This document is Annex F of ITU-T Recommendation T.84 | ISO/IEC IS 10918-3, DIGITAL COMPRESSION AND CODING OF CONTINUOUS-TONE STILL IMAGES - Extensions.

Annex F

Still Picture Interchange File Format (SPIFF)[2)]

(This annex forms an integral part of this Recommendation | International Standard)

This annex specifies a file format that can be used for the interchange of image files, containing compressed image data, between application environments. This Still Picture Interchange File Format (SPIFF) is intended to be a generic format that is simple in nature and does not include many of the features found in application specific file formats.

SPIFF files may contain image data for bi-level or continuous-tone (grayscale or colour) images. Several different standard compression algorithms are supported: MH, MR, MMR, JBIG, and JPEG (See F.1.2.3). In addition to the image data, SPIFF includes information necessary to render it on common output devices, within the constraints imposed by that device.

NOTE – The Still Picture Interchange File Format is designed to incorporate functionality found in some (ad hoc) image file formats (such as JFIF) that encapsulate compressed image data streams. It is intended that transcoding between any of these file formats and SPIFF should be simple.

F.1 General aspects of the SPIFF specification

Throughout this Recommendation | International Standard a "file" is assumed to be a representation of an array of bytes of arbitrary length. Commonly the data contained in this "file" is transmitted over a telecommunication network or stored in a computer system's hard disk storage, but the actual storage location is irrelevant to this Recommendation | International Standard. It is the purpose of this Recommendation | International Standard to impose a higher level structure on the bytes in this array and to specify the interpretation of the values in those higher level structures. All constituent parts of the file format shall be represented by byte-aligned data.

F.1.1 Constituent parts

This subclause gives a general description of each of the constituent parts of the data contained in the file format (see Figure F.1).

F.1.1.1 File header

The file header is the first data that appears in the file and serves to identify the file's contents as SPIFF data. The header also contains information about the image such as the application profile, number of components, and image dimensions.

NOTE – The definition of the header is such that SPIFF files are backward compatible, i.e. if a SPIFF file is supplied to most of the currently known commercial and public domain implementations of decoders that read compressed image data, as specified in CCITT Rec. T.81 | ISO/IEC 10918-1 and this Recommendation | International Standard, they are likely to be able to successfully decode the interchange format data stream (without using any of the other information in the SPIFF file).

F.1.1.2 Directory

The directory is a sequence of directory entries. The directory contains, or contains references to, information necessary to accurately render decoded image data, or contains, or contains references to, ancillary information accompanying the image data.

F.1.1.3 Direct and indirect data

Directory entries may contain "direct" data, or may refer to "indirect" data. Direct data is typically used if the amount of data is small and fits within the directory entry (less than 65 528 bytes). If the data for a particular directory entry is too large to fit as direct data, the entry shall contain a reference to the indirect data. This reference shall be in the format of a 32-bit unsigned integer parameter that has a value equal to the offset, in bytes, from the start of the file to the indirect data. The first byte of the file is denoted by an offset of zero.

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2) Users of this Recommendation | International Standard may freely reproduce the SPIFF in this annex so that it can be used for its intended purpose.

F.1.1.4 Image data

Every SPIFF file shall contain image data and optionally may contain ancillary data associated with the image. The image may be represented by compressed or uncompressed image data. This data, in combination with some of the information contained in the directory, is what is necessary to accurately render the image on any given output device.

Ancillary data in the file may include one or more "thumbnail" image representations, each of which may optionally be represented by a compressed image data stream and, consequently, more than one of these data streams may be present in any given SPIFF file.

F.1.2 Application profile identifier

The SPIFF file header may contain a profile identifier which specifies the application profile required to interpret the contents of the SPIFF file. The profile ID makes it unnecessary for an application-specific implementation to support the full range of parameter values defined in this annex. The profile identifier is placed in the file header so that decoders can determine the content of the file before reading the complete directory.

F.1.2.1 Continuous-tone base profile

This profile specifies that the image is represented by a compressed data stream encoded by a subset of the baseline process of CCITT Rec. T.81 | ISO/IEC 10918-1 (JPEG), and is defined by the following:

- The compression type ("C" parameter of the file header) shall be 5 (JPEG). The compressed data stream shall be encoded with the baseline process and shall contain a single scan, i.e. if more than one component is present, the components shall be interleaved.
- The colour space ("S" parameter of the file header) shall be 3 or 8.
- The image orientation directory entry is not present.
- The use of indirect data is not allowed.

F.1.2.2 Continuous-tone progressive profile

This profile provides for low-speed communication applications, especially on low speed networks (PSTN, Mobile) in connection with conversational multimedia type of services, such as a simple Still Image Transmission Mode of Videophones. It extends the continuous-tone base profile by also supporting the following coding processes (see Table B.4):

- 8 bits, Huffman, spectral selection (capability indicator value, $CAP_0 = 6$);
- 8 bits, Huffman, full progression (capability indicator value, $CAP_0 = 8$),

in addition to the baseline sequential process (capability indicator value, $CAP_0 = 0$).

F.1.2.3 Bi-level facsimile profile

This profile is used for Group 3 and Group 4 bi-level facsimile images compressed according to Rec. T.4 (Modified Huffman – MH and Modified READ – MR), Rec. T.6 (Modified Modified READ – MMR), or Rec. T.85 (which refers to ITU-T Rec. T.82 | ISO/IEC 11544 (JBIG)), and is defined by the following:

- the compression type ("C" parameter of the file header) shall be 1, 2, 3 or 4;
- the colour space ("S" parameter of the file header) shall be 0;
- the bits per sample ("BPS" parameter of the file header) shall be 1;
- the use of indirect data is not allowed.

F.1.2.4 Continuous-tone facsimile profile

This profile applies to the representation of continuous-tone (multi-level) colour and gray-scale images for Group 3 and Group 4 facsimile as specified in Recommendations T.4, T.30, and T.503, and is defined by the following:

- the compression type ("C" parameter of the file header) shall be 5;
- the colour space ("S" parameter of the file header) shall be 14;
- the bits per sample ("BPS" parameter of the file header) shall be 8 or 12;
- the use of indirect data is not allowed.

