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**Information technology — Volume and file
structure of write-once and rewritable
media using non-sequential recording for
information interchange —**

(Part 4: File structure)

File structure

[ISO/IEC 13346-4:1995](https://standards.iso.org/iso/iec/13346-4:1995)

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*Technologies de l'information — Structure de volume et de fichier de
moyens d'écriture unique et de réécriture utilisant un enregistrement non
séquentiel pour l'échange d'information —*

Partie 4: Structure de fichier

INTERNATIONAL

ISO/IEC



Reference number
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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialised system for worldwide standardisation. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organisation to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organisations, governmental and non-governmental, in liaison with ISO and IEC, also take part in this work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication of an International Standard requires approval by at least 75% of the national bodies casting a vote.

International Standard ISO/IEC 13346 was prepared by the European Association for Standardizing Information and Communication Systems, ECMA, (as Standard ECMA-167) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by National Bodies of ISO and IEC.

Annex A forms an integral part of this Part of ISO/IEC 13346.

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Introduction

ISO/IEC 13346 is a volume and file structure standard for interchanging files and as such, it is a peer to existing volume and file structure standards such as ISO 9293 and ISO 9660. It is rather different from those standards in at least two important ways. Firstly, it offers much more functionality, mainly because of user needs for increased character set support and for more powerful file system features. Secondly, it acknowledges the separate concerns of booting, volume structure and file system structure. Rather than bundling these different functions together, ISO/IEC 13346 carefully segregates these functions into separate parts and describes in detail how those parts fit together. It is expected that future volume and file structure standards will fit into this framework, rather than building other distinct and incompatible formats.

ISO/IEC 13346 is published in five Parts. Part 1 - general - specifies references, definitions, notations and basic structures used in the other four Parts. Part 2 - volume and boot block recognition - specifies formats and system requirements for recognising the volume structures on a medium and booting from a medium. Part 3 - volume structure - specifies how to record various volume-related entities such as volumes, volume sets and logical volumes. Part 4 - file structure - specifies how to record and interpret files, both file data and file attributes, and file hierarchies within logical volumes. Part 5 - record structure - specifies how to record and interpret file data encoded as records.

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Information technology - Volume and file structure of write-once and rewritable media using non-sequential recording for information interchange -

Part 4:

File structure

Section 1: General

1 Scope

ISO/IEC 13346 specifies a format and associated system requirements for volume and boot block recognition, volume structure, file structure and record structure for the interchange of information on media between users of information processing systems.

The media shall be recorded as if the recording of sectors may be done in any order.

NOTE 1 - The medium is not restricted to being of only one type; the type of medium may be either write once, or read only, or rewritable, or a combination of these types.

ISO/IEC 13346 consists of the following five Parts:

Part 1: General

Part 2: Volume and Boot Block Recognition

Part 3: Volume Structure

Part 4: File Structure

Part 5: Record Structure <https://standards.iteh.ai/catalog/standards/sist/483fe8ac-1930-43e6-9aa7-90b1507c3346-4-1995>

Annex A - ICB Strategies, is part of this Part of ISO/IEC 13346. <https://standards.iteh.ai/catalog/standards/sist/483fe8ac-1930-43e6-9aa7-90b1507c3346-4-1995>

This Part of ISO/IEC 13346 specifies a format and associated system requirements for file structure by specifying:

- the placement of files;
- the attributes of the files;
- the relationship among files of a logical volume;
- levels of medium interchange;
- requirements for the processes which are provided within information processing systems, to enable information to be interchanged between different systems; for this purpose, it specifies the functions to be provided within systems which are intended to originate or receive media which conform to this Part of ISO/IEC 13346.

2 Parts references

The first digit of a reference within ISO/IEC 13346 identifies the Part, e.g. 2/5 refers to clause 5 in ISO/IEC 13346-2, and figure 4/3 refers to figure 3 in this Part of ISO/IEC 13346.

3 Part interface

This clause specifies the interface of this Part of ISO/IEC 13346 to other standards or Parts.

3.1 Input

This Part of ISO/IEC 13346 requires the specification of the following by another standard or Part.

- Volume sets of one or more volumes.
- A means for assigning volume sequence numbers (see 4/8.1).
- Logical volumes composed of partitions.

