data in CT; JPEG compression in CT and MP; Flate compression in all formats except LW, HC and BL; spot colours (colours other than cyan, magenta, yellow and black) in LW, CT, HC, MP, BP, BL, and SD; and support for up to 65 535 colours in LW colour palettes. The new P2 compliance level incorporates all features of P1 and defines a constrained compliance level for these new capabilities.

All of the features of ISO 12639:1998, including the constrained level of conformity called Profile 1 (P1), have been retained. It should be noted that the P1 formats for CT (Colour Picture), MP (Monochrome Picture), and BP (Binary Picture) files are compatible with the popular TIFF 6.0 files for CMYK (Separated) Images, Monochrome Images and Bilevel Images respectively. The P1 formats for HC (High-Resolution Continuous-Tone), LW (Line-Art) and BL (Binary Line-Art), though not compatible with TIFF 6.0, are designed to be easier to implement within desktop systems by limiting the range of options and selections. The Profile 1 and 2 formats allow for a broader usage of this International Standard by allowing conformance to simplified, restricted subsets of functionality supported by many popular application software systems used in the prepress, graphic arts document processing and computer graphics and imaging industries. A P2-compliant reader will also read all P1-compliant files.

As a historical note, ISO 12639:1998 was based on the American National Standard ANSI IT8.8, *Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)*.

Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)

1 Scope

This International Standard specifies a media-independent means for prepress electronic data exchange using a tag image file format. This International Standard defines image file formats for encoding colour continuous-tone picture images, colour line-art images, high-resolution continuous-tone images, monochrome continuous-tone picture images, binary picture images, binary line-art images, screened data, and images of composite final pages.

2 Compliance levels and identification

2.1 General

This International Standard has three levels of conformance: TIFF/IT (also referred to as full TIFF/IT), TIFF/IT-P1 and TIFF/IT-P2. All conformance levels are intended to support a media-independent means for the exchange of various images used in the prepress, printing, graphic arts, and information processing fields.

TIFF/IT-P1 conformance provides a minimized set of options to permit simpler implementation and compatibility, where possible (for CT, BP, and MP files), with commonly available TIFF 6.0 readers and writers. TIFF/IT-P1 is intended for use where the full set of TIFF/IT options is not required.

TIFF/IT-P2 is also a subset of the TIFF/IT specification. TIFF/IT-P2 incorporates all of the options defined for TIFF/IT-P1 and, in addition, provides support for spot colours, a larger LW colour palette, the SD file format for screened data, and additional compression methods.

Only those TIFF/IT fields defined in this International Standard are required to be written, recognized and interpreted by conforming implementations. TIFF fields that are unclassified or not referred to in this International Standard are not required to be supported for an implementation to conform to this International Standard. If an unsupported field is read, processing of that field is at the discretion of the reader. The reader shall follow the strategy described in TIFF and attempt to process the file while ignoring unsupported fields (see Annex A).

This International Standard specifies the requirements for conforming TIFF/IT, TIFF/IT-P1 and/or TIFF/IT-P2 files for specific image data types. Files for each specific image data type that conform to the requirements of this International Standard shall be considered conforming TIFF/IT, TIFF/IT-P1 and/or TIFF/IT-P2 files for the specific image data type. Readers that accept and process these files shall be considered conforming TIFF/IT, TIFF/IT-P1 or TIFF/IT-P2 readers for the specific image data types. Writers that generate and output these files shall be considered conforming TIFF/IT, TIFF/IT-P1 or TIFF/IT-P2 writers for the specific image data types. Where requirements of this International Standard and TIFF 6.0 are in conflict, this International Standard shall take precedence.

2.2 Image file type identification

TIFF/IT provides the ability to represent the data structure of a wide range of printing and graphic arts images. The identification of the individual image file types is as follows (see Annex B):

— TIFF/IT-CT colour continuous-tone picture image data;

— TIFF/IT-LW colour line-art image data;

— TIFF/IT-HC high-resolution continuous-tone image data;

— TIFF/IT-MP monochrome continuous-tone picture image data;

— TIFF/IT-BP binary picture image data;

— TIFF/IT-BL binary line-art image data;

— TIFF/IT-SD screened data image data;

— TIFF/IT-FP final page data.