F.1.3 Syntax description

For the purposes of this Recommendation | International Standard, the syntax specification consists of:

- the required ordering of constituent parts;
- identification of required, optional or conditional constituent parts;
- name and definition of each possible parameter and the allowed values of each parameter;
- any restrictions on the above which are specific to the contents of the contained Interchange format data stream(s).

F.1.3.1 Parameter conventions

Parameter type is identified by one of the symbols “I.”, “B.”, “F.”, or “S.” (identifying respectively: unsigned integer, byte, fixed point, and string). For type integer, the size is indicated by following the symbol “I.” by a number indicating the number of bits in the parameter. This number shall be 8, 16 or 32, indicating single byte, double byte, or quadruple byte unsigned integers. Multiple byte integers are stored with the most significant byte first. Type “B.” is used only for filler type fields (to guarantee alignment) and reserved fields. A number immediately following the symbol “B.” indicates the number of consecutive bytes occupied by the parameter.

Parameters whose type is indicated by the symbol “F.” are 4-byte parameters in “fixed point” notation. The 16 most significant bits are essentially the same as a parameter of type I.16 and indicate the integer part of this number. The 16 least significant bits are essentially the same as an I.16 parameter and contain an unsigned integer that, when divided by 65536, represents the fractional part of the fixed point number. Fixed-length string parameters, indicated by the symbol “S.”, are to be interpreted as characters from ISO/IEC 8859-1. The number of bytes in the string is indicated by the number following the “S.”. Variable-length string parameters are described by F.2.3.2.1.

F.2 High-level syntax

Figure F.1 specifies the order of high level constituent parts of the interchange file format. A more specific example using the image coding specified in CCITT Rec. T.81 | ISO/IEC 10918-1 is given in H.4.

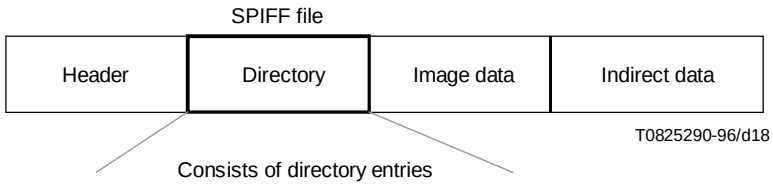

Figure F.1 – High-level syntax for the still picture interchange file format

The block labeled “indirect data” is optional and, if present, consists of one or more individual indirect data items corresponding to directory entries in the directory.

F.2.1 File header syntax

Figure F.2 specifies the syntax of the SPIFF file header, which shall be present at the start, i.e. offset zero, of every SPIFF file. This header contains some parameters that make it possible to quickly recognize a file to be a SPIFF file (by inspecting the first few bytes of the header), as well as parameters that give basic information about the image. Finally, the header contains a parameter that indicates the version of the oldest SPIFF format specification that this file conforms to.

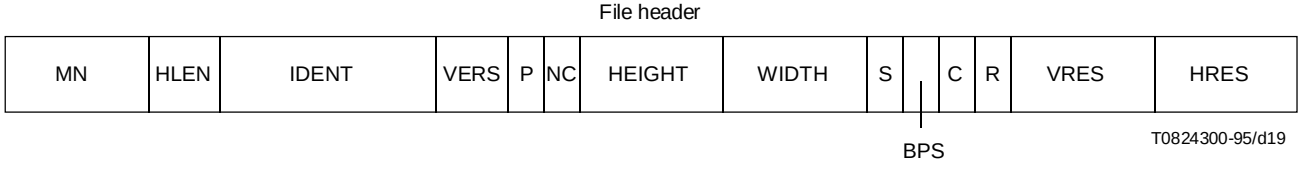

Figure F.2 – SPIFF file header syntax

FIGURE F.2...**[D19]** = 3.5 CM

The parameters shown in Figure F.2 are defined below. The size and allowed values are defined in Table F.1.

- **MN:** Magic Number – This is a number that is unique enough to distinguish the type of this file from that of many other files by just looking at these four bytes. The value of this parameter is fixed, see Table F.1.
- **HLEN:** Header Length – This parameter is the length of the file header in bytes, minus 4 (that is, MN is not included in HLEN).
- **IDENT:** An additional identifier that contributes to the uniqueness of the header – The value of this parameter is fixed and chosen to correspond to the sequence of characters "SPIFF" when interpreted using ISO/IEC 8859-1, see Table F.1.
- **VERS:** This parameter identifies the version number of this SPIFF specification that the file complies with. The parameter is defined as a two-byte integer with the most significant byte containing the major version number (currently defined as 1) and the least significant byte containing a minor revision number (currently defined as 0).

  A major version number increment (if there ever is one) represents an incompatible change in SPIFF files. Decoders should give up if they encounter an unrecognized major version number. Minor version number increments represent backwards compatible changes. Decoders should continue to process SPIFF files even if the minor version number is unrecognized.
- **P:** Profile ID – This parameter identifies the application profile which must be supported to read the SPIFF file. The allowed values are: 0 = no profile specified; 1 = continuous tone base profile; 2 = continuous tone progressive profile; 3 = bi-level facsimile profile; and 4 = continuous-tone facsimile profile.
- **NC:** Number of components – This parameter specifies the number of colour components in the image.
- **HEIGHT:** Image height – The value of this parameter indicates the number of lines in the highest component of the image.
- **WIDTH:** Image width – The value of this parameter indicates the number of samples per line in the widest component of the image.
- **S:** Colour space – This parameter specifies the colour space in which the sample values define coordinates. The order in which components are specified in the compressed image data stream shall correspond to the order established by the name of colour space. See the following subclause for a specification of the values of this parameter.
- **BPS:** Bits per sample – This parameter specifies the number of bits per sample for the components of the image. The allowed values are shown in Table F.1.
- **C:** Compression type – Specifies the compression algorithm used to compress the image data:

  0 = Uncompressed – Picture data is stored in component interleaved format, encoded at BPS per sample. When BPS is not 8, sample values shall be packed into bytes so that no bits are unused between samples. However, each scan line shall begin on a byte boundary, and padding bits having value 0 (zero) shall be inserted after the last sample of a scan line as necessary to fill out the last byte of the scan line. Sample values appear in component-interleaved order. When multiple sample values are packed into a byte, the first sample shall appear in the most significant bits of the byte. When a sample is larger than a byte, its most significant bits shall appear in earlier bytes.

