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

[Revision of first edition (ISO 12639:1998)]

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

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Contents

Foreword

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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.

Annexes A to D, I and K of this International Standard are for information only.

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. Bot ISO 12639:1998 and this revision are based on the Adobe TIFF, Version 6.0 file format, and both extend and restrict the technical features of that format.

This revised version 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 copy-dot 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 65535 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. 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 Normative references

The following normative documents contain provisions that, 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 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*

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

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

IEC 61966-2-1:1999, Colour Measurement and Management in Multimedia System and Equipment - Part 2-1: Default RGB Colour Space -sRGB

ICC.1:1998-04 *File Format for Color Profiles*, International Color Consortium

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

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

3.5
pixel
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 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
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 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
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.

3.12
TIFF/IT tag
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 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 or 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
application, system or subsystem that generates a file based on predetermined criteria and prepares the file for output

3.17
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 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 by enclosing them in single quotation marks.

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 may 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 may not be 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").

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

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

NOTE 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/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

5 Conformance

5.1 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 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 in TIFF and attempt to process the file while ignoring unsupported fields. (See Annex A.)

This International Standard specifies 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.

5.2 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

5.3 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 5.1 (e.g. TIFF/IT-CT).

5.4 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).

5.5 TIFF/IT-P2 conformance

TIFF/IT-P2 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-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 5.1 with the designation "/P2" appended (e.g. TIFF/IT-CT/P2).

5.6 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).

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

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 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.

6.4.1 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 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.

6.4.4 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 prescreened (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 0) or is to be imaged (bit value 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

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/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 may write either 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 clause 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 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.

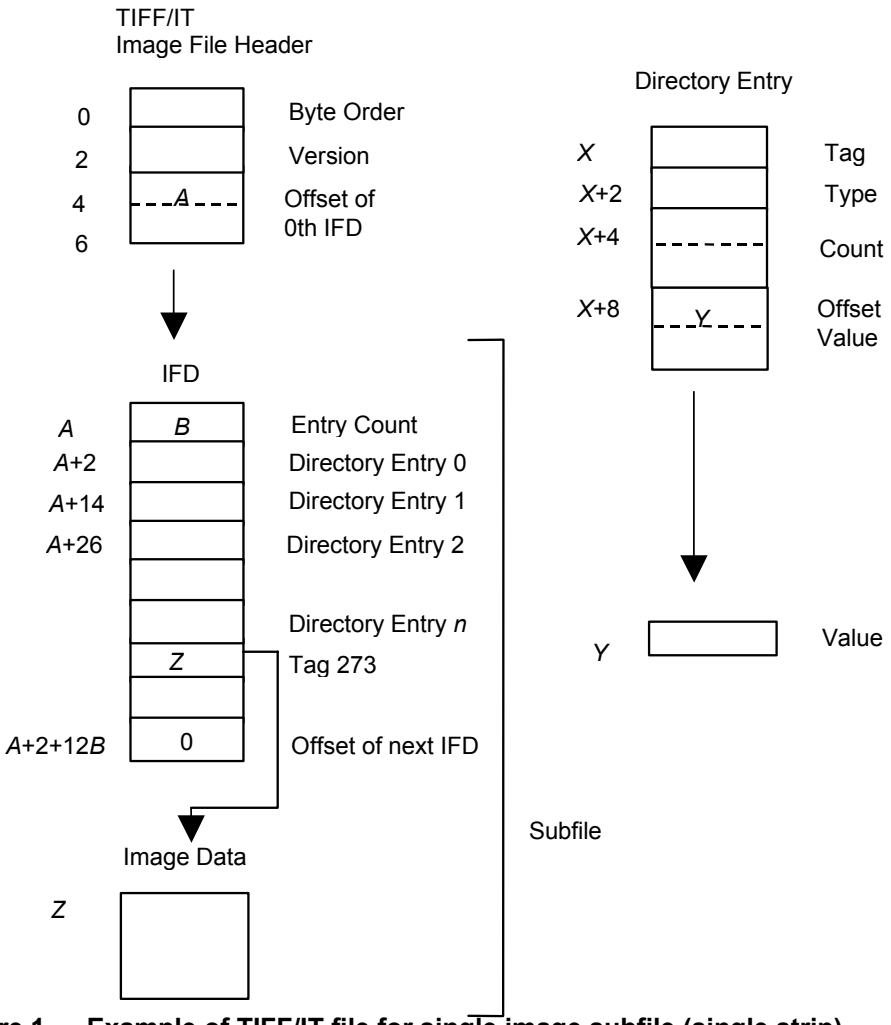


Figure 1 — Example of TIFF/IT file for single image subfile (single strip)

7.2 General parameters

7.2.1 General

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, SD, FP and BL) see the subclause appropriate to that file type. Annex D provides an alphabetical listing of TIFF/IT fields.

7.2.2 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.

269	DocumentName	ASCII
270	ImageDescription	ASCII
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

7.2.3 System identification

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

271	Make	ASCII
272	Model	ASCII
305	Software	ASCII
306	DateTime	ASCII
316	HostComputer	ASCII
34016	Site	ASCII
34018	IT8Header	ASCII

The three-character country code from ISO 3166 should be used as the last three characters, before the terminating "null" character, of the Make field, to identify the country of registry of the vendor name.

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 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. TIFF/IT readers are not required to interpret and use the contents of the IT8Header field. The use of the IT8Header tag is only recommended for compatibility with ISO 12639-1998. ISO 10755, ISO 10756, and ISO 10759 are obsolete.

7.2.4 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
257	ImageLength	SHORT or LONG
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, 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.

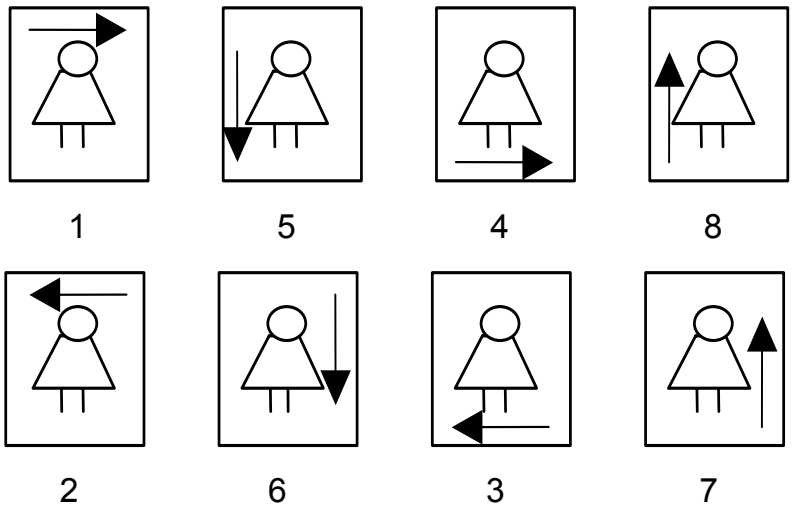
NOTE 1 TIFF/IT does not allow unknown orientations.

NOTE 2 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" 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" 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.

Image position fields are used by the FP file format to specify the X and Y offsets on a page from the origin in component image IFDs.

286 XPosition RATIONAL

287 YPosition RATIONAL



NOTE The arrow represents the sequence of the fits line of pixels in the data stream.

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

7.2.5 Image resolution

282 XResolution RATIONAL

283 YResolution RATIONAL

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, TIFF/IT-P1 and TIFF/IT-P2 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.

7.2.6 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)

— the CCITT G4 encoding scheme for the BP and SD formats (value 4)

— the JPEG encoding scheme for the CT and MP formats (value 7). See Annex E.

— the Flate encoding scheme for all formats except LW, HC and BL (value 8). See Annex F.

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.

Table 1 — Encoding of data format

File Type	SamplesPerPixel	BitsPerSample	Compression	PlanarConfiguration
Colour continuous tone picture (CT) - pixel interleaved	1-16	8, 8, … or 16, 16,…	1, 7, 8 or 32895	1
Colour continuous tone picture (CT) - line interleaved	1-16	8, 8, … or 16, 16,…	1, 7, 8 or 32895	32768
Colour continuous tone picture (CT) - colour interleaved	1-16	8, 8, … or 16, 16,…	1, 7, 8 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 or 16	1,7, 8 or 32895	omit, not used
Binary picture (BP)	1	1	1, 4 or 8	omit, not used
Binary line art (BL)	1	1	32898	omit, not used
Screened data (SD)	1-16	1, 1, …	1, 4, or 8	2

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)

The HC file has specific usages that determine the type of information contained within the file. HCUsage is an indicator of the type of information contained within the HC file.

34030	HCUsage	LONG

The bits of HCUsage indicate the type of information contained in the HC file. If all bits are 0, or the field is not present, the information type is unknown. Each bit indicates a type of information that may be coded in the file, the bits are not mutually exclusive since an HC file may contain both contone and line art information:

bit 0: 1 means the file contains high resolution CT contone information

bit 1: 1 means the file contains line art (line work) information

bit 2: 1 means the file contains trapping information

bit 3-31: Reserved, must contain zeroes

34031	TrapIndicator	BYTE (default=1)

The TrapIndicator field is optional and is used to indicate whether the file or file set has been trapped. Trapped means the modification of the boundaries of colour objects to prevent the media colour from accidentally showing through when colour planes are slightly misregistered in the reproduction process.

If the value of TrapIndicator is the default of “1” then the file or file set includes any necessary trapping data and no further trapping is needed.

If the value of TrapIndicator is “0” then no trapping modifications have been made to the file or file set. Any desired trapping must be done before final rendering.

The value of TrapIndicator shall be “1”, if present, for SD files.

In file types other than FP, the TrapIndicator indicates the presence of trapping internal to that single file.

In an FP file set, the value of TrapIndicator indicates the status of trapping both within and between all sub-files. The value in the FP file shall be used and the value in the individual files shall be ignored.

7.2.7 File format

Many prepress applications use only one strip in the TIFF/IT formats. In these cases, there will be only one strip offset and byte count, and the RowsPerStrip field may be omitted. In other cases, the usage of StripOffsets, RowsPerStrip, and StripByteCounts fields are as described in TIFF 6.0, Part 1: Baseline.

273	StripOffsets	LONG or SHORT
278	RowsPerStrip	LONG or SHORT
279	StripByteCounts	LONG or SHORT

See 7.1.6 for the use of these parameters.

7.2.8 Colour specification

7.2.8.1 General

The primary colour space for this International Standard is CMYK, with other colour spaces provided for as described below. The parameters for specifying the colour space are:

— the number of colour separations,

— the colour sequence,

— the colour values.

7.2.8.2 Number of colour separations

Images for printing are typically represented by the four separations of process colour inks, in either CMYK or YMCK order. Optionally, one to sixteen separations with varied sequences can be described as specified in 7.2.6. SamplesPerPixel specifies the number of separations except for the line art (LW) file type. For LW, the number of separations is specified as the number of colour entries specified in the ColorSequence field.

262 PhotometricInterpretation SHORT

Value 5 for PhotometricInterpretation for CT, LW, SD, and HC images signifies separated image file data in the sequence CMYK, or a separated image file data in other colours or sequences if modified by other fields. Values 2 and 8 are used for CT only. Values of 0 and 1 shall be used for MP, BP, and BL images. Value of 0 means "WhiteIsZero" (0 is imaged as white) and value of 1 means "BlackIsZero" (0 is imaged as black). In TIFF/IT, the value 0 is recommended for MP, BP, and BL images. In TIFF/IT, MP, BP, and BL images, the terms white and black in WhiteIsZero and BlackIsZero should be replaced with BackgroundColor and ImageColor (foreground colour) for proper interpretation.

Where a PhotometricInterpretation value of 2 (RGB) is used for CT data, the encoding shall be as defined in Annex G.

Where a PhotometricInterpretation value of 6 (YCbCr) is used for CT data, the encoding shall be as defined in Annex E.

Where a PhotometricInterpretation value of 8 (Lab) is used for CT data, the encoding shall be as defined in Annex H.

7.2.8.3 Colour sequence definition

7.2.8.3.1 Colour sequence tag

34017 ColorSequence ASCII

This International Standard provides for two basic colour sequences describing four-colour separations and two basic colour sequences for three-colour separations. These basic four-colour sequences are specified by values "CMYK" and "YMCK" in the ColorSequence field. The basic colour sequences for three-colour separations are “RGB” and “lab”.

To specify optional colours or colour sequences in this International Standard, the following entries in the ColorSequence field may be used in any sequence (colour entries may be repeated for additional separations of the same colour):

"Y" "M" "C" "K"	=	Yellow, magenta, cyan, and black inks
"R" "G" "B"	=	Red, green, blue light intensity
"U" "V" "L"	=	CIE 1976 projective u', v', and photopic luminance (Y)
"1" to "9",“a” to “z”	=	User-definable colours or separations; such as pink, varnish, etc.
"Q"	=	Present in the data stream but ignored

NOTE 1 The entries in the ColorSequence field do not have to be unique.

NOTE 2 ColorSequence “UVL” is included for historical reasons but its use is not recommended.

NOTE 3 ColorSequence “RGB” is included for historical reasons. It is recommended that RGB data use PhotometricInterpretation value of 2 as specified in 7.2.8.2 and Annex G.

NOTE 4 The values of the ColorSequence tag are case-sensitive. ie. The letters “A” and “a” are interpreted as different values.

332	InkSet	SHORT	
334	NumberOfInks	SHORT	(Default=4)

InkSet and NumberOfInks are optional fields. An InkSet value of 1 specifies that CMYK inks are to be used in the CMYK colour sequence. An InkSet value of 2 specifies that the inkset and/or colour sequence is other than that specified by an InkSet value of 1 (i.e. not CMYK). If this field is to be used, it must not conflict with any other fields used. NumberOfInks value specifies the number of inks or separations used and is usually equal to SamplesPerPixel but may be equal to the number of colours specified in the ColorSequence field.

7.2.8.3.2 Ink names

333 InkNames ASCII

InkNames tag may be used, when ink names corresponding to the separation in the ColorSequence (or 4 - 19th byte of the entry in ColorTable for LW). The length of this tag is total number of characters in all the ink name strings, including the null characters. The name of each ink used is written as a list of concatenated, null-terminated ASCII strings.

The number of strings shall not be inconsistent with the NumberOfInks and ColorSequence fields (see 7.2.8.3.1). If the InkNames tag is used, the order of InkNames shall be the same as in the ColorSequence tag or 4 - 19th byte of the entry in ColorTable for LW).

7.2.8.3.3 CMYKEquivalent

34032 CMYKEquivalent BYTE or SHORT

CMYKEquivalent is the set of entries of 4-values for the cyan, magenta, yellow and black inks that together define a colour that is expected to be as visually close as possible to 100% of the specified ink. The interpretation of these values depends on the Dot Range tag. CMYKEquivalent may be used to describe CMYK colour equivalent values corresponding to the element in ColorSequence field value. It may be used in TIFF/IT and TIFF/IT-LW/P2. CMYKEquivalent is an optional field.

CMYKEquivalent consists of between one and 16 entries. Each entry describes 4 equivalent colour values for the cyan, magenta, yellow and black inks in the separation, so the number of separations is determined by the value of SamplesPerPixel only. Each entry is 4 bytes (or 8 bytes of 4 SHORT elements) long.

If CMYKEquivalent is used, the number of entries shall be equal to the [Length minus one] of the ColorSequence field. Each entry describes a set of 4-values of CMYK colour equivalent values corresponding to each element of ColorSequence field.

EXAMPLE If ColorSequence value="12CMYK" with terminating null character, then "1" and "2" means that two spot colour inks are used and C,M,Y and K process colour inks are used. In this case, the length of CMYKEquivalent tag is 24 and an example value of CMYKEquivalent tag are [55,255,0,0],[0,100,100,0],[255,0,0,0],[0,255,0,0],[0,0,255,0],[0,0,0,255], where the first entry of [55,255,0,0] describes the separation of the first byte (in this case, spot colour ink 1) , the second entry of [0,100,100,0] describes the separation of the second byte (in this case, spot colour ink 2), the third entry of [255,0,0,0] describes the separation of the third byte (in this case, process colour ink C) , and so on.

In the case of the LW format, if CMYKEquivalent is used, the first entry in CMYKEquivalent describes the separation of the 4th byte (counting from 0) in the colour table. The second entry describes the separation of the 5th byte in this colour table. The 16th entry, when it exists, describes the separation of the last byte in the colour table. Hence, the order of separations is determined by the order of data in CMYKEquivalent.

7.2.8.4 Colour values

336	DotRange	BYTE or SHORT (0% dot, 100% dot)

For separated images, the scaling of the colour values shall be linear with respect to printing dot value. The colour values are unsigned, and any values from 0 through 255 may be used. The relationship between DotRange values and colour values (step size, direction of slope, and intercept) shall be at the discretion of the originator of the file, but shall be identical for all colour separations in one file. The DotRange field is used to describe these values. The count for the number of values of the DotRange field in TIFF/IT shall be 2, one value for 0% printing dot value and one value for 100% printing dot value. Default values are 0 and $2^{BitsPerSample}$ -1 (with a maximum of 255) for 0% and 100% printing dot value, respectively.

NOTE 1 TIFF 6.0 permits using either the same or different DotRange values for each separation. For simplicity, TIFF/IT requires that the same DotRange values be used for all separations of a file.

Figure 3 describes further the colour values for the case where the 0% printing dot value is the colour value 20 and the 100% printing dot value is the colour value 220.

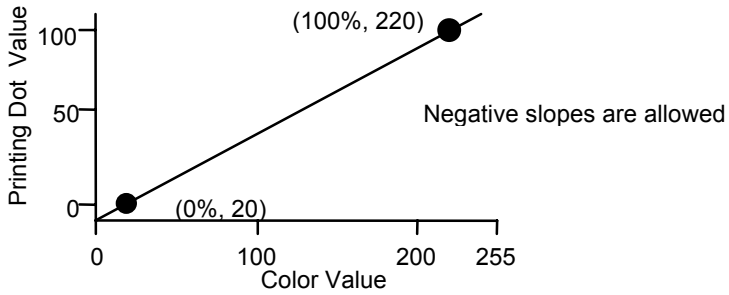


Figure 3 — Colour value versus print dot value

It is possible that the colour values of the pixels (i.e. the values in the data stream) can fall above or below the values specified for 0% dot and 100% dot. In this case, it is at the discretion of the reader to either accept or truncate the data.

NOTE 2 For example, where the value for 0% dot is 20 and the data value is 15, the resulting data value after transfer could be 20 or 15 at the discretion of the reader.

34029 ColorCharacterization ASCII

The colour values of separated, RGB or other colour images may be further characterized by the use of data tables as specified in ISO 12641 and ISO 12642, or a named colour space, such as “sRBG” as defined in IEC 61966-2-1. These ASCII data tables may be carried with the image file they describe by use of the ColorCharacterization field. For further details, see ISO 12641, ISO 12642, and Annex I.

34675 ICCProfile UNDEFINED

The colour values of separated, RGB or other colour images may also be further characterized by the use of an ICC profile. If an ICC profile is used it shall use the ICC profile tag as described in Annex J.

34022 ColorTable BYTE

In LW images, colour values are specified by encoding them in a colour palette table. The colour palette table is the value of the TIFF/IT ColorTable field (see 7.4.2.2).

