SMPTE RECOMMENDED PRACTICE

D-Cinema Distribution Master — Mapping of Images into Constrained Tag Image File

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Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Administrative Practices.

SMPTE RP 428-5 was prepared by Technology Committee 21DC.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This recommended practice is intended to facilitate the interchange of the uncompressed image files that make up a Digital Cinema Distribution Master (DCDM) between post production facilities. It is expected to be used for finished trailers as well as full-length feature films. It also defines the input image file format that would be supported by JPEG 2000 encoding tools. It can also be used for film preview screenings or an archive of the feature film project.

An appropriate file format for storing the DCDM Image files should be capable of containing a complete or partial Composition. These files should also be easily processed to create a D-Cinema Package (DCP) (including compatibility with compression, encryption and wrapping processes). The file naming and directory structure should support random frame reading and writing, allowing access to scenes or other specific frame sequences for frame inserts or frame replacements.

The Tag Image File Format (TIFF) with 16 bits each per *X'*, *Y'* and *Z'* channel, stored in Photometric R, G and B channels was selected for several reasons:

- It is widely supported in professional and consumer software applications.
- Several open source libraries are available.
- It is supported by digital cinema packaging, color space conversion, and JPEG2000 encoding applications.
- In this application, the scope is narrowed to a constrained version of the TIFF file format to simplify implementation and interoperability testing.

1 Scope

This recommended practice defines the file formats, file naming conventions, file sequences, and metadata for the interchange of uncompressed picture files that make up the Digital Cinema Distribution Master (DCDM), utilizing a constrained version of the tag image file format (TIFF).

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this recommended practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE 428-1-2006, D-Cinema Distribution Master — Image Characteristics

SMPTE RP 428-6-2009, D-Cinema Distribution Master — Digital Leader

ISO 12639:2004(E) Graphic Technology — Prepress Digital Data Exchange — Tag Image File Format for Image Technology (TIFF/IT)

ISO/IEC 646:1991, Information Technology — ISO 7-Bit Coded Character Set for Information Interchange

4 Constrained Tag Image File Format

DCDM images shall be mapped as full color images in the Tag image file format, as defined in ISO 12639:2004(E), Subclause 7.1, Structure of TIFF/IT file, and as constrained in this recommended practice. Where ISO 12639:2004(E) defines a TIFF/IT file format for prepress graphic technology, this recommended practice defines a DCDM constrained tag image file format for digital cinema. Where requirements of this recommended practice and ISO 12639:2004(E) are in conflict, this recommended practice shall take precedence.

4.1 Channel Mapping

The DCDM *X'*, *Y'* and *Z'* color channel data, as defined in SMPTE 428-1, DCDM Image Characteristics, shall be mapped to Photometric R, G and B channels as follows. For reference, see Annex A, Tag 262, PhotometricInterpretation.

- *X'* channel of DCDM to Photometric R channel,
- *Y'* channel of DCDM to Photometric G channel, and
- *Z'* channel of DCDM to Photometric B channel.

The code values shall retain the gamma 2.6 encoding of the original *X'*, *Y'* and *Z'* channels.

4.2 Data Format

The pixel interleaved data format shall be used ("chunky" format). The *X'*, *Y'* and *Z'* channels shall be stored as contiguous samples (*X'Y'Z'*). For reference, see Annex A, Tag 284, PlanarConfiguration.

Note: The pixel packing data structure was chosen for compatibility with real-time disk playback systems used in color correction and quality control operations in post production.

The *X'Y'Z'* interleaved code values shall be organized in a single image plane as a rectangular array of pixels with ImageWidth columns (number of pixels per row) and ImageLength rows, in a single strip. For reference, see Annex A, Tag 256, ImageWidth, Tag 257, ImageLength, and Tag 278, RowsPerStrip.

The code values shall utilize 16 bits for each sample (color channel), with 3 color channels for each pixel. For reference, see Annex A, Tag 258, BitsPerSample, and Tag 277, SamplesPerPixel.

4.3 Integer Pixel Representation

Each pixel in a compliant file shall be represented by three unsigned integer code values, each with a minimum of 12 bits. The 12-bit code values shall be stored in the top 12 most significant bits of the 16 bits. The remaining four least significant bits should be set to 0111.

