INTERNATIONAL STANDARD

ISO
12639

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

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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.

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.

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

Annexes A to I of this International Standard are for information only.

Introduction

This International Standard was prepared by Working Group 2 (Prepress data exchange) of ISO/TC 130, *Graphic technology*, and is based on American National Standard IT8.8-1993, *Graphic technology — Prepress digital data exchange — Tag image file format for image technology (TIFF/IT)*.

The technical content of this International Standard enables the interchange of various types of rasterised colour and monochrome image data files among electronic, digital systems used in prepress image processing, graphic arts design and related document creation and production operations. This International Standard is intended for use as a media-independent means for such interchange, thus is applicable to facilitate interchange through a variety of mechanisms such as, though not limited to, network, magnetic and optical media.

The image data types supported by this International Standard include those specified in ISO 10755:1992, ISO 10756:1993, ISO 10759:1993 (Colour Picture Data, Colour Line Art Data, and Monochrome Image Data) and also specified in ANSI IT8.8-1993.

This International Standard, though based on ANSI IT8.8-1993, goes further to specify a second, more constrained, level of conformity called Profile 1 (P1) for each image data type. 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. These Profile 1 formats allow for a broader usage of this International Standard by allowing conformance to a simplified, restricted subset of functionality supported by many popular application software systems used in the prepress, graphic arts document processing and computer graphics and imaging industries.

In support of backward compatibility, the IT8Header field provides the ability to include, in TIFF/IT, unmodified headers (appended by an ASCII "null" at the end of the character string) from ISO 10755, ISO 10756 and ISO 10759. This may be particularly useful if a file is being transported from one ISO 10755, ISO 10756, or ISO 10759 environment to another via TIFF/IT. TIFF/IT readers are not required to interpret and use the contents of the IT8Header field.

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. 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, and binary line art images.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO 3166:1993, *Codes for the representation of names of countries.*

ISO 10755:1992, *Graphic technology — Prepress digital data exchange — Colour picture data on magnetic tape.*

ISO 10756:1994, *Graphic technology — Prepress digital data exchange — Colour line art data on magnetic tape.*

ISO 10759:1994, *Graphic technology — Prepress digital*

data exchange — Monochrome image data on magnetic tape.

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.*

ANSI CGATS.15:___ [1], *Graphic technology — Prepress digital data exchange — Three-component color data definitions.*

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

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 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.

3.2 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.

3.3 offset: Address within a TIFF/IT file, relative to byte zero of the file.

3.4 offset value: SHORT or LONG value within a TIFF/IT file, containing the offset of a data element.

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1) To be published.

3.5 pixel: A picture element, 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 inch).

3.6 printing tone value; printing dot 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 1 This corresponds to the tone value of a half-tone film. The light end of the final reproduction scale (highlights) will have values approaching 0% (or often in computer files, 0) and the dark end of the scale (shadows) will have values approaching 100% (or often in computer files, 255).

3.7 reader: An 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.

3.8 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 2 Run length encoding may result in data compression.

3.9 separations: Individual planes of data that correspond to each of the single colours to be used in the rendering process. 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 imagewise finishing treatments such as varnish.

3.10 string: Serial sequence of characters, bytes, integers, etc.

3.11 TIFF/IT field, TIFF field: A one-dimensional array of values (though most are a single-entry array) having an associated count.

NOTE 3 An array is identified by a Field name, a Tag number, and a Field type.

3.12 TIFF/IT tag: A unique numeric identifier for each entry in the TIFF/IT file.

3.13 transparent colour: Attribute that signifies that the underlying image (if any) shows through.

NOTE 4 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 should show through, only the underlying substrate (paper). The "transparent" attribute may be applied to any or all separations of a pixel run or a palette colour in a LW, HC, BL or BP file.

3.14 trapping: Technique for modifying colour separations to account for dimensional variations in the printing process by overprinting in selected colours at the boundaries between colours which might inadvertently be left uncoloured by normal errors in printing press registration.

3.15 word-aligned: Sequence of bytes beginning at an even offset.

3.16 writer: An application, system or subsystem that generates a file based on predetermined criteria and prepares the file for output.

4 Notations, symbols, abbreviations and field types

4.1 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 in this International Standard by enclosing them in single quotation marks. In the descriptions of file parameters, field names from ISO 10755, ISO 10756, and ISO 10759 are enclosed in brackets.