34025 ImageColorValue BYTE

34026 BackgroundColorValue BYTE

The pixels (bits) in a BP and BL image denote either a foreground or background colour. The fields ImageColorValue and BackgroundColorValue denote the value of the image and background colour respectively.

34027 PixelIntensityRange BYTE (minimum, maximum intensity)

The pixels in an MP image denote intensities of a particular colour. The colour is defined by the ImageColorValue field. Similar to the DotRange field, percent intensity may be mapped into two-byte values as indicated by the field PixelIntensityRange. Default values are 0 and $2^{BitsPerSample}$ - 1, for 0% and 100% intensity respectively (See 7.6).

34028 TransparencyIndicator BYTE

TransparencyIndicator is used as a transparency indicator for HC files. Value "0", the default, signifies that transparency is not used. Value "1" signifies that transparency is used and may be found, encoded as described in 7.5. Other values are not supported. The field is not used for other file types. Transparency is encoded in the colour table for LW files, and in the image and background colour indicator fields for BP and BL files.

7.2.9 Image and background colour indicators

34023 ImageColorIndicator BYTE

34024 BackgroundColorIndicator BYTE

The data stream for binary images (BP and BL) functions as a switch between foreground and background colours. The ImageColorIndicator field indicates whether or not the particular image or foreground colour is encoded in the binary image (along with information about transparency) or in the monochrome continuous tone picture image (where no background colour exists). The BackgroundColorIndicator field indicates the same information about the background colour (MP images do not specify any background colour). The values of these fields indicate the nature of the image and background colour definitions, where:

"0" = image/background colour not defined (default value)

"1" = image/background colour defined

"2" = full transparency, image/background colour not defined

Full transparency means that an underlying image, if any, will show through completely in the transparent areas.

Systems that do not choose to specify any image or background colour specification may indicate this by the default value "0" in the foreground and background colour indicators. In this case, the significance of image and/or background colour is at the discretion of the reader.

7.2.10 Fields in TIFF/IT tag number order

7.2.10.1 Traditional TIFF fields

Table 2 shows the traditional TIFF (TIFF 6.0) field usage as generally applied to TIFF/IT files. Only the TIFF fields specifically used in TIFF/IT are listed (unused fields, and fields that are not applicable are not listed). For usage in specific file types (CT, LW, HC, MP, BP, BL, SD, FP), see the subclause for that file type.

Table 2 — Traditional TIFF fields

Tag No.	Field name	Data type	Remarks
254	NewSubfileType	LONG	(=0)
256	ImageWidth	LONG or SHORT	Baseline TIFF required field (pixels per line)
257	ImageLength	LONG or SHORT	Baseline TIFF required field (lines in image)
258	BitsPerSample	SHORT	See specific file type
259	Compression	SHORT	See specific file type (see also Annexes E and F)
262	PhotometricInterpretation	SHORT	See specific file type
269	DocumentName	ASCII	Optional field (Job Name)
270	ImageDescription	ASCII	Optional field (Image Name)
271	Make	ASCII	Optional field (Vendor Name)
272	Model	ASCII	Optional field
273	StripOffsets	LONG or SHORT	Baseline TIFF required field (only one value, if only one strip)
274	Orientation	SHORT	(=1, =4, =5, and =8) optional values are 2, 3, 6, and 7
277	SamplesPerPixel	SHORT	See specific file type
278	RowsPerStrip	LONG or SHORT	Omit field to take default value if whole image is in one strip
279	StripByteCounts	LONG or SHORT	Baseline TIFF required field (only one value, if only one strip)
282	XResolution	RATIONAL	Baseline TIFF required field (from pixel to pixel within line)
283	YResolution	RATIONAL	Baseline TIFF required field (from line to line within image)
284	PlanarConfiguration	SHORT	See specific file type
285	PageName	ASCII	Optional
296	ResolutionUnit	SHORT	Baseline TIFF required field
301	TransferFunction	SHORT	Optional (see annex G)
305	Software	ASCII	Optional (Program Name)
306	DateTime	ASCII	Optional
315	Artist	ASCII	Optional
316	HostComputer	ASCII	Optional
318	WhitePoint	RATIONAL	Optional (see annex G)
319	PrimaryChromaticities	RATIONAL	Optional (see annex G)
332	InkSet	SHORT	See specific file type
333	InkNames	ASCII	Optional
334	NumberOfInks	SHORT	See specific file type
336	DotRange	BYTE or SHORT	0% and 100% dot sample values
532	ReferenceBlackWhite	RATIONAL	Optional (see annex G)
33432	Copyright	ASCII	Optional
34675	ICCProfile	UNDEFINED	Optional (see annex J)

7.2.10.2 Additional TIFF/IT fields

In addition to the traditional TIFF field, TIFF/IT requires fields to hold specific TIFF/IT capabilities. Twenty (20) private tags from 34016 through 34035 are specifically allocated for TIFF/IT use. Table 3 specifies these TIFF/IT fields. For usage in specific file types (CT, LW, HC, MP, BP, BL, SD, FP) see the subclause for that file type.

Table 3 — Additional TIFF/IT fields

Tag No.	Field name	Data type	Remarks
34016	Site	ASCII	Site name
34017	ColorSequence	ASCII	Sequence of colours, Default= 'CMYK' for 4-colour files for compatibility with PhotometricInterpretation Value=5
34018	IT8Header	ASCII	Unmodified headers appended by ASCII "null" from ISO 10755, ISO 10756, and ISO 10759, if needed, may be stored here. The use of the IT8Header tag is only recommended for compatibility with ISO 12639-1998. ISO 10755, ISO 10756, and ISO 10759 are obsolete.
34019	RasterPadding	SHORT	CT and MP files may also use 0 to indicate that no raster padding is used. Default=0
34020	BitsPerRunLength	SHORT	See specific file type
34021	BitsPerExtendedRunLength	SHORT	See specific file type
34022	ColorTable	BYTE	Count=(Last Valid Colour+1) * 20 bytes. This is the entire colour palette table, up to and including the Last Valid Colour entry unmodified. See 7.4.2.2.
34023	ImageColorIndicator	BYTE	See specific file type
34024	BackgroundColorIndicator	BYTE	See specific file type
34025	ImageColorValue	BYTE	See specific file type
34026	BackgroundColorValue	BYTE	See specific file type
34027	PixelIntensityRange	BYTE	See specific file type
34028	TransparencyIndicator	BYTE	See specific file type
34029	ColorCharacterization	ASCII	See specific file type
34030	HCUsage	LONG	Type of information in HC file
34031	TrapIndicator	BYTE	(=0, =1) Default = 1
34032	CMYKEquivalent	BYTE/SHORT	Optional for LW, CT, HC and SD file types
34033	Reserved for future TIFF/IT use		
34034	Reserved for future TIFF/IT use		
34035	Reserved for future TIFF/IT use		

7.3 Colour continuous tone picture (CT) file

7.3.1 TIFF/IT-CT, TIFF/IT-CT/P1 and TIFF/IT-CT/P2

TIFF/IT-CT makes use of all the features and functionality supported by the TIFF and TIFF/IT fields appropriate to colour continuous tone picture images. TIFF/IT-CT/P1 and TIFF/IT-CT/P2 limit the field values to the default value, a single value or a small choice of values and also limit the usage of optional fields to the minimum required for reasonable interchange.

TIFF/IT-CT/P1 is a simplified image file format profile for colour continuous tone picture image (CT) data and can be considered a constrained subset of TIFF/IT-CT. TIFF/IT-CT/P1 files can be read by typical TIFF 6.0 readers and be written by typical TIFF 6.0 writers that conform to TIFF 6.0, Section 16: CMYK Images.

TIFF/IT-CT/P2 can be considered as an extension of TIFF/IT-CT/P1. TIFF/IT-CT/P2 files may not be readable by typical TIFF 6.0 readers if the CMYKEquivalent tag is used.

TIFF/IT-CT for RGB (PhotometricInterpretation value of 2) and LAB (PhotometricInterpretation value of 8) can be considered as an expansion of TIFF/IT-CT(see Annex G and Annex H, respectively).

TIFF/IT-CT and TIFF/IT-CT/P2 permit optional JPEG or Flate compression of image data. TIFF/IT-CT/P1 does not permit any compression of image data.

7.3.2 Data structure

There are three formats for describing the pixel structure of colour continuous tone picture file data: pixel interleaving (also called chunky format), line interleaving (also called row interleaving), and colour interleaving (also called planar format).

A TIFF/IT-CT writer shall write in any one of the formats and a TIFF/IT-CT reader shall read all three of the formats. TIFF/IT-CT/P1 and TIFF/IT-CT/P2 files are constrained to only the pixel interleaved format.

NOTE Some machines and applications require data to be written to 16-bit word boundaries. Therefore, if the number of bytes per line is odd, there would be one fill byte at the end of each line. In this case, field 34019 (RasterPadding) with value 1 indicates the value of the padding to the word boundary (word aligned), and value 32895 for field 259 (Compression) indicates the presence of such padding. TIFF/IT-CT/P1 and TIFF/IT-CT/P2 do not permit the use of value 32895 for field 259 (Compression) to indicate the use of raster padding nor does it permit the use of field 34019 (RasterPadding).

7.3.2.1 Pixel interleaving

Pixel interleaved data consists of a row of contiguous colour pixels which form a line of image, with a sequence of these lines extending across the image. The order of components within the pixel is defined by PhotometricInterpretation or ColorSequence.

7.3.2.2 Line interleaving

Line interleaved data consists of one line of a colour, followed by a line of the next colour for that same row of pixels ("n" lines of "m" colour separations). The sequence of colours for each line is defined by PhotometricInterpretation or ColorSequence.

7.3.2.3 Colour interleaving

Colour interleaved data consists of all lines of one colour, followed by all lines of the next. The order of planes of colour is defined by PhotometricInterpretation or ColorSequence.

7.3.2.4 Samples per pixel

TIFF/IT-CT readers shall be capable of reading and processing CT files with four samples per pixel. Other values are optional for TIFF/IT-CT and TIFF/IT-CT/P2, but are not permitted for TIFF/IT-CT/P1.

TIFF/IT-CT writers shall be capable of writing CT files with four samples per pixel. Other values are optional for TIFF/IT-CT and TIFF/IT-CT/P2, but are not permitted for TIFF/IT-CT/P1.

7.3.2.5 Colour sequences

For pixel interleaving data format of TIFF/IT-CT either the YMCK or the CMYK order of pixels shall be written and either the YMCK or the CMYK order shall be read. TIFF/IT-CT/P1 and TIFF/IT-CT/P2 only allows the CMYK order of pixels shall be written and read.

For line interleaving data format of TIFF/IT-CT only the CMYK order is required to be written and read.

Optional colour sequences for TIFF/IT-CT are defined in 7.2.8.3.1.

The names Cyan, Magenta, Yellow and Black are reserved for process colours and shall not be used as names for spot colours.

7.3.3 TIFF/IT-CT encoding

Field usage for TIFF/IT-CT, TIFF/IT-CT/P1 and TIFF/IT-CT/P2 data shall be as shown in Table 4.

Table 4 — TIFF/IT-CT, TIFF/IT-CT/P1 and TIFF/IT-CT/P2 field usage

Field Name	Tag No.	Data type	Count	Default value	TIFF/IT-CT	TIFF/IT-CT/P1	TIFF/IT-CT/P2	Remarks
NewSubfileType	254	LONG	1	0	d(=0)	d=0	d=0	
ImageWidth	256	SHORT/LONG	1	none	m	m	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	m	m	lines per image
BitsPerSample	258	SHORT	[a]	1	m(=8,…, =16,…)	m=8,8,8,8	m=8,…	
Compression	259	SHORT	1	1	d=1, =7, =8, =32895	d=1	d=1, =7, =8	
PhotometricInterpretation	262	SHORT	1	none	m=2, =5, =6, =8	m=5	m=5	[l]
DocumentName	269	ASCII	[b]	none	opt	not used	not used	
ImageDescription	270	ASCII	[b]	none	opt	opt	opt	
Make	271	ASCII	[b]	none	opt	opt	opt	vendor name
Model	272	ASCII	[b]	none	opt	not used	not used	
StripOffsets	273	SHORT/LONG	[c]	none	m	m	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	d=1	d=1	
SamplesPerPixel	277	SHORT	1	1	m(=4)	m=4	m(=4)	no. of separations
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	d	d	[e]
StripByteCounts	279	SHORT/LONG	[c]	none	d	m	m	
Xresolution	282	RATIONAL	1	none	d	m	m	
Yresolution	283	RATIONAL	1	none	d	m	m	
PlanarConfiguration	284	SHORT	1	1	d=1, =2, =32768	d=1	d=1	
PageName	285	ASCII	[b]	none	opt	not used	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	d=2, =3	
Software	305	ASCII	[b]	none	opt	opt	opt	
DateTime	306	ASCII	[d]	none	opt	opt	opt	
Artist	315	ASCII	[b]	none	opt	opt	opt	
HostComputer	316	ASCII	[b]	none	opt	not used	not used	
InkSet	332	SHORT	1	1	opt	d=1	d=1	[g]
InkNames	333	ASCII	[b]	none	opt	not used	opt	
NumberOfInks	334	SHORT	1	4	opt	d=4	d=4	[h]
DotRange	336	BYTE/SHORT	2	0,255	d	d=0,255	d=0,255	
Copyright	33432	ASCII	[b]	none	opt	opt	opt	
Site	34016	ASCII	[b]	none	opt	not used	not used	
ColorSequence	34017	ASCII	[b]	‘CMYK’	d(=’CMYK’,=’YMCK’)	not used	d(=’CMYK’)	
IT8Header	34018	ASCII	[b]	none	opt	not used	not used	
RasterPadding	34019	SHORT	1	0	[f]	not used	not used	
ColorCharacterization	34029	ASCII	[b]	none	opt	opt	opt	[l]
TrapIndicator	34031	BYTE	1	1	opt	not used	opt	
CMYKEquivalent	34032	BYTE/SHORT	[j]	none	opt	not used	opt	
ICCProfile	34675	UNDEFINED	[k]	none	opt	not used	opt	

[a] SamplesPerPixel

[b] The number of characters (bytes) in the string including the terminating null

[c] If PlanarConfiguration is equal to 1 or 32768, use StripsPerImage.

If PlanarConfiguration is equal to 2, use SamplesPerPixel x StripsPerImage.

StripsPerImage=INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip), where INTEGER(*x*) is the integer value of *x* (i.e. INTEGER (2.9) = 2)

[d] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

[e] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[f] If RasterPadding is used in CT format, then the Compression value must be specified as 32895. Values of 0, 1, 2, 9, 10 are the allowed values of RasterPadding.

[g] If InkSet tag is used and ColorSequence tag value is the default value of "CMYK", InkSet shall have the value of 1. Otherwise it shall have the value of 2.

[h] If NumberOfInks tag is used it must have the same value as the value of SamplesPerPixel.

[i] ISO 12641, ISO 12642, ASCII data tables, or named colour definition “sRGB”

[j] The count is the value of SamplesPerPixel multiplied by 4.

[k] The count is the number of bytes in the ICC profile.

[l] Value 6 (YCbCr) shall only be used when Compression has the value of 7.

7.4 Colour line art (LW) file

7.4.1 TIFF/IT-LW, TIFF/IT-LW/P1 and TIFF/IT-LW/P2

TIFF/IT-LW makes use of all the features and functionality supported by the TIFF and TIFF/IT fields appropriate to line art images. TIFF/IT-LW/P1 and TIFF/IT-LW/P2 limit the field values to the default value, a single value or a small choice of values and also limit the usage of optional fields to the minimum required for reasonable interchange.

TIFF/IT-LW/P1 is a simplified image file format profile for line art (LW) image data and can be considered a constrained subset of TIFF/IT-LW specified for simpler implementation. TIFF/IT-LW/P2 can be considered as an extension of TIFF/IT-LW/P1.

NOTE TIFF/IT-LW files are not readable by typical TIFF 6.0 Readers and cannot be written by typical TIFF 6.0 Writers because of the mandatory use of TIFF/IT-specific fields and values and non-traditional interpretations of other TIFF 6.0 fields and values (e.g. compression by mandatory run length encoding). Filters may be written for such DTP and other applications that are desired to read and write TIFF/IT-LW, TIFF/IT-LW/P1 and TIFF/IT-LW/P2 files. As simplified profiles, the filters for TIFF/IT-LW/P1 and TIFF/IT-LW/P2 are simpler to implement than for TIFF/IT-LW.

7.4.2 Data structure

7.4.2.1 General

Colour line art data consists of an image file comprising the following three parts. A first part consists of one or more blocks of run length encoded data describing the colour line art image in terms of colour numbers and run lengths. A second part is a colour table (in the IFD) that defines the colour values for the colour numbers of the first part. A third part is a table describing the separations of the second part. This data structure is similar to binary line art data with the addition of two colour tables for colour specification.

7.4.2.2 Colour table

7.4.2.2.1 Description

The colour table defines the relationship between the colour numbers assigned to pixels in the image file and the separation colour description. The table consists of from one to 65536 twenty-byte entries each describing a colour number, a discrete colour description and a transparency switch. The colour number is used to link run lengths in the data with specific colour and transparency values.

The colour table is organized as follows:

Table entry	Colour number	Description of use
1	0	reserved for transparency
2 – 65536	1 – 65535	discrete colour descriptions

Colour number "0" (zero) is always a transparent colour.

Each colour number shall be in ascending sequence from 0 through 65535, and in its proper location in the colour table; i.e., colour number 1 is the second entry, colour number 10 is the eleventh entry, etc. Colour numbers not used shall be zero filled from bytes 0 through 19 within its entry locations. The highest colour number used is the LastValidColor.

Each entry in the colour table is a 20-byte sequence of binary numbers which indicates the colour and transparency of the run length. There are two formats for the table entries, a basic format and an optional format.

7.4.2.2.2 Colour table - basic format

The colour table entry basic format describes files having no more than 4 separations named cyan, magenta, yellow and black. Their sequence is either CMYK or YMCK. It is depicted in Table 5.

Table 5 — Basic LW colour table entry

Byte	Bit 7	6	5	4	3	2	1	0
0	Upper byte in 16-bit colour number [a]							
1	Lower byte in 16-bit colour number [a]							
2	< 1	1	1	1	1	1	1	1 >
3	< 1	1	1	1	> < [b]			>
4 5 6 7	Colour value (8-bit) for each separation in the order as specified in the ColorSequence field.							
8 : 19	Not used in basic LW colour table							

[a] The colour number shall be a binary value from 0 through 65535, representing colour numbers 0 through 65535.

[b] Bits 4 through 7 shall be set to binary "1". Bits 0 through 3 are used as transparency indicators to indicate which separations, if any, are transparent. See 7.4.2.3 for the order of separations. A binary "1" indicates that the flagged separations are transparent.

0000	signifies non-transparent colour
0001 : : 1110	signifies that one or more of the defined separations will be transparent
1111	signifies that all separations are transparent

7.4.2.2.3 Colour table - optional format

The colour table entry optional format allows for colour sequences other than “CMYK” and “YMCK” and for an extended number of separations. It is depicted in Table 6. In the optional format, there can be defined up to 16 separations. For each separation, the colour table provides one byte describing the value or amount for the separation. This value is interpreted according to the DotRange tag. Unused separations must be set to a value corresponding to 0% coverage, according to the DotRange tag. Each transparency indicator bit indicates whether each separation indicated by the separation order in ColorSequence field value is transparent or not. Byte values from byte 4 through 19 correspond to the order as specified in the ColorSequence field defined in 7.2.8.3.1. If descriptions for CMYK colour equivalent value or ink names are needed for the separations in ColorSequence field, InkNames or CMYKEquivalent field may be used as described in 7.2.8.3.2 or in 7.2.8.3.3.