DCDM constrained tag image files created in compliance with this recommended practice are intended to be used as input to a 12-bit compression process. The compression process will therefore truncate or round the 16-bit samples from the files. Users are cautioned to perform appropriate rounding when creating compliant files to avoid any introduction of image artifacts due to truncated LSBs.

4.4 Image Orientation

The image orientation shall place the first pixel of a compliant file in the upper left corner of the image. The 0th row shall represent the visual top of the image, and the 0th column shall represent the visual left-hand side. For reference see Annex A, Tag 274, Orientation.

4.5 Image Structures

The image pixel array contained in a compliant file shall conform to one of the Image Structures defined in SMPTE 428-1, DCDM Image Characteristics.

4.6 Byte Order

The Byte Order used within a compliant file shall be from the most significant to the least significant, for both 16-bit and 32-bit integers. This is called big-endian byte order. Bytes 0 – 1 of the image file header at the beginning of the file shall have the values “MM” or 4D4D.h. For reference, see ISO 12639:2004(E), Subclause 7.1.2, Header.

4.7 Image Subfile

A compliant file shall convey only main image data in one image subfile, with one Image File Directory (IFD). For reference, see ISO 12639:2004(E), Subclause 7.1.3, Image subfiles.

4.8 Compression

No compression shall be applied to the image files themselves. For reference, see Annex A, Tag 259, Compression.

4.9 Encryption

No encryption shall be applied to the image files themselves.

5 File Naming and Numbering Convention

Each image shall be contained in a separate image file. An image sequence shall comprise a directory containing a series of image files where the image files have like parameters.

The file names shall be formed of only ISO 646 single byte characters, constrained to digits (character values 48 through 57), upper and lower case letters (character values 65 through 90, and 97 through 122), the underscore "_" (character value 95), the dash "-" (character value 45), and the period or dot “.”(character value 46).

The file name shall end with the file name extension: “.tif” (delimited by the period character “.”). The file name extension shall be preceded by a frame number identifier. The frame number identifier may optionally be preceded by a string of characters as constrained in this section, delimited from the frame number identifier by another period character “.”.

The file name shall not exceed 128 characters in length, including the frame number and file name extension.

The frame number identifiers shall be in an ascending numbered sequence with no gaps in the sequence for a given image sequence. Leading zeros shall be used to maintain a constant number of digits.

Post production reel names and abbreviations may be used. Any character strings used in the filename shall be constant for all image files intended for the same image sequence. The only characters that shall change from one file name to another within an image sequence shall be the digits that make up the frame number identifier.

When sorted alphanumerically, all files in an image sequence shall be in the intended temporal display order.

Example1:
```
Your_Movie_R1_SCOPE.000192.tif
Your_Movie_R1_SCOPE.000193.tif
```

Example2:
```
My_Movie_TRLR-J_FLAT.000000.tif
My_Movie_TRLR-J_FLAT.000001.tif
```

Example3:
```
086400.tif
086401.tif
```

Example4:
```
172800.tif
172801.tif
```

Note: From example 3, 086400 equals 01:00:00:00 in frames at 24 frames per second. Using one particular file naming method, this would correspond to the “picture start” frame in the head leader for reel 1. Likewise, frame number 086592, which equals 01:00:08:00 in frames at 24 frames per second, would correspond to the first frame of action (FFOA) in reel 1 after the head leader. From example 4, 172800 equals 02:00:00:00 in frames at 24 frames per second, which could be for reel 2.

6 Digital Leader

For synchronizing consistency with the digital audio files, each image file sequence that comprises a post production reel shall begin with a digital head leader that has a duration of eight seconds before the First Frame of Action. SMPTE RP 428-6, DCDM Digital Leader, defines a digital leader that should be utilized. A post production reel is an image file sequence that may be made into a D-Cinema Track File.

For example, with 24 frames per second content, 192 image files would be placed in the sequence before the First Frame of Action. Likewise, with 48 frames per second content, the count of frames in the digital leader would be 384. For more examples, with DCDM Additional Frame Rates of 25, 30, 50 or 60, the count of frames in the digital leader would be 200, 240, 400 or 480, respectively.

7 Metadata

Each frame in the file sequence shall contain accurate and complete metadata within the TIFF fields as defined in Annex A (Normative). Examples of additional information about the D-Cinema Distribution Master (DCDM) that may be carried in one or more separate XML files are shown in Annex C (Informative).