Preferred values in TIFF/IT fields are preceded by "=" and enclosed in parentheses, for example "(=5)". Preferred values are those values which 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 which 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 may not be valid for the particular TIFF/IT file type. In all such cases, a mandatory field value or values is specified.

NOTE 5 When an entry is made in a "default value" column it might reference a TIFF 6.0 default value that may not be a valid value for the particular TIFF/IT file type. This is usually

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indicated by entry of a mandatory field value or values in the tables.

Classification marks used in clause 7 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, o 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").

4.2 Symbols and abbreviations

The following symbols and abbreviations are used within this International Standard with the meanings indicated:

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

DDES   Digital Data Exchange Specification

DTP   Desktop Publishing

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

TIFF   Tag Image File Format , Version 6.0, Aldus Corporation.

TIFF/IT TIFF for image technology

NOTE 6 For character strings, it is recommended that only character values 32-126 be used and to assume letters A-Z and a-z have the same significance respectively.

4.3 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 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.

5 Conformance

This International Standard has two levels of conformance: TIFF/IT (also referred to as full TIFF/IT) conformance and TIFF/IT-P1 conformance. Both 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.

Only TIFF/IT fields defined in this International Standard need 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

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in TIFF and attempt to process the file while ignoring unsupported fields. (See annex I.)

This International Standard specifies conforming TIFF/IT and/or TIFF/IT-P1 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 and/or TIFF/IT-P1 files for the specific image data type. Readers that accept and process these files shall be considered conforming TIFF/IT or TIFF/IT-P1 readers for the specific image data types. Writers that generate and output these files shall be considered conforming TIFF/IT or TIFF/IT-P1 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.

5.1 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 E):

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

5.2 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 5.1 (e.g. TIFF/IT-CT).

5.3 TIFF/IT-P1 conformance

TIFF/IT-P1 conformance provides an 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 5.1 with the designation "/P1" appended (e.g. TIFF/IT-CT/P1).

5.4 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).

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 7 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 which 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. It does not use a palette table and as such does not have the same limited colour representation of 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 8 Annex A describes the relationship between CT, LW, and HC images. Annex D describes an additional data type called Final Page (FP) which describes a completed page.

6.4 Monochrome and binary images

In addition to the colour formats specified in 6.1, 6.2, and 6.3, monochrome continuous tone and binary DDES 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.

6.4.1 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.

6.4.2 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 0) or part of the image (bit value 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.

6.4.3 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 which 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.

7 Requirements

The format of the TIFF/IT and TIFF/IT-P1 image data files and the specific requirements for each of the individual image file types follow. See annex F for examples of the structure of these files.

7.1 Structure of TIFF/IT file

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.

7.1.1 Overview

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 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 may write either of the two byte orders. A reader shall interpret both byte orders.

NOTE 9 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 clause 7.3 through 7.8.

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

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.

NOTE 10 In the case of an ASCII string, the ISO 10755, ISO 10756, and ISO 10759 headers do not have a terminating null, and so these field sizes are one less than a corresponding TIFF/IT count with the appended 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 is 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.

7.2 General parameters

This subclause describes, in general terms, each of the fields used in TIFF/IT files. For usage specific to an image file type (i.e. CT, LW, HC, MP, BP, and BL) see the subclause appropriate to that file type. Annex H provides an alphabetical listing of TIFF/IT fields.

7.2.1 Job identification

The job and picture name of the image are described by the document name (DocumentName) and image description (ImageDescription) fields. The page name (PageName) field may also be used. Annex H contains an alphabetical list of TIFF/IT fields.

269	DocumentName	ASCII [Job Name]
270	ImageDescription	ASCII [Picture Name, Image Name]
285	PageName	ASCII

The originator of the image may be identified, and a copyright statement may be included using the Artist and Copyright fields, respectively.