  1 = Recommendation T.4, the basic algorithm commonly known as MH (Modified Huffman). This value is only permitted for bi-level images.

  2 = Recommendation T.4, commonly known as MR (Modified READ). This value is only permitted for bi-level images.

  3 = Recommendation T.6, commonly known as MMR (Modified Modified READ). This value is only permitted for bi-level images.

  4 = ITU-T Rec. T.82 | ISO/IEC 11544, commonly known as JBIG. This value is only permitted for bi-level images.

5 = CCITT Rec. T.81 | ISO/IEC 10918-1 or ITU-T Rec. T.84 | ISO/IEC 10918-3, commonly known as JPEG. The compressed image data stream shall conform to the syntax of interchange format for compressed image data as specified in the aforementioned standards. This value is only permitted for continuous-tone (grayscale or colour) images.

– **R:** Resolution units – Specifies the units in which the vertical and horizontal resolutions are expressed. Both resolutions shall be specified using the same units. A value of 1 specifies units of dots/samples per inch, a value of 2 indicates dots/samples per centimetre. A value of 0 specifies that an aspect ratio is to be defined and the values for horizontal and vertical resolutions are to be interpreted as I.32 unsigned quantities rather than fixed point number. In this case, the two numbers define the aspect ratio of the samples, i.e. the width of a sample, divided by the height of a sample.

– **VRES:** Vertical resolution – Specifies vertical resolution as a fixed point number in the units indicated by the R parameter, unless R is set to the value 0, in which case this parameter describes the numerator of a fraction that is the aspect ratio of the samples. A value for VRES of 0 is not permitted.

– **HRES:** Horizontal resolution – Specifies horizontal resolution as a fixed point number in the units indicated by the R parameter, unless R is set to the value 0, in which case this parameter describes the denominator of a fraction that is the aspect ratio of the samples. A value for HRES of 0 is not permitted.

NOTE – If vertical or horizontal resolutions are not known, R should be set to 0, and VRES and HRES both set to 1 to indicate that pixels in the image should be assumed to be square.

Table F.1 – SPIFF file header parameter sizes and values

Parameter	Type, size	Values
MN	I.32	X'FFD8FFE8'
HLEN	I.16	32
IDENT	S.6	X'535049464600'
VERS	I.16	X'0100'
P	I.8	0 - 4
NC	I.8	1 - 255
HEIGHT	I.32	1 - 4, 294, 967, 295
WIDTH	I.32	1 - 4, 294, 967, 295
S	I.8	0 - 15
BPS	I.8	1, 2, 4, 8, 12, 16
C	I.8	0 - 5
R	I.8	0 - 2
VRES	F / I.32	1 - 4, 294, 967, 295
HRES	F / I.32	1 - 4, 294, 967, 295

F.2.1.1 Allowed values for the S (colour space) parameter

This parameter identifies some well known and often used colour spaces that are perhaps not always very well defined. The values given below shall give such a definition. If an encoder does not produce/compress data in exactly one of these colour spaces, a value of 2 shall be used and applications are advised to use application specific directory entries to give further specifications.

S = 0 Bi-level – This value shall be used to indicate bi-level images. Each image sample is one bit: 0 = white and 1 = black.

S = 1 $YC_bC_r(1)$ – This is a format often used for data that originated from a video signal. The colour space is based on Recommendation ITU-R BT.709. The valid ranges of the YC_bC_r components in this space is limited to less than the full range that could be represented given an 8-bit representation. Recommendation ITU-R BT.601-1 specifies these ranges as well as defines a 3×3 matrix transform that can be used to convert these samples into RGB.

S = 2 This value indicates that the colour space interpretation of the coded sample components is none of the interpretations specified in this subclause.

S = 3 $YC_bC_r(2)$ – This is the most commonly used format for image data that was originally captured in RGB (uncalibrated format). The colour space is based on Recommendation ITU-R BT.601-1. The valid ranges of the YC_bC_r components in this space is [0,255] for Y, and [–128,127] for C_b and C_r (stored with an offset of 128 to convert the range to 0-255). These ranges are different from the ones defined in Recommendation ITU-R BT.601-1. Recommendation ITU-R BT.601-1 specifies a 3×3 matrix transform that can be used to convert these samples into RGB.

S = 4 $YC_bC_r(3)$ – This is a format often used for data that originated from a video signal. The colour space is based on Recommendation ITU-R BT.601-1. The valid ranges of the YC_bC_r components in this space is limited to less than the full range that could be represented given an 8-bit representation. Recommendation ITU-R BT.601-1 specifies these ranges as well as defines a 3×3 matrix transform that can be used to convert these samples into RGB.

S = 5 Reserved.

S = 6 Reserved.

S = 7 Reserved.

S = 8 Grayscale – This is a single component sample with interpretation as grayscale value (luminance only). This value should be used for images having number of bits per sample greater than or equal to two. A value of 0 indicates minimum intensity, and a value of $2^{BPS} – 1$ indicates maximum intensity.

S = 9 PhotoYCC – This is the colour encoding method used in the Photo CD™ system. The colour space is based on Recommendation ITU-R BT.709 reference primaries. Recommendation ITU-R BT.709 linear RGB image signals are transformed to non-linear R'G'B' signals. Values for RGB may be either positive or negative. For positive values, the non-linear transformation corresponds to the opto-electronic transfer characteristics defined in Recommendation ITU-R BT.709. Equations for transforming R'G'B' values to YCC correspond to Recommendation ITU-R BT.601-1. Details of this encoding method can be found in Kodak Photo CD Products, *A Planning Guide for Developers*, Eastman Kodak Company, Part No. DC1200R and also in Kodak Photo CD Information Bulletin PCD045.

