



Standard of the Camera & Imaging Products Association

CIPA DC- 009-Translation- 2009

**Design rule for Camera File system:
DCF Unified Version 2.0**

This translation has been made based on the original Standard (CIPA DC-009-2009). In the event of any doubts arising as the contents, the original Standard is to be the final authority.

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The following standards are technically equivalent.

CIPA:

DC-009-2009 Design rule for Camera File system: DCF Unified Version 2.0

JEITA:

CP-3461A Design rule for Camera File system: DCF Unified Version 2.0



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Contents

Introduction	1
Revision History	1
1. Scope	2
2. Normative reference	2
3. Definition	2
3.1 Definition of Terms	2
3.2 Definition of characters used in directory and file names	4
4. Overview	4
4.1 DCF and recording media	4
4.2 Configuration of DCF specification	5
4.3 Approach to playback compatibility	5
4.4 Classification of functions	6
4.5 Categories of DCF-compatible equipment	6
5. DCF Media Standard	7
5.1 Directory definition	7
5.1.1 DCF image root directory	7
5.1.2 DCF directories	7
5.1.3 Other directories	8
5.1.4 Directory example	8
5.2 File definition	8
5.2.1 DCF file names	8
5.2.2 DCF objects	9
5.2.2.1 Purpose of DCF objects	9
5.2.2.2 Object definition	9
5.2.2.3 Files included in objects	9
5.2.2.4 Object file attributes	10
5.2.2.5 Object operation	10
5.3 DCF basic files	10
5.3.1 Purpose	10
5.3.2 Directory, file names and extensions	10
5.3.3 Images in a DCF basic file	10
5.3.4 Data structure of a DCF basic main image	11
5.3.4.1 Data structure	11
5.3.4.2 Data compression	11
5.3.4.3 Pixel count	11
5.3.4.4 Image aspect ratio	11
5.3.5 Attribute information	11
5.3.5.1 Exif tag structure	11
5.3.5.2 Information about shooting conditions and camera	11
5.3.5.3 DCF basic file identifying information	12
5.3.5.4 Color space	13
5.3.6 DCF basic thumbnail data structure	14
5.3.6.1 Image data format	14
5.3.6.2 Compressed data	14
5.3.6.3 Number of pixels	14
5.3.6.4 Layout	14
5.3.7 Image data format in DCF basic files	14
5.4 DCF optional files	15
5.4.1 Purpose	15
5.4.2 Directory, file names and extensions	15
5.4.3 Data structure of a DCF optional file main image	15
5.4.3.1 Data structure	15
5.4.3.2 Data compression	15
5.4.3.3 Pixel count	15
5.4.3.4 Image aspect ratio	15
5.4.4 Attribute information	15
5.4.4.1 Exif tag structure	15
5.4.4.2 Image-related information	15

- 5.4.4.3 DCF optional file identifying information..... 16
- 5.4.4.4 Color space 17
- 5.4.5 DCF optional file thumbnail data structure 18
 - 5.4.5.1 Image data format 18
 - 5.4.5.2 Compressed data 19
 - 5.4.5.3 Number of pixels..... 19
 - 5.4.5.4 Layout..... 19
- 5.4.6 Image data format in DCF optional files 19
- 5.5 DCF thumbnail files..... 19
 - 5.5.1 Purpose 19
 - 5.5.2 Directory, file name and extension 20
 - 5.5.3 Image data structure 20
 - 5.5.3.1 Data format..... 20
 - 5.5.3.2 Compressed data specification 20
 - 5.5.3.3 Pixel count..... 20
 - 5.5.3.4 Image aspect ratio 20
 - 5.5.4 Attribute information 21
 - 5.5.4.1 Exif tag structure 21
 - 5.5.4.2 Image-related information 21
 - 5.5.4.3 DCF thumbnail identification information 21
 - 5.5.4.4 Color space 22
 - 5.5.5 DCF thumbnail file data structure..... 23
- 5.6 Tag requirement levels 23
- 5.7 File structure example..... 25
- 6. Writer Specification 26
 - 6.1 Directories..... 26
 - 6.1.1 Creating directories 26
 - 6.1.1.1 DCF image root directory 26
 - 6.1.1.2 DCF directories..... 26
 - 6.1.1.3 Other directories 26
 - 6.1.2 Deleting directories..... 26
 - 6.2 Files..... 26
 - 6.2.1 Creating files..... 26
 - 6.2.1.1 Image files 26
 - 6.2.1.2 DCF thumbnail files 27
 - 6.2.1.3 Other files making up a DCF object 27
 - 6.2.1.4 Files without a DCF file name 27
 - 6.2.2 File number..... 27
 - 6.2.3 Deleting files 27
 - 6.2.3.1 DCF objects..... 27
 - 6.2.3.2 Files that are not DCF objects..... 28
- 7. Reader Specification..... 28
 - 7.1 Directories (common to Reader 1 and 2)..... 28
 - 7.1.1 Playback..... 28
 - 7.1.1.1 Playback scope 28
 - 7.1.1.2 Playback method 28
 - 7.1.2 Deletion 28
 - 7.2 Files..... 28
 - 7.2.1 Playback..... 28
 - 7.2.1.1 Reader 1 playback scope..... 28
 - 7.2.1.2 Reader 2 playback scope..... 29
 - 7.2.1.3 DCF extended image files (common to Reader 1 and 2)..... 29
 - 7.2.1.4 Supported pixel count specification..... 29
 - 7.2.2 Playback method (common to Reader 1 and 2)..... 29
 - 7.2.3 DCF optional files and color space transformation 29
 - 7.2.4 Handling of color-related tags (common to Reader 1 and 2) 30
 - 7.2.5 Deletion (common to Reader 1 and 2) 30
 - 7.2.5.1 DCF objects..... 30
 - 7.2.5.2 Files that are not DCF objects..... 31
 - 7.3 Directory number and file number display (common to Reader 1 and 2)..... 31
- 8. Other Points to Note 31

- 8.1 Naming directories under the DCF image root directory 31
 - 8.1.1 When lower-case letters are used in a directory name 32
 - 8.1.2 When directory numbers are duplicated across DCF directories..... 32
 - 8.1.3 Handling of directories that are not DCF directories 32
- 8.2 Naming of files in a DCF directory 33
 - 8.2.1 When lower-case letters are used in the file name 33
 - 8.2.2 When file numbers are duplicated across DCF basic files or DCF optional files 33
 - 8.2.3 Handling of files without DCF file names 33
- 8.3 Updating of tag data when saving 34
 - 8.3.1 Handling of date and time tags..... 34
 - 8.3.2 Handling of Make, Model, and Software tags 34
- 8.4 DCF object bulk operations..... 34
- 8.5 Identification of DCF optional files 35
- Annex A Data Verification 36
- Annex B Relation to JPEG and Exif Standards 37
- Annex C Notes on Image File Playback 38
- Annex D Limits on DCF Object Operations 39
- Annex E Notes on DCF Optional Color Space Use 40
- Annex F Guidelines for Handling Exif/DCF 41
 - Overview 41
 - 1. Background / Purpose 41
 - 1.1 Background 41
 - 1.2 Purpose 42
 - 2. Scope 43
 - 3. Definition of terms 44
 - 3.1 Verbal forms for the expression of provisions..... 44
 - 3.2 Terminology..... 45
 - 4. Handling Exif/DCF files in consideration of workflow..... 46
 - 4.1 Workflow for editing an image with application software 46
 - 4.1.1 Actions..... 47
 - 5. Issues related to the Exif standard 48
 - 5.1 JPEG compressed data 48
 - 5.1.1 Application marker segments 48
 - 5.1.2 How to deal with APPn markers undefined in the Exif standard..... 51
 - 5.1.3 Recording data other than the primary image..... 51
 - 6. Issues related to the DCF standard 53
 - 6.1 Large-capacity memory media..... 53
 - 6.1.1 File system 53
 - 7. References..... 54
 - 8. Participating members 55
- Annex G Explication of the DCF 2.0 Revision 57
 - 1. Purpose..... 57
 - 2. History of Revision 57
 - 3. Main Issues Arising in the Deliberations..... 58
 - 4. Main Revisions..... 58
 - 4.1 Definition of DCF optional files..... 58
 - 4.2 Writer specifications..... 58
 - 4.3 Reader specifications..... 58
 - 5. Intellectual Property Rights 59
 - 6. DCF Optional Color Space 59
 - 6.1 Overview 59
 - 6.2 Color space characteristics..... 60
 - 7. Committee Organization for Preparing the Draft Standard..... 60
- Participating members 63

Introduction

This document is a standard that combined “Design rule for Camera File system DCF Version 2.0 (JEITA CP-3461)” (hereinafter called “the DCF standard”) defined by JEITA with “Guidelines for Handling Exif/DCF “(CIPA DCG-004-2009) defined by CIPA. Although newly found errors were corrected and style was edited, the content of the standard has not been added nor changed anything.

In addition, the whole content of “Guidelines for Handling Exif/DCF “was added “as is” in Annex F.

Likewise, “Explication of the DCF 2.0 Revision” was added in Annex G. If the publish date is added;

Revision History

Rev	Date	Comments	Page
2.0	September, 2003	Published Revision 2.0.	
2.0 Unified Version	September, 2009	Published Revision 2.0 Unified Version.	
		<ul style="list-style-type: none"> ● Added “Guidelines for Handling Exif/DCF “(CIPA DCG-004-2009) defined by CIPA in Annex F ● Added “Explication of the DCF 2.0 Revision” in Annex G. ● Corrected errors. 	

1. Scope

DCF is applicable to products for writing image files on an interchangeable medium (removable memory) formatted with the DOS FAT file system, and to products for reading (or printing) the images recorded on removable memory by these reader products.

2. Normative reference

The standards listed below compose a part of this standard. If the publish date is added, only that version composes a part of this standard. If the publish data is not added, the latest version is adopted.

a) JEITA

CP-3451 Exchangeable image file format for digital still cameras(Exif)

b) IEC

IEC 61966-2-1 Amd.1 Ed.1 to Multimedia systems and equipment - Color measurement and management - Part 2-1: Colour Management - Default RGB colour space - sRGB (2003).

c) ISO

ISO/IEC 10918-1 / ITU-T Recommendation T81 information technology Digital compression and coding of continuous-tone still images -Requirements and guide-lines

3. Definition

3.1 Definition of Terms

DCF	The standard specified in this document.
Exif Standard	Digital Still Camera Image File Format Standard (Exif) of the Japan Electronics and Information Technology Industries Association (JEITA)
Exif Ver. 2	Exif versions 2.x, from 2.1 and later
JPEG Standard	ISO/IEC 10918-1 ITU-T Recommendation T81 information technology - Digital compression and coding of continuous-tone still images - Requirements and guidelines
DSC	Digital still camera
PC	Personal computer
DCF-compatible	Compliant with the DCF
DCF media	Removable memory recorded in compliance with the DCF
Play	To display an image or output it as a hard copy
Application	Image application software for use on a PC

File name	An 8-character file name of the DOS/FAT file system, excluding the dot and file extension.
File extension	Three identifying characters used in the DOS/FAT file system following the file name and dot.
Horizontal pixels	The number of pixels of image data in the main scanning direction.
Vertical pixels	The number of pixels of image data in the sub-scanning direction.
Main image	The primary data of the image
Thumbnail	A small version of the main image, used for indexing.

The following are specified in detail in the subsequent chapters, but are summarized here for convenience.

DCF image root directory	The directory directly under the root directory, created in accord with the DCF directory rules.
DCF directory	A directory under the DCF image root directory created in accord with the DCF directory rules, for storing images.
DCF directory name	A directory name assigned in accord with the DCF directory naming conventions.
DCF object	A group of files recorded in accord with DCF.
DCF file name	A file name assigned in accord with the DCF file naming conventions.
Directory number	A three-digit number making up part of the DCF directory name.
File number	A four-digit number making up part of the DCF file name.
Free characters	The five characters following the directory number in a DCF directory name, or the four characters at the head of a DCF file name.
DCF basic file	An image file stored directly under a DCF directory, having a DCF file name and the extension "JPG," and having the data structure specified in this standard.
DCF basic main image	An Exif primary image included in a DCF basic file.
DCF basic thumbnail	An Exif thumbnail image included in a DCF basic file.
DCF optional file	An image file stored directly under a DCF directory, having a DCF file name and the extension "JPG," and recorded in the DCF optional color space specified in this standard.
DCF optional main image	The primary image in a DCF optional file.
DCF extended image file	An image file stored directly under a DCF directory, having a DCF file name but an extension other than "JPG" or "THM" and its own data structure.
DCF thumbnail file	A compressed file for storing the thumbnail image of a DCF extended image file.
Protection	Setting the Read Only attribute for a DCF object or directory.
Level 1	A playback compatibility level capable of detecting the existence of a DCF basic file and recognizing thumbnail images.
Level 2	A playback compatibility level capable of displaying and using DCF basic file main images.
Writer	A recording function compliant with the DCF Writer specification

Reader 1	Playback function in conformity with the DCF Reader 1 specification
Reader 2	Playback function in conformity with the DCF Reader 2 specification
DCF basic color space	The color space used in a DCF basic file, the widely used sRGB. Its characteristics are indicated in IEC 61966-2-1: 2003.
DCF optional color space	The color space used in a DCF optional file. Its characteristics are indicated in Chapter 5 of this standard.
Color space transformation	Processing for converting image data to the proper colors for playback when the color space assumed in recording differs from that used in the playback environment.