Table 6 — Optional LW colour table entry

Byte	Bit 7 6 5 4 3 2 1 0
0	Upper byte in 16-bit colour number [a]
1	Lower byte in 16-bit colour number [a]
2 – 3	Transparency Indicator for optional separations [b]
4 . . 19	Colour value (8-bit) for each separation in the order as specified in the ColorSequence field.

[a] The colour number shall be a binary value from 0 through 65535, representing colour numbers 0 through 65535.

[b] Bits 0 through 15 (bits 0 to 7 of bytes 2 and 3) shall be used as transparency indicators to indicate which separations, if any, are transparent. See 7.4.2.3 for the order of separations. A binary "1" indicates that the flagged separations are transparent, such that for colour numbers 1 to 65535.

---byte 2---	---byte 3---	
7 0	7 0	Bit number in byte
15 8	7 0	Bit number in word composed of byte 2 and 3
----------	----------	----------
0000 0000	0000 0000	Non-transparent colour
0000 0000	0000 0001	one of the defined separations is transparent. (the first separation in ColorSequence field is transparent.
0000 0000	0000 0010	one of the defined separations is transparent. (the second separation in ColorSequence field is transparent.
0000 0000	0000 0011	two of the defined separations are transparent. (the first and second separations in ColorSequence field are transparent.)
: :	: :	
1111 1111	1111 1110	all separations but one are transparent. (the first separation in ColorSequence field is not transparent.)
1111 1111	1111 1111	all separations are transparent.

7.4.2.3 Transparent colours

Colour number 0 and the value hex "FF" in byte 3 of colour numbers 1 through 65535 are reserved to signify a fully transparent colour using the basic format. The value hex "FF" shall always be loaded in colour number 0 when colour number 0 is used. Any colour values in bytes 4 through 19, which are flagged as transparent colour or unused separations are reserved for vendor-specific (system) use and treated as non-printing.

The value hex "F1" to hex "FE" in byte 3 of the basic format colour table for colour numbers 1 through 65535 signify that one or more of the four defined separations will be transparent. The bit mask defined by the value specified defines which separations are transparent according to the colour sequence specified, such that the least significant bit of the defined bit mask corresponds to the first separation defined by the colour sequence.

NOTE For example:

— the value F1 (bit mask: 1111 0001) signifies that "Y" would be transparent where the colour sequence is "YMCK".

— the value F6 (bit mask: 1111 0110) signifies the second and third separations are transparent, or "M" and "Y" where the colour sequence is "CMYK".

Likewise, optionally formatted separations are provided for using bytes 2 and 3 with the value hex "0000 0000" indicating all separations are non-transparent colours, the value hex "FFFF FFFF" indicating all separations are transparent, and the values hex "0000 0001 " to hex "FFFF FFFE" various combinations in between. Transparency indicators for any unused separations should be set to binary one.

7.4.2.4 Basic run length encoding structure

7.4.2.4.1 Formats

There are two basic formats for encoding run lengths: a short form (16 bits long) for encoding run lengths up to $2^{BitsperRunLength}$ -1 pixels long, and a long form (32 bits long) for encoding run lengths up to 65535 pixels long. Both forms may be freely mixed within a file. Writers are required to write the short form. There is no requirement to write both forms, since long runs may be encoded by repetitions of the short form. However, readers shall be capable of reading both forms.

NOTE 1 The special case of BitsPerRunLength = 0 (LastValidColour between 2^{15} and 2^{16} -1) requires that only the long form be used.

Each line of data (whose orientation to the image is defined according to 7.2.4) is initiated by two zero bytes and terminated by two zero bytes.

NOTE 2 Two adjacent zero bytes may also occur within the encoding of a line, so this occurrence should not be used as a means of detecting an end of line.

If the number of pixels in an encoded line does not equal the declared number of pixels per line of the image, or the number of encoded lines of data does not equal the declared number of lines in the image, an error exists and continued processing is left to the discretion of the processing system. Run lengths of zero shall not be used for either the long form or the short form since this would conflict with other indicators.

7.4.2.4.2 Short form encoding structure

The short form consists of a two-byte (16-bit) entry consisting of two segments. The first segment is the colour number in the colour table and the second segment is the run length. The length of the run length segment is defined by the BitsPerRunLength field. The length of the colour number segment is 16 - BitsPerRunLength, which must correspond to the encoding bits required for the LastValidColour. Conforming TIFF/IT-LW/P1 files shall use the BitsPerRunLength field value of 8. The short form encoding structure is shown in Figure 4.

The relationship between Last Valid Colour numbers and encoding bits required are shown in Table 7.

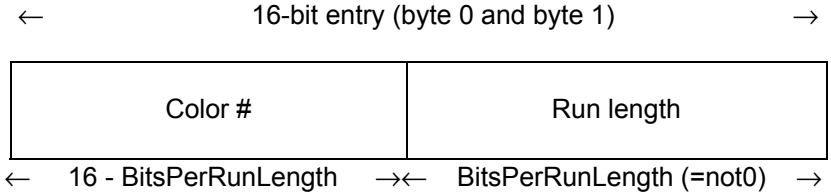


Figure 4 — Short form encoding structure in TIFF/IT-LW

Table 7 — Relationship between LastValidColor numbers and encoding bits required

LastValidColour	Encoding bits required (= 16 - BitsPerRunLength)
0 to 1	1
2 to 3	2
4 to 7	3
8 to 15	4
16 to 31	5
32 to 63	6
64 to 127	7
128 to 255	8
256 to 511	9
512 to 1023	10
1024 to 2047	11
2048 to 4095	12
4096 to 8191	13
8192 to 16383	14
16384 to 32767	15
32768 to 65535	16 (no short form encoding)

7.4.2.4.3 Long form encoding structure

The long form consists of a four-byte (32-bit) entry consisting of three segments. The length of the first segment, which is the colour number, is determined from Table 7. In other words, the length of the colour number segment is 16 - BitsPerRunLength. The remaining bits of the first 16 bits (2 bytes) shall be set to zero to signify the long form encoding; the special case of LastValidColor greater than 32768 (determined from the ColorTable value) shall also signify the long form encoding. The last 16 bits of the 32-bit entry are used to encode the run length. It shall be non-zero (Its value is between 1 and 65535 inclusive.) The use of the long form to encode a run length of less than 256 shall set the 8 high-order bits of the last 16-bit segment to zero and the run length shall be contained in the 8 low-order bits. This byte ordering corresponds to the big-endian ("MM") byte order, regardless of the ordering used in TIFF/IT directories (IFD). The long form encoding structure is shown in Figure 5.

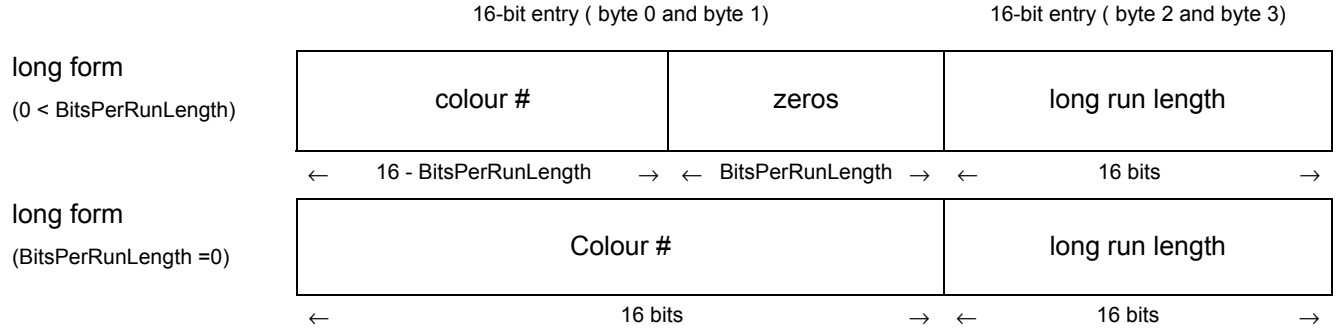


Figure 5 — Long form encoding structure in TIFF/IT-LW

7.4.3 TIFF/IT-LW, TIFF/IT-LW/P1 and TIFF/IT-LW/P2 encoding

Field usage for TIFF/IT-LW , TIFF/IT-LW/P1 and TIFF/IT-LW/P2 data is as shown in Table 8.

Table 8 — TIFF/IT-LW, TIFF/IT-LW/P1 and TIFF/IT-LW/P2 Field usage

Tag Name	Tag #	Data Type	Count	Default Value	TIFF/IT-LW	TIFF/IT-LW/P1	TIFF/IT-LW/P2	Remarks
NewSubfileType	254	LONG	1	0	d(=0)	d=0	d(=0)	
ImageWidth	256	SHORT/LONG	1	none	m	m	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	m	m	lines per image
BitsPerSample	258	SHORT	1	1	m[j]	m=8	m=8	
Compression	259	SHORT	1	1	m=32896	m=32896	m=32896	
PhotometricInterpretation	262	SHORT	1	none	m=5	m=5	m=5	
DocumentName	269	ASCII	[a]	none	opt	not used	not used	
ImageDescription	270	ASCII	[a]	none	opt	opt	opt	
Make	271	ASCII	[a]	none	opt	opt	opt	vendor name
Model	272	ASCII	[a]	none	opt	not used	not used	
StripOffsets	273	SHORT/LONG	[b]	none	m	m	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1,=4,=5, =8)	d=1	d=1	
SamplesPerPixel	277	SHORT	1	1	m=1	m=1	m=1	
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	d	d	[e]
StripByteCounts	279	SHORT/LONG	[b]	none	m	m	m	
XResolution	282	RATIONAL	1	none	m	m	m	
YResolution	283	RATIONAL	1	none	m	m	m	
PageName	285	ASCII	[a]	none	opt	not used	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	d=2, =3	
Software	305	ASCII	[a]	none	opt	opt	opt	
DateTime	306	ASCII	[c]	none	opt	opt	opt	
Artist	315	ASCII	[a]	none	opt	opt	opt	
HostComputer	316	ASCII	[a]	none	opt	not used	not used	
InkSet	332	SHORT	1	1	opt	d=1	d=1	[g]
InkNames	333	ASCII	[a]	none	opt	not used	opt	
NumberOfInks	334	SHORT	1	4	opt	d=4	d=4	[h]
DotRange	336	BYTE/SHORT	2	0,255	d	d=0,255	d	
Copyright	33432	ASCII	[a]	none	opt	opt	opt	
Site	34016	ASCII	[a]	none	opt	not used	not used	
ColorSequence	34017	ASCII	[a]	CMYK	d(=CMYK, =YMCK)	not used	d	sequence of colours
IT8Header	34018	ASCII	[a]	none	opt	not used	not used	
BitsPerRunLength	34020	SHORT	1	8	d	d=8	d	[i]
BitsPerExtendedRunLength	34021	SHORT	1	16	d=16	d=16	d=16	
ColorTable	34022	BYTE	[d]	none	m	m	m	
ColorCharacterization	34029	ASCII	[a]	none	opt	opt	opt	[f]
TrapIndicator	34031	BYTE	1	1	opt	not used	opt	
CMYKEquivalent	34032	BYTE/SHORT	[j]	none	opt	not used	opt	
ICCProfile	34675	UNDEFINED	[k]	none	opt	not used	opt	

[a] The number of characters (bytes) in the string including the terminating null

[b] StripsPerImage = INTEGER ((ImageLength + RowsPerStrip - 1) / RowsPerStrip), where INTEGER (x) is the integer value of x (i.e., INTEGER (2.9) = 2)

[c] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

[d] ([Last Valid Colour]+1) x 20

[e] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[f] ISO 12641, ISO 12642 ASCII data tables or named colour definition “sRGB”

[g] If InkSet tag is used and ColorSequence tag value is the default value of "CMYK", InkSet shall have the value of 1. Otherwise it shall have the value of 2.

[h] If NumberOfInks tag is used, it must have the same value as the value of SamplesPerPixel.

[i] Size, in bits, of the run length segment in LW short form encoding structure (see Figure 4)

[j] The count is the value of SamplesPerPixel multiplied by 4.

[k] The count is the number of bytes in ICC profile.

7.5 High resolution continuous tone (HC) file

7.5.1 TIFF/IT-HC, TIFF/IT-HC/P1 and TIFF/IT-HC/P2

TIFF/IT-HC makes use of all the features and functionality supported by the TIFF and TIFF/IT fields appropriate to high resolution continuous tone images. TIFF/IT-HC/P1and TIFF/IT-HC/P2 limit the field values to the default value, a single value or a small choice of values. TIFF/IT-HC/P1 and TIFF/IT-HC/P2 also limit the usage of optional fields to the minimum required for reasonable interchange.

TIFF/IT-HC/P1 is a simplified image file format profile for high resolution continuous tone (HC) image data and can be considered a constrained subset of TIFF/IT-HC specifically intended for simpler implementation. TIFF/IT-HC/P2 is an extension of TIFF/IT-HC/P1. TIFF/IT-HC, TIFF/IT-HC/P1 and TIFF/IT-HC/P2 files are not readable by typical TIFF 6.0 readers and cannot be written by typical TIFF 6.0 writers because of the mandatory use of TIFF/IT-specific fields and values and non-traditional interpretations of other TIFF 6.0 fields and values (e.g., compression by mandatory run length encoding). Filters may be written for DTP and other applications which are desired to read and write TIFF/IT-HC, TIFF/IT-HC/P1 and TIFF/IT-HC/P2 files. As simplified profiles, the filters for TIFF/IT-HC/P1 and TIFF/IT-HC/P2 are simpler to implement than for TIFF/IT-HC.

7.5.2 Data structure

High resolution continuous tone data consist of an image file of one or more blocks of run length encoded pixel data. The number of lines is defined in the ImageLength field. Each line is made up of pixel runs and starts and ends with a blank pixel run (all zero bytes). Each pixel run is made up of two components: a run length followed by a colour value. The run length is a 16-bit integer as defined in 7.2.2.4.3. The big-endian byte order is used regardless of the order used in the TIFF/IT directories (IFD). The sum of the run lengths in the line shall be the value found in ImageWidth. Run lengths shall not cross line boundaries. The colour value is defined by the values of SamplesPerPixel, BitsPerSample, ColorSequence and DotRange in the same manner that CT colour values are specified except that a special case of colour value is reserved for a transparent colour, if used.

TIFF/IT field 34028 is used as the transparency indicator. If transparency is used, colour values of zero become a special case, and signify transparency in that separation of the high resolution continuous tone (HC) data. Transparency indicates that the underlying colour picture separation value is used.

If transparency is used, then colour values of 0 shall indicate transparency for the separation to which they refer. When the writer uses "0" internally as a data value and also uses transparency (field 34028 with value "1"), both data values "0" and "1" are transferred as "1" and the reader shall treat this data as "0". If more or fewer than four colours are required, then SamplesPerPixel may take other even-numbered values (2, 6, 8...).

NOTE For example, pixel runs for four-separation colours are coded with six bytes each, two bytes for the run length followed by four bytes for the separation values. In this case, each line begins and ends with six zero bytes.

If the separations are CMYK, the encoding is:

Byte	Value
0 and 1	run length
2	cyan colour value
3	magenta colour value
4	yellow colour value
5	black colour value

7.5.3 TIFF/IT-HC, TIFF/IT-HC/P1 and TIFF/IT-HC/P2 encoding

Field usage for TIFF/IT-HC, TIFF/IT-HC/P1 and TIFF/IT-HC/P2 data is as shown in Table 9.

Table 9 — TIFF/IT-HC, TIFF/IT-HC/P1 and TIFF/IT-HC/P2 field usage

Field Name	Tag No.	Data type	Count	Default value	TIFF/IT-HC	TIFF/IT-HC/P1	TIFF/IT-HC/P2	Remarks
NewSubfileType	254	LONG	1	0	d(=0)	d=0	d=0	
ImageWidth	256	SHORT/LONG	1	none	m	m	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	m	m	lines per image
BitsPerSample	258	SHORT	[a]	1	m(=8,…)	m=8,8,8,8	m=(8…)	
Compression	259	SHORT	1	1	m=32897	m=32897	m=32897	
PhotometricInterpretation	262	SHORT	1	none	m=5	m=5	m=5	
DocumentName	269	ASCII	[b]	none	opt	not used	not used	
ImageDescription	270	ASCII	[b]	none	opt	opt	opt	
Make	271	ASCII	[b]	none	opt	opt	opt	vendor name
Model	272	ASCII	[b]	none	opt	not used	not used	
StripOffsets	273	SHORT/LONG	[c]	none	m	m	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	d=1	d=1	
SamplesPerPixel	277	SHORT	1	1	m(=4)	m=4	m(=4)	no. of separations
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	d	d	[e]
StripByteCounts	279	SHORT/LONG	[c]	none	m	m	m	
Xresolution	282	RATIONAL	1	none	m	m	m	
Yresolution	283	RATIONAL	1	none	m	m	m	
PlanarConfiguration	284	SHORT	1	1	d=1	d=1	d=1	
PageName	285	ASCII	[b]	none	opt	not used	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	d=2, =3	
Software	305	ASCII	[b]	none	opt	opt	opt	
DateTime	306	ASCII	[d]	none	opt	opt	opt	
Artist	315	ASCII	[b]	none	opt	opt	opt	
HostComputer	316	ASCII	[b]	none	opt	not used	not used	
InkSet	332	SHORT	1	1	opt	d=1	d=1	[f]
InkNames	333	ASCII	[b]	none	opt	not used	opt	
NumberOfInks	334	SHORT	1	4	opt [f]	d=4	d=4	
DotRange	336	BYTE/SHORT	2	0,255	d	d=0,255	d=0,255	
Copyright	33432	ASCII	[b]	none	opt	opt	opt	
Site	34016	ASCII	[b]	none	opt	not used	not used	
ColorSequence	34017	ASCII	[b]	‘CMYK’	d(=’CMYK’,=’YMCK’)	not used	d(=’CMYK’)	sequence of colours
TransparencyIndicator	34028	BYTE	1	0	d=0, =1	d=0, =1	d=0, =1	
ColorCharacterization	34029	ASCII	[b]	none	opt	opt	opt	[h]
HCUsage	34030	LONG	1	0	d [I]	d [i]	d[i]	
TrapIndicator	34031	BYTE	1	1	opt	not used	opt	
CMYKEquivalent	34032	BYTE/SHORT	[j]	none	opt	not used	opt	
ICCProfile	34675	UNDEFINED	[k]	none	opt	not used	opt	

[a] The count is the value of SamplesPerPixel.

[b] The number of characters (bytes) in the string including the terminating null

[c] StripsPerImage = INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip), where INTEGER(x) is the integer value of x (i.e. , INTEGER(2.9)=2)

[d] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

[e] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[f] If InkSet tag is used and ColorSequence tag value is the default value of "CMYK", InkSet shall have the value of 1. Otherwise, it shall have the value of 2.

[g] If NumberOfInks tag is used, it must have the same value as the value of SamplesPerPixel.