315	Artist	ASCII
33432	Copyright	ASCII

7.2.2 System identification

The following fields may be used to describe system data relating to the image:

271	Make	ASCII [Vendor Name]
272	Model	ASCII
305	Software	ASCII [Program Name]
306	DateTime	ASCII
316	HostComputer	ASCII
34016	Site	ASCII [Site Name]
34018	IT8Header	ASCII

It is recommended to include the three-character country code from ISO 3166 as the last three characters, before the terminating "null" character, of the Make field, to identify the country of registry of the vendor name.
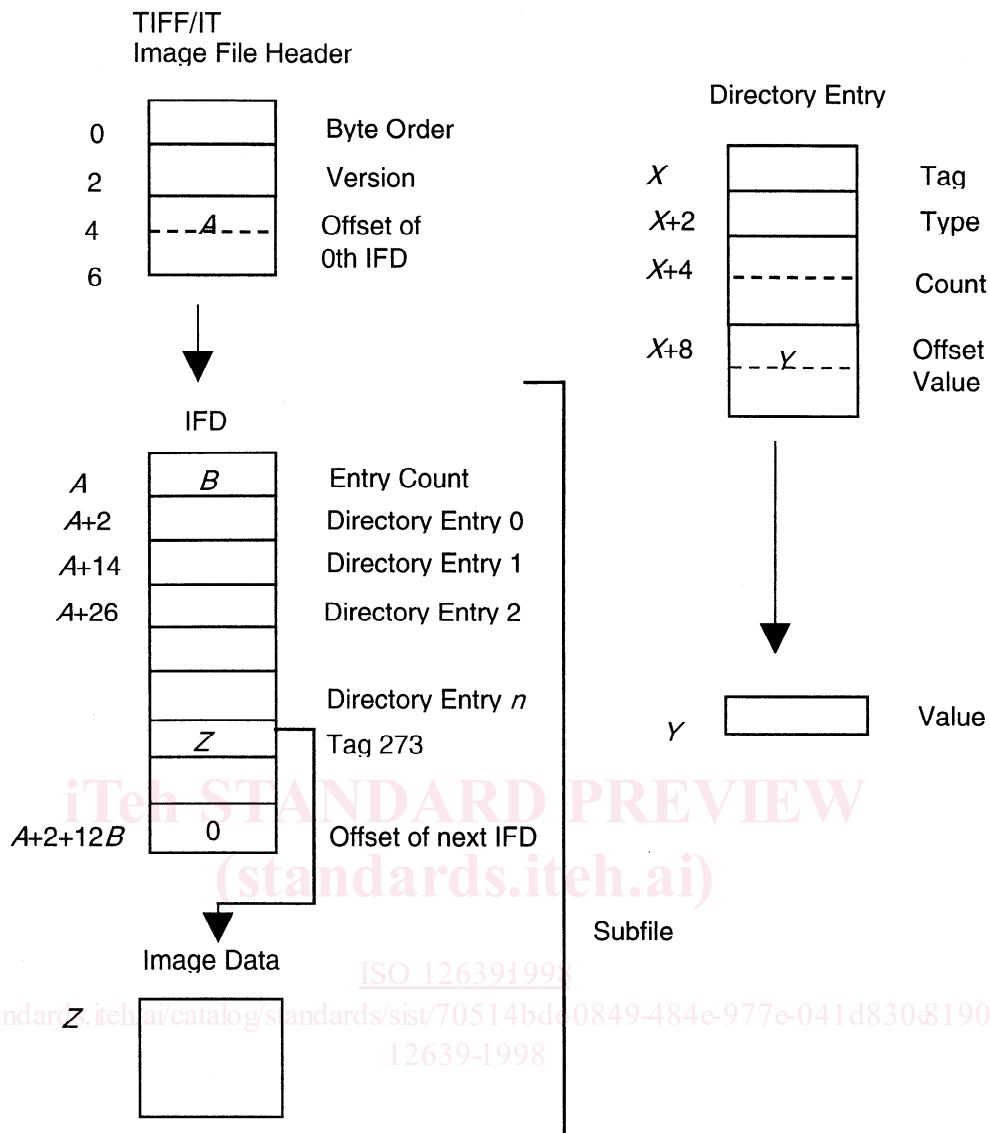
TIFF/IT
Image File Header

Directory Entry

Figure 1 — Structure of TIFF/IT file for single image subfile (single strip)

The Site field allows the identity of the location at which the image was digitized (or encoded into TIFF/IT) to be included with the file.