3.2 Definition of characters used in directory and file names

When a directory or file is created, only the characters shown in **Table 1** are used. Two-byte characters or other special codes shall not be used. If an existing directory or file name uses lower-case letters, they shall be treated as all upper-case letters.

Table 1 Allowed characters

					b7	0	0	0	0	0	0	0	0	0
					b6	0	0	0	0	1	1	1	1	1
					b5	0	0	1	1	0	0	1	1	1
					b4	0	1	0	1	0	1	0	1	1
b3	b2	b1	b0		0	1	2	3	4	5	6	7		
0	0	0	0	0				0		P				
0	0	0	1	1				1	A	Q				
0	0	1	0	2				2	B	R				
0	0	1	1	3				3	C	S				
0	1	0	0	4				4	D	T				
0	1	0	1	5				5	E	U				
0	1	1	0	6				6	F	V				
0	1	1	1	7				7	G	W				
1	0	0	0	8				8	H	X				
1	0	0	1	9				9	I	Y				
1	0	1	0	A					J	Z				
1	0	1	1	B					K					
1	1	0	0	C					L					
1	1	0	1	D					M					
1	1	1	0	E					N					
1	1	1	1	F					O	_				

30.H to 39.H,41.H to 5A.H,and 5F.H are used.

If lower-case letters from 61.H through 7A.H are used, they shall be treated as upper-case letters from 41.H to 5A.H

4. Overview

4.1 DCF and recording media

DCF is intended to enable use of files interchangeably among different equipment using the same kinds of DCF media. It must be noted carefully that equipment using different kinds of media will not be able to exchange files even if they adopt DCF.

4.2 Configuration of DCF specification

DCF consists of the three specifications shown in **Figure 1**.

- DCF media specification ([Chapter 5](#)) The status of data that should be on DCF media, and the status of data for enabling files to be exchanged among DCF-compatible products are specified.
- Writer specification ([Chapter 6](#)) Based on the media specification in [Chapter 5](#) the Writer specification stipulates the directory and file structure for recording data, and the file operations.
- Reader specifications ([Chapter 7](#)) The directory and file scope, playback methods and deletion methods are specified for reading data from DCF media recorded in accord with the DCF media specification in [Chapter 5](#).

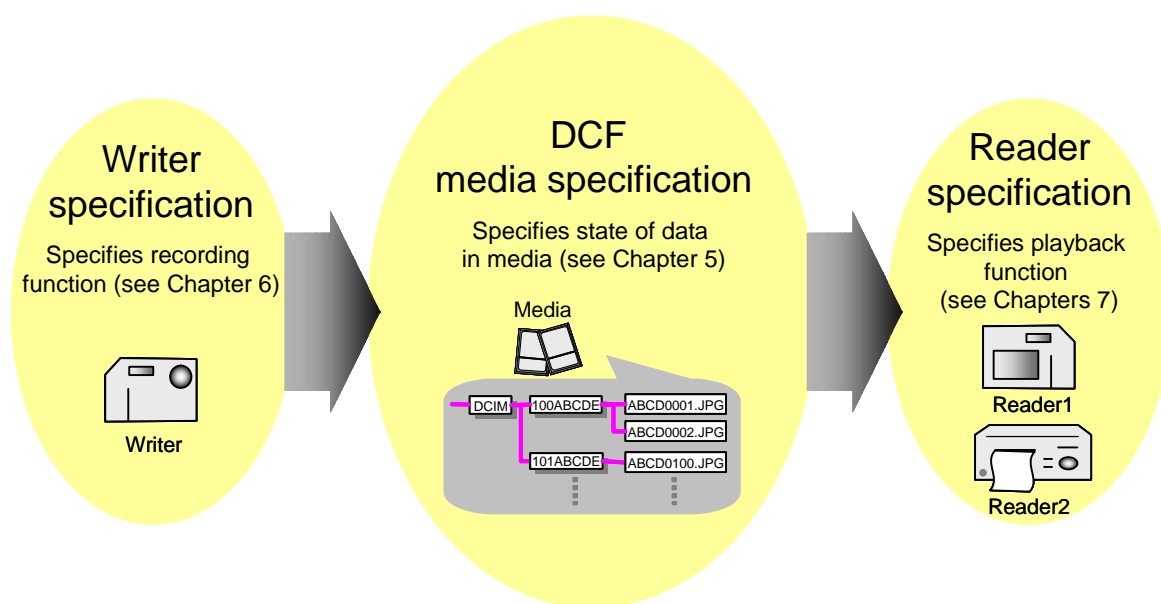


Figure 1 DCF standards

4.3 Approach to playback compatibility

In considering playback compatibility, a division is made into two levels as follows.

- Level 1 Even when a device is incapable of reproducing the DCF basic main image in a DCF basic file recorded on DCF media, it shall be able to read and display the corresponding DCF basic thumbnail.
- Level 2 Level 2 compatibility means the ability to read and display DCF basic main images in DCF basic files, within the supported pixel count specification. Layout is left up to individual product specifications.

DCF, in stipulating as mandatory items the rules for directory and file naming and the form of thumbnail image recording, establishes as a minimum condition that a DSC, for example, shall implement level 1 playback compatibility. Printers or other playback products, whose primary function is to reproduce main images, are expected to implement level 2 compatibility, for which a supported pixel count specification is

defined.

4.4 Classification of functions

The functions of DCF-compatible equipment are classified into Writer, Reader 1, and Reader 2 functions as shown in **Table 2**. This classification is based on the recording and playback functions with which the products are equipped, and is not a classification of equipment specifications. (On the applicable equipment, see 4.5.)

Table 2 Classification of DCF functions

Classification		Functionality	Remarks
Writer		Functionality for recording in conformity with the DCF Writer specification.	Includes move, copy and delete functions.
Reader	Reader 1	Playback function in conformity with the DCF specifications for Reader 1.	Equipped with Level 1 playback compatibility. Only equipment whose primary function is that of a Writer may be equipped with the Reader 1 functionality. Includes move, copy and delete functions.
	Reader 2	Playback function in conformity with the DCF specifications for Reader 2.	Equipped with Level 2 playback compatibility. Assumed here are printers and other equipment whose main function is main image playback. Playback here means display and printing. Includes move, copy and delete functions.

4.5 Categories of DCF-compatible equipment

The categories of DCF-compatible equipment are the four types shown in **Table 3**. The products given are only examples and are not intended to specify the equipment.

Table 3 Categories of DCF-compatible equipment

	Recording				Playback						Typical Products
	A	B	C	D	A		B		C	D	
					Main image	Thumb	Main image	Thumb			
Category 1 (Writer only)	M	O	O	O	N		N		N	O ^(a)	Record-only DSC, scanner, etc
Category 2 (Writer + Reader 1)	M	O	O	O	T		T ^(c)		O	O	DSC with simple playback function, etc
Category 3 (Writer + Reader 2)	M	O	O	O	M	O	O ^(d)	O	O	O	DSC with playback function; printer/player with recording function; application software, etc.
Category 4 (Reader 2)	N	N	N	O ^(b)	M	O	O ^(d)	O	O	O	Printer, player, print service, etc

A: DCF basic files

B: DCF optional files

C: DCF objects other than DCF basic files and DCF optional files

D: Other files

M: Mandatory function

O: Optional function

N: Not to be implemented. Does not apply to move, delete and copy functions.

T: Thumbnail substitute playback function present if main image cannot be displayed

Note^(a) Having a function for image playback but having neither Reader 1 nor Reader 2 functionality is prohibited.

^(b) Being a Reader with an image recording function but not having a Writer function is prohibited

^(c) Preferably playback should be made using color space transformation processing. In the absence of a color space transformation capability, playback shall be made in the sRGB color space.

^(d) Preferably playback should be made using color space transformation.

5. DCF Media Standard

5.1 Directory definition

The following are defined here.

- Directory structure
- Directory name

5.1.1 DCF image root directory

The directory with the name "DCIM" directly under the root directory is called the DCF image root directory.

DCIM stands for "Digital Camera Images"

5.1.2 DCF directories

The directories that store DCF objects are called DCF directories. They are created directly under the DCF image root directory. The directory names conforming to the following rules are called DCF directory names.

- The directory name is 8 characters in length.
- The first three characters are a number between "100" and "999"; numbers "000" through "099" shall not be used. This number is referred to as the directory number.
- The rest of the name after the directory number shall be five characters. These are referred to here as the DCF directory name Free characters.
- These five characters consist only of the upper-case alphanumeric characters shown in **Table 1**.

They shall not contain two-byte characters or special codes.

The conventions of DCF directory names are illustrated in **Table 4**.

Table 4 DCF directory naming example (excluding extension)

Specification	Directory number			Free characters (5 alphanumerics)				
Example	1	0	0	A	B	C	D	E

The Read Only attribute of the DOS FAT file system may be assigned to each directory to prevent accidental deletion. This is called directory protection. No other directory attributes are specified.

Directory operations are handled as per the Writer and Reader specifications.

5.1.3 Other directories

The following is prohibited. No specification is made regarding other directories.

- DCF file names are used as directory names under the DCF image root directory.

5.1.4 Directory example

A typical DCF directory is shown in **Figure 2**.

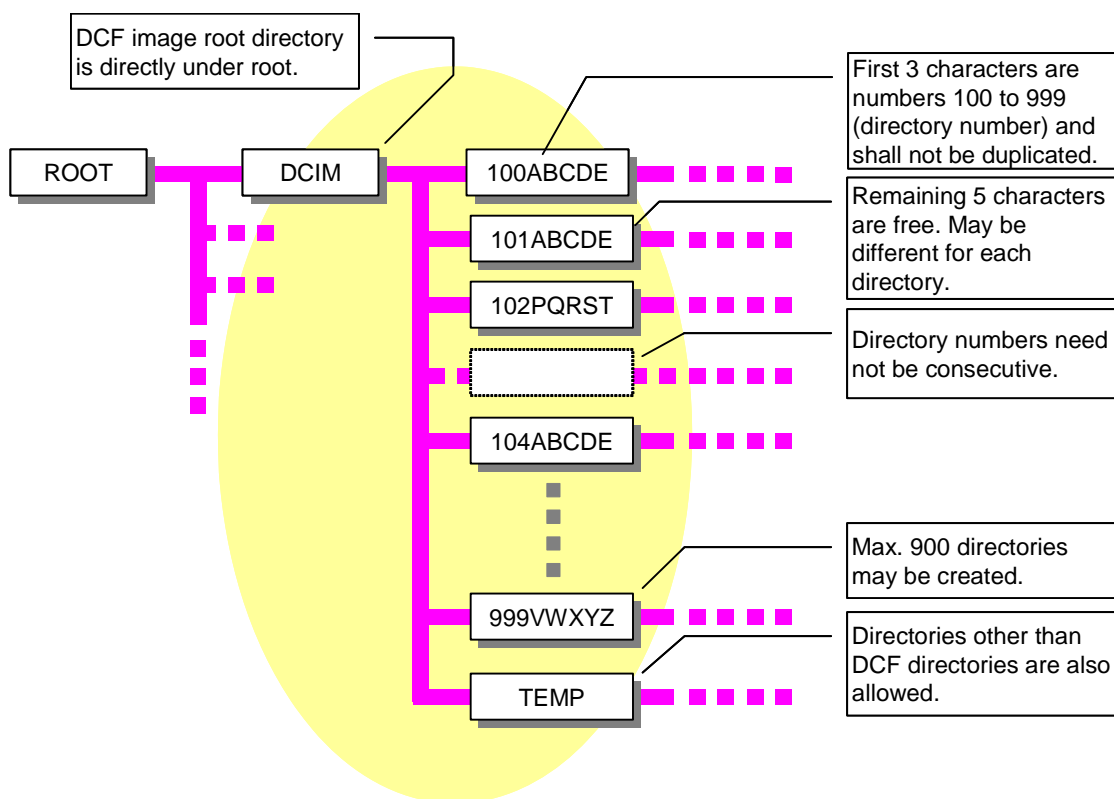


Figure 2 Typical DCF directory

5.2 File definition

5.2.1 DCF file names

File names conforming to the following rules are called DCF file names.

- The file name is 8 characters (not including the file extension).
- The first four characters consist only of the upper-case alphanumeric characters shown in **Table 1**.
- These are referred to as the DCF file name Free characters. They shall not contain two-byte characters or special codes.
- The four characters that follow are a number between "0001" and "9999". "0000" shall not be used.

These four digits are referred to as File number.

- Files with the same file number stored in the same DCF directory are considered to be object component files as defined in 5.2.2.

The DCF file naming conventions are illustrated in **Table 5**.

Table 5 DCF file naming example (excluding extension)

Specification	Free (4 alphanumerics)				File number			
Example	A	B	C	D	0	0	0	1

5.2.2 DCF objects

DCF objects are file groups defined as follows.

5.2.2.1 Purpose of DCF objects

Of the files stored on DCF media, objects may be created for the files related with each other, such as the main image file and the related audio file, to be handled together for the convenience of users.

5.2.2.2 Object definition

All files stored in a DCF directory with DCF file names are DCF object components. The free characters of the file name and the extensions may be different for files belong to the same object. A standalone file for which no other file with the same file number exists is still a DCF object. Two or more files in a DCF directory that share the same file number belong to the same DCF object. Files in directories that are not located under a DCF directory are not DCF object components, regardless of their file name.