[h] ISO 12641, ISO 12642, ASCII data tables, or named colour definition “sRGB”

[i] The bits of HCUsage indicate the type of information contained in the HC file. If all bits are 0, or the field is not present, the information type is unknown. Each bit indicates a type of information that may be coded in the file (see 7.2.6).

[j] The count is the value of SamplesPerPixel multiplied by 4.

[k] The count is the number of bytes in the ICC profile.

7.6 Monochrome continuous tone picture (MP) file

7.6.1 TIFF/IT-MP, TIFF/IT-MP/P1 and TIFF/IT-MP/P2

TIFF/IT-MP makes use of all the features and functionality supported by the TIFF and TIFF/IT fields appropriate to monochrome continuous tone picture images. TIFF/IT-MP/P1 and TIFF/IT-MP/P2 limit the field values to the default value, a single value or a small choice of values. TIFF/IT-MP/P1 and TIFF/IT-MP/P2 also limit the usage of optional fields to the minimum required for reasonable interchange.

TIFF/IT-MP/P1 is a simplified image file format profile for monochrome continuous tone picture image (MP) data and can be considered a constrained subset of TIFF/IT-MP specifically intended for simpler implementation. TIFF/IT-MP/P1 files can be read by typical TIFF 6.0 readers and be written by typical TIFF 6.0 writers. TIFF/IT-MP/P1 files will be recognized by baseline TIFF 6.0 readers as Grayscale Images as described in Section 4 of the TIFF 6.0 specification. As such, all reference to colour specifications will be lost since those fields describing colour are not recognized by a baseline TIFF 6.0 reader.

TIFF/IT-MP/P2 is an extension of TIFF/IT-MP/P1. TIFF/IT-MP/P2 may not be readable by typical TIFF 6.0 readers and writers may not be able to write them because of TIFF/IT specific fields and values and non-traditional interpretations of other TIFF 6.0 fields and values (e.g. Compression tag).

TIFF/IT-MP and TIFF/IT-MP/P2 permit optional JPEG or Flate compression of image data. TIFF/IT-MP/P1 does not permit any compression of image data.

7.6.2 Data structure

7.6.2.1 Image colour values

The image colour values for a pixel are obtained by combining the colour values for each of the colour components with the pixel intensity values in the data stream. This applies to foreground colours only. Monochrome continuous tone pictures do not have background colour specifications. The scaling of these intensity values is linear with respect to printing dot percent. The bytes for pixel data values are unsigned, and any values from 0 through 255 may be found. The relationship between the colour value parameters and the intensity value (step size, direction of slope, and intercept) is linear, and determined by the originator of the file. It is defined by expressing the data values corresponding to 0% intensity and 100% intensity in PixelIntensityRange.

7.6.2.2 Image colour indicators

For monochrome continuous tone pictures, the image colour indicator (ImageColorIndicator) shall be "0" or "1". Applications that do not specify any image colour may indicate this by putting the value "0" in the ImageColorIndicator field. In this case, the significance of image colour is at the discretion of the reader.

NOTE In this case, though the originator of the file defines the conversion from pixel intensity values to percent intensity values by specifying the PixelIntensityRange field, the originator does not define the conversion from the percent intensity values to printing dot percent values.

Applications that specify an image colour shall indicate this by putting the value "1" in the ImageColorIndicator field. In this case, ImageColorValue shall contain the values of the colour components for the image colour, specified in the sequence as defined in ColorSequence. These colour values apply to the image colour when printed at 100% intensity for monochrome continuous tone pictures.

Annex K illustrates the relationships between pixel data values, intensity values, image colour values, and dot percent.

7.6.3 TIFF/IT-MP, TIFF/IT-MP/P1 and TIFF/IT-MP/P2 encoding

Field usage for TIFF/IT-MP, TIFF/IT-MP/P1 and TIFF/IT-MP/P2 data is as shown in Table 10.

Table 10 — TIFF/IT-MP, TIFF/IT-MP/P1 and TIFF/IT-MP/P2 field usage

Field name	Tag No.	Data type	Count	Default value	TIFF/IT-MP	TIFF/IT-MP/P1	TIFF/IT-MP/P2	Remarks
NewSubfileType	254	LONG	1	0	d(=0)	d=0	d=0	
ImageWidth	256	SHORT/LONG	1	none	m	m	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	m	m	lines per image
BitsPerSample	258	SHORT	1	1	d=8,=16	m=8	m=8	
Compression	259	SHORT	1	1	d=1, =7, =8, =32895	d=1	d=1, =7, =8	
PhotometricInterpretation	262	SHORT	1	none	m(=0) [g]	m=0	m=0	
DocumentName	269	ASCII	[a]	none	opt	not used	not used	
ImageDescription	270	ASCII	[a]	none	opt	opt	opt	
Make	271	ASCII	[a]	none	opt	opt	opt	vendor name
Model	272	ASCII	[a]	none	opt	not used	not used	
StripOffsets	273	SHORT/LONG	[b]	none	m	m	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	d=1	d=1	
SamplesPerPixel	277	SHORT	1	1	d=1	d=1	d=1	no. of separations
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	d	d	[e]
StripByteCounts	279	SHORT/LONG	[b]	none	m	m	m	
Xresolution	282	RATIONAL	1	none	m	m	m	
Yresolution	283	RATIONAL	1	none	m	m	m	
PageName	285	ASCII	[a]	none	opt	not used	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	d=2, =3	
Software	305	ASCII	[a]	none	opt	opt	opt	
DateTime	306	ASCII	[c]	none	opt	opt	opt	
Artist	315	ASCII	[a]	none	opt	opt	opt	
HostComputer	316	ASCII	[a]	none	opt	not used	not used	
InkSet	332	SHORT	1	1	opt	not used	opt	[m]
InkNames	333	ASCII	[a]	none	opt	not used	opt	
NumberOfInks	334	SHORT	1	4	opt	not used	opt	[n]
DotRange	336	BYTE/SHORT	2	0,255	d	d=0,255	d=0,255	
Copyright	33432	ASCII	[a]	none	opt	opt	opt	
Site	34016	ASCII	[a]	none	opt	not used	not used	
ColorSequence	34017	ASCII	[a]	CMYK	d(='CMYK', ='YMCK')	not used	opt	sequence of colours
IT8Header	34018	ASCII	[a]	none	opt	not used	not used	
RasterPadding	34019	SHORT	1	0	[f]	not used	not used	
ImageColorIndicator	34023	BYTE	1	0	d=0, =1	d=0, =1	d=0, =1	[h]
ImageColorValue	34025	BYTE	[d]	none	[g, h]	[g, h]	[g, h]	
PixelIntensityRange	34027	BYTE	2	[j]	d [g]	d=0,255	d=0,255	
ColorCharacterization	34029	ASCII	[a]	none	opt	opt	opt	[i]
TrapIndicator	34031	BYTE	1	1	opt	not used	not used	
CMYKEquivalent	34032	BYTE/SHORT	[l]	none	opt	not used	opt	
ICCProfile	34675	UNDEFINED	[k]	none	opt	not used	opt	

[a] The number of characters (bytes) in the string including the terminating null

[b] StripsPerImage=INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip), where INTEGER(*x*) is the integer value of *x* (i.e., INTEGER (2.9)=2)

[c] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

[d] One byte for each colour indicated in ColorSequence (count of one less than count of ColorSequence)

[e] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[f] If RasterPadding is used in MP format, then Compression value must be specified as 32895. Values of 0, 1, 2, 9, 10 are the allowed values of RasterPadding.

[g] If PhotometricInterpretation value is 0, pixel values of 0 are imaged as white (background), pixel values of $2^{BitsPerSample}$-1 are imaged as maximum density image colour, as specified by ImageColorIndicator, ImageColorValue, and PixelIntesityRange tag values.

If PhotometricInterpretation value is 1, pixel values of $2^{BitsPerSample}$-1 are imaged as white (background), pixel values of 0 are imaged as maximum density image colour (i.e. the image is reversed from the interpretation of PhotometricInterpretation value of 0).

[h] If ImageColorIndicator value is 1, ImageColorValue is mandatory. If ImageColorIndicator value is 0, ImageColorValue is not used.

[i] ISO 12641, ISO 12642, ASCII data tables

[j] 0 and $2^{BitsPerSample}$ -1 for 0% and 100% intensity respectively

[k] The count is the number of bytes in the ICC profile.

[l] The count is the value of SamplesPerPixel multiplied by 4.

[m] If InkSet tag is used and ColorSequence tag value is the default value of "CMYK", InkSet shall have the value of 1. Otherwise it shall have the value of 2.

[n] If NumberOfInks tag is used it must have the same value as the value of SamplesPerPixel.

7.7 Binary picture (BP) file

7.7.1 TIFF/IT-BP, TIFF/IT-BP/P1 and TIFF/IT-BP/P2

TIFF/IT-BP makes use of all the features and functionality supported by the TIFF and TIFF/IT fields appropriate to binary picture images. TIFF/IT-BP/P1 and TIFF/IT-BP/P2 limit the field values to the default value, a single value or a small choice of values. TIFF/IT-BP/P1 and TIFF/IT-BP/P2 also limit the usage of optional fields to the minimum required for reasonable interchange.

TIFF/IT-BP/P1 is a simplified image file format profile for binary picture (BP) image data and can be considered a constrained subset of TIFF/IT-BP specifically intended for simpler implementation. TIFF/IT-BP/P1 files can be read by typical TIFF 6.0 readers and be written by typical TIFF 6.0 writers. TIFF/IT-BP/P1 files will be recognized by baseline TIFF 6.0 readers as Bilevel Images as described by Section 3 of the TIFF 6.0 specification. As such, all reference to colour specifications will be lost since those fields describing colour are not recognized by a baseline TIFF 6.0 reader.

TIFF/IT-BP/P2 is an extension of TIFF/IT-BP/P1. TIFF/IT-BP/P2 may not be readable by typical TIFF 6.0 readers and writers may not be able to write them because of TIFF/IT specific fields and values and non-traditional interpretations of other TIFF 6.0 fields and values (e.g. Compression tag).

TIFF/IT-BP and TIFF/IT-BP/P2 permit optional CCITT G4 and Flate compression of data. TIFF/IT-BP/P1 does not permit any compression of data.

7.7.2 Data structure

For binary pictures, ImageColorValue and BackgroundColorValue may contain the values of the colour components for the image (foreground) and background colour, specified in the sequence as defined in ColorSequence. These colour values apply to the solid image and background colours for binary pictures.

The data stream indicates which of the colours, foreground and background, will print. The bits in the data stream function as a switch between the image colour and the background colour. Bitmap fill order is from most significant bit to least significant bit within the byte, the default TIFF fill order. ImageColorIndicator and BackgroundColorIndicator field values shall be used to indicate when, if, and how image and background colours are used, including the use of transparency (see 7.2.9). An example of this data encoding is shown in Annex K.

7.7.3 TIFF/IT-BP, TIFF/IT-BP/P1 and TIFF/IT-BP/P2 encoding

Field usage for TIFF/IT-BP, TIFF/IT-BP/P1 and TIFF/IT-BP/P2 data is as shown in Table 11.

Table 11 — TIFF/IT-BP, TIFF/IT-BP/P1 and TIFF/IT-BP/P2 Field usage

Field name	Tag No.	Data type	Count	Default value	TIFF/IT-BP	TIFF/IT-BP/P1	TIFF/IT-BP/P2	Remarks
NewSubfileType	254	LONG	1	0	d(=0)	d=0	d=0	
ImageWidth	256	SHORT/ LONG	1	none	m	m	m	pixels per line
ImageLength	257	SHORT/ LONG	1	none	m	m	m	lines per image
BitsPerSample	258	SHORT	1	1	d=1	d=1	d=1	
Compression	259	SHORT	1	1	d=1, =4, =8	d=1	d=1, =4, =8	
PhotometricInterpretation	262	SHORT	1	none	m(=0) [f]	m=0	m=0	
DocumentName	269	ASCII	[a]	none	opt	not used	not used	
ImageDescription	270	ASCII	[a]	none	opt	opt	opt	
Make	271	ASCII	[a]	none	opt	opt	opt	vendor name
Model	272	ASCII	[a]	none	opt	not used	not used	
StripOffsets	273	SHORT/ LONG	[b]	none	m	m	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	d=1	d=1	
SamplesPerPixel	277	SHORT	1	1	d=1	d=1	d=1	no. of separations
RowsPerStrip	278	SHORT/ LONG	1	FFFFFFFFh	d	d	d	[e]
StripByteCounts	279	SHORT/ LONG	[b]	none	m	m	m	
XResolution	282	RATIONAL	1	none	m	m	m	
YResolution	283	RATIONAL	1	none	m	m	m	
PageName	285	ASCII	[a]	none	opt	not used	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	d=2, =3	
Software	305	ASCII	[a]	none	opt	opt	opt	
DateTime	306	ASCII	[c]	none	opt	opt	opt	
Artist	315	ASCII	[a]	none	opt	opt	opt	
HostComputer	316	ASCII	[a]	none	opt	not used	not used	
InkSet	332	SHORT	1	1	opt	not used	opt	[j]
InkNames	333	ASCII	[b]	none	opt	not used	opt	
NumberOfInks	334	SHORT	1	4	opt	not used	opt	[k]
DotRange	336	BYTE/ SHORT	2	0,255	d	d=0,255	d=0,255	
Copyright	33432	ASCII	[a]	none	opt	opt	opt	
Site	34016	ASCII	[a]	none	opt	not used	not used	
ColorSequence	34017	ASCII	[a]	'CMYK'	d('CMYK', ='YMCK')	not used	opt	sequence of colours
IT8Header	34018	ASCII	[a]	none	opt	not used	not used	
ImageColorIndicator	34023	BYTE	1	0	d=0, =1, =2	d=0, =1, =2	d=0, =1, =2	[g]
BackgroundColorIndicator	34024	BYTE	1	0	d=0, =1, =2	d=0, =1, =2	d=0, =1, =2	[g]
ImageColorValue	34025	BYTE	[d]	none	[f, g]	[f, g]	[f, g]	
BackgroundColorValue	34026	BYTE	[d]	none	[f, g]	[f, g]	[f, g]	
ColorCharacterization	34029	ASCII	[a]	none	opt	opt	opt	[h]
TrapIndicator	34031	BYTE	1	1	opt	not used	opt	
CMYKEquivalent	34032	BYTE/SHORT	[i]	none	opt	not used	opt	

[a] The number of characters (bytes) in the string including the terminating null

[b] StripsPerImage=INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip), where INTEGER(*x*) is the integer value of x (i.e., INTEGER (2.9)=2)

[c] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

[d] One byte for each colour indicated in ColorSequence (count of one less than count of ColorSequence)

[e] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[f] If PhotometricInterpretation value is 0, pixel values of 0 are imaged as background and pixel values of 1 are imaged as image, as specified by imageColorIndicator, BackgroundColorIndicator, ImageColorValue, and BackgoundColorValue. If PhotometricInterpretation value is 1, pixel values of 1 are imaged as background and pixel values of 0 are imaged as image (i.e., the image is reversed from the interpretation of PhotometricInterpretation value of 0).

[g] If ImageColorIndicator value is 1, ImageColorValue is mandatory; otherwise, ImageColorValue is not used.

If BackgroundColorIndicator value is 1, BackgroundColorValue is mandatory; otherwise, BackgroundColorValue is not used.

[h] ISO 12641, ISO 12642, ASCII data tables, or named colour definition "sRGB"

[i] The count is the value of SamplesPerPixel multiplied by 4.

[j] If InkSet tag is used and ColorSequence tag value is the default value of "CMYK", InkSet shall have the value of 1. Otherwise it shall have the value of 2.

[k] If NumberOfInks tag is used it must have the same value as the value of SamplesPerPixel.

7.8 Binary line art (BL) file

7.8.1 TIFF/IT-BL and TIFF/IT-BL/P1

TIFF/IT-BL makes use of all the features and functionality supported by the TIFF and TIFF/IT fields appropriate to binary line art images. TIFF/IT-BL/P1 limits the field values to the default value, a single value or a small choice of values. TIFF/IT-BL/P1 also limits the usage of optional fields to the minimum required for reasonable interchange.

TIFF/IT-BL/P1 is a simplified image file format profile for binary line art (BL) image data and can be considered a constrained subset of TIFF/IT-BL specifically intended for simpler implementation. Neither TIFF/IT-BL nor TIFF/IT-BL/P1 files are readable by typical TIFF 6.0 readers and neither can be written by typical TIFF 6.0 writers because of the mandatory use of TIFF/IT-specific fields and values, and non-traditional interpretations of other TIFF 6.0 fields and values (e.g., compression by mandatory run length encoding). Filters may be written for DTP and other applications which are desired to read and write TIFF/IT-BL and TIFF/IT-BL/P1 files. As a simplified profile, the filters for TIFF/IT-BL/P1 are simpler to implement than for TIFF/IT-BL.

7.8.2 Data structure

7.8.2.1 General

Each line of data shall be encoded as a sequence of pairs of background and image run lengths. Each new scan line shall start with a background run. In the case where a continuous background or an image section of a scan line has to be encoded by more than one run length pair, a zero run length of the "opposite" colour shall be inserted.

For binary line art, the data stream indicates which of the colours, foreground or background, will print. The decoded run lengths of the data stream function as a switch between the image (foreground) colour and the background colour.

An example of this data encoding is shown in Annex K.

7.8.2.2 Run length encoding structure

There are two basic formats for encoding run lengths. The short form (8 bits long) is used for encoding run lengths up to 254 pixels long, and the long format (24 bits long) for encoding run lengths up to 65535 pixels long. Both forms may be combined within a single background/image run length pair, and may be freely mixed within a file, as the long form is encoded as a special case of the short form. Writers are required to write the short form. There is no requirement to write both forms, since long runs may be encoded with repetitions of the short form. Readers shall be capable of reading both forms.

The short form consists of a single-byte entry representing a binary number signifying the run length from 0 through 254 as follows:

Byte: 0

Value: run length (0 through 254)

The value 0 indicates an "empty" run; two successive zero bytes are not allowed within a scan line, as this would conflict with other indicators.

The long form consists of a three-byte entry, with the first eight bits a binary number always equal to 255 to signify the long form. The next 16 bits are a binary number representing the run length from 1 through 65535. In the event the long form is used to encode a run length of less than 256, byte 1 will be binary zero, and the run length will be found in byte 2. The long form looks as follows:

Byte:	0	1 and 2
Value:	255	run length (0 through 65535)

Each line of data is initiated by two zero bytes and terminated by two zero bytes.

NOTE Two adjacent zero bytes may also occur within the encoding of a line, so this occurrence should not be used as a means of detecting an end of line.

If the number of pixels in an encoded line does not equal the declared number of pixels per line of the image, or the number of encoded lines does not equal the declared number of lines in the image, an error exists and continued processing is left to the discretion of the processing system.

If an image and/or background colour is specified, the image colour value for a pixel is obtained by using the alternating sequence of the run lengths as a switch between the background colour and the image colour, as defined in ImageColorValue and BackgroundColorValue, starting with background colour at the beginning of each scan line.

7.8.2.3 Line repeat code

This International Standard does not permit the use of line repeat codes.

7.8.3 TIFF/IT-BL and TIFF/IT-BL/P1 encoding

Field usage for TIFF/IT-BL and TIFF/IT-BL/P1 data is as shown in Table 12.