S = 10 RGB – The encoded data consists of samples of (uncalibrated) R, G and B data, directly suitable for display on typical RGB devices. For each component, a value of 0 indicates minimum intensity, and a value of $2^{BPS} – 1$ indicates maximum intensity.

S = 11 CMY – The encoded data consists of samples of Cyan, Magenta and Yellow samples, directly suitable for printing on typical CMY devices. A value of 0 shall indicate 0% ink coverage, whereas a value of $2^{BPS} – 1$ shall indicate 100% ink coverage for given component sample.

S = 12 CMYK – As CMY above, except there is also a black (K) ink component. Ink coverage is defined as above.

S = 13 YCCK – This is the result of transforming original CMYK type data by computing $R = (2^{BPS} – 1) – C$, $G = (2^{BPS} – 1) – M$, and $B = (2^{BPS} – 1) – Y$, applying the RGB to YCC transform specified for S = 3, and then recombining the result with the unmodified K-sample value.

NOTE 1 – This transform is intended to be the same as that specified in Adobe PostScript.

S = 14 CIELab – The CIE 1976 (L* a* b*) colour space. A colour space defined by the CIE (Commission Internationale de l'Eclairage), having approximately equal visually perceptible difference between equally spaced points throughout the space. The three components are L*, or Lightness, and a* and b* in chrominance. Default version as defined in Recommendation T.42.

S = 15 Bi-level – This value shall be used to indicate bi-level images. Each image sample is one bit: 1 = white and 0 = black.

NOTE 2 – The value encoded in the S parameter does not imply that when the original samples were captured they were represented in the same colour space. Quite often encoders will decide, in order to achieve greater compression performance, to apply some colour space transformation to the samples before encoding. A good example is original data in the RGB colour space which is almost always transformed into the $YC_bC_r(2)$ colour space before encoding.

F.2.2 Directory syntax

Figure F.3 specifies the syntax of the directory format. The EOD entry is mandatory even if no other directory entries are present.

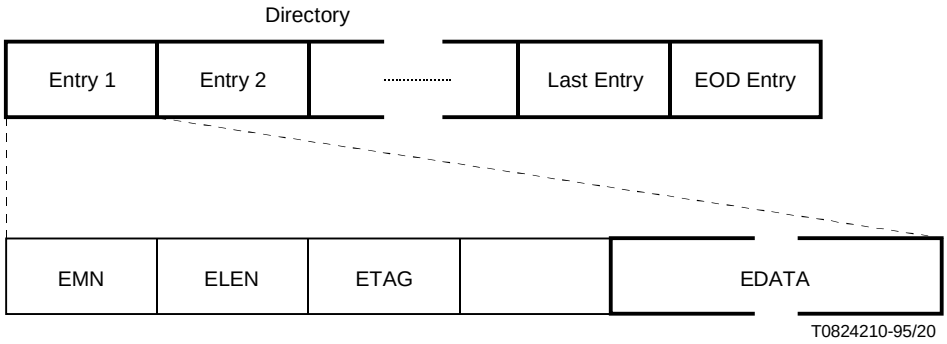

Figure F.3 – Directory syntax

The parameters shown in Figure F.3 are defined below. The size and allowed values are defined in Table F.2.

- **EMN:** Entry Magic Number – This two-byte code signals the start of a directory entry. The value of this parameter is fixed, see Table F.2.
- **ELEN:** Entry Length – This parameter is the length of the directory entry in bytes, minus 2 (that is, EMN is not included in ELEN).
- **ETAG:** Uniquely defines each set of logically related pieces of information about the image, or ancillary information, that is stored either within the entry (in the EDATA field), or is found in the indirect data part of the file. The value of this parameter is decomposed into several groups of bits. The 8 most significant bits are reserved and must be zero. Of the following 24 bits that make up the tag identification, the 3 most significant bits are used to subdivide the available range of values for tags identification into 5 separate ranges, each of which is assigned to a particular standards body or are assigned for application use, see F.2.2.2. The rest of the bits in the tag are defined by the respective standards body or application. This Recommendation | International Standard, and possible future extensions, shall only define ETAG values that use the value 0 (zero) for these 3 bits.
- **EDATA:** Contains data specific for this ETAG. This data has a format specific for the corresponding ETAG value (for specifics see the definitions of the possible ETAG values). In some cases the EDATA field will contain nothing but an offset to the “real” data stored in one of the indirect data blocks.

Table F.2 – Directory parameter sizes and values

Parameter	Type, size	Values
EMN	I.16	X’FFE8’
ELEN	I.16	8 - 65534
ETAG	I.32	0 - 16, 777, 215
EDATA	Varies	defined by ETAG

The minimum entry size is 8 bytes, for an entry with no associated data. It is required that each directory entry occupies a multiple of 4 bytes. Entries that at first do not meet this requirement should be made to adhere to this rule by adding 1, 2 or 3 filler bytes to the EDATA parameter. Alignment restrictions for individual pieces of indirect data may cause one or more "filler" bytes to exist in between two such indirect items where none of these bytes is described by, or belongs to, any particular directory entry. All bits in such bytes shall be set to zero.

Applications that decode the still picture interchange file format shall deal with all possible ETAG values. Any directory entry that is encountered with an unknown (by the decoder) ETAG value shall be ignored and skipped using the ELEN parameter value.

The term "Tag value" is used hereafter to refer to the value of the ETAG parameter.

F.2.2.1 Directory entry length specification

The ELEN parameter allows applications that do not recognize certain tags to skip directory entries and continue with a subsequent entry. A value of 'n' for the ELEN parameter indicates a directory entry with n + 2 bytes. Consequently directory entries can vary in size from 8 to 65536 (0-65528 bytes of EDATA) bytes.

Therefore directory entries are allowed to contain up to 65528 bytes of "direct" data. If more space is needed for the parameters of a particular directory entry, this must be done through the use of "indirect" data, i.e. the direct data part of the entry should contain at least one I.32 type parameter containing the offset in the file to the indirect data. This indirect data can then be defined to have any appropriate format, as there are essentially no size restrictions for indirect data.