2.3 TIFF/IT conformance

For conformance to this International Standard, all image file types do not have to be implemented. Each image file type described in Clause 7 may be individually implemented. Files, readers or writers may be identified as conforming for either all image file types or specifically identified image file types.

Conformance with TIFF/IT requires implementation of the requirements for all image file types as described in Clause 7. Conformance with a specific image file type or types requires identification of the specific image file type using the identification defined in 2.2 (e.g. TIFF/IT-CT).

2.4 TIFF/IT-P1 conformance

TIFF/IT-P1 conformance provides the ability to represent the data structure of various images in as simple and straightforward a way as possible in order to support image-file exchange with prepress, printing, graphic arts, and information processing systems and applications. TIFF/IT-P1 is a subset of TIFF/IT.

Conformance with TIFF/IT-P1 requires implementation of the requirements for all image file types as described in Clause 7. Conformance with a specific image file type or types requires identification of the specific image file type using the identification defined in 2.2 with the designation “/P1” appended (e.g. TIFF/IT-CT/P1).

2.5 TIFF/IT-P2 conformance

TIFF/IT-P2 conformance provides the ability to represent the data structure of various images in as simple and straightforward a way as possible in order to support image file exchange with prepress, printing, graphic arts, and information processing systems and applications. TIFF/IT-P2 is a subset of TIFF/IT and forms an intermediate conformance level between TIFF/IT and TIFF/IT-P1.

Conformance with TIFF/IT-P2 requires implementation of the requirements for all image file types as described in Clause 7. Conformance with a specific image-file type or types requires identification of the specific image file type using the identification defined in 2.2 with the designation “/P2” appended (e.g. TIFF/IT-CT/P2).

2.6 Conformance identification

Conformance with the provisions of this International Standard shall be identified individually for files, readers, and writers. The accepted terminology shall be the image-file type followed by the designation “file”, “reader” or “writer” (e.g. TIFF/IT writer, TIFF/IT-CT/P1 reader, TIFF/IT-LW file).

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3166 (all parts), *Codes for the representation of names of countries and their subdivisions*

ISO 12641:1997, *Graphic technology — Prepress digital data exchange — Colour targets for input scanner calibration*

ISO 12642:1996, *Graphic technology — Prepress digital data exchange — Input data for characterization of 4-colour process printing*

ISO 13655:1996, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 10918-1:1994, *Information Technology — Digital compression and coding of continuous-tone still images: Requirements and guidelines.*

IEC 61966-2-1:1999, *Multimedia Systems and Equipment — Colour Measurement and Management — Part 2-1: Colour management — Default RGB Colour Space — sRGB*

ICC.1:2001-12, *File Format for Color Profiles*, International Color Consortium

TIFF, Revision 6.0 Final, Aldus Corporation (now Adobe Systems Incorporated), June 3, 1992

RFC:1950, *ZLIB Compressed Data Format Specification version 3.3*, RFC, 1950: DEUTSCH, P., and J-L. GAILLY, Aladdin Enterprises, May 1996

RFC:1951, *DEFLATE Compressed Data Format Specification version 1.3*, RFC, 1951: DEUTSCH, P., Aladdin Enterprises, May 1996

4 Terms, definitions and abbreviated terms

4.1 Terms and definitions

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

4.1.1
big-endian
⟨byte-ordering⟩ method for arranging the sequence of the bytes within a SHORT or LONG from the most significant to the least significant byte as the byte address increases

4.1.2
little-endian
⟨byte-ordering⟩ method for arranging the sequence of the bytes within a SHORT or LONG from the least significant to the most significant byte as the byte address increases

4.1.3
offset
address within a TIFF/IT file relative to byte zero of the file

4.1.4
offset value
SHORT or LONG value containing the offset of a data element

4.1.5
pixel
picture element, or the smallest single building block of a picture containing colour identification and size (when used to describe dimensions relating to the picture resolution, as in pixels per unit length)

4.1.6
printing dot value
printing tone value
⟨of a data set⟩ number, recorded as data in the computer, corresponding to the percentage area on a printing forme that is intended to accept ink for transfer to the final sheet

NOTE This corresponds to the tone value of a half-tone film. The light end of the final reproduction scale (highlights) has values approaching 0 % (or often in computer files, 0) and the dark end of the scale (shadows) has values approaching 100 % (or often in computer files, 255).