NOTE 11 The IT8Header field provides the ability to include unmodified headers (appended by an ASCII "null" at the end of the character string) from ISO 10755, ISO 10756, and ISO 10759 in the TIFF/IT files. This may be particularly useful if a file is being transported from one ISO 10755, ISO 10756, or ISO 10759 environment to another via TIFF/IT. TIFF/IT readers are not required to interpret and use the contents of the IT8Header field.
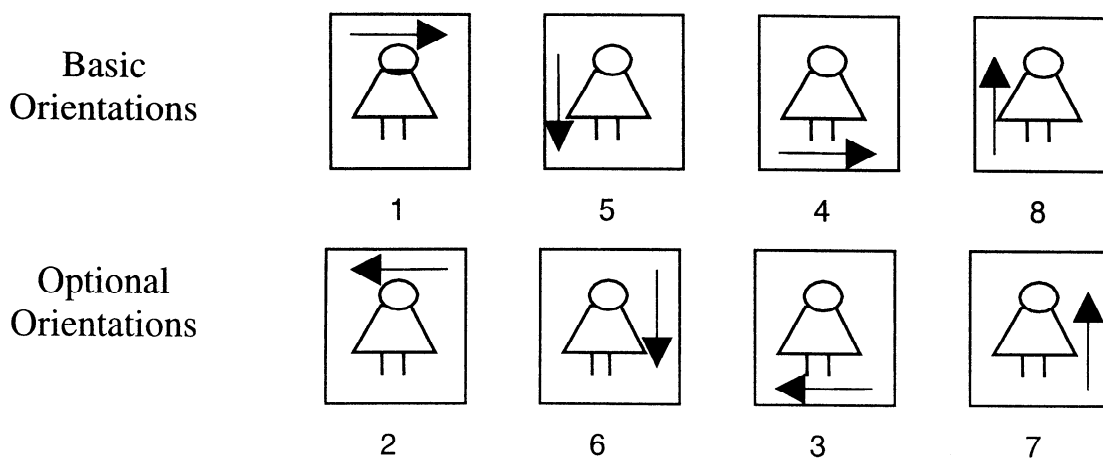
7.2.3 Image size and orientation

Image size and orientation are defined by three fields. One field specifies the width of an image, another specifies the length of the image, and the third specifies the orientation of the scan lines with respect to the image content as viewed by the end user.

256	ImageWidth	SHORT or LONG [pixels per line]
257	ImageLength	SHORT or LONG [lines in image]
274	Orientation	SHORT

Basic orientations are specified as follows (see figure 2):

1 =   Load from top left, horizontally (default)
the 0th row represents the visual top of the image, and the 0th column represents the visual left-hand side.

5 =   Load from top left, vertically
the 0th row represents the visual left-hand side of the image, and the 0th column represents the visual top.

4 =   Load from bottom left, horizontally
the 0th row represents the visual bottom of the image,

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Basic Orientations

Optional Orientations

Arrow represents the sequence of the first line of pixels in the data stream

Figure 2 — Relationship between first line of data, image orientation, and orientation code.

and the 0th column represents the visual left-hand side.

8 = Load from bottom left, vertically
the 0th row represents the visual left-hand side of the image, and the 0th column represents the visual bottom.

Conformance to this International Standard requires that at least one basic orientation be written and all four basic orientations be read.

Optional orientations are specified as follows (see figure 2):

2 = Load from top right, horizontally
the 0th row represents the visual top of the image, and the 0th column represents the right-hand side.

6 = Load from top right, vertically
the 0th row represents the visual right-hand side of the image, and the 0th column represents the visual top.

3 = Load from bottom right, horizontally
the 0th row represents the visual bottom of the image, and the 0th column represents the visual right-hand side.

7 = Load from bottom right, vertically
the 0th row represents the visual right-hand side of the image, and the 0th column represents the visual bottom.

NOTE 12 ISO 10755, ISO 10756, and ISO 10759 made provision for unknown orientations; TIFF/IT does not.

NOTE 13 The size, resolution, and orientation fields interact to describe the size and orientation of the logical image in the data stream. The ImageWidth (pixels per scanline) and ImageLength

(scanlines in image) fields refer to the sequence of pixels in the data stream and not the logical image itself. The TIFF and TIFF/IT term "Width" ("length of line" in ISO 10755, ISO 10756, or ISO 10759) refers to the dimension of the image represented by the first line of pixels in the data stream. The TIFF and TIFF/IT term "Length" ("breadth of area" in ISO 10755, ISO 10756, or ISO 10759) refers to the dimension of the image represented by the number of lines in the data stream. For example, orientations "1" and "4" define "Width" as the horizontal axis of the logical image, and "Length" as the vertical axis. Orientations "5" and "8" define "Width" as the vertical axis and "Length" as the horizontal axis.