Annex A Constrained TIFF Tags (Normative)

This annex defines the TIFF tag numbers and fields that are utilized in the entries of the IFD (Image File Directory) of a compliant DCDM constrained tag image file. For reference, see ISO 12639:2004(E), Subclause 7.1.4, IFD (Image File Directory), and Subclause 7.1.5, IFD entry.

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

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

The field types used in Table A.1 and A.2 are as follows:

– ASCII 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);

– LONG a 32-bit unsigned binary integer;

– RATIONAL two LONGs, the first representing the numerator of a fraction and the second its denominator;

– SHORT a 16-bit unsigned binary integer.

Table A.1 – Mandatory Fields

TIFF Tag #	TIFF Field Name	Field type	Field value	Field contents or interpretation
256	ImageWidth	SHORT or LONG	≤2048 for 2K image ≤4096 for 4K image	Image width in pixels
257	ImageLength	SHORT or LONG	≤1080 for 2K image ≤2160 for 4K image	Image height in pixels (equals image rows)
258	BitsPerSample	SHORT	16,16,16	Bits per channel (for each color channel)
259	Compression	SHORT	1	None
262	PhotometricInterpretation	SHORT	2	RGB samples
273	StripOffsets	SHORT or LONG	Should not exceed Hex 1000h	The byte offset to the beginning of the strip of image data with respect to the beginning of the file
274	Orientation	SHORT	1	The 0th row represents the visual top of the image, and the 0th column represents the visual left-hand side.
277	SamplesPerPixel	SHORT	3	Color channels per pixel
278	RowsPerStrip	SHORT or LONG	Same as ImageLength	The entire image (all image rows) packaged into one single strip
279	StripByteCounts	SHORT or LONG	ImageWidth x ImageLength x 6	The number of bytes in the single strip = ImageWidth * ImageLength * bytes per pixel
284	PlanarConfiguration	SHORT	1	Chunky format, single image plane. The component values for each pixel are stored contiguously. For RGB data, the data is stored as RGBRGBRGB…

The TIFF fields listed in Table A.1 shall be included in the DCDM constrained tag image file. Field values that do not depend on image size shall be set to the indicated values. The fields ImageWidth, ImageLength, RowsPerStrip, and StripByteCounts depend on image size. Additional TIFF fields are allowed, as long as they do not affect the DCDM interpretation.

Table A.2 – Recommended Fields

TIFF Tag #	TIFF Field Name	Field type	Field value	Field contents or interpretation
282	XResolution	RATIONAL	2000 / 400 or any valid value	Approximate physical dimension, pixels per inches. ImageWidth [in pixels] / theater screen width [in inches]. (This value is informative only and is not used for display.)
283	YResolution	RATIONAL	2000 / 400 or any valid value	Same as XResolution (for square pixels)
296	ResolutionUnit	SHORT	2	Inch. Applies to XResolution and YResolution
270	Image Description	ASCII string	"SMPTE DCDM X'Y'Z' image as defined in SMPTE RP428-5"	Human readable text
51056	SMPTEDCDMVersion	SHORT	1	Machine readable tag identifies the file as being compliant with SMPTE RP428-5

The TIFF fields listed in Table A.2 are recommended and should be included in the DCDM constrained tag image file.

Note: The fields XResolution, YResolution and ResolutionUnit are usually required for TIFF, but in practice are often omitted.

A.1 ICC Profile Tag

To avoid accidental use, the TIFF field for ICC profile, Tag 34675, shall not be included in a compliant DCDM constrained tag image file.

Annex B Sample C Code for DCDM Constrained Tag Image File Creation (Informative)