4.1.7
reader
application, system or subsystem that accepts a file as its input and performs a level of processing on that file that, at the minimum, accepts or rejects the file based on predetermined criteria and, if accepted, passes the file to the next stage of processing

4.1.8
run length encoding
data encoding method in which a sequence of data items, which may include many adjacent repetitions of the same value, is represented by a sequence of ordered pairs, each consisting of a value and a repeat count

NOTE Run length encoding can result in data compression.

4.1.9
separations
individual planes of data that correspond to the colours to be used in the rendering process

NOTE For “process” colours these are cyan (C), magenta (M), yellow (Y), and black (K). Additional separations are often required for spot or speciality colours or for image-wise finishing treatments such as varnish.

4.1.10
spot colour
single colorant, identified by name, whose printing tone values are specified independently from colour values specified in a colour co-ordinate system

4.1.11
string
serial sequence of characters, bytes, integers, etc.

4.1.12
TIFF/IT field
TIFF field
one-dimensional array of values (though most are a single-entry array) having an associated count

NOTE An array is identified by a Field name, a Tag number, and a Field type.

4.1.13
TIFF/IT tag
unique numeric identifier for each entry in the TIFF/IT file

4.1.14
transparent colour
attribute that signifies that the underlying image (if any) shows through

NOTE A clear run is where no colour is present and the underlying image (if any) shows through. The colour “white” signifies that no underlying image will show through, only the underlying substrate (paper). The “transparent” attribute can be applied to any or all separations of a pixel run or a palette colour in a LW, HC, BL or BP file.

4.1.15
trapping
technique of modifying colour separations to account for dimensional variations in the printing process by overprinting in selected colours at the boundaries between colours which otherwise might inadvertently be left uncoloured by normal errors in printing press registration

4.1.16
word-aligned
sequence of bytes beginning at an even offset

4.1.17
writer
application, system or subsystem that generates a file based on predetermined criteria and prepares the file for output

4.2 Abbreviated terms

BL Binary Line-art (or run length encoded bitmap) image or file

BP Binary Picture (or byte-packed bitmap) image or file

CEPS Colour Electronic Prepress System

CT colour Continuous-Tone picture image or file

DTP Desktop Publishing

FP Final Page file

HC High-resolution Continuous-tone (colour) image or file

IFD Image File Directory

LW colour line-art (or Line-Work) image or file

MP Monochrome continuous-tone Picture image or file

P1 Profile 1

P2 Profile 2

TIFF TIFF, Revision 6.0 Final: Aldus Corporation

SD Screened Data image or file

5 Notations and field types

5.1 Notations

All numeric values in this International Standard are expressed in decimal notation, unless otherwise indicated. A letter “h” is suffixed to indicate a hexadecimal value. Literal strings are denoted by enclosing them in single quotation marks.

For character strings, only character values 32 through 126 should be used and letters A through Z and a through z, respectively, should have the same significance.

Preferred values in TIFF/IT fields are preceded by “=” and enclosed in parentheses, for example “(=5)”. Preferred values are those values that are required to be accepted and recognized by a compliant application

or reader. A compliant application or writer may write values other than preferred values but the reader is not required to accept or recognize the value. It is left to the discretion of the reader.

Required values in TIFF/IT fields are preceded by “=” but not enclosed in parentheses, for example “=5”. Required values are those values that are required to be written by a compliant application or writer and are required to be accepted and recognized by a compliant application or reader.

Default values, if specified, are preceded by “Default =” or “d=”, for example “Default = 0,255”. In some tables, default values are indicated in a “default value” column. The reader shall assume the default value if no value is written by the writer in the default-specified field. Because the default values shown for all “TIFF” tag numbers are those specified for TIFF files, they might not be valid for the particular TIFF/IT file type. In all such cases, a mandatory field value or values is specified.

NOTE When an entry is made in a “default value” column, it might reference a TIFF 6.0 default value that is not a valid value for the particular TIFF/IT file type. This is usually indicated by entry of a mandatory field value or values in the tables.

Classification marks used in this International Standard are defined as follows:

— m Mandatory (absolute requirement) field

The writer is required to include mandatory fields. The reader is required to read and process the field. The reader is allowed to reject those files where mandatory fields are omitted.

— opt Optional field

The writer may include or omit optional fields. The reader is not required to read or process optional fields.

— d Default field

The writer may include or omit default fields. The reader shall assume the default value for the field if the field is omitted. The reader is required to read and process the field when it contains any required or preferred values.