7.2.4 Image resolution

282	XResolution	RATIONAL [resolution of line]
283	YResolution	RATIONAL [resolution of breadth]
296	ResolutionUnit	SHORT

The resolution (number of pixels per ResolutionUnit) may be specified in both the Width (line) and Length (breadth) directions. The values for ResolutionUnit for TIFF/IT and TIFF/IT-P1 conformity levels shall be centimetres represented by value 3 and inches represented by value 2 (default value) in field 296. The other value recognized by TIFF, but not by TIFF/IT, is 1, meaning no absolute unit of measurement is specified.

Pixels do not need to be square in size. To properly size an image, the resolution of both axes must be considered. The necessary information is provided by the resolution specifications for each axis, and the number of pixels for each axis. From this, the size of each axis may be determined by dividing the number of pixels by the resolution.

Table 1 — Encoding of data format

File Type	SamplesPerPixel	BitsPerSample	Compression	PlanarConfiguration
Colour continuous tone picture (CT) - pixel interleaved	1-16	8, 8, ...	1 or 32895	1
Colour continuous tone picture (CT) - line interleaved	1-16	8, 8, ...	1 or 32895	32768
Colour continuous tone picture (CT) - colour interleaved	1-16	8, 8, ...	1 or 32895	2
Colour line art (LW)	1	8	32896	omit, not used
High resolution continuous tone (HC)	2 -16 even values only	8, 8, ...	32897	1
Monochrome continuous tone picture (MP)	1	8	1 or 32895	omit, not used
Binary picture (BP)	1	1	1	omit, not used
Binary line art (BL)	1	1	32898	omit, not used

7.2.5 Data format

The data format parameters describe the style and order of the data stream. A number of TIFF/IT fields are used to encode them.

254   NewSubfileType   LONG

NewSubfileType is a general indication of the kind of data contained in the subfile. The value is made up of 32 flag bits. Unused bits shall be 0. Bit 0 is the low-order bit.

258   BitsPerSample   SHORT
259   Compression   SHORT
277   SamplesPerPixel   SHORT
284   PlanarConfiguration SHORT

The fields SamplesPerPixel and BitsPerSample determine the number of samples (separations, colours) and their size. This information, with that provided in the fields Compression and PlanarConfiguration, determine the format of the data in the file. The count of BitsPerSample data elements shall equal the value of the SamplesPerPixel fields.

If the value of Compression is the default value of "1", there is no compression. (The BP data format packs data into bytes as tightly as possible, with no unused bits except at the end of a row.) The other TIFF/IT values of the compression indicate:

—   the use of RasterPadding in the CT or MP format (value 32895)
—   the run length encoding scheme for the LW format (value 32896)
—   the run length encoding scheme for the HC format (value 32897)

—   the run length encoding scheme for the BL format (value 32898)

PlanarConfiguration distinguishes between CT formats that are pixel (sometimes referred to as "chunky"), line or colour (i.e. colour plane or separation) interleaved, by values 1, 32768, and 2 respectively. The value defaults to 1, and the field may be omitted when SamplesPerPixel equals 1.

Table 1 summarizes how the data formats for the different file types are encoded by these TIFF/IT fields.

34019 RasterPadding   SHORT

The RasterPadding field allows each line of colour or interleaved colours to be padded to a 1-, 2-, 4-, 512-, or 1024-byte boundary.

0 = byte raster (default value)   — pad to 1 byte
1 = word raster   — pad to 2 bytes
2 = long word raster   — pad to 4 bytes
9 = sector raster   — pad to 512 bytes
10 = long sector raster   — pad to 1024 bytes

When applied to line interleaved data, this field relates to each line of colour, rather than to each line of pixels. The value of the field is the power of two corresponding to the padding length (in bytes).

Two additional fields are required for the TIFF/IT-LW line art files. They describe the number of bits required to describe short and long runs. See the individual file type for more information.

34020 BitsPerRunLength   SHORT (default = 8)
34021 BitsPerExtendedRunLength SHORT (default = 16)