Here is an example of sample c code for setting the parameters for the creation of a DCDM constrained tag image file (using the "libtiff" implementation):

```
/*
        the following are just c code snippets for writing
        a tiff file compatible with DCDM masters -

        all function calls here link with libtiff.a
        which can be found at www.libtiff.org
*/

/*
        man page for tiffopen:
        http://linux.die.net/man/3/tiffopen
*/

#include <tiffio.h>

TIFF *out;
char *outfile;
int nx, ny;
unsigned short *outbuf;

...

        /* “wb” opens the file for write as big-endian */

        out = TIFFOpen(outfile, "wb");
        if (out == NULL)
                return -1;      /* error opening file */

        /* the following set the tiff attributes */


        TIFFSetField(out, TIFFTAG_IMAGEWIDTH, nx);
        TIFFSetField(out, TIFFTAG_IMAGELENGTH, ny);
        TIFFSetField(out, TIFFTAG_SAMPLESPERPIXEL, 3);
        /* libtiff sets all color channels to the same bits per sample */
        TIFFSetField(out, TIFFTAG_BITSPERSAMPLE, 16);
        /* sampleformat is here to ensure usage of unsigned integer data */
        TIFFSetField(out, TIFFTAG_SAMPLEFORMAT, SAMPLEFORMAT_UINT);
        TIFFSetField(out, TIFFTAG_PHOTOMETRIC, PHOTOMETRIC_RGB);
        TIFFSetField(out, TIFFTAG_PLANARCONFIG, PLANARCONFIG_CONTIG);
        TIFFSetField(out, TIFFTAG_ORIENTATION, ORIENTATION_TOPLEFT);
        TIFFSetField(out, TIFFTAG_ROWSPERSTRIP, ny);
        TIFFSetField(out, TIFFTAG_RESOLUTIONUNIT, 2);
        TIFFSetField(out, TIFFTAG_XRESOLUTION, 5);
        TIFFSetField(out, TIFFTAG YRESOLUTION, 5);
        TIFFSetField(out, TIFFTAG_COMPRESSION, COMPRESSION_NONE);
        TIFFSetField(out, TIFFTAG_IMAGEDESCRIPTION, "SMPTE DCDM X’Y’Z’ image as
defined in SMPTE RP 428-5");
```

```
        /* this is the output buffer for one scanline (row) */
        outbuf = (unsigned short *) malloc (nx*3*sizeof(short));


        /* here's where we write the file scanline by scanline (row by row) */
        for (y=0 ; y<ny; y++) {

                /*
                        fill outbuf one scanline (row) at a time -
                        each RGB pixel is 48 bits (16bits each for R, G, B)

                        RGBRGBRGBRBGRBG...

                        and write each scanline (row) to the tiff file:
                */

                if (TIFFWriteScanline(out, outbuf, y, 0) < 0)
                      return -1;        /* error writing scanline (row) */
        }

        free (outbuf);
        (void) TIFFClose(out);

...
```

Note: The TIFF field SampleFormat has been included in this example to ensure usage of unsigned integer data. It is not a mandatory field. However, it is allowed because the field value used does not affect the DCDM interpretation. Unsigned integer code values for a DCDM constrained tag image file are defined in this recommended practice, Section 4.3, Integer Pixel Representation. SampleFormat is described in TIFF 6.0, Section 19.

Annex C Examples of additional DCDM image information (Informative)

Here are examples of additional information for the D-Cinema Distribution Master (DCDM).

C.1 DCDM Composition Information

The information items in this subsection are constant for a given composition. A composition is a complete D-Cinema work as defined in SMPTE 429-7.

- Content Title
- Content Version
- Content Kind (as defined in SMPTE 429-7. For example, feature, trailer, advertisement, etc.)
- Frame Rate
- Sequence Type (normal, stereoscopic_left, stereoscopic_right)
- File Pixel Count Horizontal
- File Pixel Count Vertical

C.2 DCDM Post Production Reel Information

The information items in this subsection are for a specific post production reel or given file sequence. A post production reel is an image sequence that would typically be made into a D-Cinema Track File.

- Post Production Reel Identifier (Reel Number)
- File Date
- File Name of the First Frame that is intended for playback display (First Frame of Action, FFOA), including any relevant directory path or folder names, and frame count
- Duration (total number of frames to be played in the sequence)

  OR

  First Frame (First Frame of Action, FFOA) and Last Frame (Last Frame of Action, LFOA). The Last Frame is “inclusive”, as the frame is actually included as part of the image sequence. It is common practice for the First Frame and Last Frame values to be expressed as feet + frames, assuming 16 frames per foot of 35mm film.

  For example, the First Frame may be 12 + 00, and the Last Frame may be 1511 + 15.

  To calculate the duration, add one to the Last Frame number, and subtract the First Frame number. First convert the feet and frames values to frames. (Multiply the feet by 16 and then add the frames.)

  Using the example, the First Frame number is 192 (12 times 16 plus 0). The Last Frame number is 24191 (1511 times 16 plus 15). Then, 24191 plus 1 minus 192 is equal to 24000 frames of duration.