These classifications may vary by file type, and are discussed further in Clause 7.

Image File Directory (IFD) entries are identified by a field name of one or more words, written with initial capital letters, and no internal spaces (e.g. “PageName”).

5.2 Field types

The field types used in this International Standard are as follows:

— ASCII a field type consisting of a byte containing a graphic character code from ISO/IEC 646; the last character in an ASCII string shall be a “null” (character 0/0);

— BYTE a field type consisting of an 8-bit unsigned binary integer;

— LONG a field type consisting of a 32-bit unsigned binary integer;

— RATIONAL a field type consisting of two LONGs, the first representing the numerator of a fraction and the second its denominator;

— SHORT a field type consisting of a 16-bit unsigned binary integer;

— UNDEFINED a field type consisting of an array of 8-bit unsigned binary data.

6 Image data type description

6.1 Colour continuous-tone picture image (CT) data

A colour continuous-tone picture image (CT) is a rectangular array of pixels (picture elements). A pixel is represented by a set of values corresponding to its colour components.

NOTE In graphic technology applications, pixels typically consist of four bytes, representing cyan (C), magenta (M), yellow (Y), and black (K) process colours.

6.2 Colour line-art (LW) image data

A colour line-art or line-work (LW) image is a rectangular array of pixels. Each pixel is one of a limited number of colours. The colours are defined in a palette table that specifies the values of the colour-separation components for each entry in the palette. Line-work images have areas of many pixels of the same palette entry. Run-length encoding techniques are used. Underlying images may be made visible by the use of a transparent colour capability. Colour line-art images are normally of higher resolution than colour continuous-tone picture images (CT).

6.3 High-resolution continuous-tone (HC) image data

A high-resolution continuous-tone (HC) image is a rectangular array of pixels. A pixel is represented by a set of values corresponding to its colour components. It is typically at the higher resolution of colour line-art. It is also characterized by a transparent colour capability and run length encoded similar to colour line-art. An HC image does not use a palette table and as such does not have the same limited colour representation as colour line-art. High-resolution continuous-tone images are typically used to define the edges between merged colour continuous-tone picture images, and between colour line-art and colour continuous-tone picture images.

NOTE Annex C describes the relationship between CT, LW, and HC images.

6.4 Monochrome and binary images

6.4.1 General

In addition to the colour formats specified in 6.1, 6.2, and 6.3, monochrome continuous-tone and binary images are also supported. These images are similar to their colour counterparts, except that their formats take advantage of the reduced amount of data associated with monochrome (single-colour) and binary images.

An additional colour format based on binary image data is supported for screened (copydot) images. Each separation is based on binary image data which, when combined, represent a screened colour image.

6.4.2 Monochrome continuous tone picture image (MP) data

A monochrome continuous-tone picture image (MP) consists of a rectangular array of pixels. Each pixel is represented by a single byte value indicating the varying intensity of the single image colour at that pixel location. The intended effect is to reproduce the monochrome continuous-tone picture using various levels of the specified image colour.

The monochrome continuous-tone picture format is similar to, though not identical to, a monochrome version of the colour continuous-tone picture format with a single colour per pixel and is therefore not interleaved.

6.4.3 Binary picture image (BP) data

A binary picture image (BP) consists of a rectangular array of pixels. Each pixel is represented by a single bit value indicating that the pixel location is to be part of the background (bit value of 0) or part of the image (bit value of 1) for that pixel location. The bits are ordered left to right within the byte; i.e., the most significant bit first. A background and a foreground colour may each be specified.

6.4.4 Binary line-art image (BL) data

A binary line-art image (BL) consists of a rectangular array of pixels. Each pixel is represented by a single value that is encoded as a sequence of pairs of background and image colours.

The binary line-art image is further characterized by having continuous areas of many pixels of image and background colour. Run-length encoding techniques are used.

6.4.5 Screened data image (SD) data

A screened data image (SD) consists of a series of rectangular arrays of pixels. Each array represents a single separation of a pre-screened (copydot) image. For each separation, each pixel is represented by a single bit value indicating that the pixel location is to be part of the unimaged background (bit value of 0) or is to be imaged (bit value of 1) for that pixel location. The bits are ordered left to right within the byte; i.e. the most significant bit first.