F.2.2.2 Directory standards body specification

The 3 bits following the 8 most significant bits (bits 23:21) in the ETAG value are used to define the "originating standards body". The values are assigned as follows:

0 - 3 ISO/IEC and common text generic standards – All entries defined in this Recommendation | International Standard shall use this originator indication.

4 ISO application standards – Entries with tag values having the originator bits set to this value are defined in ISO application standards.

5 ITU-T – Entries with tag values having the originator bits set to this value are defined in ITU-T Recommendations.

6 National standards bodies – Entries with tag values having the originator bits set to this value are defined by the various national standards bodies. There shall be 10 bits immediately following these three bits that shall indicate what country is responsible according to the numeric version of the country codes as specified in ISO 3166:1993.

7 Other – This part of the total code space for the directory entry tag value is available for application specific use (see F.2.3.1).

F.2.2.3 End of directory

A special directory entry, the EOD entry, is used to signal the end of the directory. This entry is mandatory, even if no other directory entries are present. No additional directory entries may follow the EOD entry. The tag is followed immediately by compressed image data. Table F.3 describes the size of and allowed values for the parameters of this entry.

– **EMN:** Entry Magic Number – This two-byte code signals the start of a directory entry.

– **EODLEN:** EOD Entry Length – This parameter is the exact length of the EOD entry in bytes. Note that the EOD entry length is defined differently from the lengths of other directory entries (ELEN).

– **EODTAG:** Identifies the EOD entry.

Table F.3 – End of directory parameter sizes and values

Parameter	Type, size	Values
EMN	I.16	X'FFE8'
EODLEN	I.16	8
EODTAG	I.32	1

F.2.3 Specific directory entry definitions

This subclause lists all currently defined directory entries. Each of these entries has a unique ETAG value and each subclause defining such an entry shall also specify the format of the corresponding EDATA entry.

F.2.3.1 Application specific directory entries

In order to make this file format as flexible as possible, a provision has been made that allows specific applications to add information to a SPIFF file that could not be described using the tag values defined in this Recommendation | International Standard. It should be noted, however, that such use is application specific and other applications may not recognize these entries. Unrecognized application specific tags should be skipped over and ignored.

Application specific directory entries are those that have the 3 bits immediately following the 8 most significant bits (bits 23:21) set to all 1's. All other tag values are reserved for standards bodies (see F.2.3.2).

NOTE – It is advisable for any application that decides to use these application specific tags to make sure that the EDATA field for such entries contains a value that further uniquely identifies this use of the tag to best of the application's knowledge. Such use should reduce the probability of incorrect interpretation by other applications.

F.2.3.2 Standard directory entries

All entries with tag values other than the application specific tag values defined in F.2.3.1, are reserved for use by ISO, ITU-T or national standards bodies. Several of these entries are currently defined and their specifications can be found in the following subclauses.

F.2.3.2.1 Common representation of string parameters

All standard directory entries use a common representation for string parameters. This representation allows strings to be stored as direct or indirect data and specifies the character set used to interpret the character data. All character strings are terminated with a single byte with all bits set to zero (null byte terminated). Following the terminating byte, null bytes shall be added as necessary to pad to a 4-byte boundary. Table F.4 describes the size of and allowed values for a generic example of the parameters of this entry.

- **STRLOC:** String location – If the value of this parameter is zero, the string is stored as direct data immediately following the CHARSET parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.
- **CHARSET:** Specifies a character set to be used to interpret the bytes stored in any string type parameter for the purpose of display in human readable form. A value of 0 (zero) is not allowed. A value of *N* indicates interpretation using the code tables defined by the ISO/IEC 8859-*N* standard. A value of 254 indicates interpretation according to Recommendation T.51. A value of 255 indicates interpretation according to ISO/IEC 10646 (also known as Unicode), a representation that allows for international multi-byte characters. The allowed values for *N* are determined by the existence of the corresponding ISO/IEC 8859 standard. (See the examples and guidelines in Annex H).

NOTE – If the line feed character (X'0A') is encountered, it should be treated as the "new line" function. Use of all characters with a value < X'20' should be avoided.

Table F.4 – String parameter sizes and values

Parameter	Type, size	Values
STRLOC	I.32	0, or in range from EOI marker offset to 4, 294, 967, 295
CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255

Table F.5 lists the tags, and their values, which are defined in this subclause.

Table F.5 – Tags defined in this Recommendation | International Standard

Tag name	Values
Transfer characteristics	X'00000002'
Component registration	X'00000003'
Image orientation	X'00000004'
Thumbnail	X'00000005'
Image title	X'00000006'
Image description	X'00000007'
Time stamp	X'00000008'
Version identifier	X'00000009'
Creator identification	X'0000000A'
Protection indicator	X'0000000B'
Copyright information	X'0000000C'
Contact information	X'0000000D'
Tile index	X'0000000E'
Scan index	X'0000000F'
Set reference	X'00000010'

F.2.3.2.2 Tag – Transfer characteristics

This entry describes the opto-electronic transfer characteristics of the source image. Table F.6 describes the size of and allowed values for the parameters of this entry.

- **TRANCHAR:** An 8-bit integer which describes the opto-electronic transfer characteristics (gamma correction) of the source image. If this entry is applicable for the value of the S (colour space) parameter in the file header and does not appear in the directory, a default value of 1 is assumed.

This entry shall appear at most once in the directory, and only when parameter C (compression type) in the file header has the value 5.

Table F.6 – Transfer characteristics

Transfer characteristics			Tag value: X'00000002'
Offset	Parameter	Type, size	Values
0	TRANCHAR	I.8	1 - 8
1	RESERVED	B.3	0

F.2.3.2.2.1 Allowed values for the TRANCHAR parameter

This parameter identifies well known standard transfer characteristics. The allowed values for this parameter are defined below:

- TRANCHAR = 1 Recommendation ITU-R BT.709.
- TRANCHAR = 2 Unspecified. Image characteristics are unknown.