5.2.2.3 Files included in objects

DCF defines files included in DCF objects. Files with other extensions and data structures not specified in DCF may also be included in a DCF object.

a) DCF basic file

- An image file conforming to the Exif standard.
- The extension is "JPG".
- The data structure and other details are given below.

b) DCF optional file

- An image file conforming to the Exif standard.
- The extension is "JPG".
- The data structure and other details are given below.

c) DCF extended image file

- A file with a DCF file name but having an extension and data structure other than "JPG" or "THM".
- The data structure is not specified.

d) DCF thumbnail file

- A file containing only a thumbnail image. It will be possible to achieve level 1 equivalent playback compatibility of a DCF extended image file.
- It shall always coexist with the corresponding DCF extended image file.
- The extension is "THM".
- The data structure and other details are given below.

e) The rules for DCF object structure and elements prohibit the following.

- More than one DCF basic file in the same object.
- More than one DCF optional file in the same object.
- More than one DCF thumbnail file in the same object.
- A DCF basic file and DCF thumbnail file in the same object.
- A DCF optional file and DCF thumbnail file in the same object.
- A DCF basic file and DCF optional file in the same object.
- A standalone DCF thumbnail file with no corresponding DCF extended image file in the same object.
- Files with the extension "JPG" other than DCF basic files and DCF optional files.
- A file with the extension "THM" having a data format other than that of a DCF thumbnail file.

5.2.2.4 Object file attributes

The Read Only attribute of the DOS FAT file system may be set for each file as Protection of individual objects, to prevent accidental deletion. A DCF object is protected when all the files in the object are set with the Read Only attribute. No specification is made regarding other file attributes.

5.2.2.5 Object operation

Object handling is as stipulated in the Writer and Reader specifications.

5.3 DCF basic files

5.3.1 Purpose

Image files conforming to Exif Ver. 2 and recorded as stipulated in this chapter are called DCF basic files. The purpose of DCF basic files is to achieve interchangeability of image files among DCF-compatible devices and applications. For level 2 playback compatibility to be realized among DCF-compatible devices and applications, the image files shall be DCF basic files.

5.3.2 Directory, file names and extensions

A DCF basic file is a component of a DCF object, is stored directly under a DCF directory, has a DCF file name, and has the extension "JPG". The character "_" shall not be used as the first character of a file name.

5.3.3 Images in a DCF basic file

An Exif primary image in a DCF basic file is called a DCF basic main image. An Exif thumbnail image in a DCF basic file is called a DCF basic thumbnail.

5.3.4 Data structure of a DCF basic main image

5.3.4.1 Data structure

The only supported data format for DCF basic main image data is Exif compressed format (JPEG format).

The pixel composition and sampling may be either YCbCr 4:2:2 or YCbCr 4:2:0.

5.3.4.2 Data compression

The compression ratio of DCF main basic images is not specified. The JPEG data structure is as stipulated in the Exif standard. Insertion of a restart marker is optional. As Huffman Table, the Typical Huffman Table specified in the JPEG standard shall be used.

5.3.4.3 Pixel count

The number of pixels is not specified.

5.3.4.4 Image aspect ratio

The image aspect ratio is not specified.

5.3.5 Attribute information

Attribute information is recorded as follows, based on the Exif standard.

5.3.5.1 Exif tag structure

The byte order used in the TIFF structure may be either Big Endian or Little Endian, as in the Exif specification.

5.3.5.2 Information about shooting conditions and camera

Image-related information shall be recorded, as per the Exif standard. In addition to the Exif mandatory tags, inclusion of the following tags is mandatory in DCF.

Make (0th IFD, mandatory)

In the Exif standard this is optional, but its inclusion is mandatory here so the Writer manufacturer name can be determined.

Tag	=	271 (10F.H)
Type	=	ASCII
Count	=	Any
Default	=	none

Model (0th IFD, mandatory)

In the Exif standard this is optional, but its inclusion is mandatory here so the Writer model name can be determined.

Tag	=	272 (110.H)
Type	=	ASCII

Count = Any
 Default = none

DateTimeOriginal (Exif IFD, mandatory)

In the Exif standard this is optional, but its inclusion is mandatory here so the original image creation date and time can be determined. If the date and time the original image was shot are unknown, this field may be filled with spaces as stipulated in the Exif standard.

Tag = 36867 (9003.H)
 Type = ASCII
 Count = 20
 Default = none

DateTimeDigitized (Exif IFD, mandatory)

In the Exif standard this is optional, but its inclusion is mandatory here so the digital data creation date and time can be determined. If the date and time of digital data creation are unknown, this field may be filled with spaces as stipulated in the Exif standard.

Tag = 36868 (9004.H)
 Type = ASCII
 Count = 20
 Default = none

5.3.5.3 DCF basic file identifying information

Information is specified in the Interoperability IFD for identifying a file as a DCF basic file. See the Exif standard for details of the Interoperability IFD. Tags in the Interoperability IFD are specified as follows in DCF.

InteroperabilityIndex (Interoperability IFD, mandatory)

Since the file content is equivalent to ExifR98 Version 1.0, the value is "R98". The tag including end code is 4 Bytes. Note that this differs from the value (THM) defined for DCF thumbnail files in **section 5.5.4**.

Tag = 1 (1.H)
 Type = ASCII
 Count = 4
 Default = "R98"

InteroperabilityVersion (Interoperability IFD, mandatory)

This tag records the Interoperability version. Since the file content is equivalent to ExifR98, the value is the 4-Byte ASCII "0100" meaning Version 1.00. This is not terminated by NULL since the Type is UNDEFINED.

Tag = 2 (2.H)
 Type = UNDEFINED

Count = 4
 Default = 0100

RelatedImageFileFormat (Interoperability IFD, optional)

This is normally used in a DCF thumbnail file, but it may also be included in a DCF basic file, in which case it indicates that file's own format (Exif JPEG Ver. 2.1, etc.). It is recorded as an ASCII character string.

Tag = 4096 (1000.H)
 Type = ASCII
 Count = Any
 Default = none

RelatedImageWidth (Interoperability IFD, optional)

This is normally used in a DCF thumbnail file, but it may also be included in a DCF basic file, in which case it indicates the number of horizontal pixels of that image itself.

Tag = 4097 (1001.H)
 Type = SHORT or LONG
 Count = 1
 Default = none

RelatedImageLength (Interoperability IFD, optional)

This is normally used in a DCF thumbnail file, but it may also be included in a DCF basic file, in which case it indicates the number of vertical pixels of that image itself.

Tag = 4098 (1002.H)
 Type = SHORT or LONG
 Count = 1
 Default = none

5.3.5.4 Color space

The ColorSpace tag declares sRGB in the Exif IFD specified in the Exif standard, as follows.

ColorSpace (Exif IFD, mandatory)

This tag declares sRGB.

Tag = 40961 (A001.H)
 Type = SHORT
 Value = 1 (sRGB)
 Count = 1

5.3.6 DCF basic thumbnail data structure

5.3.6.1 Image data format

The thumbnail data structure is in accord with the Exif compressed thumbnail specification. The pixel composition and sampling is YCbCr 4:2:2. The reason for limiting to one choice here is to ensure Level 1 playback compatibility. The color space used for a thumbnail image shall be sRGB as with main images.

5.3.6.2 Compressed data

The JPEG data structure is as specified in Exif. As in the Exif specification, no restart marker is inserted. As Huffman Table, the Typical Huffman Table specified in the JPEG standard shall be used. The compression ratio of DCF basic thumbnails is not specified.

5.3.6.3 Number of pixels

The number of pixels for thumbnail recording is 160 horizontal pixels by 120 vertical pixels, chosen as a size large enough to enable the image to be recognized. Any other pixel size is prohibited.

5.3.6.4 Layout

If the DCF basic main image has an aspect ratio different from that of the DCF basic thumbnail, the difference shall be adjusted by padding. The recommended method for recording thumbnail images is as follows.

- Padding data: black (RGB all 0)
- Image position: centered
- Relation to main image: should conform to the field angle of the main image to the extent possible, without cutting out part of the image.

5.3.7 Image data format in DCF basic files

The DCF basic main image format is summarized in **Table 6**. The DCF basic thumbnail data format is summarized in **Table 7**.

Table 6 DCF Basic Main Image Data Format

Compression	Number of pixels	Aspect ratio	Chrominance sampling	Compression ratio	Huffman Table	Color space
Compressed (JPEG)	Not specified	Not specified	4:2:2 or 4:2:0	Not specified	Typical	sRGB

Table 7 DCF Basic Thumbnail Data Format

Compression	Number of pixels	Aspect ratio	Chrominance sampling	Compression ratio	Huffman Table	Color space
Compressed (JPEG)	160 x 120 (fixed)	4:3 (fixed)	4:2:2 (fixed)	Not specified	Typical	sRGB

5.4 DCF optional files

5.4.1 Purpose

A DCF optional file is used when an image is to undergo extensive processing, notably in professional uses such as commercial printing. The image data uses the DCF optional color space.

5.4.2 Directory, file names and extensions

A DCF optional file is a component of a DCF object, is stored directly under a DCF directory, has a DCF file name, and has the extension "JPG". The character "_" shall always be used as the first character of the file name.

Typical file name: "_ABC0001.JPG"

5.4.3 Data structure of a DCF optional file main image

5.4.3.1 Data structure

The only supported data format for DCF optional main image data is Exif compressed format (JPEG format). The pixel composition and sampling may be either YCbCr 4:2:2 or YCbCr 4:2:0.

5.4.3.2 Data compression

The compression ratio of image data is not specified. The JPEG data structure is as stipulated in the Exif standard. Insertion of a restart marker is optional. As Huffman Table, the Typical Huffman Table specified in the JPEG standard shall be used.

5.4.3.3 Pixel count

The number of pixels is not specified.

5.4.3.4 Image aspect ratio

The image aspect ratio is not specified.

5.4.4 Attribute information

Attribute information is recorded as follows, based on the Exif standard.

5.4.4.1 Exif tag structure

The byte order used in the TIFF structure may be either Big Endian or Little Endian, as in the Exif specification.

5.4.4.2 Image-related information

Image-related information shall be recorded, as per the Exif standard. In addition to the Exif mandatory tags, inclusion of the following tags is mandatory in DCF.

Make (0th IFD, mandatory)

Tag data is the same as for DCF basic files (see **5.3.5**).

Model (0th IFD, mandatory)

Tag data is the same as for DCF basic files (see 5.3.5.).

DateTimeOriginal (Exif IFD, mandatory)

Tag data is the same as for DCF basic files (see 5.3.5.).

DateTimeDigitized (Exif IF, mandatory)

Tag data is the same as for DCF basic files (see 5.3.5.).

5.4.4.3 DCF optional file identifying information

Information is specified in the Interoperability IFD for identifying a file as a DCF optional file. See the Exif standard for details of the Interoperability IFD. Tags in the Interoperability IFD are specified as follows for DCF optional files.

InteroperabilityIndex (Interoperability IFD, mandatory)

The value is "R03". The tag including end code is 4 Bytes.

Tag	=	1 (1.H)
Type	=	ASCII
Count	=	4
Default	=	"R03"

InteroperabilityVersion (Interoperability IFD, mandatory)

This tag records the version of the InteroperabilityIndex value. The value is the 4-Byte ASCII "0100" meaning Version 1.00. This is not terminated by NULL since the Type is UNDEFINED.

Tag	=	2 (2.H)
Type	=	UNDEFINED
Count	=	4
Default	=	0100

RelatedImageFileFormat (Interoperability IFD, optional)

This is normally used in a DCF thumbnail file, but it may also be included in a DCF optional file, in which case it indicates that file's own format (Exif JPEG Ver. 2, etc.). It is recorded as an ASCII character string.

Tag	=	4096 (1000.H)
Type	=	ASCII
Count	=	Any
Default	=	none

RelatedImageWidth (Interoperability IFD, optional)

This is normally used in a DCF thumbnail file, but it may also be included in a DCF optional file, in which case it indicates the number of horizontal pixels of that image itself.

Tag	=	4097 (1001.H)
Type	=	SHORT or LONG
Count	=	1
Default	=	none

RelatedImageLength (Interoperability IFD, optional)

This is normally used in a DCF thumbnail file, but it may also be included in a DCF optional file, in which case it indicates the number of vertical pixels of that image itself.

Tag	=	4098 (1002.H)
Type	=	SHORT or LONG
Count	=	1
Default	=	none

5.4.4.4 Color space

The DCF optional color space is used in a DCF optional file, and its characteristics are defined using the WhitePoint tag, PrimaryChromaticities tag, YCbCrCoefficients tag, and Gamma tag.

ColorSpace (Exif IFD, mandatory)

This tag records Uncalibrated, indicating non-use of the sRGB color space.

Tag	=	40961 (A001.H)
Type	=	SHORT
Value	=	FFFF.H (Uncalibrated)
Count	=	1

WhitePoint (0th IFD, mandatory)

This tag indicates the chromaticities of reference whitepoint. Information shall be recorded as follows in a DCF optional file.

Tag	=	318 (13E.H)
Type	=	RATIONAL
Count	=	2
Value	=	139.H / 3E8.H 149.H / 3E8.H

The above values are for chromaticities of $(X, Y) = (0.313, 0.329)$.

PrimaryChromaticities (0th IFD, mandatory)

This tag indicates the chromaticities of the three primary colors. Information shall be recorded as follows in a DCF optional file.

Tag = 319 (13F.H)
 Type = RATIONAL
 Count = 6
 Value = 40.H / 64.H 21.H / 64.H 15.H / 64.H 47.H / 64.H F.H / 64.H 6.H / 64.H

The above values are for the following chromaticities.