Table 12 — TIFF/IT-BL and TIFF/IT-BL/P1 field usage

Field name	Tag No.	Data type	Count	Default value	TIFF/IT-BL	TIFF/IT-BL/P1	Remarks
NewSubfileType	254	LONG	1	0	d(=0)	d=0	
ImageWidth	256	SHORT/LONG	1	none	m	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	m	lines per image
BitsPerSample	258	SHORT	1	1	d=1	d=1	
Compression	259	SHORT	1	1	m =32898	m=32898	
PhotometricInterpretation	262	SHORT	1	none	m=0, =1 [f]	m=0	
DocumentName	269	ASCII	[a]	none	opt	not used	
ImageDescription	270	ASCII	[a]	none	opt	opt	
Make	271	ASCII	[a]	none	opt	opt	vendor name
Model	272	ASCII	[a]	none	opt	not used	
StripOffsets	273	SHORT/LONG	[b]	none	m	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	d=1	
SamplesPerPixel	277	SHORT	1	1	d=1	d=1	no. of separations
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	d	[e]
StripByteCounts	279	SHORT/LONG	[b]	none	m	m	
XResolution	282	RATIONAL	1	none	m	m	
YResolution	283	RATIONAL	1	none	m	m	
PageName	285	ASCII	[a]	none	opt	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	
Software	305	ASCII	[a]	none	opt	opt	
DateTime	306	ASCII	[c]	none	opt	opt	
Artist	315	ASCII	[a]	none	opt	opt	
HostComputer	316	ASCII	[a]	none	opt	not used	
InkSet	332	SHORT	1	1	opt	not used	[j]
InkNames	333	ASCII	[a]	none	opt	not used	
NumberOfInks	334	SHORT	1	4	opt	not used	[k]
DotRange	336	BYTE/SHORT	2	0,255	d	d=0,255	
Copyright	33432	ASCII	[a]	none	opt	opt	
Site	34016	ASCII	[a]	none	opt	not used	
ColorSequence	34017	ASCII	[a]	'CMYK'	d(='CMYK', ='YMCK')	not used	sequence of colours
IT8Header	34018	ASCII	[a]	none	opt	not used	
ImageColorIndicator	34023	BYTE	1	0	d=0, =1, =2	d=0, =1, =2	[g]
BackgroundColorIndicator	34024	BYTE	1	0	d=0, =1, =2	d=0, =1, =2	[g]
ImageColorValue	34025	BYTE	[d]	none	[f, g]	[f, g]	
BackgroundColorValue	34026	BYTE	[d]	none	[f, g]	[f, g]	
ColorCharacterization	34029	ASCII	[a]	none	opt	opt	[h]
TrapIndicator	34031	BYTE	1	1	opt	not used	
CMYKEquivalent	34032	BYTE/SHORT	[i]	none	opt	not used	

[a] The number of characters (bytes) in the string including the terminating null

[b] StripsPerImage=INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip), where INTEGER(*x*) is the integer value of *x* (i.e., INTEGER (2.9)=2)

[c] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

[d] One byte for each colour indicated in ColorSequence (count of one less than count of ColorSequence)

[e] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[f] If PhotometricInterpretation value is 0, pixel values of 0 are imaged as background and pixel values of 1 are imaged as image, as specified by ImageColorIndicator, BackgroundColorIndicator, ImageColorValue, and BackgoundColorValue. If PhotometricInterpretation value is 1, pixel values of 1 are imaged as background and pixel values of 0 are imaged as image (i.e., the image is reversed from the interpretation of PhotometricInterpretation value of 0).

[g] If ImageColorIndicator value is 1, ImageColorValue is mandatory; otherwise, ImageColorValue is not used.

If BackgroundColorIndicator value is 1, BackgroundColorValue is mandatory; otherwise, BackgroundColorValue is not used.

[h] ISO 12641, ISO 12642, ASCII data tables

[i] The count is the value of SamplesPerPixel multiplied by 4.

[j] If InkSet is used and the value of ColorSequence is the default value of “CMYK”, InkSet shall have the value of 1. Otherwise, it shall have the value of 2.

[k] If NumberOfInks is used, it must have the same value as SamplePerPixel.

7.9 Screened data image (SD) file

7.9.1 TIFF/IT-SD and TIFF/IT-SD/P2

TIFF/IT-SD makes use of all the features and functionality supported by the TIFF and TIFF/IT fields appropriate to prescreened (copydot) colour separation images. TIFF/IT-SD/P2 limits the field values to the default value, a single value or a small choice of values. TIFF/IT-SD/P2 also limits the usage of optional fields to the minimum required for reasonable interchange.

TIFF/IT-SD/P2 is a simplified image file format profile for screened data image (SD) data and can be considered a constrained subset of TIFF/IT-SD specifically intended for simpler implementation. Neither TIFF/IT-SD nor TIFF/IT-SD/P2 files are readable by typical TIFF 6.0 readers and neither can be written by TIFF 6.0 writers because of the non-traditional interpretations of some TIFF 6.0 fields and values (e.g., the combination of PhotometricInterpretation and BitsPerSample). Filters may be written for DTP and other applications which are desired to read and write TIFF/IT-SD and TIFF/IT-SD/P2 files. As a simplified profile, the filters for TIFF/IT-SD/P2 are simpler to implement than for TIFF/IT-SD.

TIFF/IT-SD and TIFF/IT-SD/P2 permit optional CCITT G4 or Flate compression of image data.

NOTE 1 While the TIFF/IT-SD/P2 format is not compliant with any TIFF 6.0 format, it is intended to be easily converted to and from sets of TIFF 6.0 Bilevel images. Such conversions can allow existing copydot scanning and imaging applications to be used with TIFF/IT-SD/P2 files either by having additional application programs perform conversions or by modifying the applications in a straightforward manner. The conversion involves copying each TIFF/IT-SD/P2 separation's image data directly to or from TIFF 6.0 Bilevel image files and adjusting the StripOffsets, StripByteCounts, BitsPerSample, SamplesPerPixel, PhotometricInterpretation, and PlanarConfiguration field values.

NOTE 2 There is no TIFF/IT-SD/P1 conformance level.

7.9.2 Data structure

The pixel structure of screened data image files is described by colour interleaving (also called planar format). All lines of one colour (separation) are followed by all lines of the next colour. The order of planes of colour is defined by PhotometricInterpretation or ColorSequence.

The data stream indicates whether or not a dot is intended to be imaged at a particular position. The bits in the data stream function as a switch between imaged and unimaged points. Bitmap fill order is from most significant bit to least significant bit within the byte, the default TIFF 6.0 fill order

7.9.3 TIFF/IT-SD and TIFF/IT-SD/P2 encoding

Field usage for TIFF/IT-SD and TIFF/IT-SD/P2 data is as shown in Table 13.

Table 13 — TIFF/IT-SD and TIFF/IT-SD/P2 field usage

Field name	Tag No.	Data type	Count	Default value	TIFF/IT-SD	TIFF/IT-SD/P2	Remarks
NewSubfileType	254	LONG	1	0	d(=0)	d=0	
ImageWidth	256	SHORT/LONG	1	none	m	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	m	lines per image
BitsPerSample	258	SHORT	1	1	d=1	d=1	
Compression	259	SHORT	1	1	d=1, =4, =8	d=1, =4, =8	
PhotometricInterpretation	262	SHORT	1	none	m=5[g]	m=5	
DocumentName	269	ASCII	[a]	none	opt	not used	
ImageDescription	270	ASCII	[a]	none	opt	opt	
Make	271	ASCII	[a]	none	opt	opt	vendor name
Model	272	ASCII	[a]	none	opt	not used	
StripOffsets	273	SHORT/LONG	[b]	none	m	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	d=1	
SamplesPerPixel	277	SHORT	1	1	d(=1, =4)	d=1, =4	no. of separations
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	d	[e]
StripByteCounts	279	SHORT/LONG	[b]	none	m	m	
Xresolution	282	RATIONAL	1	none	m	m	
Yresolution	283	RATIONAL	1	none	o	m	
PlanarConfiguration	284	SHORT	1	1	m=2	m=2	
PageName	285	ASCII	[a]	none	opt	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	
Software	305	ASCII	[a]	none	opt	opt	
DateTime	306	ASCII	[c]	none	opt	opt	
Artist	315	ASCII	[a]	none	opt	opt	
HostComputer	316	ASCII	[a]	none	opt	not used	
InkSet	332	SHORT	1	1	d=1	d=1	[i]
InkNames	333	ASCII	[b]	none	opt	opt	
NumberOfInks	334	SHORT	1	4	opt	d=4	[j]
DotRange	336	BYTE/SHORT	2	0,255	opt	opt	
Copyright	33432	ASCII	[a]	none	opt	opt	
Site	34016	ASCII	[a]	none	opt	not used	
ColorSequence	34017	ASCII	[a]	'CMYK'	d('CMYK', 'YMCK')	not used	sequence of colours
IT8Header	34018	ASCII	[a]	none	opt	not used	
ColorCharacterization	34029	ASCII	[a]	none	opt	opt	[f]
TrapIndicator	34031	BYTE	1	1	opt	opt	
CMYKEquivalent	34032	BYTE/SHORT	[h]	none	opt	opt	

[a] The number of characters (bytes) in the string including the terminating null

[b] StripsPerImage=INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip), where INTEGER(x) is the integer value of x (i.e. INTEGER (2.9)=2)

[c] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

[d] One byte for each colour indicated in ColorSequence (count of one less than count of ColorSequence)

[e] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[f] ISO 12641, ISO 12642, ASCII data tables, or named colour definition “sRGB”

[g] Files with a single separation may be encoded by settings SamplesPerPixel = 1.

[h] The count is the value of SamplesPerPixel multiplied by 4.

[i] If InkSet tag is used and ColorSequence tag value is the default value of "CMYK", InkSet shall have the value of 1. Otherwise, it shall have the value of 2.

[j] If NumberOfInks tag is used it must have the same value as the value of SamplesPerPixel.

7.10 Final page (FP) file

7.10.1 TIFF/IT-FP, TIFF/IT-FP/P1 and TIFF/IT-FP/P2

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.

By default it is assumed that, for each image type, the page assembly processes have combined all the page input components of that data type into one output file: the single component image file of that data type for the page, though this is only a requirement for both TIFF/IT-P1 and TIFF/IT-P2 conformance.

The component image files of a final page may be of any of TIFF/IT, TIFF/IT-P1, or TIFF/IT-P2 conformance levels. The final page is considered to be TIFF/IT-P1 conformant only if all of its component files are TIFF/IT-P1 conformant and its own fields are TIFF/IT-FP/P1 conformant as specified in 7.10.2.5. The final page is considered to be TIFF/IT-P2 conformant only if all of its component files are TIFF/IT-P1 or TIFF/IT-P2 conformant and its own fields are TIFF/IT-FP/P2 conformant as specified in 7.10.2.5.

7.10.2 Data structure

7.10.2.1 Component image files

A final page consists of at least two files: the FP file which describes the page and at least one component image file which may be of any of the following types: CT, MP, SD, LW, BL, BP or HC. A TIFF/IT-P1 conformant FP file shall not refer to MP, SD, BL or BP image files.

As a simple step toward data volume reduction, each component image need not extend to the page boundaries, but may be the minimum rectangle that can contain all its elements, correctly positioned. The component images shall not extend beyond the page boundaries by more than a fractional pixel. Optional offset dimensions are used to correctly position the component files within the page area (see Figure 6). A single component image may be placed in multiple positions on the page, allowing step-and-repeat in FP files not restricted by TIFF/IT-P1 or TIFF/IT-P2 conformance.

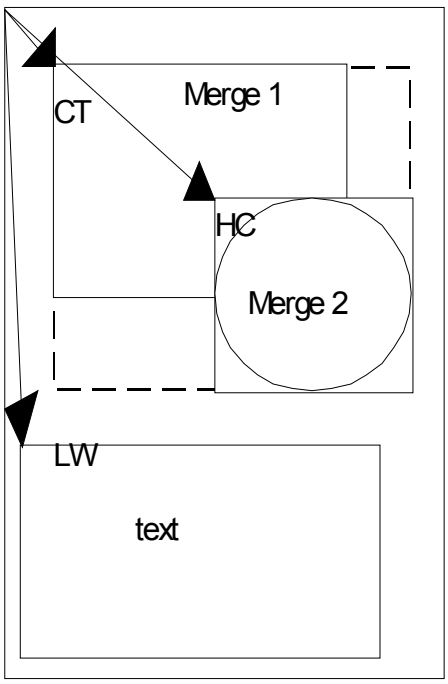


Figure 6 — Sample FP file

Where component files of more than one type are positioned such that they overlap, the ordering shall be all linework files over all transparent image data files over all opaque image data files, where LW and BL files are linework, HC and BP files are transparent image data and CT, MP and SD are opaque image data. Subfiles are regarded as overlapping if even a single fractional pixel overlaps. Transparent areas of linework and transparent image data files allow lower layers to show through where present. In areas of the final page where more than one subfile from a single category overlap, the ordering shall be latest referenced over earlier referenced.

Any area of the final page which does not contain image data is considered to be a non-printing area.

All component files in a final page shall have the same values for Orientation and ResolutionUnit as the FP file. If HC, BL and LW files overlap each other, they shall have the same values for XResolution and YResolution, and their XPosition and YPosition values shall be such that their pixels are precisely aligned with each other. To ensure accurate alignment of linework data over BP files, when they are used in conjunction, it may be desirable, but is not mandatory, to apply the same restrictions to BP files in respect of positioning and resolution.

7.10.2.2 FP file structure

The FP file uses the TIFF subfile structure (see Figure 7). An FP file consists of at least two Image File Directories (IFDs), one for the FP itself and one for each of the CT, MP, SD, LW, BL, BP and HC component images present. The FP IFD is the 0th IFD. Component images' IFDs may appear in any sequence; the ordering may be significant however, as described in 7.10.2.1.

The component images' IFDs are copies of the IFDs of the actual component files, except as detailed in 7.10.2.5.

The component images' IFDs are included to assure that the processing system has all the information necessary to process the FP file without having to actually access the component files until they are needed.

The image data for each component image shall not be included in the FP file. The value of the StripOffsets tag in the IFD for that component shall be zero, with a count of one.

The FP file shall contain "image" data referred to by the final page (0th) IFD, in keeping with TIFF 6.0 requirements and to allow positioning the FP file using page make-up applications. This data may be a low-resolution rendering of the page, but may be any other image, including white space, at the discretion of the writer. The image size in pixels in each dimension divided by the resolution in that direction must give the exact actual page size in the appropriate resolution units. The image data referenced by the 0^{th} IFD may be TIFF 6.0 Bilevel, Grayscale, RGB, Palette colour, or CMYK, using the tags specified in 7.10.3, and may be compressed using PackBits or Flate. A TIFF/IT-P1 conformant FP file shall not use compression.

NOTE Although the 0th IFD is TIFF 6.0-compliant, the FP file itself may not be, because the image data for subsequent IFDs shall not be included.

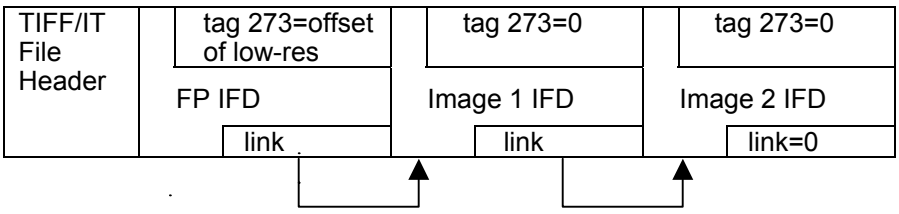


Figure 7 — Example of FP file with subfile structure for an FP with two component files

7.10.2.3 Referencing component image files

The ImageDescription field in each component image's IFD in the FP file must contain the actual name of the original TIFF/IT component image file at creation time. The file name shall be included in the ImageDescription field without volume identifier or directory path. ImageDescription fields within a single FP file referring to different component image files shall have different values. Because files may be renamed after creation, particularly if they are exchanged between heterogeneous operating systems, the original file name should also be included in the ImageDescription field of each component image file as shown in Table 14.

NOTE While it is recommended that the ImageDescription field in each component file contain its file name, this may not always be possible if the final page is created separately from its components. Changing the IFD of a file being included in a final page may not be feasible, such as when the FP file is being added to a write-once medium which already contains some or all of the component files.

Table 14 — ImageDescription field usage in component image files of a TIFF/IT-FP file

Field name	Tag No.	Data type	Count	Default value	TIFF/IT-FP	TIFF/IT-FP/P1 & /P2	Remarks
ImageDescription	270	ASCII	[a]	none	[b]	[b]	

[a] The number of characters (bytes) in the string including the terminating null

[b] In an image file which is a component of a final page, ImageDescription shall contain the name of the component file at the time the final page is created, unless the usage is not reasonably possible. For example, if the medium is write-once, this usage is not required. Use facilitates identifying the file in case of a subsequent renaming. (Optional and descriptive only in an individual image file.)

7.10.2.4 Page positions of component image files

The position of each instance of each component image on the page is specified by the XPosition and YPosition fields in its IFD in the FP file. The Count of each of these fields in an IFD indicates the number of times that the component image referenced by that IFD is to appear on the page. This allows for step-and-repeat of component files without requiring multiple complete IFDs to be included in the FP file. The Count of the XPosition tag shall be equal to the Count of the YPosition tag. Each corresponding value of XPosition and YPosition constitutes an ordered pair to be applied to one of the instances of the component image; the first occurrence of XPosition is paired with the first occurrence of YPosition, the second with the second, and so on. If the values of the XPosition and YPosition tags are such that some of the instances of the component file overlap on the final page, the ordering shall be latest referenced over earlier referenced. The Count of an XPosition or YPosition tag shall not be less than one. If the XPosition and YPosition fields are not included for a component, the component is assumed to be positioned at the top left corner of the page, and that the Count for each is one. In a TIFF/IT-P1 conformant FP file the Count of XPosition and YPosition in all IFDs shall be one.

More than one IFD referencing each type of subfile may be present, except for TIFF/IT-P1 conformant FP files that shall refer to no more than one instance of each component image type.

The XPosition and YPosition fields may also be set in the actual component image files, but there they are informational only. All processing is to be performed according to the fields within the IFDs in the FP file.

7.10.2.5 Component image IFD encoding

Additional field usage for component images' IFD fields for inclusion in TIFF/IT-FP and TIFF/IT-FP/P1 is as shown in Table 15. These fields are in addition to the fields defined in the appropriate subclause in this International Standard for the component files. For fields that appear in both places, the usage within the FP file is as shown in Table 15.

Table 15 — TIFF/IT-FP, TIFF/IT-FP/P1 and TIFF/IT-FP/P2 component image IFD field usage

Field name	Tag No.	Data type	Count	Default value	TIFF/IT-FP	TIFF/IT-FP/P1 & /P2	Remarks
ImageDescription	270	ASCII	[a]	none	m [b]	m [b]	
StripOffsets	273	SHORT/LONG	[h]	none	m [g]	m=0	no image data
Xposition	286	RATIONAL	[e]	0	d	d [f]	[c]
Yposition	287	RATIONAL	[e]	0	d	d [f]	[d]

[a] The number of characters (bytes) in the string including the terminating null

[b] ImageDescription contains the actual name of the component image file as created.

[c] XPosition is the offset of the left side of the image from the left side of the page, in positive ResolutionUnits.