– TRANCHAR = 3 Reserved.
– TRANCHAR = 4 Recommendation ITU-R BT.470-3 System M. Assumed display gamma = 2.2.
– TRANCHAR = 5 Recommendation ITU-R BT.470-3 System B, G. Assumed display gamma = 2.8.
– TRANCHAR = 6 SMPTE 170M.
– TRANCHAR = 7 SMPTE 240M.
– TRANCHAR = 8 Linear transfer characteristics.

F.2.3.2.3 Tag – Component registration

This entry specifies component registration, the spatial positioning of samples within components relative to the samples of other components. This entry is variable length; the number of parameters contained in this entry is given by the number of components in the image (specified by the NC parameter of the file header). Note that if the number of components is not a multiple of 4, one or more zero bytes must be appended to pad to the next 32-bit word boundary. This entry shall not be present for images having only one component. Table F.7 describes the size of and allowed values for the parameters of this entry.

– **$CROFFSET_i$:** Component registration vertical and horizontal offsets – Specifies the vertical and horizontal distances in one-half sample units to offset the current component (down and to the right). This offset is specified with respect to the grid having dimensions defined by the HEIGHT and WIDTH parameters in the file header. The vertical offset is specified in the most significant 4 bits of this parameter; the horizontal offset is specified in the least significant 4 bits. If this entry is applicable for the value of the S parameter and does not appear in the directory, a default value of 0 (zero) shall apply.

This entry shall appear at most once in the directory.

Table F.7 – Component registration

Component registration			Tag value: X'00000003'
Offset	Parameter	Type, size	Values
0	$CROFFSET_0$	I.8	0 - 255
1	$CROFFSET_1$	I.8	0 - 255
2	…		

F.2.3.2.4 Tag – Image orientation

The compressed image data commonly does not specify the order of encoding the image samples completely. For example, A.1.4 of CCITT Rec. T.81 | ISO/IEC 10918-1 mentions that encoding shall be left-to-right and top-to-bottom, but it is up to applications to define which edges of the image shall be considered left, right, top and bottom. Table F.8 describes the size of and allowed values for the parameters of this entry.

– **IMGOR:** This parameter specifies the orientation of the image, i.e. defines which edge of the image, as decoded shall be considered the top of the image for the purpose of display and rendering. The allowable values indicate a rotation in terms of multiples of 90 degrees, in clock-wise direction, that will make the image be oriented correctly after decoding and rotation. Thus, a value of 1 indicates a 90 degree rotation, 2 indicates 180 degree rotation and 3 indicates 270 degree rotation.
– **IMGFLIP:** If this parameter is set to 1 it indicates that after decoding and applying the rotation as specified by the IMGOR parameter, the image needs to have its left-to-right orientation reversed in order to be displayed correctly.

Table F.8 – Image orientation

Image orientation			Tag value: X'00000004'
Offset	Parameter	Type, size	Values
0	IMGOR	I.8	0 - 3
1	IMGFLIP	I.8	0, 1
2	RESERVED	B.2	0

If this entry is not present in the directory, the defaults shall be 0 (zero) for IMGOR and 0 (zero) for IMGFLIP, indicating that the first row of MCUs resulting from decoding shall be along the top of the resulting image. If this entry is present in the directory, it shall appear at most once.

NOTE – In most cases, images have been encoded using a fairly trivial model of this orientation issue. Generally the only issue is that of landscape versus portrait mode. Landscape mode is the most often used implementation of this orientation issue, corresponding to the normal application of typical 35 mm photography cameras. In this case, the image is larger in the horizontal dimension and IMGOR will typically be 0 (no rotation required). The other common case is portrait mode, where, using the same 35 mm camera model, this camera has been rotated 90 degree clockwise or counter-clockwise. This corresponds to IMGOR values of 1 or 3, respectively. In both scenarios above IMGFLIP would be 0.

F.2.3.2.5 Tag – Thumbnail image specification

A SPIFF file may contain a number of ancilliary images in addition to the primary compressed image data stream. All of these images shall be renditions of the primary image. The purpose of these ancilliary images is typically to supply low resolution preview images, commonly known as a "thumbnail". Table F.9 describes the size of and allowed values for the parameters of this entry.

- **TNDATA:** This parameter specifies the offset in the file to the image data for the ancillary image. If the value of this parameter is zero, the image data for the ancillary image is stored as direct data immediately following the reserved byte at the end of the parameter list. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.

  The other parameters of this entry describe how this data is to be interpreted and used to render the ancillary image.
- **TNHEIGHT:** This parameter specifies the size of the thumbnail image in terms of the number of samples in the highest component of the thumbnail image. A value of 0 (zero) is not allowed.
- **TNWIDTH:** This parameter specifies the size of the thumbnail image in terms of the number of samples in the widest component of the thumbnail image. A value of 0 (zero) is not allowed.
- **TNS:** This parameter describes the colour space defined for the sample data comprising the thumbnail. The allowed values are identical to those defined for the S parameter in the file header. There is no requirement for the colour space defined by TNS to be the same as that defined in the file header for the primary image.
- **TNBPS:** This parameter specifies the number of bits per sample for the image components of the thumbnail image. The allowed values are shown in Table F.9. The number of bits per sample in the thumbnail image shall not be greater than the number of bits per sample defined in the file header for the primary image.
- **TNC:** This parameter specifies the compression type of the thumbnail data. The allowed values for this parameter are identical to those defined for the C parameter of the file header. There is no requirement for the compression type defined by TNC to be the same as that defined in the file header for the primary image.

Table F.9 – Thumbnail image specification

Thumbnail image specification			Tag value: X'00000005'
Offset	Parameter	Type, size	Values
0	TNDATA	I.32	Any
4	TNHEIGHT	I.16	1 - 65535
6	TNWIDTH	I.16	1 - 65535
8	TNS	I.8	0 - 14
9	TNBPS	I.8	1, 2, 4, 8, 12, 16
10	TNC	I.8	0 - 5
11	RESERVED	B.1	0
12	…		

When TNC is zero and TNBPS is not 8, sample values shall be packed into bytes so that no bits are unused between samples. However, each scan line shall begin on a byte boundary, and padding bits having value 0 (zero) shall be inserted after the last sample of a scan line as necessary to fill out the last byte of the scan line. Sample values appear in component-interleaved order. When multiple sample values are packed into a byte, the first sample shall appear in the most significant bits of the byte. When a sample is larger than a byte, its most significant bits shall appear in earlier bytes.