R chromaticities: (X, Y) = (0.64, 0.33)
 G chromaticities: (X, Y) = (0.21, 0.71)
 B chromaticities: (X, Y) = (0.15, 0.06)

YCbCrCoefficients (0th IFD, mandatory)

This tag indicates the color transform matrix coefficients for going from RGB to YCbCr image data. Information shall be recorded as follows in a DCF optional file.

Tag = 529 (211.H)
 Type = RATIONAL
 Count = 3
 Value = 12B.H / 3E8.H 24B.H / 3E8.H 72.H / 3E8.H

The above values correspond to the following coefficients.

0.299, 0.587, 0.114

Gamma (Exif IFD, mandatory)

This tag indicates a gamma compensation coefficient used by the transformation function in playback. Information shall be recorded as follows in a DCF optional file.

Tag = 42240 (A500.H)
 Type = RATIONAL
 Count = 1
 Value = 16.H / 0A.H

The above value is for a gamma compensation coefficient of 2.2.

5.4.5 DCF optional file thumbnail data structure

5.4.5.1 Image data format

The thumbnail data structure is in accord with the Exif compressed thumbnail specification. The pixel composition and sampling is YCbCr 4:2:2. The color space used for a thumbnail image shall be the same DCF optional color space used with main images.

5.4.5.2 Compressed data

The JPEG data structure is as specified in Exif. As in the Exif specification, no restart marker is inserted. As Huffman Table, the Typical Huffman Table specified in the JPEG standard shall be used. The compression ratio of thumbnails is not specified.

5.4.5.3 Number of pixels

The number of pixels for thumbnail recording is 160 horizontal pixels by 120 vertical pixels, chosen as a size large enough to enable the image to be recognized. Any other pixel size is prohibited.

5.4.5.4 Layout

If the main image has an aspect ratio different from that of the thumbnail image, the difference shall be adjusted by padding. The recommended method for recording thumbnail images is as follows.

- Padding data: black (RGB all 0)
- Image position: centered
- Relation to main image: should conform to the field angle of the main image to the extent possible, without cutting out part of the image.

5.4.6 Image data format in DCF optional files

The DCF optional file main image format is summarized in **Table 8**. The DCF optional file thumbnail data format is summarized in **Table 9**.

Table 8 DCF Optional File Main Image Data Format

Compression	Number of pixels	Aspect ratio	Chrominance sampling	Compression ratio	Huffman Table	Color space
Compressed (JPEG)	Not specified	Not specified	4:2:2 or 4:2:0	Not specified	Typical	DCF optional color space

Table 9 DCF Optional File Thumbnail Data Format

Compression	Number of pixels	Aspect ratio	Chrominance sampling	Compression ratio	Huffman Table	Color space
Compressed (JPEG)	160 x 120 (fixed)	4:3 (fixed)	4:2:2 (fixed)	Not specified	Typical	DCF optional color space

5.5 DCF thumbnail files

5.5.1 Purpose

DCF extended image files recorded with proprietary functions often cannot be displayed on other Reader systems. In order to allow the images and their attributes to be checked on other systems and achieve playback equivalent to DCF basic file level 1 compatibility, small indexing files are defined, which are recorded separate from the DCF extended image files. These are called DCF thumbnail files.

The inclusion of DCF thumbnail files with DCF extended image files is not mandatory. For this reason, level

1-equivalent compatibility is not necessarily achieved for DCF extended image files.

Likewise, it should be noted carefully that even if DCF thumbnail files are used, this does not guarantee playback equivalent to DCF basic file level 2 compatibility.

5.5.2 Directory, file name and extension

DCF thumbnail files shall be located in the same directory as their corresponding DCF extended image file.

They have a DCF file name and "THM" as the file extension. The file number is the same as that of the corresponding DCF extended image file, and together they belong to one DCF object.

5.5.3 Image data structure

5.5.3.1 Data format

The data structure of a DCF thumbnail file is that specified in the Exif standard for compressed thumbnails. If the file has attribute information, however, the structure may be the same as the Exif file using APP1 and APP2 as specified in the Exif standard for compressed files. It shall not have APPn markers other than APP1 and APP2, or COM markers. APP1 shall not contain a thumbnail of the thumbnail. The DCF thumbnail file data structure is outlined in **Figure 3**.

The pixel composition and sampling is YCbCr 4:2:2 only, as with DCF basic files specified at **5.3.4**.

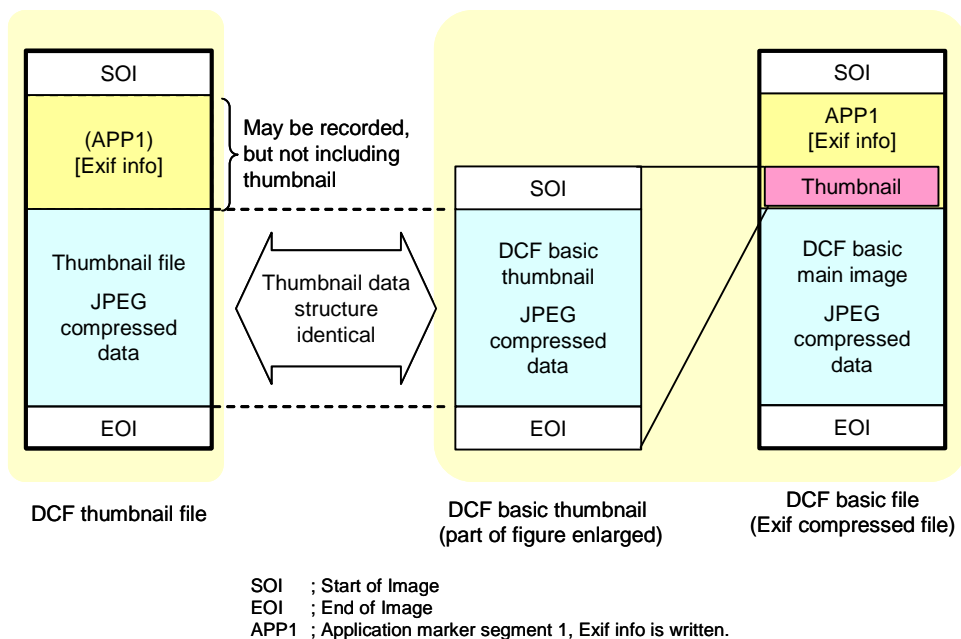


Figure 3 DCF thumbnail file structure

5.5.3.2 Compressed data specification

This is the same as that for DCF basic files specified at **5.3.4**.

5.5.3.3 Pixel count

This is the same as that for DCF basic files specified at **5.3.4**.

5.5.3.4 Image aspect ratio

This is the same as that for DCF basic files specified at **5.3.4**.

5.5.4 Attribute information

When attribute information is included, it is recorded as follows.

5.5.4.1 Exif tag structure

The byte order used in the TIFF structure may be either Big Endian or Little Endian, as in the Exif specification.

5.5.4.2 Image-related information

When attribute information is included, it is recorded as in the Exif standard. In addition to Exif mandatory tags, the following tags are mandatory for DCF thumbnail files.

Make (0th IFD, mandatory when attribute information is recorded)

The contents are the same as for DCF basic files (see 5.3.5.).

Model (0th IFD, mandatory when attribute information is recorded)

The contents are the same as for DCF basic files (see 5.3.5.).

DateTimeOriginal (Exif IFD, mandatory when attribute information is recorded)

The contents are the same as for DCF basic files (see 5.3.5.).

DateTimeDigitized (Exif IFD, mandatory when attribute information is recorded)

The contents are the same as for DCF basic files (see 5.3.5.).

5.5.4.3 DCF thumbnail identification information

DCF identifying information is specified in the Interoperability IFD. For details of the Interoperability IFD, see the separate Exif standard. In DCF, the following tags are specified in the Interoperability IFD.

InteroperabilityIndex

(Interoperability IFD, mandatory when attribute information is recorded)

The value is "THM". The tag including end code is 4 Bytes. Note that this differs from the value ("R98") specified as attribute information with DCF basic files.

Tag	=	1 (1.H)
Type	=	ASCII
Count	=	4
Default	=	"THM"

InteroperabilityVersion

(Interoperability IFD, mandatory when attribute information is recorded)

Records the Interoperability version. The value here is the 4-Byte ASCII "0100" meaning Version 1.00. This

not terminated by NULL since the Type is UNDEFINED.

Tag	=	2 (2.H)
Type	=	UNDEFINED
Count	=	4
Default	=	0100

RelatedImageFileFormat (Interoperability IFD, optional)

This tag is used to record in a DCF thumbnail file the file format of the corresponding DCF extended image file. It consists of an ASCII character string.

Tag	=	4096 (1000.H)
Type	=	ASCII
Count	=	Any
Default	=	none

RelatedImageWidth (Interoperability IFD, optional)

This tag is used to record in a DCF thumbnail file the horizontal pixel count of the corresponding DCF extended image file.

Tag	=	4097 (1001.H)
Type	=	SHORT or LONG
Count	=	1
Default	=	none

RelatedImageLength (Interoperability IFD, optional)

This tag is used to record in a DCF thumbnail file the vertical pixel count of the corresponding DCF extended image file.

Tag	=	4098 (1002.H)
Type	=	SHORT or LONG
Count	=	1
Default	=	none

5.5.4.4 Color space

The ColorSpace tag in the Exif IFD specified in the Exif standard declares sRGB as follows.

ColorSpace (Exif IFD, mandatory when attribute information is recorded)

The contents are the same as for DCF basic files (see **5.3.5**).

5.5.5 DCF thumbnail file data structure

The thumbnail data specifications for DCF thumbnail files are summarized in **Table 10**.

Table 10 DCF thumbnail file data format

Compression	Number of pixels	Aspect ratio	Chrominance sampling	Compression ratio	Huffman Table	Color space
Compressed (JPEG)	160 x 120 (fixed)	4:3 (fixed)	4:2:2 (fixed)	Not specified	Typical	sRGB

5.6 Tag requirement levels

Some of the optional tags specified in the Exif standard are mandatory in DCF. This level difference is shown for the 0th IFD, Exif IFD and Interoperability IFD in **Table 11**, **Table 12** and **Table 13**, respectively.

Table 11 0th IFD requirement level

Field Name	Tag No.		Requirement Level			Remarks
	Dec	Hex	DCF basic	DCF optional	Thumbnail	
Make	271	10F	M	M	C	R
Model	272	110	M	M	C	R
WhitePoint	318	13E	N	M	N	O
PrimaryChromaticities	319	13F	N	M	N	O
YCbCrCoefficients	529	211	N	M	N	O

Table 12 Exif IFD requirement level

Field Name	Tag No.		Requirement Level			Remarks
	Dec	Hex	DCF basic	DCF optional	Thumbnail	
DateTimeOriginal	36867	9003	M	M	C	O
DateTimeDigitized	36868	9004	M	M	C	O
Interoperability IFD Pointer	40965	A005	M	M	C	O
Gamma	42240	A500	N	M	N	O

Table 13 Interoperability IFD requirement level

Field Name	Tag No.		Requirement Level			Remarks
	Dec	Hex	DCF basic	DCF optional	Thumbnail	Exif standard
InteroperabilityIndex	1	1	M	M	C	O
InteroperabilityVersion	2	2	M	M	C	--
RelatedImageFileFormat	4096	1000	O	O	O	--
RelatedImageWidth	4097	1001	O	O	O	--
RelatedImageLength	4098	1002	O	O	O	--

Notation

- M : Mandatory (shall be recorded)
- C : Conditionally mandatory (shall be recorded when attribute information is included)
- R : Strongly recommended (shall be recorded if possible)
- O : Optional (recorded if required by particular equipment)
- N : Prohibited
- : Not specified

5.7 File structure example

An example of the file structure in a DCF directory is shown in **Figure 4**.