C.3 DCDM Supplemental (Insert) Sequence Information (Optional)

The following information items are optional, for supplemental (insert) file sequences. A supplemental sequence is a sequence of frames that is used for revising an existing targeted sequence of frames, to produce a new version. In practice, a supplemental (insert) sequence does not include a digital head leader.

- Supplemental (Insert) Sequence; (Y/N) indicates if this image sequence is intended to be a supplement for already existing material

  Absence of this indication means that this is not a Supplemental Sequence, and no supplemental sequence information is needed.

- Reference to existing material that is to be revised

- Existing Composition PlayList (CPL) file that will be revised (if known)

- Identification of the first frame in the existing targeted sequence where the supplemental sequence will be inserted

  This is the reel name and frame number of the first frame that will be replaced or moved.

- The number of frames in the existing targeted sequence that will be replaced by the supplemental (insert) sequence

  This is zero where the supplemental sequence type is to Augment, where all of the original existing frames will be moved and continue playing after this supplemental sequence is inserted.

- Supplemental sequence type (Replace or Augment).

Annex D Example ICC profile (Informative)

Where viewing an image in a compliant DCDM constrained tag image file, and using a display device that is not a cinema projector, it is possible for the viewing software to apply an ICC profile to color convert the image. The ICC profile would be used to transform from a DCDM *X'Y'Z'* color space with perceptual neutral around 6000K, to the ICC Profile Connection Space. This example profile represents a transform from *X'Y'Z'* with a neutral balance at 6000°K.

To avoid accidental use, the TIFF field and tag number for ICC profiles is not used in a compliant DCDM constrained tag image file. For reference, see Annex A.1, ICC Profile Tag.

For details on the ICC profile format, see ISO 15076-1, *Image technology colour management -- Architecture, profile format and data structure -- Part 1: Based on ICC.1:2004-10*. Alternatively, see International Color Consortium, ICC.1:2004-10, http://www.color.org/ICC1v42_2006-05.pdf

Hex dump

```
Length:       640 bytes
       0:_ 00 00 02 80 41 44 42 45 02 40 00 00 6D 6E 74 72  ....ADBE.@..mntr _
      16:_ 52 47 42 20 58 59 5A 20 07 D7 00 05 00 0E 00 0E  RGB XYZ ........ _
      32:_ 00 25 00 19 61 63 73 70 20 20 20 20 00 00 00 00  .%..acsp    .... _
      48:_ 53 4D 50 54 44 43 44 4D 00 00 00 00 00 00 00 00  SMPTDCDM........ _
      64:_ 00 00 00 00 00 00 F6 D6 00 01 00 00 00 00 D3 2D  ..............- _
      80:_ 41 44 42 45 00 00 00 00 00 00 00 00 00 00 00 00  ADBE............ _
      96:_ 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................ _
     112:_ 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................ _
     128:_ 00 00 00 0C 64 65 73 63 00 00 01 14 00 00 00 7D  ....desc.......} _
     144:_ 63 70 72 74 00 00 01 94 00 00 00 1D 72 54 52 43  cprt........rTRC _
     160:_ 00 00 01 B4 00 00 00 0E 67 54 52 43 00 00 01 C4  ........gTRC.... _
     176:_ 00 00 00 0E 62 54 52 43 00 00 01 D4 00 00 00 0E  ....bTRC........ _
     192:_ 72 58 59 5A 00 00 01 E4 00 00 00 14 67 58 59 5A  rXYZ........gXYZ _
     208:_ 00 00 01 F8 00 00 00 14 62 58 59 5A 00 00 02 0C  ........bXYZ.... _
     224:_ 00 00 00 14 63 68 61 64 00 00 02 20 00 00 00 2C  ....chad... ...,  _
     240:_ 77 74 70 74 00 00 02 4C 00 00 00 14 6C 75 6D 69  wtpt...L....lumi _
     256:_ 00 00 02 60 00 00 00 14 74 65 63 68 00 00 02 74  ...`....tech...t _
     272:_ 00 00 00 0C 64 65 73 63 00 00 00 00 00 00 00 23  ....desc.......# _
     288:_ 44 43 44 4D 20 44 65 66 61 75 6C 74 20 56 69 65  DCDM Default Vie _
     304:_ 77 69 6E 67 20 50 72 6F 66 69 6C 65 20 36 30 30  wing Profile 600 _
     320:_ 30 4B 00 00 00 00 00 00 00 00 00 00 00 00 00 00  0K.............. _
     336:_ 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................ _
     352:_ 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................ _
     368:_ 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................ _
     384:_ 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................ _
     400:_ 00 00 00 00 74 65 78 74 00 00 00 00 43 6F 70 79  ....text....Copy _
     416:_ 72 69 67 68 74 20 32 30 30 37 20 53 4D 50 54 45  right 2007 SMPTE _
     432:_ 00 00 00 00 63 75 72 76 00 00 00 00 00 00 00 01  ....curv........ _
     448:_ 02 9A 00 00 63 75 72 76 00 00 00 00 00 00 00 01  ....curv........ _
     464:_ 02 9A 00 00 63 75 72 76 00 00 00 00 00 00 00 01  ....curv........ _
     480:_ 02 9A 00 00 58 59 5A 20 00 00 00 00 00 00 01 20 E6  ....XYZ ...... . _
     496:_ 00 00 04 B9 FF FF F5 8D 58 59 5A 20 00 00 00 00  ........XYZ .... _
     512:_ 00 00 06 15 00 01 15 1A FF FF FC 73 58 59 5A 20  ...........sXYZ  _
     528:_ 00 00 00 00 FF FF FE 12 00 00 03 26 00 00 E3 3E  ...........&...> _
     544:_ 73 66 33 32 00 00 00 00 00 01 08 C9 00 00 04 54  sf32...........T _
     560:_ FF FF F6 6C 00 00 05 93 00 00 FD F9 FF FF FC BF  ...l............ _
     576:_ FF FF FE 3B 00 00 02 E3 00 00 D0 46 58 59 5A 20  ...;.......FXYZ  _
     592:_ 00 00 00 00 00 00 F6 D6 00 01 00 00 00 00 D3 2D  ..............- _
     608:_ 58 59 5A 20 00 00 00 00 00 00 00 00 00 00 30 00 00  XYZ .........0.. _
     624:_ 00 00 00 00 73 69 67 20 00 00 00 00 64 63 70 6A  ....sig ....dcpj _
```