NOTE – It is strongly suggested that the value of TNS be set to either 3, 8, or 10. This should make it possible for applications that do not want to implement full decoders to still use thumbnails from SPIFF files.

Notice that there is no indication of the resolution (in dots per inch or centimeter) for the thumbnail. This is not necessary, as this information can be directly derived from the corresponding information for the primary image.

F.2.3.2.6 Tag – Image title

This entry describes in textual form a title for the image. Table F.10 describes the size of and allowed values for the parameters of this entry.

– **TITLELOC:** Location of a string containing textual representation of the image title – If the value of this parameter is zero, the string is stored as direct data immediately following the CHARSET parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.

– **CHARSET:** Specifies the character set to be used to interpret the character data (see F.2.3.2.1).

NOTE – The meaning and interpretation of the text in this entry is application specific.

Table F.10 – Image title

Image title			Tag value: X'00000006'
Offset	Parameter	Type, size	Values
0	TITLELOC	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255
5	…		

F.2.3.2.7 Tag – Image description

This entry refers to data in textual form containing additional descriptive information about the image contained in this file. Table F.11 describes the size of and allowed values for the parameters of this entry.

- **DESCLOC:** Location of a string containing additional descriptive material about the image – If the value of this parameter is zero, the string is stored as direct data immediately following the CHARSET parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.
- **CHARSET:** Specifies the character set to be used to interpret the character data (see F.2.3.2.1).

NOTE – The meaning and interpretation of the text in this entry is application specific

Table F.11 – Image description

Image description			Tag value: X'00000007'
Offset	Parameter	Type, size	Values
0	DESCLOC	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255
5	…		

F.2.3.2.8 Tag – Time stamp

This entry describes the date and time of the last modification of the image. The parameters of this entry are fixed-length strings which do not follow the conventions used by the string parameters of other tags. The character set used to interpret the data contained in this tag shall be that specified in ISO 8859-1. Table F.12 describes the size of and allowed values for the parameters of this entry.

- **DATE:** A string containing textual representation of the last modification date for the image – This representation is to conform to the format prescribed by the extended format of the ISO 8601 standard and is of the form YYYY-MM-DD, where YYYY specifies the year, MM specifies the month (01-12) and DD specifies the day of the month (01-31).
- **TIME:** A string containing textual representation of the last modification time for the image – This representation is to conform to the format prescribed by the ISO 8601 standard for Coordinated Universal Time (UTC) and is of the form HH:MM:SS.mmmZ. HH represents the hour (using a 24-hour time system), MM represents the minutes (00-59), and SS.mmm represents the seconds (00-59.999) to one millisecond resolution. The Z character (coded as X'5A') indicates UTC timing.

This entry shall appear at most once in the directory.

Table F.12 – Time stamp

Time Stamp			Tag value: X'00000008'
Offset	Parameter	Type, size	Values
0	DATE	S.10	ISO 8601 format date
10	TIME	S.13	ISO 8601 format time
23	RESERVED	B.1	0 (reserved)

F.2.3.2.9 Tag – Version identifier

This entry describes in textual form a version identifier which refers to the number of revisions of the image. Table F.13 describes the size of and allowed values for the parameters of this entry.

- **VERSNLOC:** Location of a string containing textual representation of the Version identifier – If the value of this parameter is zero, the string is stored as direct data immediately following the CHARSET parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.
- **CHARSET:** Specifies the character set to be used to interpret the character data (see F.2.3.2.1).

NOTE – The meaning and interpretation of the text in this entry is application specific.

Table F.13 – Version identifier

Version identifier			Tag value: X'00000009'
Offset	Parameter	Type, size	Values
0	VERSNLOC	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255
5	…		

F.2.3.2.10 Tag – Creator identification

This entry describes in textual form the creator of the image. The concept of what constitutes the creator of an image is application specific. Table F.14 describes the size of and allowed values for the parameters of this entry.

- **CREATLOC:** Location of a string containing textual representation of the creator identification – If the value of this parameter is zero, the string is stored as direct data immediately following the CHARSET parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.
- **CHARSET:** Specifies the character set to be used to interpret the character data (see F.2.3.2.1).

NOTE – The meaning and interpretation of the text in this entry is application specific.

Table F.14 – Creator identification

Creator identification			Tag value: X'0000000A'
Offset	Parameter	Type, size	Values
0	CREATLOC	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255
5	…		

F.2.3.2.11 Tag – Protection indicator

The presence of this entry, indicates that the image's owner has retained copyright protection and usage rights for the image. The concept of what constitutes valid copyright information is open to interpretation and this Recommendation | International Standard does not intend to attempt to resolve that question. Table F.15 describes the size of and allowed values for the parameters of this entry.

- **LEVAUT:** Indicates the "level of authenticity" assigned to the image by the owner. The allowed values for this parameter are:
  0 = indicates an unknown status;
  1 = indicates a master image;
  2 = indicates an unmodified part of a master image;
  3 = indicates that the image has been modified from the master image.
- **COPYRID:** An 8-bit copyright identifier allocated in accordance with the registration scheme defined in ISO/IEC 13818-2, Amendment 1. It identifies a work type code identifier (such as ISBN, ISSN, ISRC, etc.) whose value is defined by the Copyright Registration Authority established in accordance with ISO/IEC IS13818-2, Amendment 1. If no appropriate value has been allocated, COPYRID shall be set to X'00'.

This entry shall appear at most once in the directory.

Table F.15 – Protection indicator

Protection Indicator			Tag value: X'0000000B'
Offset	Parameter	Type, size	Values
0	LEVAUT	I.8	0 - 3
1	COPYRID	I.8	0 - 255
2	RESERVED	B.2	0 (reserved)

F.2.3.2.12 Tag – Copyright information

This entry describes in textual form copyright information for the image. The concept of what constitutes valid copyright information is open to interpretation and this Recommendation | International Standard does not intend to resolve that question. Table F.16 describes the size of and allowed values for the parameters of this entry.