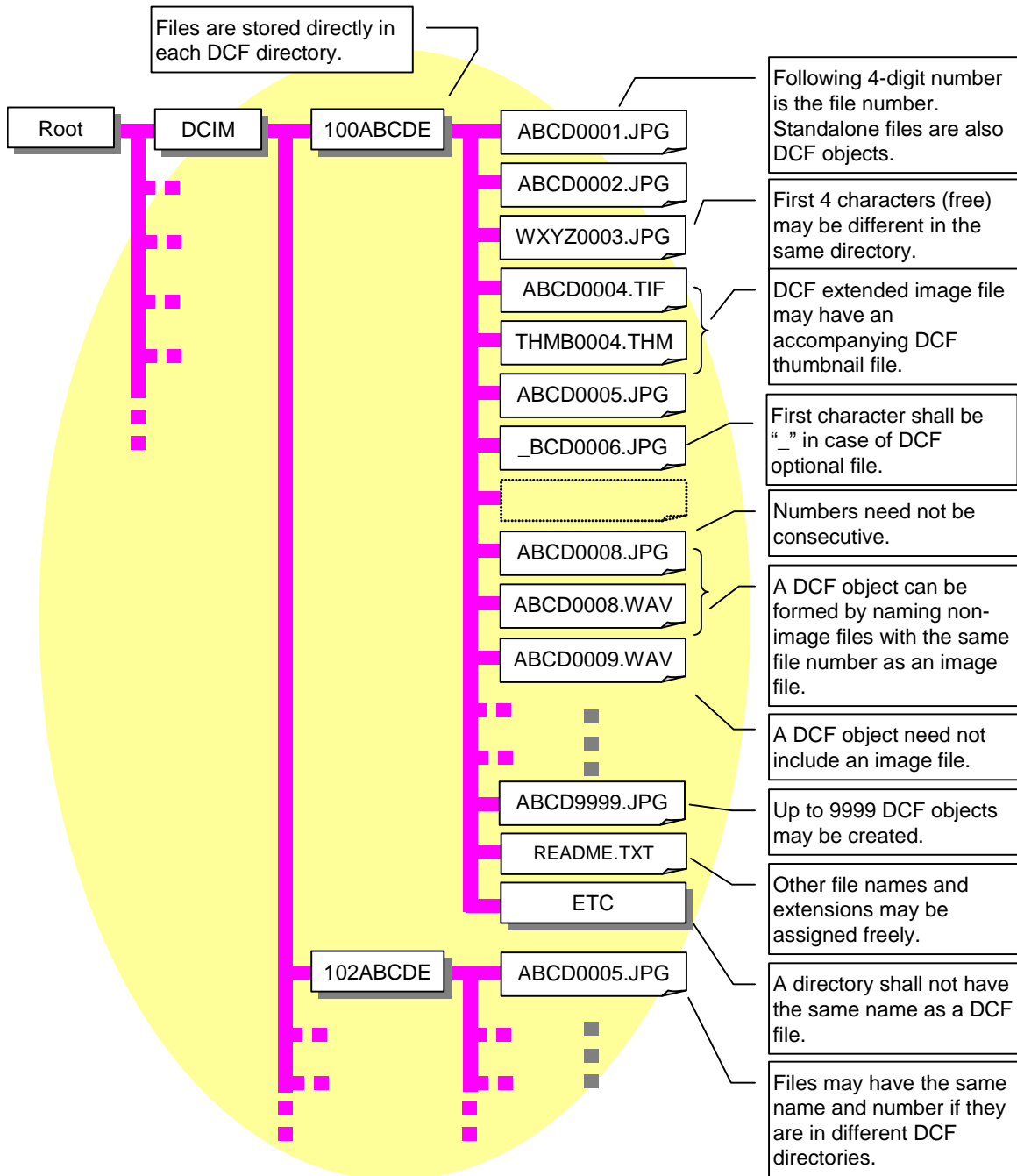


Figure 4 Typical file structure in a DCF directory

6. Writer Specification

6.1 Directories

6.1.1 Creating directories

6.1.1.1 DCF image root directory

A Writer shall have a function for creating a DCF image root directory on the DCF recording medium if no such directory exists.

6.1.1.2 DCF directories

A maximum of 900 DCF directories may be created under the DCF image root directory. The directory numbering rules are as follows.

- If a new DCF directory is being created when no other DCF directory exists directly under the DCF image root directory on the DCF recording medium, any directory number may be assigned.
- When an additional DCF directory is added, it is recommended that it be given a directory number of 1 greater than the largest existing directory number.
- Directory numbers shall not be duplicated on the same recording medium.

6.1.1.3 Other directories

It is permissible to locate directories besides the DCF image root directory directly below the root directory. It is likewise permissible to locate directories besides DCF directories, based on individual equipment specifications, under the DCF image root directory.

Directories based on individual equipment specifications may be created inside a DCF directory, but a DCF file name shall not be used for the directory name in this case.

6.1.2 Deleting directories

It is permissible for deletion of a specific DCF directory to result in a directory number discontinuity. A user attempting to delete a protected directory shall be presented with a warning to this effect. When an entire removable medium is initialized (formatted), the handling of directory protection is left up to the specifications for individual equipment.

6.2 Files

6.2.1 Creating files

6.2.1.1 Image files

Image files are recorded in a DCF directory in accord with the specifications below.

To assure interoperability across Writer and Reader using DCF basic files, all Writer products shall have a function for recording DCF basic files. DCF optional files or DCF extended image files may be recorded as well, for the sake of proprietary functions. Note, however, that no image file without a DCF file name shall be recorded in a DCF directory.

6.2.1.2 DCF thumbnail files

A thumbnail file may be recorded along with a DCF extended image file to form a DCF object.

6.2.1.3 Other files making up a DCF object

Other files besides DCF basic files, DCF optional files, DCF extended image files, and DCF thumbnail files may be given DCF file names and recorded.

Another file having a DCF file name may be included in a DCF object, by giving it the same file number as another file. A file shall not, however, be recorded with a file number without the express intention of the Writer user.

6.2.1.4 Files without a DCF file name

When a file other than an image file is recorded in a DCF directory, it may be given any desired file name, but shall not have the "JPG" or "THM" file extension.

6.2.2 File number

The rules for recording file numbers are as follows.

- If there is no DCF file name among the files in the DCF directory where a file is to be stored, any initial file number may be used.
- If a DCF file name already exists in the DCF directory where a file is to be stored, it is recommended that the file number be assigned as the largest existing number + 1.
- Within the same DCF directory, the file numbers of DCF basic files and DCF optional files shall not be duplicated. DCF basic files and DCF optional files in different DCF directories may have the same file number.
- File numbers may be duplicated in the same directory for the purpose of forming a DCF object. Note, however, that when a DCF basic file and DCF extended image file are made part of the same object, a Reader will normally give playback priority to the DCF basic file (see **Chapter 7**), which may result in a different file being displayed than the one intended by the Writer user. For this reason, it is best to avoid recording a DCF basic file and DCF extended image file in the same object; or if they are in the same object, to notify the Writer user of this possibility either in the manual or by displaying a notice on the Writer display.
- The upper limit on the number of DCF objects that may be stored in one DCF directory is 9999, the same as the number of file numbers.

6.2.3 Deleting files

6.2.3.1 DCF objects

All DCF objects, that is, all DCF basic files, DCF optional files, DCF extended image files, DCF thumbnail files and other files with DCF file names, are deleted, moved and copied in object units (see **8.4**). Copying is

treated in the same way as recording a new file. Moving is treated as a combination of copying and deletion. It is possible, with the Writer user's express intention, to delete, move, or copy one or some of the files in an object. A protected object shall not be deleted without presenting the user with a warning to that effect.

If a DCF object contains a file with the Hidden attribute, that file is also treated as part of the object. The Hidden flag may be ignored.

When removable memory is initialized (formatted), the handling of protection is left up to the specifications for individual equipment.

6.2.3.2 Files that are not DCF objects

No specification is made.

7. Reader Specification

7.1 Directories (common to Reader 1 and 2)

7.1.1 Playback

7.1.1.1 Playback scope

A reader shall detect the directories on a DCF medium, and shall display the files in them according to the specifications in 7.2. No specification is made regarding the playback of other directories, except that if they exist, they shall not hinder the displaying of images located in DCF directories.

7.1.1.2 Playback method

The order of playback is not specified.

7.1.2 Deletion

A user attempting to delete a protected directory shall be presented with a warning to this effect. When removable memory is initialized (formatted), the handling of directory protection is left up to the specifications for individual equipment.

7.2 Files

7.2.1 Playback

7.2.1.1 Reader 1 playback scope

Reader 1 shall display the DCF basic files and DCF optional files in a DCF directory detected as in 7.1.1.1. Playback of the main image in a DCF basic file is preferable; but if the main image cannot be displayed because the pixel count exceeds the playback capability, etc., the corresponding thumbnail shall be displayable (thumbnail substitute playback).

It is preferable that Reader 1 be able to perform the necessary color space transformation processing for playback of the main image in a DCF optional file; but if Reader 1 lacks that capability, it shall at least be capable of thumbnail substitute playback without color space transformation. Reader 1 may also display main images without color space transformation processing.

7.2.1.2 Reader 2 playback scope

Reader 2 shall be able to detect the DCF basic files in a DCF directory as in 7.1.1.1 and shall be able to display the DCF basic main images within the range of the supported pixel count specification explained in 7.2.1.4 below. If a DCF basic main image is outside the supported pixel count and cannot be displayed, the corresponding DCF basic thumbnail may be displayed instead.

It is preferable that Reader 2 be able to detect a DCF optional file in a DCF directory and to display a DCF optional main image within the range of the supported pixel count specification. If Reader 2 lacks the capability for color space transformation processing, displaying of main images without that processing is allowable.

7.2.1.3 DCF extended image files (common to Reader 1 and 2)

No specification is made regarding DCF extended image file playback. If the same object contains both a DCF basic file and DCF extended file, as a rule priority shall be given to playback of the DCF basic file. The priority of other file playback is not specified.

7.2.1.4 Supported pixel count specification

The supported pixel count specification indicates the maximum and minimum DCF basic main image size that shall be displayable on a Reader 2 device. Reader 2 shall be able to display DCF basic main images within the range shown in **Table 14**.

Table 14 Displayable pixel count range

	Pixel count ranges			
	Minimum			Maximum
Horizontal pixel range	160	<=	X	<= 1800
	and			
Vertical pixel range	120	<=	Y	<= 1200

(Pixels)

7.2.2 Playback method (common to Reader 1 and 2)

No specification is made as to the playback display layout or order of display.

7.2.3 DCF optional files and color space transformation

The relation of DCF optional file playback and the Reader 1 and 2 color space transformation capability is shown in **Table 15**.

Table 15 DCF optional files and color space transformation capability

Image data	Color space transformation	Reader1	Reader2
Main image	No	Optional	Optional
	Yes	Optional	Optional
Thumbnail (substitute playback)	No	Mandatory (if color space transformation not possible)	Optional
	Yes	Optional	Optional

7.2.4 Handling of color-related tags (common to Reader 1 and 2)

If a color-related tag other than the ColorSpace tag is found in a DCF basic file, it is ignored. The tags shown in **Table 16** are meant by color-related tags.

Table 16 Ignored color-related tags

Field Name	IFD	Tag no
TransferFunction	0th IFD	301
WhitePoint	0th IFD	318
PrimaryChromaticities	0th IFD	319
YCbCrCoefficients	0th IFD	529
ReferenceBlackWhite	0th IFD	532
Gamma	Exif IFD	42240

In the case of DCF optional files, the tags listed in **Table 17** may be referenced to find out the recorded color space characteristics. See **8.5** on the method of identifying DCF optional files.

Table 17 Referenced color-related tags

Field Name	IFD	Tag no
WhitePoint	0th IFD	318
PrimaryChromaticities	0th IFD	319
YCbCrCoefficients	0th IFD	529
Gamma	Exif IFD	42240

7.2.5 Deletion (common to Reader 1 and 2)

7.2.5.1 DCF objects

All DCF objects, that is, all DCF basic files, DCF optional files, DCF extended image files, DCF thumbnail files and other files with DCF file names, are deleted, moved and copied in object units (see **8.4**). Copying is treated in the same way as recording a new file. Moving is treated as a combination of copying and

deletion. It is possible, with the Reader user's express intention, to delete, move, or copy one or some of the files in an object. A protected object shall not be deleted without presenting the user with a warning to that effect.

If a DCF object contains a file with the Hidden attribute, that file is also treated as part of the object. The Hidden flag may be ignored.

When removable memory is initialized (formatted), the handling of protection is left up to the specifications for individual equipment.

7.2.5.2 Files that are not DCF objects

No specification is made.

7.3 Directory number and file number display (common to Reader 1 and 2)

A Reader with number display function shall also have a function for displaying the directory numbers and file numbers of DCF basic files and DCF optional files, and for enabling the user to designate any images with the numbers. The purpose is to allow users to designate DCF basic files and DCF optional files on DCF media without using the full path name.

The display rules are as follows.

- Show the directory number on the left and the file number on the right, separating them with a hyphen.
- Details such as zero suppression or padding are not specified.
- Directory numbers and file numbers may be displayed at all times or only when called up by some kind of operations.
- Other methods of displaying image numbers may be used alongside this method.

The directory numbers and file numbers of DCF extended image files may also be displayed if desired.

An example of directory number and file number display is given in **Table 18**.

Table 18 Typical directory number and file number display

	Directory number				File number			
Example 1	1	0	2	-	0	0	1	5
Example 2	1	0	2	-			1	5
Example 3	1	0	2	-	1	5		

8. Other Points to Note

8.1 Naming directories under the DCF image root directory

The method by which a Writer adds a new directory to media containing directories that do not follow the DCF specifications, on a PC or the like as in **Figure 5**, is specified here along with the Reader playback

method in such cases.

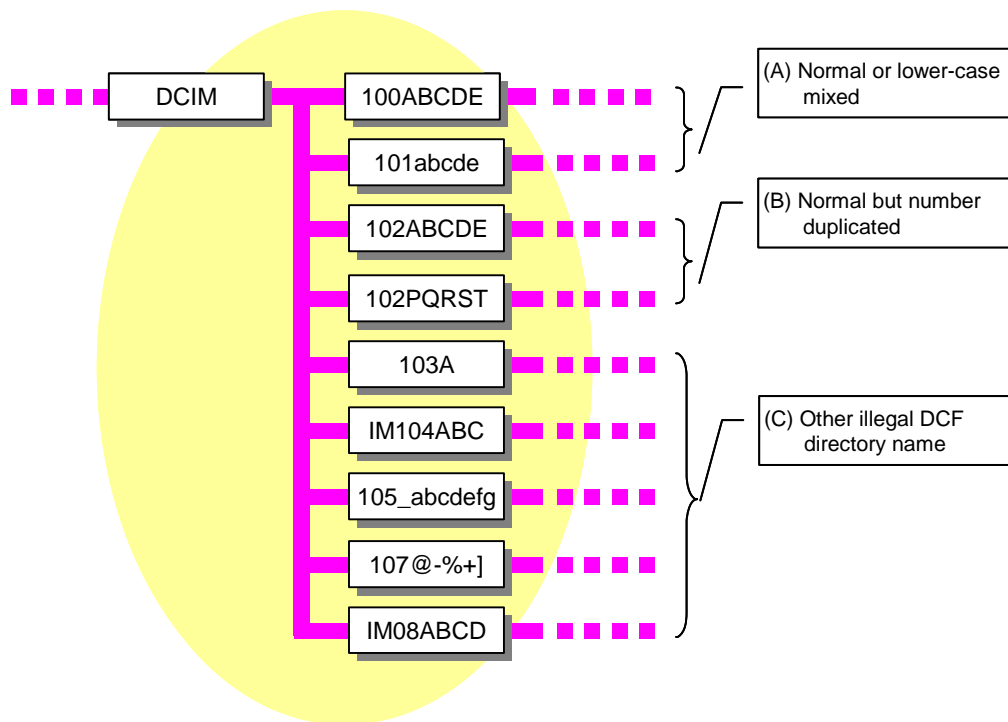


Figure 5 Directory naming precautions

8.1.1 When lower-case letters are used in a directory name

If lower-case letters are used in the free characters of a directory name but the name is otherwise compliant with DCF directory naming conventions, it shall be treated as a DCF directory without distinguishing case. A Writer may add files to such a directory, and may create new directories so long as the directory number is not duplicated. A Reader shall treat the directory as a DCF directory without distinguishing case.