[d] YPosition is the offset of the top of the image from the top of the page, in positive ResolutionUnits.

[e] The number of occurrences of the component image on the page. This shall not be less than 1. The Count for YPosition must equal that of XPosition.

[f] In a TIFF/IT-FP/P1 file the Count of XPosition and YPosition tags shall be 1.

[g] The location of the image data if included in the FP file, zero if the component image data is omitted from the FP file.

[h] If the image data for this component is omitted the Count of the StripOffsets tag shall be one. If the image data is present then the Count shall be the number of strips. Component image data may not be included in a TIFF/IT-FP/P1 file.

7.10.3 TIFF/IT-FP, TIFF/IT-FP/P1 and TIFF/IT-FP/P2 encoding

General field usage for TIFF/IT-FP, TIFF/IT-FP/P1 and TIFF/IT-FP/P2 final page (0th) IFD is as shown in Table 16. Table 17 defines field usage for those fields that depend on the encoding of the low-resolution image data.

Table 16 — TIFF/IT-FP and TIFF/IT-FP/P1 0th IFD field usage

Field name	Tag No.	Data type	Count	Default value	TIFF/IT-FP	TIFF/IT-FP/P1	TIFF/IT-FP/P2	Remarks
NewSubfileType	254	LONG	1	0	m=bit 3=1	m=bit 3=1	m=bit 3=1	[a]
ImageWidth	256	SHORT/LONG	1	none	m [b]	m [b]	m [b]	pixels per line
ImageLength	257	SHORT/LONG	1	none	m [c]	m [c]	m [c]	lines per image
DocumentName	269	ASCII	[d]	none	opt	not used	not used	
ImageDescription	270	ASCII	[d]	none	m [e]	m [e]	m [e]	FP file name
Make	271	ASCII	[d]	none	opt	opt	opt	vendor name
Model	272	ASCII	[d]	none	opt	not used	not used	
StripOffsets	273	SHORT/LONG	[f]	none	m	m	m	
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	d=1	d=1	
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	d	d	[g]
StripByteCounts	279	SHORT/LONG	[f]	none	m	m	m	
XResolution	282	RATIONAL	1	none	m [b]	m [b]	m [b]	
YResolution	283	RATIONAL	1	none	m [c]	m [c]	m [c]	
PlanarConfiguration	284	SHORT	1	1	d=1	d=1 [h]	d=1 [h]	
PageName	285	ASCII	[d]	none	opt	not used	not used	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	d=2, =3	d=2, =3	
Software	305	ASCII	[d]	none	opt	opt	opt	
DateTime	306	ASCII	[l]	none	opt	opt	opt	
Artist	315	ASCII	[d]	none	opt	opt	opt	
HostComputer	316	ASCII	[d]	none	opt	not used	not used	
Copyright	33432	ASCII	[d]	none	opt	opt	opt	
Site	34016	ASCII	[d]	none	opt	not used	not used	

[a] Bit 3 of NewSubfileType has been allocated to uniquely identify TIFF/IT-FP files. The least significant bit is bit 0.

[b] Any value of XResolution may be used such that ImageWidth divided by XResolution equals the exact actual page width in ResolutionUnits.

[c] Any value of YResolution may be used such that ImageLength divided by YResolution equals the exact actual page length in ResolutionUnits.

[d] The number of characters (bytes) in the string including the terminating null

[e] The name of the FP file at creation time, in order to facilitate identifying it in case of a subsequent rename

[f] StripsPerImage

[g] The default value FFFFFFFFh is effectively infinite, meaning that the entire image is contained in a single strip.

[h] Only pixel interleave (“chunky” format) is allowed in keeping with Baseline TIFF requirements.

[i] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Month, Day, space, Hour, Minute, Second, null

Table 17 — TIFF/IT-FP 0th IFD field usage for various low-resolution image data encodings

Field name	Tag No.	Data type	Count	Default value	Bilevel	Grayscale	RGB	Palette colour	CMYK
BitsPerSample	258	SHORT	[a]	1	not used	m=4, =8	m=8,8,8	m=4, =8	m=8,8,8,8
Compression	259	SHORT	1	1	m=1, =8, =32773	m=1, =8, =32773	m=1, =8, =32773	m=1, =8, =32773	m=1, =8, =32773
PhotometricInterpretation	262	SHORT	1	none	m [b]	m [b]	m=2	m=3	m=5
SamplesPerPixel	277	SHORT	1	1	not used	not used	m=3	not used	m=4
ColorMap	320	SHORT	[c]	none	not used	not used	not used	m	not used
InkSet	332	SHORT	1	1	not used	not used	not used	not used	d=1
NumberOfInks	334	SHORT	1	4	not used	not used	not used	not used	d=4
DotRange	336	BYTE/ SHORT	2	0,255	not used	not used	not used	not used	d=0,255

[a] Count is the value of SamplesPerPixel.

[b] 0=WhiteIsZero, 1=BlackIsZero

[c] =48 if BitsPerSample is 4; =768 if BitsPerSample is 8

Annex A
(informative)

Background of conformity levels

A.1 Background of the P1 (Profile 1) conformity level – TIFF/IT-P1

The P1 conformity level of TIFF/IT (TIFF/IT-P1) was developed in order to support a simplified and reliable means of image data interchange among prepress, DTP and information processing environments.

TIFF/IT-P1 for each of the data types (CT, LW, HC, MP, BP, BL, and FP) is specified as a constrained profile of fields and field values. In many instances, TIFF/IT-P1 restricts the fields such that a simple and reliable interchange is enabled between systems. For example, a TIFF/IT-CT/P1 file can be easily written or read by Adobe PhotoShop[1)].

Various formats of P1 profiles have the following aims:

TIFF/IT-CT/P1 is intended to support a common image data exchange format among prepress, DTP, and information processing fields and is compatible with TIFF 6.0 Section 16: CMYK Images. A TIFF/IT-CT/P1 file represents a colour continuous tone image by specific data structure as a constrained profile of a TIFF/IT-CT file.

TIFF/IT-LW/P1, TIFF/IT-HC/P1, and TIFF/IT-BL/P1 formats are intended to represent a specific data structure of line art (LW) images, colour high resolution continuous tone (HC) images, and binary line art (BL) images as constrained profiles of TIFF/IT-LW, TIFF/IT-HC, and TIFF/IT-BL formats, respectively. They do not correspond to any representations in the TIFF 6.0 specification in that they all use fields and/or values that are not specified within TIFF 6.0.

TIFF/IT-MP/P1 is intended to support a common image data exchange format among prepress, DTP, and information processing fields and is compatible with TIFF 6.0 Section 4: Grayscale Images. A TIFF/IT-MP/P1 file represents a monochrome continuous tone image by specific data structure as a constrained profile of a TIFF/IT-MP file.

TIFF/IT-BP/P1 is intended to support a common image data exchange format among prepress, DTP, and information processing fields and is compatible with TIFF 6.0 Section 3: Bilevel Images. A TIFF/IT-BP/P1 file represents a binary image by specific data structure as a constrained profile of a TIFF/IT-BP file.

The primary constraints of TIFF/IT-P1 on the more general form of TIFF/IT are:

— CMYK only (when appropriate),

— pixel interleaved only (when appropriate),

— single choice of image orientation,

— single choice of dot range,

— additional TIFF/IT fields optional unless they are essential to the representation of the image data type,

— compression methods are restricted

Other constraints are specified within each file type.

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1) PhotoShop is the trade name of a product supplied by Adobe Systems, Incorporated. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

In the case where the full TIFF/IT conformity level must be used, users and vendors must pay close attention to the data and file structure for data exchange between systems. For example, it seems that processing of some orientations or interleaving of raster image data files requires a complex system or application architecture.

A.2 Background of the P2 (Profile 2) conformity level – TIFF/IT-P2

The P2 conformity level of TIFF/IT (TIFF/IT-P2) was designed to extend TIFF/IT-P1 by adding support for new features including compression methods, spot colours, a larger LW colour palette and the SD file format.

TIFF/IT-P2 for each of the data types (CT, LW, HC, MP, BP, SD and FP) is specified as a constrained profile of fields and field values. In many instances, TIFF/IT-P2 restricts the fields such that a simple and reliable interchange is enabled between systems. A TIFF/IT-P2 conformance level for BL was not defined because no new capabilities were added to the existing baseline TIFF/IT-BL.

The primary constraints of TIFF/IT-P2 on the more general form of TIFF/IT are:

— CMYK spot colours only (when appropriate),

— single choice of image orientation,

— single choice of dot range,

— compression methods are restricted,

— additional TIFF/IT fields optional unless they are essential to the representation of the image data type.

Other constraints are specified within each file type.

In the case where the full TIFF/IT conformity level must be used, users and vendors must pay close attention to the data and file structure for data exchange between systems. For example, it seems that processing of some orientations or interleaving of raster image data files requires a complex system or application architecture

Annex B
(informative)

Identification and determination procedures

B.1 Procedure for determination of TIFF/IT file type

The following logic can be used to determine the file type of a valid TIFF/IT file: In E.1 "FCD" and "JCD" mean "Flate compressed data" and "JPEG compressed data", respectively.

```
if SubfileType is = 1 or is non-existent then
    if Compression = 1 or 32895 then
        if PhotometricInterpretation = 5 then
            if PlanarConfiguration = 1 then                  type is CT with pixel interleaving
            if PlanarConfiguration = 32768 then              type is CT with line interleaving
            if PlanarConfiguration = 2 then
                if BitsPerSample > 1 then                    type is CT with colour interleaving
                if BitsPerSample = 1 then                    type is SD with no compression
        if PhotometricInterpretation = 2 then
                if PlanarConfiguration = 1 then              type is CT for RGB with pixel interleaving
                if PlanarConfiguration = 32768 then          type is CT for RGB with line interleaving
                if PlanarConfiguration = 2 then              type is CT for RGB with colour interleaving
        if PhotometricInterpretation = 8 then
            if PlanarConfiguration = 1 then                  type is CT for LAB with pixel interleaving
            if PlanarConfiguration = 32768 then              type is CT for LAB with line interleaving
            if PlanarConfiguration = 2 then                  type is CT for LAB with colour interleaving
        if PhotometricInterpretation = 0 or 1 then
            if BitsPerSample = 1 then                        type is BP
            if BitsPerSample > 1 then                        type is MP
    if Compression = 4 then
        If PhotometricInterpretation = 0 or 1 then           type is BP with CCITT G4 compression
        If PhotometricInterpretation = 5 then                type is SD with CCITT G4 compression
    if Compression = 7 then
        if PhotometricInterpretation = 5 then
            if PlanarConfiguration = 1 then                  type is CT with JCD and pixel interleaving
        if PhotometricInterpretation = 2 then
            if PlanarConfiguration = 1 then                  type is CT for RGB with JCD and pixel interleaving
        if PhotometricInterpretation = 6 then
            if PlanarConfiguration = 1 then                  type is CT for YCbCr with JCD and pixel interleaving
        if PhotometricInterpretation = 8 then
            if PlanarConfiguration = 1 then                  type is CT for LAB with JCD and pixel interleaving
        if PhotometricInterpretation = 0 or 1 then
            if BitsPerSample > 1 then                        type is MP with JCD
    if Compression = 8 then
        if PhotometricInterpretation = 5 then
            if PlanarConfiguration = 1 then                  type is CT with FCD and pixel interleaving
            if PlanarConfiguration = 32768 then              type is CT with FCD and line interleaving
            if PlanarConfiguration = 2 then
                If BitsPerSample > 1 then                    type is CT with FCD and colour interleaving
                If BitsPerSample = 1 then                    type is SD with FCD
        if PhotometricInterpretation = 2 then
                if PlanarConfiguration = 1 then              type is CT for RGB with FCD and pixel interleaving
                if PlanarConfiguration = 32768 then          type is CT for RGB with FCD and line interleaving
                if PlanarConfiguration = 2 then              type is CT for RGB with FCD and colour interleaving
        if PhotometricInterpretation = 8 then
            if PlanarConfiguration = 1 then                  type is CT for LAB with FCD and pixel interleaving
            if PlanarConfiguration = 32768 then              type is CT for LAB with FCD and line interleaving
            if PlanarConfiguration = 2 then                  type is CT for LAB with FCD and colour interleaving
        if PhotometricInterpretation = 0 or 1 then
            if BitsPerSample = 1 then                        type is BP with FCD
            if BitsPerSample > 1 then                        type is MP with FCD
    if Compression = 32896 then                              type is LW
    if Compression = 32897 then                              type is HC
    if Compression = 32898 then                              type is BL
    if bit3 of NewSubfileType = 1 then                       type is FP
```

B.2 Procedure for identifying the component image files of a final page

The component images' ImageDescription fields in their IFDs in the FP file contain the names of the component image files at the time the final page was created. The ImageDescription field in each component image file should also contain this name, but may not in certain cases (see D.2.3). Files may be renamed, however, after the final page is created. In particular, renaming may be done automatically when files are exchanged between operating systems with differing file naming rules.

The Inter-Company File Exchange Network (IFEN) specification defines files which may, in some cases, partially comply with this International Standard. A reader application could be designed to process both TIFF/IT and IFEN final pages. In IFEN, however, file names are not explicitly coded within the files. All files of an IFEN final page, including the FP file, have the same base file name with a three-character extension specifying the file type (.ICT for IFEN CT, .ILW for IFEN LW, .IHC for IFEN HC, and .IFP for IFEN FP).

The following algorithm can be used to locate the component files of a final page, given the FP file:

```
FileName = component image's ImageDescription field from its IFD in the FP file, if present
if ImageDescription exists but the file "FileName" does not exist it is possibly renamed or IFEN
        search all TIFF/IT files for a file of the correct type with ImageDescription = FileName
if file not found, or no ImageDescription in IFD it is possibly IFEN
        FileName = FP base file name with IFEN extension ('.ICT', '.ILW', '.IHC')
        if the file "FileName" does not exist
                error, or allow manual file name specification
```

If the reader application supports IFEN files, it may be more efficient to test for IFEN file naming first if the FP file's name includes the IFEN FP file extension.

Annex C
(informative)

Relationship between image types on a colour page

A page generally consists of CT and LW areas. The CT areas are typically scanned images or colour gradations ("vignettes", "degrades") and the LW areas are typically text, rules, logotypes, etc.

The LW data needs to be at a high resolution (typically more than 35 pixels per mm) to avoid the appearance of jagged edges where there is high colour contrast; e.g., black letters on white paper. The CT data typically has less colour contrast between adjacent pixels because of the sampling techniques used in scanning images and the response of the eye. Hence the spatial resolution, and with it the volume of data, can be reduced; typically, fewer than 25 pixels per mm are used. Each processing and output system will have its own restrictions on CT and LW resolutions, and the relationship between them.

Typically, both CT and LW pixels are square, the ratio between their linear resolutions is a small integer, and they are positioned such that the LW grid appears to subdivide the CT grid, each having edges coincident with the axes of the imaging area.

LW data is considered to take precedence over CT data, as if layered over it. The combination of LW and CT on the page is achieved by using two special colours in the LW palette: "white" and "transparent". White (0% in all separations) is conceptually a solid colour like any other in the LW palette, and thus "knocks out" any underlying CT data, in this case ensuring that no ink is printed and the bare substrate (paper) is seen. Transparent is a special indication that may apply to any or all separations of the palette colour. It has the effect of making the LW transparent in that separation, allowing the underlying CT to show through.

The above description of resolution suggests that the CT resolution is lower than the LW resolution. While this is true within the image, it is not always true of the edges of CT features. Where a shape has a sloping or curved edge it may be necessary or desirable to "cut into" CT pixels at LW resolution. The HC data format provides a method for doing this.

The HC file is at the same resolution as the LW file, and is also run-length encoded, but each run has its colour specified by a full CMYK or other colour value, instead of a palette reference. By this means, the limit on the number of palette colours is removed. Another way of looking at the HC data is to consider it as a higher resolution continuous tone (CT) file in which each pixel is accompanied by a repeat count. The HC file may have the same concept of "transparency" as the LW file, but uses colour byte values of zero to indicate it. The HC file is considered as lying between the LW and CT files in the imaging model. It is possible to carry the line art data in the HC file and omit the LW file if this is desired. However, this may lead to an increase in file size owing to the less compact encoding (six bytes per run instead of two or four). If there are fewer than 255 colours in the line art, the LW format will produce a smaller file.

Annex D
(informative)

Alphabetical list of TIFF/IT field names

An alphabetical list of TIFF/IT field names with short descriptions is shown in Table D.1.