Description of profile fields

Profile Header

Field	*Value*
Size	640
Preferred CMM	ADBE
Version	2.4
DeviceClass	mntr
ColorSpace	RGB
PCS	XYZ
Date	2007 5 14 14 37 25
Magic	acsp
Platform	
Flags	0
Manufacturer	SMPT
Model	DCDM
Attributes	0
Intent	0
PCS Illuminant	0.9642 1 0.8249
Creator	ADBE
ProfileID	0

Tag Table

Tag count = 12

Tag	*Offset*	*Size*	*Type*	*Value*		
Desc	276	125	desc	DCDM Default Viewing Profile 6000K		
Cprt	404	29	text	Copyright 2007 SMPTE		
rTRC	436	14	curv	2.6016		
gTRC	452	14	curv	2.6016		
bTRC	468	14	curv	2.6016		
rXYZ	484	20	XYZ	1.1285	0.0184	-0.0408
gXYZ	504	20	XYZ	0.0238	1.0824	-0.0139
bXYZ	524	20	XYZ	-0.0075	0.0123	0.8877
Chad	544	44	sf32	1.0343	0.0169	-0.0374
				0.0218	0.9921	-0.0127
				-0.0069	0.0113	0.8136
Wtpt	588	20	XYZ	0.9642	1	0.8249
Lumi	608	20	XYZ	0	48	0
Tech	628	12	sig	dcpj		

Annex E Bibliography (Informative)

SMPTE 429-7-2006, D-Cinema Packaging — Composition Playlist

TIFF, Revision 6.0 Final, Aldus Corporation (now Adobe Systems Incorporated), June 3, 1992
http://partners.adobe.com/public/developer/en/tiff/TIFF6.pdf

Some helpful sites:
http://partners.adobe.com/public/developer/tiff/index.html

http://www.libtiff.org/
http://www.remotesensing.org/libtiff
http://www.awaresystems.be/imaging/tiff.html
http://www.awaresystems.be/imaging/tiff/tifftags/sampleformat.html

man page for tiffopen:
http://linux.die.net/man/3/tiffopen

International Color Consortium, ICC.1:2004-10,
http://www.color.org/ICC1v42_2006-05.pdf

ISO 15076-1*, Image technology colour management -- Architecture, profile format and data structure -- Part 1: Based on ICC.1:2004-10*