8.1.2 When directory numbers are duplicated across DCF directories

Directories with duplicate directory numbers are all treated as non-DCF directories. New DCF objects shall not be recorded in such a directory. A Reader may display the files in such a directory, but the directory numbers and file numbers shall not be displayed. It shall also be made apparent to the user that files in such directories are not DCF basic files. When a Writer creates a new directory, it shall not be allowed to duplicate directory numbers.

8.1.3 Handling of directories that are not DCF directories

A Reader or Writer may completely ignore a directory that is not a normal DCF directory and that does not fall under cases 8.1.1 or 8.1.2 above. A Reader may display the files in such a directory, but the directory numbers and file numbers shall not be displayed. It shall also be made apparent to the user that files in such directories are not DCF basic files.

8.2 Naming of files in a DCF directory

The method by which a Writer adds a new object to a directory containing files with names that do not follow the DCF specifications, on a PC or the like as in **Figure 6**, is specified here along with the method by which a Reader displays DCF objects in such cases.

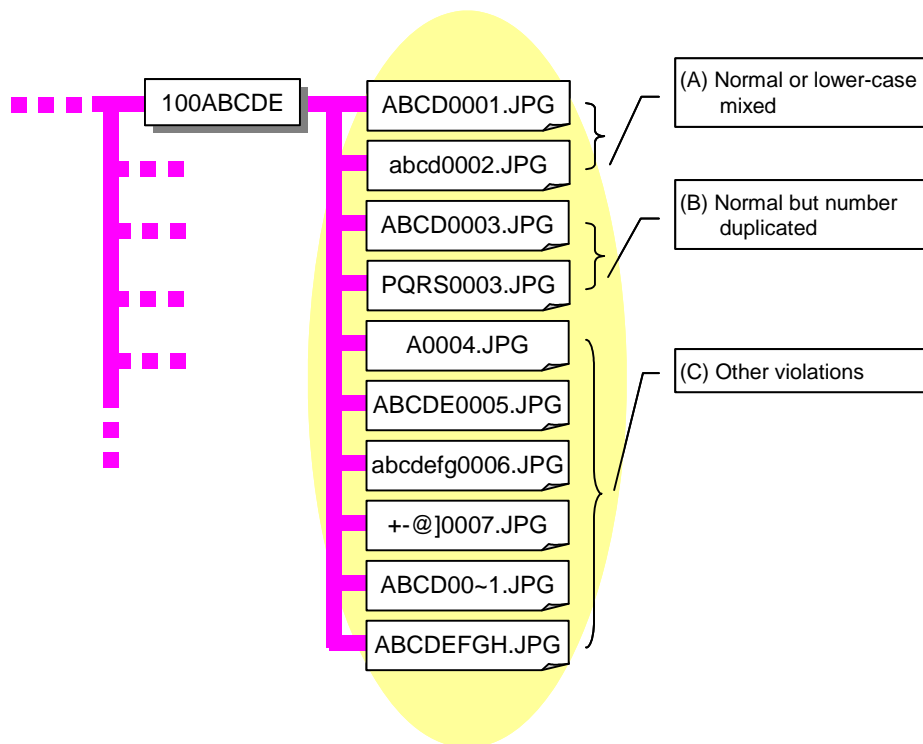


Figure 6 File naming precautions

8.2.1 When lower-case letters are used in the file name

If lower-case letters are used in the four free characters of a file name or in the extension, but otherwise the file is named in accord with DCF file naming conventions, it is treated as a DCF object without distinguishing case.

8.2.2 When file numbers are duplicated across DCF basic files or DCF optional files

If file numbers are duplicated across DCF basic files or DCF optional files, a Reader may display the files, but the directory numbers and file numbers shall not be displayed. It shall also be made apparent to the user that the files are not DCF basic files or DCF optional files. When a Writer creates a new DCF object, it shall not be allowed to duplicate the file numbers.

8.2.3 Handling of files without DCF file names

A file without a normal DCF file name that does not fall under cases 8.1.1 or 8.1.2 above may be completely ignored. A Reader may display such files, but the directory numbers and file numbers shall not be displayed. It shall also be made apparent to the user that the files are not DCF basic files.

8.3 Updating of tag data when saving

8.3.1 Handling of date and time tags

The Exif standard specifies the following three date and time tags.

- DateTimeOriginal
- DateTimeDigitized
- DateTime

DateTime records the date and time of file updating, like a file time stamp. DateTimeOriginal records the date and time when an image was shot, and DateTimeDigitized has the date and time when digital data was created. On a DSC, in many cases these three are identical.

If a DCF basic file or DCF optional file is saved again at a time after the image was originally captured, it is recommended that only the DateTime tag be updated and not the DateTimeOriginal or DateTimeDigitized tags. If, however, the image is processed in a way that invalidates the date and time of original image capture, it is allowable to update the DateTimeOriginal and DateTimeDigitized tags as well.

When a DCF basic file or DCF optional file is created not on a DSC but on a PC or the like, and the capture date and time cannot be determined, the DateTimeOriginal tag may have the date and time left blank (filled with space characters), as indicated in the Exif standard.

8.3.2 Handling of Make, Model, and Software tags

The Exif standard specifies the following three tags for recording information about equipment and applications.

- Make
- Model
- Software

The Make tag records the equipment or application vendor name, and Model gives the model name. Software may be used to record the name of software used in equipment (embedded software) or for the application software name.

If any of these tags is updated when a DCF basic file or DCF optional file is saved, it is recommended that only the Software tag be changed and the Make and Model tags be left as is. If, however, the image is processed in such a way as to invalidate the equipment information of the original image, the Make and Model tags may also be updated.

When a DCF basic file or DCF optional file is created not on a DSC but on a PC or the like, Make and Model may be used to record the software name.

8.4 DCF object bulk operations

Write-protecting a DCF object requires that the Read Only attribute be assigned to all the files in the DCF object. If file attributes are changed on a PC or the like, it is conceivable that only some of the files in a DCF object will be protected.

A Writer or Reader, respecting the DCF object configuration, is designed to operate so that if even one file in a DCF object has the Read Only attribute, all files in that object are considered protected.

If an object consists of a very large number of files such that bulk operations (copying, moving, deleting) are not practical, a Writer or Reader shall not perform operations involving only some of the files at one time, regardless of the Writer or Reader user's intention.

8.5 Identification of DCF optional files

A DCF optional file is identified based on the InteroperabilityIndex tag value and the color space-related tags specified in **Chapter 5**. A Reader uses these tags to determine whether a file is a DCF optional file. In the case of a noncompliant file such as one missing a mandatory color space-related tag or having a recorded value that differs from the specifications, the InteroperabilityIndex value may be used. If both the Gamma and TransferFunction tags are present, precedence shall be given to the Gamma tag.

Annex A Data Verification

1. Validation method

Validation testing is performed by the makers of DCF-compatible equipment and applications themselves.

Annex B Relation to JPEG and Exif Standards

The Exif standard specifies requirement levels as mandatory, recommended, and optional for each item relating to image and audio file recording methods. For example, thumbnail recording is optional, and leeway is permitted in thumbnail format.

The DCF standard specifies administrative rules, which add further stipulations to the Exif standard for the sake of playback compatibility. The file format in DCF is based on the Exif standard. The relationship among JPEG, Exif and DCF standards is summarized in **Figure 7**. See [Chapter 5](#) and following for details.

Standard name Specification	JPEG	Exif Ver.2	DCF Ver2.0
Compressed image file format	JPEG Baseline specification JPEG extended specification	Marker segment limits Pixel sampling limits	Exif Ver. 2 conformant Typical Huffman Table used
Thumbnail image format		JPEG 4:2:2 JPEG 4:2:0 TIFF	Size 160x120 fixed Typical Huffman Table used
Image attribute information		Camera information Color space information Other information	Some mandatory items sRGB and DCF optional color space Exif Ver. 2 conformant
FlashPix Ready function		Specified	Exif Ver. 2 conformant
Directory and file naming		Not specified	Specified
Writer and reader specifications			Writer and reader conditions specified
Uncompressed image file format		TIFF Rev. 6.0 conformant (some restrictions specified)	
Audio file format		WAV format (some restrictions specified)	
Object specification			Related files specified as objects

Figure 7 Relation of DCF to Exif and JPEG standards

Annex C Notes on Image File Playback

When displaying an image file, a Reader should make the user aware of whether the file being displayed is a DCF basic file or some other kind of image, so that the user can determine whether the image is displayable on another Reader as well.

The recommended method of making the user aware is either by indicating that the displayed image is a DCF basic file when a DCF basic file is being displayed, or by indicating that the displayed image is not a DCF basic file when an image file other than a DCF basic file is being displayed. **(Figure 8)**

The method of distinguishing main image playback from thumbnail substitute playback is not specified but is optional.

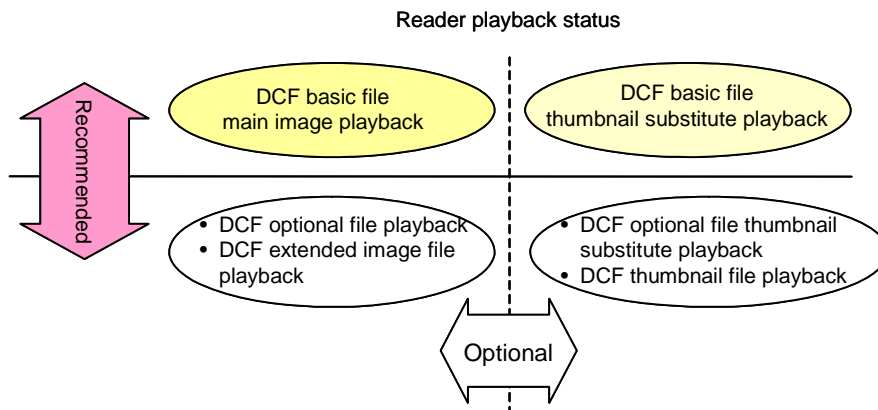


Figure 8 Playback status identification

Annex D Limits on DCF Object Operations

When there are limitations placed on the number of DCF objects that can be handled or other device specifications that may limit the ability to perform operations on some DCF objects, the user shall be warned of these limitations, such as by indicating them in product manuals or by product display.

Annex E Notes on DCF Optional Color Space Use

1. Writer

A Writer capable of recording DCF optional files shall inform users, in manuals or by other means, of the significance of the optional color space, its functions and use.

The following are examples of such indication.

- It is applicable mainly for use in commercial printing, when images undergo extensive processing.
- It is intended for professional-use software.
- DCF basic files are geared to use in kiosks, print services, and home printers.

2. Reader

If a Reader displays DCF optional files without color space transformation processing, it is recommended that the user be warned of the possibility of incorrect color rendition.

Annex F Guidelines for Handling Exif/DCF

Overview

This document is a guideline prescribed in order to enhance compatibility and interoperability when using both “Exchangeable image file format for digital still cameras Exif Version 2.21(JEITA CP-3451 + CP-3451-1)” (hereinafter called “[the Exif standard](#)”) and “Design rule for Camera File system DCF Version 2.0 (JEITA CP-3461)” (hereinafter called “[the DCF standard](#)”) defined by JEITA.

This guideline does not add new definitions or modify the existing Exif/DCF standard, but it provides examples of recommended implementation methods and handling policies.

1. Background / Purpose

1.1 Background

Image input devices including digital still cameras (hereinafter called “DSC”) have rapidly increased in popularity due to higher-resolution images, improved photographic functions and lower prices. The Exif/DCF standard is the global standard for the image-recording format of the DSC.

Due to the spread of DSC, images compliant with Exif/DCF are dealt with not only by image input devices, but also by recording and playback devices such as those for storage and display, including TVs and digital photo frames. In addition, files compliant with Exif/DCF are widely used in application fields from general consumers to business use such as commercial printing and mass media.

Moreover, Exif/DCF files are used in various ways. For example, Exif images can be retouched and edited, and Exif tag information can be changed and added by using image-editing applications on PCs. In some cases, additional information such as the ICC profile is provided for managing color space undefined in the Exif standard.

Because of the increasing utilization of Exif/DCF, it is becoming more important to improve the compatibility and interoperability of images compliant with Exif/DCF.

Furthermore, various trade groups and standardization committees are demanding that the Exif/DCF standard be expanded and clarified.