Table D.1 — Alphabetical list of TIFF/IT field names, including final page (FP) usage

Field name	Tag No.	Type of parameter	Description	Clause
Artist	315	Job Identification	optional - name of person who created image, may also be used for comments on the image	7.2.2
BackgroundColorIndicator	34024	Colour Specification	BP and BL only - indicates if background colour or transparency is specified	7.2.9
BackgroundColorValue	34026	Colour Specification	BP and BL only - specifies background colour	7.2.8.4
BitsPerExtendedRunLength	34021	Data Format	LW only - specifies number of bits describing long run length encoding	7.2.6
BitsPerRunLength	34020	Data Format	LW only - specifies number of bits describing short run length encoding	7.2.6
BitsPerSample	258	Data Format	specifies the number of bits for each sample - see specific file types	7.2.6
ColorCharacterization	34029	Colour Specification	optional - specifies ASCII table or other reference to characterize colours per ISO 12641 and ISO 12642	7.2.8.4
ColorSequence	34017	Colour Specification	optional - specifies sequence of colours if other than CMYK	7.2.8.3.1
ColorTable	34022	Colour Specification	LW only - specifies colour value in a colour pallet table	7.2.8.4
Compression	259	Data Format	indicates if data compression is used and the method of compression	7.2.6
Copyright	33432	Job Identification	optional - copyright statement relating to image	7.2.2
CMYKEquivalent	34032	Colour Specification	Optional – specifies CMYK equivalent value for specific separations	7.2.8.3.3
DateTime	306	System Identification	optional - date and time of image creation	7.2.3
DocumentName	269	Job Identification	optional – document name of the scanned image	7.2.2
DotRange	336	Colour Specification	default - specifies 0% and 100% dot values	7.2.8.4
HCUsage	34030	Data Format	HC only - indicates the type of information contained within the HC file	7.2.6
HostComputer	316	System Identification	optional – computer or system used to create image	7.2.3
ICCProfile	34675	Colour Specification	optional – indicates the relationship between TIFF/IT image data and PCS	7.2.8.4
ImageColorIndicator	34023	Colour Specification	MP, BP, and BL only - indicates if image (foreground) colour or transparency(BP and BL only) is specified	7.2.9
ImageColorValue	34025	Colour Specification	MP, BP, and BL only - specifies image (foreground) colour	7.2.8.4
ImageDescription	270	Job Identification	optional - description of subject of image	7.2.2
ImageLength	257	Image Size and Orientation	image length in pixels, the number of rows of pixels in image	7.2.4
ImageWidth	256	Image Size and Orientation	image width in pixels, the number of pixels per row in image	7.2.4
InkNames	333	Colour Specification	Optional – specifies ink names	7.2.8.3.2

Table D.1 (continued)

Field name	Tag No.	Type of parameter	Description	Clause
InkSet	332	Colour Specification	optional -specifies "CMYK" or "not CMYK" ink set and colour sequence	7.2.8.3.2
IT8Header	34018	System Identification	optional (obsolete)	7.2.3
Make	271	System Identification	optional - specifies the manufacturer name or source of scanner	7.2.3
Model	272	System Identification	optional - specifies model name and number of scanner	7.2.3
NewSubfileType	254	Data Format	default, except in FP - specifies the type of data in subfile(s), replaces older field "SubfileType" in most cases	7.2.6
NumberOfInks	334	Colour Specification	optional - specifies the number of inks used	7.2.8.3.1
Orientation	274	Image Size and Orientation	default - specifies the direction of scanning relative to image orientation	7.2.4
PageName	285	Job Identification	optional - page name of scanned image	7.2.2
PhotometricInterpretation	262	Colour Specification	colour space type of image data (i.e. separations, WhiteIsZero, BlackIsZero, etc.) specific to file type	7.2.8.2
PixelIntensityRange	34027	Colour Specification	MP only - specifies data values for 0% and 100% pixel intensity	7.2.8.4
PlanarConfiguration	284	Data Format	specifies how the colour components of each pixel are interleaved (Pixel or Colour or Line interleaving)	7.2.6
PrimaryChromaticities	319	Colour Specification	optional – may be used to specify the chromaticities of a CT RGB image	G.2.2
RasterPadding	34019	Data Format	default - specifies the type of raster padding used, if any	7.2.6
ReferenceBlackWhite	532	Colour Specification	Optional - may be used to specify the relationship between RGB-black-white-reference and encoded RGB data values	G.2.3
ResolutionUnit	296	Image Resolution	default - specifies inch or centimetre as resolution unit	7.2.6
RowsPerStrip	278	File Format	specifies the number of rows for each strip of image	7.2.7
SamplesPerPixel	277	Data Format	specifies the number of samples which define a pixel	7.2.6
Site	34016	System Identification	optional - the site or location where the image was created	7.2.3
Software	305	System Identification	optional - name of application that created image	7.2.3
StripByteCounts	279	File Format	specifies the number of bytes in each strip of the image	7.2.7
StripOffsets	273	File Format	pointer to the image (to each strip of the image)	7.2.7
TransferFunction	301	Colour Specification	optional – may be used to specify the transfer function to be used with a CT image defined in RGB	G.2.2
TransparencyIndicator	34028	Colour Specification	HC only - specifies if transparency is used in HC file	7.2.8.4
TrapIndicator	34031	Trap Indicator	optional – indicates whether trapping has been applied to file.	7.2.6
WhitePoint	318	Colour Specification	optional – may be used to define the chromaticity of the white point of a CT image defined in RGB	G.2.2
XPosition	286	Final Page	FP only - specifies X offset on page from origin in component image IFDs in FP file	7.2.4
XResolution	282	Image Resolution	specifies the number of pixels per resolution unit in the width direction	7.2.5
YPosition	287	Final Page	FP only - specifies Y offset on page from origin in component image IFDs in FP file	7.2.4
YResolution	283	Image Resolution	specifies the number of pixels per resolution unit in the length direction	7.2.6

Annex E
(normative)

Incorporating JPEG compressed data into TIFF/IT

E.1 Incorporating JPEG compressed data into TIFF/IT

This annex defines JPEG compressed data that may be included in TIFF/IT-CT and TIFF/IT-MP images or files. The images described in this annex belong to TIFF/IT-CT or TIFF/IT-MP image types. JPEG compression may be used in TIFF/IT-CT, TIFF/IT-MP, TIFF/IT-CT/P2 and TIFF/IT-MP/P2. JPEG compression shall not be used in TIFF/IT-P1.

Unless other descriptions are indicated in this annex, the compliant file, reader and writer for TIFF/IT-CT or TIFF/IT-MP with JPEG compressed data shall accept the conforming level for TIFF/IT-CT or TIFF/IT-MP, respectively.

In descriptions of TIFF/IT-CT and TIFF/IT-MP for the JPEG compressed data, classification marks and values of TIFF/IT fields basically conform to those of TIFF/IT-CT or TIFF/IT-MP images or files (See tables 4 and 10).

NOTE Addition information can be found in *Adobe Photoshop TIFF Technical Notes*.

E.2 Requirement for incorporating JPEG compressed data into TIFF/IT-CT or TIFF/IT-MP

E.2.1 General

JPEG compressed data in this annex are based on JPEG baseline process described in ISO/IEC 10918-1:1994. The JPEG baseline process is a DCT(Discrete Cosine Transform)-based algorithm that compresses images having 8 bits per component. The JPEG baseline algorithm cannot be utilized for loss-less compression.

TIFF/IT-CT or TIFF/IT-MP image or file with JPEG baseline compressed data shall have Compression field with the value of 7.

259 Compression SHORT=7

NOTE TIFF/IT JPEG files with Compression tag value of 7 are not compatible with JPEG TIFF file with Compression tag value of 6.

In TIFF/IT file with the JPEG compressed data, TIFF/IT tag fields which are related to the JPEG compressed data strip are StripOffsets and StripByteCounts (see 7.1.6). The compressed data stored in the file shall have the same colour space defined by the PhotometricInterpretation field (see E.2.3). Other tag fields are not related to the compressed strip format. However, for easy exchange of the JPEG files, usage in TIFF/IT JPEG compressed files is restricted as follow.

— TIFF/IT JPEG compression procedure may be applied to TIFF/IT-CT and TIFF/IT-MP images. TIFF/IT JPEG compression procedure shall not be applied to TIFF/IT images with deflate compressed data. TIFF/IT JPEG data shall not be applied to other type TIFF/IT images such as TIFF/IT-LW, -HC, -SD, -BP and -BL.

— Strip data in TIFF/IT images with JPEG compressed data shall be in conformity with JPEG baseline specified in Annex B of ISO/IEC 10918-1:1994. That is, only 8-bit precision data is accepted. The abbreviated format for compressed image data and the abbreviated format for table-specification data in the three compressed data format shall not be applied in TIFF/IT file.

— Strip data in TIFF/IT images with JPEG compressed data shall be in the form of one strip that is represented as a whole JPEG interchange format including Huffman tables and quantization tables.

— In the case of images with multiple colour components, only pixel interleaving is accepted in the TIFF/IT JPEG images.

E.2.2 Strip format in TIFF/IT JPEG images

The compressed data stream format in this annex shall be in conformity with the interchange format for the baseline sequential DCT mode of Annex B in ISO/IEC 10918-1:1994 under the restrictions specified in E.2.1.

Additionally, usable markers are restricted as follows.

— Writer shall use and reader shall read and properly process the markers SOI, SOF0, SOS, and EOI.

— Writer may use and reader shall read and properly process the markers DRI, DHT, DQT, and RSTn (n=0–7).

— Writer may use and reader shall read and skip the markers COM, APPn (n= 0–15).

— Writer and reader shall not use markers of SOFn (n=1-15), JPG, DNL, DHP, EXP, JPGn, TEM and RES.

E.2.3 Colour space conversion in JPEG compression process.

In the case of TIFF/IT-CT with JPEG compressed data, some colour space conversion may be applied before the JPEG compression process (and the reverse conversion may be applied after JPEG decompression process). The PhotometricInterpretation field must match the colour space of the compressed data.

Annex F
(normative)

Incorporating Flate compressed data into TIFF/IT

F.1 Incorporating Flate compressed data into TIFF/IT

This annex defines Flate compressed data that may be included in TIFF/IT images or files. The images described in this annex belong to the TIFF/IT image types TIFF/IT-CT, -MP, -BP, -SD and -FP. Each image type with the Flate compressed data has TIFF/IT or TIFF/IT-P2 conforming level. Flate compression shall not be used in TIFF/IT-P1.

Unless other descriptions are indicated in this annex, the compliant file, reader and writer for each of TIFF/IT images with Flate compressed data shall accept the conforming level for each of TIFF/IT images or files, respectively.

In descriptions of TIFF/IT for the Flate compressed data, classification marks and values of TIFF/IT fields basically conform to those of TIFF/IT images or files.

F.2 Requirement for incorporating Flate compressed data into TIFF/IT

Flate compressed data may be incorporated into each of TIFF/IT images or files. The Flate compressed method is a general purpose loss-less compressed method and uses a combination of the LZ77 algorithm and Huffman coding. For use in TIFF/IT, this annex uses the deflate data format defined in RFC 1950 and the deflate data stream format defined in RFC 1951.

NOTE Additional information can be found in *Adobe Photoshop TIFF Technical Notes*.

F.2.1 Format for Flate compressed data strip

In the case that Flate compressed data are used in TIFF/IT images or files, the value of Compression tag field shall be 8. The Flate compressed data may be included in TIFF/IT-CT, -MP, -BP, -SD and -FP files.

259 Compression SHORT =8

NOTE 1 The popular open-source library, libtiff, has used the value 32946 to indicate Flate This value should be considered obsolete. It is recommended that TiFF reader software support both values 8 and 32946 and TIFF writing software only use value of 8.

In TIFF/IT file with the Flate compressed data, TIFF/IT tag fields that are related to the Flate compressed data strip are StripOffsets and StripByteCounts. Other tag fields are not related to the descriptions of compressed strip format, and specify information related to the original (or uncompressed) TIFF/IT file format or image types to be reconstructed from the compressed image.

A strip for the Flate compressed data in this annex shall be in conformity with RFC 1950 (ZLIB Compressed Data Format Specification) with the following restrictions.

— FDICT bit in FLG byte shall always be 0 and there shall not be a DICTID field.

— TIFF/IT images or files may use the values 1, 2, 3, or 8 for the CM field in the CMF byte.

— TIFF/IT-P2 conforming images or files shall only use the value 8 for the CM field in the CMF byte

NOTE 2 The value of 8 for the CM field indicates that the original image data shall not be modified by an prediction calculations. Other values of CM may result in the modification of the original image data before compression to provide better compression rates.

A strip shall consist of a sequence of bytes containing the fields CMF, FLG, the compressed data, and field ADLER32 as described in RFC 1950.

The CM values 1, 2, and 3 mean that Left prediction, Right prediction and Average prediction are applied to the original image data, respectively. (i.e. predicted data is applied to the original data and will then be compressed). Each prediction method applies an equation to the original image data. Left predicition (CM=1) applies the equation of “Raw(x) – Raw(px)”. Upper prediction (CM=2) applies the equation of “Raw(x) – Raw(ux)”. Average prediction (CM=3) applies the equation of “Raw(x) – (Raw(px) + Raw(ux))/2”.

Raw(x) - Byte value of raw (original) data at the byte position of the current compressing pixel on the current compressing line.

Raw(x-px) - Byte value of the raw (original) data at the byte position of the proceeding compressed pixel on the current compressing line.

Raw(ux) - Byte value of the raw (original) data at the byte position corresponding to the current compressing pixel on the proceeding compressed line.

During the decompression step, the prediction reverse functions, each of which correspond to the CM values of 1,2 or 3, are applied to the byte values generated by the Flate decompressor to reconstruct the original byte values.

F.2.2 Format for Flate compressed data stream

The compressed data stream format in this annex shall be in conformity with RFC 1951 (DEFLATE Compressed Data Format Specification). Refer to RFC 1951 for more details.

Annex G
(normative)

RGB colour space data in TIFF/IT-CT

G.1 TIFF/IT-CT for RGB

This annex defines TIFF/IT-CT file format where PhotometricInterpretation value of "2" may be used for CT image with RGB colour space data. The RGB image type belongs to TIFF/IT-CT image type. For the RGB images or files, only TIFF/IT conforming level is defined. TIFF/IT-P1 and TIFF/IT-P2 conformance levels do not exist for RGB image data or files.

Unless other descriptions are indicated in this annex, the compliant file, reader and writer for the RGB images or files shall accept the conforming level for TIFF/IT-CT.

In descriptions of TIFF/IT-CT for the RGB images or files, classification marks and values of TIFF/IT fields basically conform to those of TIFF/IT-CT images or files. However, in the case of conflict with TIFF/IT-CT field usage in 7.3.3, descriptions in this annex take priority.

G.2 Requirements for Incorporating RGB colour space data into TIFF/IT-CT

In the case that PhotometricInterpretation value of "2" is used in TIFF/IT-CT images or files, the data in it shall be in RGB colour space. The encoded RGB data are the data that are directly suitable for display on typical RGB device.

G.2.1 Data structure

In TIFF/IT-CT for the RGB colour space data, data area is specified by StripOffsets and StripByteCounts tag fields. Usage of multiple data area for the RGB colour space data may be accepted. If multiple data area is used, RowsPerStrip field shall be specified.

Three formats of pixel interleaving, line interleaving and colour interleaving may be used for describing the pixel structure of the RGB colour space data. A TIFF/IT-CT writer that specifies PhotometricInterpretation value 2 shall write in any one of the formats. A TIFF/IT-CT reader that reads TIFF/IT-CT file with PhotometricInterpretation value 2 shall read all three of the formats.

Either of 8-bit or 16-bit images (BitsPerSample = 8,8,8 or 16,16,16) shall be used for the RGB colour space data. Other BitsPerSample values are not allowed. Samples per pixel value shall be 3 (SamplesPerPixel = 3). PhotometricInterpretation value 2 for the CT images signifies the order of components within the pixel is "RGB". For 16-bit pixel data, the byte ordering within a component corresponds to the big-endian byte order, regardless of the ordering used in TIFF/IT directories (IFD).

Fields of InkSet, NumberOfInks, IT8Header and RasterPadding that are available in TIFF/IT-CT shall not be used for the RGB colour space data.

NOTE 1 RGB data in this section is device-specific. For TIFF/IT-CT for the RGB colour space with colorimetric information, see G.2.2.

NOTE 2 If appropriate tag fields and values are used, TIFF/IT-CT files for RGB will be compatible with TIFF 6.0 RGB Full Colour Images as described by Section 6 of the TIFF 6.0 specification

G.2.2 Colorimetric information in TIFF/IT-CT for RGB colour space

In the previous section, pixel data values in the TIFF/IT-CT for RGB colour space represent the RGB colour values at the time they were written. However, in the case that representing data equivalent for the colorimetric values is

desired, combinations of optional tag fields of WhitePoint, PrimaryChromaticities, TransferFunction and ColorCharacterization may be used.

318	WhitePoint	RATIONAL	(white[x], white[y])
319	PrimaryChromaticities	RATIONAL	(red[x], red[y], green[x], green[y], blue[x], and blue[y])
301	TransferFunction	SHORT	(pointer to a transfer function for the image in tabular style. associated count=3 x $2^{BitsPerSample}$ or 1 x $2^{BitsPerSample}$)

WhitePoint tag field means the chromaticity of the white point of the image. This value is described by using the CIE xy chromaticity diagram. For example, if D65 light source is used, the value of WhitePoint is [3127/10000,3290/10000]. No default for this field value is specified.

PrimaryChromaticities tag field means chromaticity of the primaries of the image. These values are described by using the 1931 CIE xy chromaticity diagram. The ordering is red[x], red[y], green[x], green[y], blue[x], and blue[y]. For example, ITU-R BT.709 primaries is [640/1000, 330/1000, 300/1000, 600/1000, 150/1000, 60/1000]. No default for this field value is specified.

TransferFunction tag field specifies the transfer function for the pixel data in tabular style. Using this tag field, pixel data can be gamma-compensated. The TransferFunction maps the pixel components from a non-linear encoded data value form into a 16-bit linear form. the number of a non-linear encoded data is specified by count (that is, the number of data elements) of this field. If the count=1 x $2^{BitsPerSample}$, the transfer function is the same for each component of RGB and all components share a single table. If the count=3 x $2^{BitsPerSample}$, there are three tables, and the order of the three tables is "RGB". These tables are separate and are not interleaved.

NOTE 1 Default value of TransferFunction field is a single table corresponding to the NTSC standard gamma value of 2.2. However, the case that this field is not used (that is, default value is valid) is the time when transfer function is not needed, this default value will not be valid. In the case that transfer function is needed, it is recommended that the needed table data are written without using the default table.

If ColorCharacterization field is used, the field means that "the colour values of RGB images may be characterized by short definition words like named colour definitions. The accepted short definition word for this RGB colour space data in TIFF/IT-CT is "sRGB". "sRGB" means that data are encoded by using colour definition of "sRGB" as described in IEC 61966-2-1.

NOTE 2 The meaning of ColorCharacterization field in this section differs from that of general usage in TIFF/IT file.

NOTE 3 If ColorCharacterization field is used with WhitePoint, PrimaryChromaticities or TransferFunction tag field, there shall not be inconsistency between their descriptions.

NOTE 4 RGB data described in TIFF/IT file specifies values of encoded data in that file and does not specify the method of transformation from encoded data values into values in the other colour space. Tag fields added in this section signify the encoded condition of the RGB data.

G.2.3 Scaling of encoded RGB data value

The field of ReferenceBlackWhite may be used to specify the relationship between RGB-black-white-reference and encoded RGB data values.

532	ReferenceBlackWhite	RATIONAL	([pixel value associated with ReferenceBlack of R], [pixel value associated with ReferenceWhite of R], [pixel value associated with ReferenceBlack of G], [pixel value associated with ReferenceWhite of G], [pixel value associated with ReferenceBlack of B], [pixel value associated with ReferenceWhite of B])

ReferenceBlackWhite tag field specifies the coded pixel value associated with ReferenceBlack and the coded pixel value associated with ReferenceWhite for each colour component. The ordering is [pixel value associated with ReferenceBlack of R], [pixel value associated with ReferenceWhite of R], [pixel value associated with ReferenceBlack of G], [pixel value associated with ReferenceWhite of G], [pixel value associated with ReferenceBlack of B], [pixel value associated with ReferenceWhite of G]. For example, ReferenceBlackWhite values for 8-bit device-depended RGB is [0/1, 255/1,0/1, 255/1, 0/1, 255/1]. Default value for this field is [0/,NV/1, 0/1, NV/1, 0/1, NV/1] where NV = $2^{\text{BitsPerSample}} - 1$.

Table G.1 shows the relationship between pixel data values and RGB values with default values of ReferenceBlackWhite fields

Table G.1 — Relationship between pixel data values and non-linear RGB values with default ReferenceBlackWhite value

Non liner R/G/B value	8-bit pixel data	16-bit pixel data
0(=black)	0	0
1(=white)	255(FFh)	65535(FFFFh)

G.3 TIFF/IT-CT encoding for RGB image data

Field usage for TIFF/IT-CT for RGB image data is as shown in table G.2.