- **COPYRLOC:** Location of a string containing textual representation of the copyright information – If the value of this parameter is zero, the string is stored as direct data immediately following the CHARSET parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.
- **CHARSET:** Specifies the character set to be used to interpret the character data (see F.2.3.2.1).

Table F.16 – Copyright information

Copyright information			Tag value: X'0000000C'
Offset	Parameter	Type, size	Values
0	COPYRLOC	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255
5	…		

F.2.3.2.13 Tag – Contact information

This entry describes in textual form contact information for use of the image. The contents of this entry is application specific. Table F.17 describes the size of and allowed values for the parameters of this entry.

- **REGCON:** This indicates the country of the national body responsible for allocating the contact Registration Authority identifier, REGAUT, according to the numeric version of the country codes as specified in ISO 3166:1993. The appropriate national body shall be nominated by ISO/IEC JTC1/SC29. A value of X'0000' indicates that the contact Registration Authority identifier has been directly allocated by ISO/IEC JTC1/SC29.
- **REGAUT:** An identifier, allocated by the organization indicated by REGCON, specifying a particular contact Registration Authority – A value of X'0000' is used to indicate non-registered contact information.
- **REGID:** A 32-bit registration identifier obtained from the contact Registration Authority indicated by REGAUT – If REGAUT is zero, the meaning of the registration identifier is unspecified.
- **CONTLOC:** Location of a string containing textual representation of the contact information – If the value of this parameter is zero, the string is stored as direct data immediately following the CHARSET parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.
- **CHARSET:** Specifies the character set to be used to interpret the character data (see F.2.3.2.1).

Table F.17 – Contact information

Contact information			Tag value: X'0000000D'
Offset	Parameter	Type, size	Values
0	REGCON	I.16	0 - 65535
2	REGAUT	I.16	0 - 65535
4	REGID	I.32	0 - 4, 294, 967, 295
8	CONTLOC	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
12	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255
13	...		

F.2.3.2.14 Tag – Tile index

This entry refers to data containing a list of offsets into the file. Each offset points to the X'FF' byte of a define tile (DTT) marker present in the compressed data stream of the image. The list contains one offset for each and every DTT marker segment in the compressed data stream. Table F.18 describes the size of and allowed values for the parameters of this entry.

- **DTTINDX:** This parameter contains the offset in the file to data that contains a list of offsets into the file pointing at X'FF' byte of define tile (DTT) marker segments, as described above. This list is sorted in ascending order. The length of the list is given by the NUMDTT parameter. If the value of this parameter is zero, the string is stored as direct data immediately following the NUMDTT parameter. If non-zero, the string is stored as indirect data and the value of the parameter is the string's starting offset.
- **NUMDTT:** This parameter contains the total number of DTT marker segments (tiles) in the compressed data stream.

This entry shall appear at most once in the directory and only when parameter C (Compression type) of the file header is 5.

Table F.18 – Tile index

Tile index			Tag value: X'0000000E'
Offset	Parameter	Type, size	Values
0	DTTINDX	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
4	NUMDTT	I.32	2 - 4, 294, 967, 295

F.2.3.2.15 Tag – Scan index

This entry refers to data containing a list, the scan list, having a length equal to the number of scans in the compressed data stream. The scan list contains one 4-word entry for each and every scan in the compressed data stream. Table F.19 describes the size of and allowed values for the parameters of this entry.

- **SCANLIST:** This parameter contains the offset in the file to data that contains a list of 4-word entries. Each entry in the list is comprised of these four 32-bit words:
  1) SCANSTRT, the file offset to the X'FF' byte of the SOS marker.
  2) SCANEND, the file offset of the first marker after the scan's compressed data (not counting any RSTn markers within the scan).
  3) RSTLIST, the file offset to the start of the restart marker index list for the scan or zero (if the scan does not contain restart markers, or if the encoder chooses not to store a restart index for this scan). The restart marker index list contains offsets which point to the X'FF' byte of each RST markers in the scan. This list is sorted in ascending order. The length of the list is given by the NUMRST parameter.
  4) NUMRST, the number of restart markers within the scan or zero (if the scan does not contain restart markers).

  Entries in the scan list shall appear in ascending order by SCANSTRT value.
- **NUMSCAN:** This parameter contains the total number of SOS marker segments in the compressed data stream.

Table F.19 – Scan index

Scan index			Tag value: X'0000000F'
Offset	Parameter	Type, size	Values
0	SCANLIST	I.32	0 or in range from EOI marker offset to 4, 294, 967, 295
4	NUMSCAN	I.32	1 - 4, 294, 967, 295

The purpose of this entry is to provide direct access to specific scan or restart interval without having to scan through the entire compressed data stream. Before a decoder can use this entry for direct access, the compressed data stream shall be processed sequentially until the first SOS marker is encountered. The decoder can then use the SCANEND file offset to skip to the end of any scan and continue decoding. When a scan index is present, the location of table and miscellaneous markers is restricted to permit random access to the data stream. A scan index may appear only if:

a) tables and miscellaneous markers appear only before the first SOS marker; or

b) all tables and miscellaneous markers are repeated before each SOS marker.

This entry shall appear at most once in the directory and only when parameter C (Compression type) of the file header is 5.

F.2.3.2.16 Tag – Set reference

This entry contains a 96-bit reference number (stored as three 32-bit parameters) intended to relate images stored in separate files. Use of this reference number is application specific. Table F.20 describes the size of and allowed values for the parameters of this entry.

- **REFNO1:** The first 32-bit reference number for the image in this file.
- **REFNO2:** The second 32-bit reference number for the image in this file.
- **REFNO3:** The third 32-bit reference number for the image in this file.

Table F.20 – Set reference

Set reference			Tag value: X'00000010'
Offset	Parameter	Type, size	Values
0	REFNO1	I.32	0 - 4, 294, 967, 295
4	REFNO2	I.32	0 - 4, 294, 967, 295
8	REFNO3	I.32	0 - 4, 294, 967, 295