After examining the problems related to the current Exif/DCF standard in consideration of the above situation, it was determined that both clarification and establishment of operation policies of the standard are required as follows:

First, it is necessary to clarify any parts of the Exif/DCF standard where interpretation is ambiguous.

Next, it is necessary to establish appropriate policies for dealing with Exif/DCF files in consideration of workflow.

Moreover, it is necessary to revise the method for handling the file format and file system at the same time as drawing up this guideline.

1.2 Purpose

As stated in the previous section, the purpose of this guideline is to provide clarification and operational policies for the standard in order to solve current problems and meet user demands. Specifically, its purpose is to present examples related to the recommended implementation of devices dealing with Exif/DCF and to explain the mechanism for maintaining consistency among devices or applications.

In other words, implementation in accordance with this guideline is aimed at maintaining compatibility and enhancing interoperability among devices or applications from different companies.

In addition, responding to the progress of DSC and the infrastructure environment, this guideline aims at enhancing further usability and availability and expanding the opportunities to use digital image data.

This guideline presents the following concrete policies in response to the problems stated in the background section.

Regarding the first point, that is, ambiguous interpretation in the standard, this guideline firstly clarifies how to deal with APP marker segments undefined in the Exif standard. This will lead to enhanced consistency with the existing metadata specified by CIPA and other organizations and manufacturers and metadata undefined in the Exif standard. This guideline also clarifies how to handle files for recording multiple images.

Regarding the next point, that is, policies in consideration of workflow, this guideline provides the following:

- Rules for enhancing stability, compatibility and interoperability of images and metadata when they are edited using PC applications and then exported to DSC again,
- Handling policies on the side of playback devices, and
- Precautions regarding the method of assigning file names and directory names at the time of exporting.

Moreover, regarding the revision of file format and file system, this guideline presents policies related to handling a new file format and new file system in consideration of the current progress in larger-capacity memory media.

As this guideline presents policies and recommended examples in order to enhance compatibility and interoperability among devices and application software dealing with Exif/DCF, implementation in accordance with this guideline is recommended and expected from this point on.

However, since it would be difficult to examine all problems mentioned above in the short term, this guideline will be revised as necessary in the future by examining the problems step by step in consideration of their priority and importance. Furthermore, new problems not mentioned here will be dealt with as well.

2. Scope

This guideline covers devices, memory media and application software dealing with Exif/DCF files.

As devices mentioned above, the applicable objects are devices with functions such as capturing, recording, displaying, playing, editing, and printing images.

Specifically, examples of capture/recording devices include DSC, DVC and camera phones, etc.

Examples of display/playback devices include image display devices such as DTV, digital photo frames and car navigation systems. In addition, image storage devices include image storers and home servers. Image printing devices include printers.

As application software mentioned above, the applicable objects are application software providing functions for editing, displaying, printing and recording metadata as well as importing and editing images.

Specifically considered is application software that edits Exif/DCF tags and then saves them again or application software that adds metadata information undefined in the Exif standard in Exif/DCF files and then saves it again.

3. Definition of terms

3.1 Verbal forms for the expression of provisions

The keywords in this document are to be interpreted as described in ISO/IEC Directives 2.

(See [Directives2](#) Annex H "Verbal forms for the expression of provisions".)

Requirement	
Verbal forms	Equivalent expressions
shall	is mandatory
shall not	

Recommendation	
Verbal forms	Equivalent expressions
should	it is recommended that is recommended
should not	

Permission	
Verbal forms	Equivalent expressions
may	is optional
need not	

Possibility and capability	
Verbal forms	Equivalent expressions
can	it is possible to
cannot	

3.2 Terminology

DSC	Digital Still Camera
DVC	Digital Video Camera
DTV	Digital Television
Primary image	“Recording image as the main data” described in 2 Definition of Terms of the Exif Standard
DCF media	“Removable memory recorded in compliance with the DCF” described in 3.1 Definition of Terms of the DCF Standard
Exif writer	“A digital still camera (DSC) or other device or application software that can output an Exif file” described as a writer in 2 Definition of Terms of the Exif Standard
Exif editor	A device or application to edit existing Exif files (add, change or delete part of a file) (Major examples are image editing applications. It includes certain types of DTV, digital photo frames or DSC.)
Exif reader	“A device, such as a printer with memory card slot, capable of directly reading an Exif file and printing or performing other output processing, as well as application software that uses Exif tags to perform image processing for output” described as a reader in 2 Definition of Terms of the Exif Standard
DCF Reader	“Playback function in conformity with the DCF Reader 1 and Reader 2 specifications” described in 3.1 Definition of Terms of the DCF Standard
DCF Writer	“A recording function compliant with the DCF Writer specification” described in 3.1 Definition of Terms of the DCF Standard

4. Handling Exif/DCF files in consideration of workflow

This chapter presents the workflow dealt with in this guideline. The guideline is described in consideration of this workflow for handling Exif/DCF files from the next chapter.

4.1 Workflow for editing an image with application software

Figure 4-1 shows the workflow when an Exif/DCF file is edited using an application. DSCs in this figure are examples of image capture/playback devices. Consideration is also given to the use of other devices such as a TV or printer.

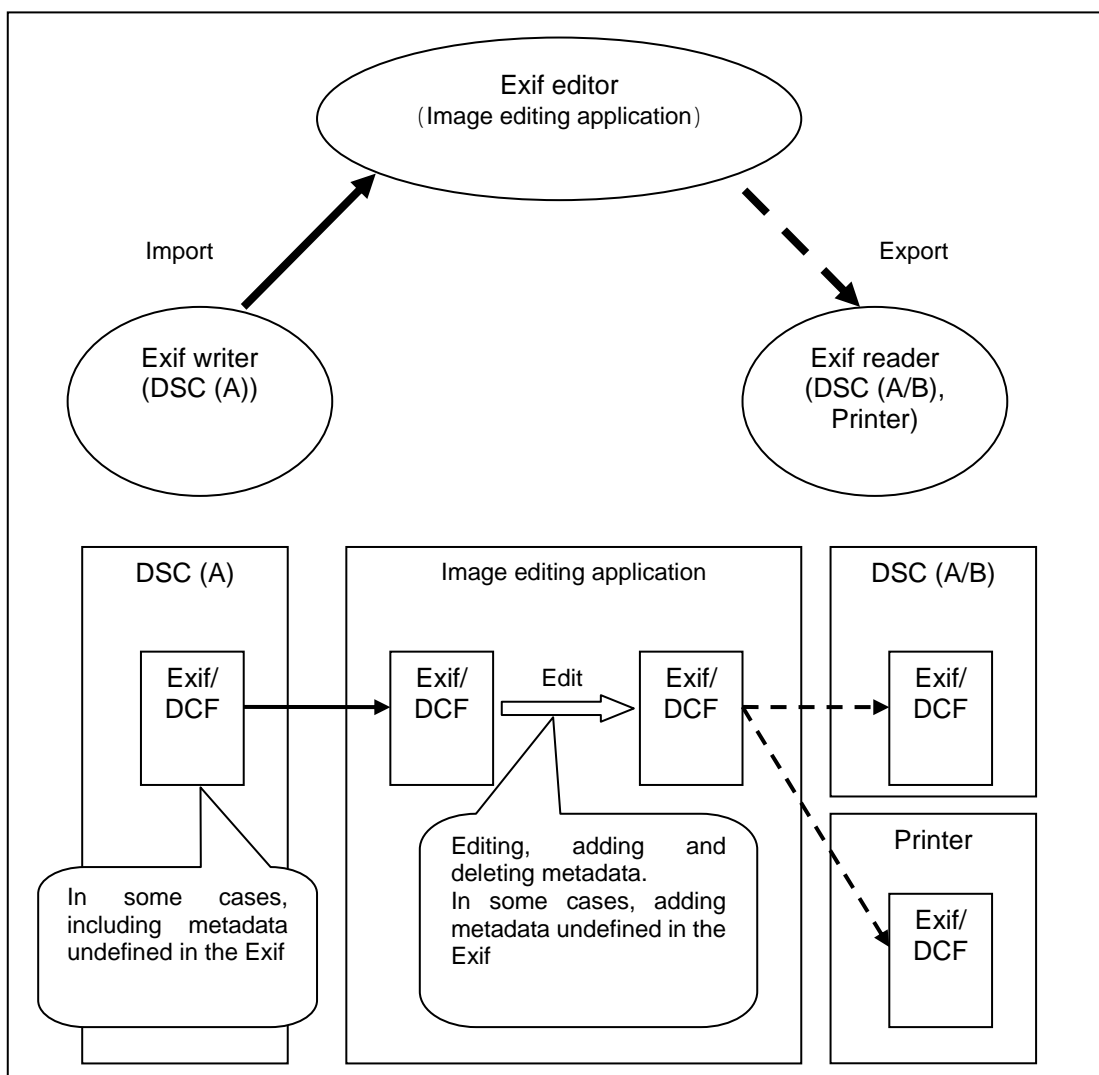


Figure 4-1 Editing images with application software

4.1.1 Actions

In this workflow, the following cases are considered:

1. Recording an image using an Exif writer (in some cases, recording metadata undefined in the Exif)
2. Importing the image into an Exif editor and editing it (in some cases, adding metadata undefined in the Exif at this time)
3. Exporting the edited image to an Exif reader. At this time, there are cases in which the Exif reader is a DCF Reader, but in other cases, that is not so.
4. Viewing the image with an Exif reader.

5. Issues related to the Exif standard

This chapter explains how to deal with the primary image data defined in the Exif standard as follows.

5.1 JPEG compressed data

This section provides guidelines related to the basic structure of [JPEG](#) compressed data.

5.1.1 Application marker segments

The basic structure of JPEG compressed data in Exif adopts a configuration based on marker segments compliant with the “Baseline DCT format of JPEG.”

In the JPEG standard on which the Exif standard is based, the use of the APPn (Reserved for application segments) and COM (Comment) marker is not restricted. In the Exif standard (4.5.4 Basic Structure of JPEG Compressed Data), it is written, "APPn other than APP1 and APP2 or COM segments are not used". However, there is no mention of prohibited use of undefined APPn markers. Therefore, undefined APPn markers can be optionally used for recording by vendors or trade groups. In this case, compliance with the following rules is recommended in order to maintain reproduction compatibility with the Exif devices. In this guideline, marker segments of JPEG compressed data should be recorded in accordance with the order shown in **Table 5-1** and should be interpreted as described in the table.

That is, it is possible to optionally record multiple APPn (n is a value from zero to 15) markers immediately after APP1 and APP2 defined in the Exif standard.

The bracketed marker segment names show optional marker segments in the Exif standard. In addition, this guideline clarifies the No. 4 marker segment, which has a mesh background.

Table 5-1 Marker segments of JPEG compressed data in Exif

No	Name of marker	Specification in the Exif standard	Clarified part in this guideline
1.	SOI	Recording this marker is mandatory. It shall be recorded in this position at the beginning of all markers.	
2.	APP1	Exif Attribute Information Recording this marker is mandatory. It shall be recorded in this position immediately after SOI.	
3.	(APP2)	Flashpix Extension data Recording this marker is optional. Multiple APP2 markers can be optionally recorded in any order. It shall be recorded in this position, if necessary.	

4.	(APPn)	Data undefined in Exif (including APP1, APP2)	Recording this marker is optional. Multiple markers can be recorded, as necessary.
5.	DQT, DHT, (DRI), SOF	Other marker groups defined in Exif Only the DRI marker is optional. Recording the rest of the markers is mandatory. Their recording order may be changeable.	
6.	SOS (compressed data)	If the DRI marker is recorded, the RSTm marker shall be inserted as well.	
7.	EOI	Recording this marker is mandatory. It shall be recorded in this position.	

In accordance with **Table 5-1**, the structure of JPEG compressed data in the current Exif standard is shown.

Mesh background indicates mandatory segments in the Exif standard.

SOI	Start of Image
APP1	Application marker segment 1 (for Exif Attribute Information)
(APP2)	Application marker segment 2 (for Flashpix Extension data)
DQT	Quantization Table
DHT	Huffman Table
(DRI)	(Restart Interval)
SOF	Frame Header
SOS	Scan Header
	Compressed Data
EOI	End of Image

Figure 5-2 Structure of JPEG compressed data in the current Exif standard

The following figure shows an example structure of JPEG compressed data when undefined data in the Exif standard is added.

In this case, the added segments are assumed as APPx, APPy and APPz (x, y and z are optional numbers from zero to 15).

SOI	Start of Image
APP1	Application marker segment 1 (for Exif Attribute Information)
(APP2)	Application marker segment 2 (for Flashpix Extension data)
(APPx)	Application marker segment x (data 1 undefined in Exif)
(APPy)	Application marker segment y (data 2 undefined in Exif)
(APPz)	Application marker segment z (data 3 undefined in Exif)
DQT	Quantization Table
DHT	Huffman Table
(DRI)	(Restart Interval)
SOF	Frame Header
SOS	Scan Header
	Compressed Data
EOI	End of Image

Figure5-3 Structure of JPEG compressed data with added APPn in Exif (Example)

5.1.2 How to deal with APPn markers undefined in the Exif standard

Exif writers should record only the minimum for vendors when recording APPn markers undefined in the Exif standard. Especially, metadata for which the content is inconsistent with that of metadata written in the Exif standard should not be recorded.

Even if APPn markers are undefined in the Exif standard and incomprehensible, Exif editors should not delete them, in consideration that the necessary information is recorded. Moreover, Exif editors should add only the minimum for vendors when adding APPn markers undefined in the Exif standard. Especially, metadata for which the content is inconsistent with that of metadata written in the Exif standard should not be added.