Table G.2 - Field usage for TIFF/IT-CT for RGB image data (PhotometricInterpretation =2)

Field Name	Tag No.	Data type	Count	Default value	TIFF/IT-CT for RGB	Remarks
NewSubfileType	254	LONG	1	0	d=0	
ImageWidth	256	SHORT/LONG	1	none	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	lines per image
BitsPerSample	258	SHORT	3	1	m=8,8,8, =16,16,16	
Compression	259	SHORT	1	1	d=1, =7, =8	
PhotometricInterpretation	262	SHORT	1	none	m=2	
DocumentName	269	ASCII	[b]	none	opt	
ImageDescription	270	ASCII	[b]	none	opt	
Make	271	ASCII	[b]	none	opt	vendor name
Model	272	ASCII	[b]	none	opt	
StripOffsets	273	SHORT/LONG	[c]	none	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	
SamplesPerPixel	277	SHORT	1	1	m=3	no. of separations
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	[a]
StripByteCounts	279	SHORT/LONG	[c]	none	m	
XResolution	282	RATIONAL	1	none	m	
YResolution	283	RATIONAL	1	none	m	
PlanarConfiguration	284	SHORT	1	1	d=1, =2, =32768	
PageName	285	ASCII	[b]	none	opt	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	
TransferFunction	301	SHORT	[e]	[f]	opt	
Software	305	ASCII	[b]	none	opt	
DateTime	306	ASCII	[d]	none	opt	
Artist	315	ASCII	[b]	none	opt	
HostComputer	316	ASCII	[b]	none	opt	
WhitePoint	318	RATIONAL	2	none	opt	
PrimaryChromaticities	319	RATIONAL	6	none	opt	
InkSet	332	SHORT	1	1	not used	
NumberOfInks	334	SHORT	1	4	not used	
DotRange	336	BYTE/SHORT	2	0,255	not used	
ReferenceBlackWhite	532	RATIONAL	6	[g]	opt	
Copyright	33432	ASCII	[b]	none	opt	
Site	34016	ASCII	[b]	none	opt	
ColorSequence	34017	ASCII	[b]	"CMYK"	not used	sequence of colours
IT8Header	34018	ASCII	[b]	none	not used	
RasterPadding	34019	SHORT	1	0	not used	
ColorCharacterization	34029	ASCII	[b]	none	opt	[h]

[a] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[b] The number of characters (bytes) in the string including the terminating null.

[c] If PlanarConfiguration is equal to 1 or 32768, use StripsPerImage.

If PlanarConfiguration is equal to 2, use SamplesPerPixel x StripsPerImage.

StripsPerImage= INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip), where INTEGER(x) is the integer value of x (i.e. INTEGER (2.9) = 2).

[d] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Colon, Month, Colon, Day, space, Hour, Colon, Minute, Colon, Second, null

[e] $1 \times 2^{BitsPerSample}$ which means that the transfer function is the same for each component, or $3 \times 2^{BitsPerSample}$, which means the separate transfer function for each component.

[f] Single table corresponding to the NTSC standard gamma value of 2.2

[g] [0/,NV/1, 0/1, NV/1, 0/1, NV/1] where $NV = 2^{BitsPerSample} - 1$

[h] If this field is used the short word "sRGB" is the only currently defined option. sRGB is the colour space described in IEC 61966-2-1.

Annex H
(normative)

LAB colour space data in TIFF/IT-CT

H.1 TIFF/IT-CT for LAB

This annex defines TIFF/IT-CT file format where PhotometricInterpretation value of "8" may be used for CT image with LAB colour space data. LAB shall be as defined in ISO 13655. The LAB image type belongs to TIFF-CT image type. For the LAB images or files, only TIFF/IT conforming level is defined. TIFF/IT-P1 and TIFF/IT-P2 conforming levels do not exist for LAB image or files.

NOTE ISO 13655 defines LAB to be based on D50, 2 degree observer, 0/45 measurement geometry for reflection and 0/diffuse geometry for transmission.

Unless other descriptions are indicated in this annex, the compliant file, reader and writer for the LAB images or files shall accept the conforming level for TIFF/IT-CT.

In descriptions of TIFF/IT-CT for the LAB images or files, classification marks and values of TIFF/IT fields basically conform to those of TIFF/IT-CT images or files. However, in cases of conflict with TIFF/IT-CT field usage in 7.3.3, descriptions in this annex take priority.

H.2 Requirements for Incorporating LAB colour space data into TIFF/IT-CT

In the case that PhotometricInterpretation value of "8" is used in TIFF/IT-CT images or files, the data in it shall be in LAB colour space.

H.2.1 Data structure

In TIFF/IT-CT for the LAB colour space data, data area is specified by StripOffsets and StripByteCounts tag fields. Usage of multiple data area for the LAB colour space data may be accepted. If multiple data area is used, RowsPerStrip field shall be specified. Encoded pixel values in the TIFF/IT-CT for LAB signify colour space data described in 1976 CIE L*a*b*.

Three formats of pixel interleaving, line interleaving and colour interleaving may be used for describing the pixel structure of the LAB colour space data. A TIFF/IT-CT writer that specifies PhotometricInterpretation value 8 shall write in any one of the formats. A TIFF/IT-CT reader that reads TIFF/IT-CT file with PhotometricInterpretation value 8 shall read all three of the formats.

Either of 8-bit or16-bit images (BitsPerSample = 8,8,8 or 16,16,16) shall be used for the LAB colour space data. Other BitsPerSample values are not allowed. Samples per pixel value shall be 3 (SamplesPerPixel = 3). Value 8 for PhotometricInterpretation for the CT images signifies the order of components within the pixel is "L*a*b*". For 16-bit pixel data, the byte ordering within a component corresponds to the big-endian byte order, regardless of the ordering used in TIFF/IT directories(IFD).

Fields of InkSet, NumberOfInks, DotRange, ColorSequence, IT8Header, RasterPadding and ColorCharacterization which are available in TIFF/IT CT shall not used for LAB colour space data,

H.2.2 Ranges on components of LAB

The *L** range which can be represented in this annex is from 0 (perfect absorbing black) to 100 (perfect reflecting diffuse white). The ranges of a* and *b** which can be represented in this annex are from –128 to +127. Tables H.1 and H.2 show the relationship between pixel data values and L*, a*, and b* values. Pixel data value in a* and b* shall be two's complement.

Table H.1 — Relationship between pixel data values and L* values

L*	8-bit pixel data	16-bit pixel data
0	0	0
100.0	255(FFh)	65535 (FFFFh)

Table H.2 — Relationship between pixel data values and a* and b* values

a* or b*	8-bit pixel data	16-bit pixel data
-128.0	-128(80h)	-32768(8000h)
0	0(0h)	0(0h)
127.0	127(7Fh)	32512(7F00h)
NOTE 1 The 16-bit values of a* and b* equal the 8-bit values multiplied by 256. NOTE 2 If appropriate tag fields and values such as BitsPerSample value of "8,8,8" and so on are used, TIFF/IT-CT files for LAB will be compatible with TIFF 6.0 CIE L*a*b* Images as described by Section 23 of the TIFF 6.0 specification		

H.3 Requirement for using LAB colour space in TIFF/IT-CT

Field usage for TIFF/IT-CT for LAB image data is as shown in Table H.3.

Table H.3 — Field usage for TIFF/IT-CT for LAB image data (PhotometricInterpretation =8)

Field Name	Tag No.	Data type	Count	Default value	TIFF/IT-CT for LAB	Remarks
NewSubfileType	254	LONG	1	0	d	
ImageWidth	256	SHORT/LONG	1	none	m	pixels per line
ImageLength	257	SHORT/LONG	1	none	m	lines per image
BitsPerSample	258	SHORT	3	1	m=8,8,8, =16,16,16	
Compression	259	SHORT	1	1	d=1, =7, =8	
PhotometricInterpretation	262	SHORT	1	none	m =8	
DocumentName	269	ASCII	[b]	none	opt	
ImageDescription	270	ASCII	[b]	none	opt	
Make	271	ASCII	[b]	none	opt	vendor name
Model	272	ASCII	[b]	none	opt	
StripOffsets	273	SHORT/LONG	[c]	none	m	pointer to image data
Orientation	274	SHORT	1	1	d(=1, =4, =5, =8)	
SamplesPerPixel	277	SHORT	1	1	m=3	no. of separations
RowsPerStrip	278	SHORT/LONG	1	FFFFFFFFh	d	[a]
StripByteCounts	279	SHORT/LONG	[c]	none	m	
XResolution	282	RATIONAL	1	none	m	
YResolution	283	RATIONAL	1	none	m	
PlanarConfiguration	284	SHORT	1	1	d=1, =2, =32768	
PageName	285	ASCII	[b]	none	opt	
ResolutionUnit	296	SHORT	1	2	d(=2, =3)	
Software	305	ASCII	[b]	none	opt	
DateTime	306	ASCII	[d]	none	opt	
Artist	315	ASCII	[b]	none	opt	
HostComputer	316	ASCII	[b]	none	opt	
InkSet	332	SHORT	1	1	not used	
NumberOfInks	334	SHORT	1	4	not used	
DotRange	336	BYTE/SHORT	2	0,255	not used	
Copyright	33432	ASCII	[b]	none	opt	
Site	34016	ASCII	[b]	none	opt	
ColorSequence	34017	ASCII	[b]	"CMYK"	not used	sequence of colours
IT8Header	34018	ASCII	[b]	none	not used	
RasterPadding	34019	SHORT	1	0	not used	
ColorCharacterization	34029	ASCII	[b]	none	not used	

[a] The default value FFFFFFFFh means that the entire image is contained in a single strip.

[b] The number of characters (bytes) in the string including the terminating null.

[c] If PlanarConfiguration is equal to 1 or 32768, use StripsPerImage.

If PlanarConfiguration is equal to 2, use SamplesPerPixel x StripsPerImage.

StripsPerImage= INTEGER((ImageLength+RowsPerStrip-1)/RowsPerStrip); where INTEGER(x) is the integer value of x (i.e. INTEGER (2.9) = 2)

[d] 20 characters in the format YYYY:MM:DD HH:MM:SS indicating Year, Colon, Month, Colon, Day, space, Hour, Colon, Minute, Colon, Second, null.

Annex I
(informative)

Colour values

This International Standard provides a method of transferring images destined for print using the four-colour printing process. These images can originate from a wide variety of sources, and may be transferred at any point in the production process. Therefore, this International Standard does not attempt to specify the final printed result, but to define the components of the image (sometimes referred to as a "bag of pixels") and its current parameters, such as size, resolution, colour saturation, etc. This does not imply that these parameters, and the specific colour values assumed by their definition, will remain unchanged prior to the printing process.

The relative colour values of the pixels represent the colour of the image at the time it was written in the TIFF/IT format. Relative colour values may be changed as the image passes from stage to stage in the production process. After scanning, they represent the scanned colour percentages; after colour correction, they represent the corrected colour percentages; etc. They may represent a target value for dots on film for either lithographic or gravure printing, or the final dot value printed on paper after dot gain, or any of a number of other representations of the printing process. The current generation of data exchange standards makes no assumptions about what the value represents, but does provide a vehicle for transferring the values. It is necessary to understand where the image is in the printing process, and how it was created, to understand what the dot percent represents in absolute terms, and this can only be done with information from the originator of the image. The various parts of ISO 12641 and ISO 12642 address this issue, and the field ColorCharacterization is provided to carry calibration data as specified in them. In addition provision is made to include ICC profiles to characterize the relationship between the data in the file and the colorimetric definition of profile connection space (PCS).

Annex J
(normative)

ICC Profile tag in TIFF/IT image

J.1 Incorporating an ICC Profile into TIFF/IT

An ICC Profile may be included in a TIFF/IT file by using the ICCProfile tag as described in Annex B.3 of ICC.1. TIFF/IT-P1 file shall not include ICCProfile tag.

Unless other descriptions are indicated below, the compliant file, reader and writer for TIFF/IT images or files with ICCProfile shall accept the conforming level for TIFF/IT.

ICCProfile tag may be used as optional fields in TIFF/IT-CT, TIFF/IT-CT/P2, TIFF/IT-LW, TIFF/IT-LW/P2, TIFF/IT-HC, TIFF/IT-HC/P2, TIFF/IT-MP and TIFF/IT-MP/P2 files or images (see Tables 4, 8, 9 and 10).

J.2 Requirement for Incorporating ICC Profile into TIFF/IT

The ICCProfile tag indicates the relationship between colour space that describes TIFF/IT data and PCS (Profile Connection colour space).

The ICCProfile tag may be used as an optional TIFF/IT field in all TIFF/IT image types. The following IFD entry shall be used in order to incorporate ICCProfile tag into TIFF/IT.

34675 ICCProfile UNDEFINED [pointer to the beginning of the ICC profile]

The ICCProfile field is identified by the tag number 34675(8773H). The count of the field is the size of the embedded ICC Profile in bytes. The offset value field of an IFD entry is the offset in bytes, to the beginning of the ICC Profile.

An ICC profile shall be embedded, in its entirety, as a single TIFF/IT field or Image File Directory (IFD) entry in the IFD containing the corresponding image data. A TIFF/IT file may contain more than one image, more than one IFD. Each IFD may have its own embedded profile. However, TIFF/IT readers are not required to read any IFDs beyond the first one.

An embedded ICC profile itself shall include the following elements of 128-byte ICC Profile Header, tag table and tagged data elements. All profile data in the embedded profile shall be encoded as big-endian. Usage and structure of each of these elements shall be in conformity with those specified in ICC.1.

NOTE Colour space in which TIFF/IT data described (by using PhotometricInterpretation tag) shall not in conflict with the colour space of source colour space in the embedded ICC profile.

Annex K
(informative)

Monochrome continuous tone picture colour value calculation

K.1 Monochrome picture example

In the case of monochrome continuous tone picture when:

ColorSequence	=	'CMYK'
DotRange	=	100, 200
ImgeColorValue	=	150, 180, 100, 120
PixelInensityrange	=	20, 220
ImageColorIndicator	=	1

This defines image colour values at 100% intensity of C=50%, M=80%, Y=0%, and K=20%. A pixel in the monochrome image with value 120 will indicate 50% intensity which results in a colour of C=25%, M=40%, Y=0%, and K=10%

Figure K.1 shows the relationship between pixel data value, intensity values, image colour values, and printing dot value percentage for a monochrome continuous tone picture.

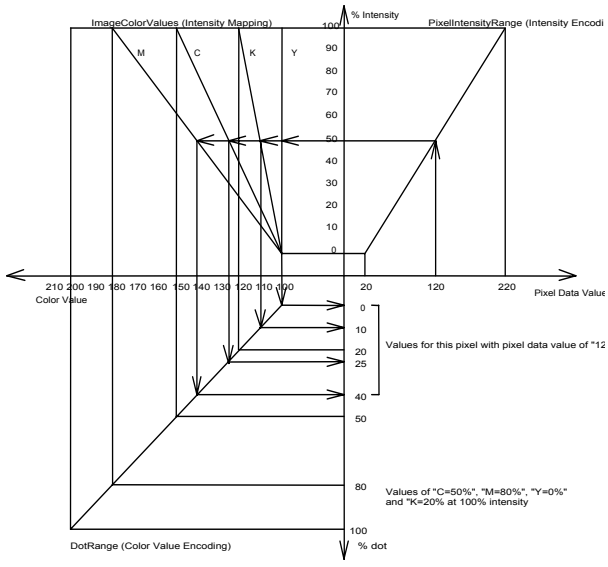

Figure K.1 — Example of MP colour value calculation

For this example, the input data is obtained as follows:

PixelDataValue is the data value in the TIFF/IT-MP or TIFF/IT-MP/P1 file,
PixelIntensityMin is the value for 0% intensity in PixelIntensityRange field,
PixelIntensityMax is the value for 100% intensity in PixelIntensityRange field,
DotRangeMin is the value for 0% dot in DotRange field,
DotRangeMax is the value for 100% dot in DotRange field, and
ImageColorValueS is the value corresponding to the colour value for separation S in ImageColorValue field.

Then %Intensity, ColorValueS, and %dotS in Figure G.1 can be obtained as follows:

$$\%Intensity = \frac{(PixelDataValue - PixelIntensity) \times 100}{(PixelIntensityMax - PixelIntensityMin)} \quad (1)$$

$$ColorValueS = \frac{\%Intensity \times (ImageColorValuesS - DotRangeMin)}{100} + DotRangeMin \quad (2)$$

$$\%dotS = \frac{(ColorValueS - DotRangeMin) \times 100}{(DotRangeMax - DotRangeMin)} \quad (3)$$

Hence the %dotS which is the percent dot value corresponding to the PixelDataValue for separation S is obtained as follows:

$$\%dotS = \frac{(ColorValueS - DotRangeMin) \times 100}{(DotRangeMax - DotRangeMin)}$$

$$= \frac{\left[\left(\frac{\%Intensity \times (ImageColorValueS - DotRangeMin)}{100} + DotRangeMin\right) - DotRangeMin\right] \times 100}{(DotRangeMax - DotRangeMin)}$$

$$= \frac{\%Intensity \times (ImageColorValueS - DotRangeMin)}{(DotRangeMax - DotRangeMin)}$$

$$= \frac{\left(\frac{PixelDataValue - PixelIntensityMin) \times 100}{(PixelntensityMax - PixelIntensityMin}\right) \times (ImageColorValueS - DotRangeMin)}{(DotRangeMax - DotRangeMin)}$$

$$= \frac{(PixelDataValue - PixelIntensityMin) \times (ImageColorValueS - DotRangeMin) \times 100}{(PixelIntensityMax - PixelIntensityMin) \times (DotRangeMax - DotRangeMin)} \quad (4)$$

Where %dotC, %dotM, %dotY, and %dotK are dot percent values for separations C, M, Y, and K respectively, substituting the values of the above example into equation 4, they are:

%dotC = ((120 - 20) × (150 - 100) × 100) / ((220 - 20) × (200 - 100)) = 100 × 50 × 100 / 20000 = 25%

%dotM = ((120 - 20) × (180 - 100) × 100) / ((220 - 20) × (200 - 100)) = 100 × 80 × 100 / 20000 = 40%

%dotY = ((120 - 20) × (100 - 100) × 100) / ((220 - 20) × (200 - 100)) = 100 × 0 × 100 / 20000 = 0%

%dotK = ((120 - 20) × (120 - 100) × 100) / ((220 - 20) × (200 - 100)) = 100 × 20 × 100 / 20000 = 10%

K.2 Binary picture example

In the case of binary pictures when:

ColorSequence	= "CMYK"
DotRange	= 100, 200
ImageColorIndicator	= 1
BackgroundColorIndicator	= 1
ImageColorValue	= 150, 180, 100, 120
BackgroundColorValue	= 100, 120, 150, 100

This defines image colour values of C = 50%, M = 80%, Y = 0%, K = 20% with background colour values of C =0%, M =20%, Y =50%, K =0%. Colour intensity values do not apply.

A line in the binary picture file starting with a binary sequence of:

00000000 00000000 00001111 11111100 11111111 0...

meaning 20 pixels of background colour, 10 pixels of image colour, 2 pixels of background colour, 8 pixels of image colour, etc.

K.3 Binary line art example

In the case of binary line art when:

ColorSequence	= "CMYK"
DotRange	= 100, 200
ImageColorIndicator	= 1
BackgroundColorIndicator	= 2
ImageColorValue	= 150, 180, 100, 120
BackgroundColorValue	Not used

This defines image colour values of C = 50%, M = 80%, Y = 0%, K = 20%. Colour intensity values do not apply. The background is defined as fully transparent in this example, so background colour values are not used. An encoded line in the binary line art file with a byte sequence of:

0	0	20	10	2	255	1	4
...	(decimal)						
00	00	14	0A	02	FF	01	04
...	(hexadecimal)						

would signify

(line start) (short run, length = 20) (short run, length = 10) (short run, length = 2) (long run, length = 260) etc.

meaning 20 pixels fully transparent, 10 pixels of image colour, 2 pixels fully transparent, 260 pixels of image colour, etc.

Bibliography

[1] *Adobe Photoshop TIFF Technical Notes*; Adobe Systems Incorporated, March 22, 2002

[2] ISO/IEC 10918-3:1997 *Information Technology - Digital compression and coding of continuous-tone still images: Extensions*