6.5 Final page (FP) data

Typically, a final page, ready for exposure on an output recorder, consists of more than one of the CT, MP, SD, LW, BL, BP and HC raster formats described in this International Standard. TIFF/IT-FP provides a mechanism for associating image files of the different types that make up a final page.

7 Requirements for TIFF/IT, TIFF/IT-P1 and TIFF/IT-P2 image data files

7.1 Structure of TIFF/IT file

7.1.1 General

This International Standard incorporates the notation and structure as defined in TIFF 6.0, Sections 1 and 2. In addition, those TIFF tags identified but not defined in this International Standard shall be as defined in TIFF 6.0. Where requirements of this International Standard and TIFF 6.0 are in conflict, this International Standard shall take precedence.

A TIFF/IT file conveys image data for a single image or a set of related images. The TIFF/IT structure includes a short header, one or more Image File Directories (IFD), and the image data associated with the IFDs. Image parameters are encoded in tagged fields in the IFD. Fields that are not used to describe an image are omitted from its IFD. Each field is identified by its tag value rather than its position in the directory entry.

7.1.2 Header

A TIFF/IT file begins with an eight-byte image-file header.

— Bytes 0 - 1: The pair of bytes at offset 0 of the file contains the ISO/IEC 646 characters “II” (4949h) or “MM” (4D4Dh). “II” signifies that the file is stored in little-endian byte order. “MM” signifies that the file is stored in big-endian byte order. A writer shall be able to write one of the two byte orders. A reader shall interpret both byte orders.

NOTE In normal TIFF usage, this parameter applies to all data within headers, directories, and image data. In this International Standard, certain 16-bit fields in the image data have a fixed big-endian byte order which will be defined with the specific image-data types in 7.3 through 7.10.

— Bytes 2 - 3: The pair of bytes (SHORT) at offset 2 contains the constant 42 (2Ah).

— Bytes 4 - 7: The four bytes (LONG) at offset 4 contain the offset of the first IFD of the file. The directory is required to begin on a word-aligned boundary.

7.1.3 Image subfiles

A TIFF/IT file contains one or more subfiles, each representing a single image which may be among a set of related images in the same TIFF/IT file. Each subfile consists of an Image File Directory (IFD) together with one or more referenced word-aligned sequences containing image data.

7.1.4 IFD (Image File Directory)

Each IFD is located at an arbitrary word-aligned offset within the file. The IFDs are forward-chained together. An IFD consists of a two-byte count of the quantity of IFD entries within it, one or more IFD entries sorted in ascending order of tag number, and a four-byte offset to the next IFD in the chain (zero in the case of the last IFD in the file). Each IFD entry is a 12-byte field, describing a one-parameter field that defines an attribute of the file.

7.1.5 IFD entry

Each IFD entry consists of a SHORT (two-byte) tag number identifying the field, a SHORT (two-byte) data type identifying the field type, a LONG (four-byte) count, and a LONG (four-byte) offset value. The offset value shall be an even number since the value is expected to be on a 16-bit word boundary.

The field type codes are

— 1 BYTE

— 2 ASCII

— 3 SHORT

— 4 LONG

— 5 RATIONAL

— 7 UNDEFINED

The count determines the number of data elements in the value. The count of an ASCII string entry shall be the number of characters (bytes) in the string, including the terminating null character.

The data value associated with an IFD entry is stored directly in the offset-value field of the IFD entry, if its type and count combine to indicate a length of four bytes or less. Otherwise, the offset-value field of the IFD entry contains the offset of a referenced, word-aligned sequence that contains the indicated count of data elements.

7.1.6 Image data

Image data are stored in one or more word-aligned sequences. The array of pixels making up the image may be divided into strips. Each strip of an image, except possibly the last strip, contains the number of rows specified in the RowsPerStrip field (tag 278, SHORT or LONG, default FFFFFFFFh). If RowsPerStrip equals or exceeds ImageLength, as is the default, then the entire image is contained within a single strip. Each strip is held in a single word-aligned sequence of data.

The offsets of the word-aligned sequences containing the image data for each strip are contained in the data values of the mandatory StripOffsets field (tag 273, LONG or SHORT, count = StripsPerImage).

The StripByteCounts field (tag 279, LONG or SHORT, Count = StripsPerImage) specifies the number of bytes for each strip.

The structure of a TIFF/IT file containing a single image subfile is shown in Figure 1.