When adding APPn markers, because the volume becomes quite large, current devices might not be able to handle the file itself. In other cases, the large volume might affect the performance of the device. Such cases should be kept in mind. For example, when an Exif editor uses optional APPn to add unique information to the file created by an Exif writer, the file size increases by the amount of added information. Even if the additional information is small, because the file size increases, some Exif readers might not properly handle the file itself due to the regulation in the specifications of the device. Other Exif readers might be affected in terms of performance. Therefore, it is necessary to take into account such cases.

Exif readers should be implemented to operate without interruption even if APPn markers undefined in the Exif standard have been recorded. It is recommended that Exif readers be designed to skip over unknown APP markers in the Exif standard (4.5.4 Basic Structure of JPEG Compressed Data).

5.1.3 Recording data other than the primary image

The JPEG standard defines data formats such as compressed image data format and it does not mention file formats. Therefore, it is possible to add information other than the primary image by separately defining the structure of an image file.

For example, the file formats for recording multiple images and for information other than images are considered. If there is a standard specification, specific methods for implementation and handling should comply with the standard specification.

In Exif editors, when APP markers compliant with a standard specification are used to manage the start address of an image with offset in files, it should be considered that the start address of the image might be changed by adding the APPn markers.

In Exif writers, when data is recorded using a unique method that does not comply with a standard specification, it should be kept in mind that the data might be changed or deleted when used with other Exif writers or editors.

Moreover, Exif readers should be implemented to operate without interruption even if certain kinds of data have been recorded after EOI of the primary image defined in the Exif standard. Specifically, unknown data after EOI of the primary image should be skipped.

6. Issues related to the DCF standard

This chapter explains how to deal with memory media defined in the DCF standard.

6.1 Large-capacity memory media

The DOS FAT file system specified in the DCF standard has become insufficient due to larger-capacity memory media.

This section provides guidelines related to the file system used in DCF media.

6.1.1 File system

The file system used in DCF media having a capacity of over 2 GByte is in fact operated by FAT32.

Interoperability should be enriched by adopting an appropriate file system within the specified range of the DCF standard depending on such conditions as capacity when selecting the file system to be used in DCF media.

7. References

All reference citations in this document use the abbreviations defined in the following table.

DCF	Design rule for Camera File system: DCF Version 2.0 JEITA CP-3461, September 2003. http://www.jeita.or.jp/
Exif	Exchangeable image file format for digital still cameras: Exif Version 2.2 JEITA CP-3451, April 2002. Exchangeable image file format for digital still cameras: Exif Version 2.21 (Amendment Ver2.2) JEITA CP-3451-1, September 2003. http://www.jeita.or.jp/
JPEG	“Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines”, ISO/IEC 10918-1:1994. http://www.iso.org/
Directives2	ISO/IEC Directives, Part 2 “Rules for the structure and drafting of International Standards” http://www.iso.org/ http://isotc.iso.org/livelink/livelink/fetch/2000/2122/3146825/4229629/4230450/4230456/ISO IEC Directives Part 2 Rules for the structure and drafting of International Standards 2004 5th edition pdf format .pdf?nodeid=4230517&vernum=0

8. Participating members

The bulk of the deliberations over the formulation of the standards described in this document was performed by the Exif/DCF Sub-Working Group.

The members of the Working Group are listed below.

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Chair	Canon Inc.	Nobuaki Sakurada
Vice Chair	Olympus Imaging Corp .	Hideaki Yoshida
Vice Chair	Konica Minolta Opto, Inc.	Iwao Aizawa
Vice Chair	Sony Corporation	Eiichi Ichimura
Vice Chair	Nikon Corporation	Tetsuro Goto
Vice Chair	FUJIFILM Corporation	Mikio Watanabe
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	Canon Inc.	Makoto Gouda
	KODAK JAPAN LTD.	Koichi Settai
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Annex G Explication of the DCF 2.0 Revision

This document provides explanatory information on the latest revision to the DCF Standard, Version 2.0. This document includes explanations referring to the definitions in the DCF Standard, reference material in relation to the standard, and information in relation to the development of the standard. This document is entirely informative and shall not be considered as an integral part of the DCF Standard.

This section gives a supplementary explanation of matters indicated or referred to in this specification and its annexes, and of related matters. It is not part of the specification itself.

1. Purpose

The present revision to the Design Rule for Camera File System (DCF) standard was undertaken mainly for the purpose of adding an optional color space (described below), as a color space specification suitable for commercial applications. In this way the DCF specification is made readily usable for such applications in addition to ordinary consumer applications as up to now.

2. History of Revision

The DCF standard, first drawn up in 1999 as a companion to the Exif format (Exchangeable image file format for digital still camera), has contributed importantly to the popularity of digital still cameras (DSC) by enabling image files to be exchanged among a variety of media and devices.

In the DCF standard, only Exif compressed format (JPEG format) files are defined as mandatory files (DCF basic files) that must be supported by image writer and reader hardware or application software. This ensures direct exchangeability of image data recorded on removable memory.

As DSC performance levels have risen, these products have come to be widely used in professional applications as well as by ordinary consumers. The professional uses include the commercial printing field, where it has become evident that the image data recorded in JPEG files (DCF basic files) can meet the requirements quite adequately.

The existing DCF Version 1.0 (DCF 1.0) specification, however, is affected by the following issues when the attempt is made to use DCF-recorded image files in such commercial applications. DCF 1.0 specifies that image data in DCF basic files be recorded assuming playback using the sRGB color space. In applications like commercial printing, however, image data is recorded for a color space different from sRGB, which means that data conversion (color space transformation) must be performed when using image data recorded by a DSC conforming to DCF 1.0. For this reason there have been calls to extend the DCF standard so as to enable direct use of the image data in professional fields like the above.

DCF Version 2.0 (DCF 2.0) was drawn up in response to these needs. In addition to the sRGB color space assumed in DCF 1.0, it enables image data for an optional color space in standard use in the commercial printing field to be recorded as Exif compressed format (JPEG format) files. This revision is therefore made only to support a specific existing color space (optional color space), and is not intended to allow for other color space extensions. The Writer and Reader specifications have been revised to accommodate the additional recording of image files matched to the optional color space. Other revisions have been made correcting erroneous or unclear wording in the DCF 1.0 standard, in order to make the specifications easier to understand.

3. Main Issues Arising in the Deliberations

As noted above, the purpose of this revision is to enable use of an optional color space different from the sRGB color space used as standard in DCF 1.0. The main point of argument in the discussions was how to record files using the optional color space (DCF optional files) without causing problems for users of Reader products conformant to DCF 1.0. The data structure of the optional files is Exif compressed format as noted above, and tags are used to distinguish DCF optional files from DCF basic files. However, since the InteroperabilityIndex tag for identifying a DCF optional file is ignored by a Reader based on the DCF 1.0 specification, or by an ordinary JPEG reader not conforming to Exif, the images will be displayed by these readers. In this case the image data recorded for the optional color space will be displayed as sRGB color space data, causing concern that the color rendering will not be accurate. One possibility considered was to use a file extension other than ".JPG" so that DCF optional files would not be displayed by conventional Reader products. The concern in this case, however, was that users would be confused by the inability to play these files due to their different file extension. It was therefore decided to keep the same extension as that used with basic files, but to specify the prefixing of "_" at the beginning of all optional file names, as this is a character unlikely to be used ordinarily as the first character of a file name. This prefix makes it possible to identify a DCF optional file even if the identification tag in the file cannot be recognized.

4. Main Revisions

4.1 Definition of DCF optional files

DCF optional files have the following characteristics.

- Image data is recorded using the DCF optional color space. The file name shall begin with "_".
- A newly defined InteroperabilityIndex value is recorded to identify a DCF optional file.
- The Color Space tag is assigned a certain value different from sRGB.
- Tags indicating the characteristics of the optional color space (WhitePoint, PrimaryChromaticities, YCbCrCoefficient, and Gamma) are recorded in a DCF optional file.

4.2 Writer specifications

In addition to the existing specifications applying to DCF directories, these directories are now able to contain DCF optional files.

4.3 Reader specifications

In addition to the existing specifications applying to Reader 1 products, they are now able to display DCF optional file thumbnails. In displaying these files, color space transformation is preferable but is not mandatory if Reader limitations prevent it.

Display of DCF optional files by a Reader 2 product is optional (implementation dependent).

5. Intellectual Property Rights

The companies listed below have declared that they hold the patent right(s) shown below, which include issued patents and pending patent applications, and have announced that they will grant a license to these patents under reasonable and non-discriminately terms and conditions for products which conform to the JEITA standard "Design rule for Camera File system: DCF Version 2.0". Such licenses should be negotiated with each patent holder.

- KONICA PHOTO IMAGING CORPORATION JAPAN 2976113
- Eastman Kodak Company US 5164831
JAPAN 3072852, 3302671
2002-64813(application number)
- Sony Corporation JAPAN 2003-153025(application number)
- FUJI PHOTO FILM CO., LTD. JAPAN 3203290
- RICOH COMPANY, LTD JAPAN 11-4404(application number)

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights other than those identified above. JEITA shall not be held responsible for any or all such patent rights.

6. DCF Optional Color Space

6.1 Overview

As a result of recent improvements in digital still camera image quality and advances in image processing techniques, the commercial printing industry has begun to change the way images are input when printing photographs. Direct input of digital images shot with digital still cameras is replacing the conventional procedure of capturing pictures on film and then putting them through a film scanner. Magazine ads and catalogs can be created more efficiently and in shorter time than before. Image data using the sRGB color space standardized in the existing Exif 2.2 specification is being used in some commercial publishing tasks. At the same time, in the printing part of the workflow, the industry is moving in the direction of standardizing on an adequate color space, capable of rendering RGB data in ink with brighter, more saturated colors. If the RGB data input in the editing, design and layout stages use a different color space, conversion must be made between color spaces. Given the large amount of image data handled in the industry, the need for color space transformation processing puts a heavy strain on work efficiency and maintenance of quality.

With this revision of the DCF standard, an adequate color space is specified, having special advantages in the commercial printing industry workflow. The optional color space specified here is defined with the same color gamut as the Adobe RGB*1 color space in wide use by professional photographers, prepress industry including DTP, and designers. And its character is shown in **chapter 6.2**.

While viewing conditions are left to the discretion of respective manufacturers, it is desired that the conditions should be standardized in the future.

6.2 Color space characteristics

The characteristics of DCF optional color space are as follows.

Gamma compensation: $\gamma=2.2$

White Point: $x=0.313, y=0.329$ (D65)

Chromaticity coordinates	x	y
R	0.64	0.33
G	0.21	0.71
B	0.15	0.06

*1: This color space is called Adobe RGB

7. Committee Organization for Preparing the Draft Standard

This standard was deliberated by Exif/DCF Sub Committee of CIPA ,Camera & Imaging Products Association . The draft standard was then presented to JEITA Technical Standardization Committee on AV & IT Storage-Systems and Equipment, and approved by that Committee in September, 2003.

The committees involved in drafting the standard are as follows:

<Technical Standardization Committee on AV & IT Storage Systems and Equipment>

Chairman Tadashi Ezaki Sony Corporation

<Technical Standardization Committee on Color Management>

Chairman Nobuaki Usui Fujitsu Corporation

<Digital Camera Standardization Group>

Group Leader:	Takashi Sakaguchi	Matsushita Electric Industrial Co., Ltd.
Sub Leader:	Takao Tsuchiya	Sony Corporation
Sub Leader:	Hiroaki Sugiura	Mitsubishi Electric Corporation
Advisor:	Shin Ohno	Tokyo Institute of Polytechnics
Member:	Hideaki Yoshida	Olympus Optical Co., Ltd.
	Hideaki Kawamura	CANON INC.
	Shuji Hayashi	KONICA PHOTO IMAGING CORPORATION
	Shinji Ukita	SANYO Electric Co., Ltd.
	Mitsuhiko Maeda	SANYO Electric Co., Ltd.
	Yukio Okano	SHARP CORPORATION
	Yoshiyuki Ozawa	SEIKO EPSON CORPORATION
	Hiroko Hayashi	SEIKO EPSON CORPORATION
	Tadashi Ezaki	Sony Corporation
	Naoya Kato	Sony Corporation
	Sadao Maeyama	Sony Corporation
	Kenji Sakamoto	Dai Nippon Printing Co., Ltd.
	Kazuya Yoshida	Dai Nippon Printing Co., Ltd.
Tatsuro Abe	TOSHIBA CORPORATION	

Norihiro Aso	Victor Company of Japan, Limited
Kazuyuki Sato	Hitachi, Ltd.
Makoto Tsugita	FUJI PHOTO FILM CO., LTD.
Masaaki Shimizu	Matsushita Electric Industrial Co., Ltd.

<CIPA Standardization Committee>

Chairman	Kazuya Hosoe	CANON INC.
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Sub Chief :	Toshihisa Kuroiwa	NIKON CORPORATION
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	Yoshiharu Hibi	Fuji Xerox Co., Ltd.
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	Motokazu Ohkawa	CIPA
	Kumiko Kamochi	CIPA
	Keiko Miura	CIPA

Participating members

The bulk of the deliberations over the formulation of the standards described in this document was performed by the Exif/DCF Working Group.

The members of the Working Group are listed below.

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Vice Chair	Sony Corporation	Eiichi Ichimura
Vice Chair	Nikon Corporation	Koichiro Kawamura
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