- Numeric identification of the partitions within a logical volume.
- If the volume is recorded according to ISO/IEC 13346-3, the partitions shall be numbered according to 3/8.8.
- Identification of a logical volume on which one or more file sets may be recorded.
- Division of the partitions for a logical volume into fixed size logical blocks.
- Numeric identification of the logical blocks within a partition.
- The size of a logical block for a logical volume. This shall be an integral multiple of 512.
- A means for detecting if a logical block is unrecorded.
- If the volume is recorded according to ISO/IEC 13346-3, a logical block shall be unrecorded if all of the logical sectors comprising that logical block are unrecorded. A logical block should either be completely recorded or unrecorded.
- A means for identifying the first extent of the File Set Descriptor Sequence (see 4/8.3.1) of a logical volume;
- If the volume is recorded according to ISO/IEC 13346-3, the extent in which the first File Set Descriptor Sequence of the logical volume is recorded shall be identified by a long_ad (4/14.14.2) recorded in the Logical Volume Contents Use field (see 3/10.6.7) of the Logical Volume Descriptor describing the logical volume in which the File Set Descriptors are recorded.
- A means for specifying the Logical Volume Header Descriptor (see 4/14.15) of a logical volume
- If the volume is recorded according to ISO/IEC 13346-3, the Logical Volume Header descriptor shall be recorded in the Logical Volume Contents Use field (see 3/10.10.5) of the prevailing Logical Volume Integrity Descriptor for the logical volume.
- A means for identifying the following for each partition of the logical volume on which a file set is recorded:
 - Unallocated Space Table and Unallocated Bit Map (see 4/10)
 - Freed Space Table and Freed Bit Map (see 4/10)
 - Partition Integrity Table (see 4/11)

If the volume is recorded according to ISO/IEC 13346-3, the Partition Contents Use field (see 3/10.5.6) of the Partition Descriptor (see 3/10.5) describing the partition shall be recorded as a Partition Header Descriptor (see 4/14.3). Such a Partition Descriptor shall have "+NSR02" recorded in the Partition Contents field.

3.2 Output

This Part of ISO/IEC 13346 specifies the following which may be used by other standards or Parts.

- Data space of a file (see 4/8.8.2).
- Attributes of a file.
- Attributes of a directory.
- Attributes of a directory hierarchy.

4 Conformance

4.1 Conformance of a medium

A medium shall be in conformance with ISO/IEC 13346 when it conforms to a standard for recording (see 1/5.10) and information recorded on sectors of the medium conform to the specifications of ISO/IEC 13346-1 and one or more of Parts 2, 3, 4 and 5. A statement of conformance shall identify the sectors of the medium on which information is recorded according to the specifications of ISO/IEC 13346, and the Parts and the levels of medium interchange (see 2/10, 3/11, and 4/15) to which the contents of those sectors of the medium conform.

4.2 Conformance of an information processing system

An information processing system shall be in conformance with ISO/IEC 13346 if it meets the requirements specified in ISO/IEC 13346-1 and one or more of Parts 2, 3, 4 and 5 either for an originating system (see 2/12, 3/13, 4/17 and 5/11) or for

a receiving system (see 2/13, 3/14, 4/18 and 5/12) or for both types of system. A statement of conformance shall identify the Parts, and the levels of the requirements for each of those Parts, which can be met by the system.

5 Definitions

For the purposes of this Part of ISO/IEC 13346, the definitions given in ISO/IEC 13346-1 (see 1/5) and the following definitions apply.

- 5.1 **extent:** A set of logical blocks, the logical block numbers of which form a continuous ascending sequence. The address, or location, of an extent is the number of the first logical block in the sequence.
- 5.2 **file set:** A collection of files and directories.
- 5.3 **group ID:** An identification of a group of users.
- 5.4 **logical block:** The unit of allocation of a logical volume.
- 5.5 **logical volume:** A nonempty set of partitions over which one or more file sets are recorded.
- 5.6 **partition:** An extent of logical blocks within a volume.
- 5.7 **user ID:** An identification of a user.

6 Notation

The notation of ISO/IEC 13346-1 (see 1/7) applies to this Part of ISO/IEC 13346.

7 Basic types

In addition to the basic types of ISO/IEC 13346-1 (see 1/7), the following basic types apply for this Part of ISO/IEC 13346.

7.1 Recorded address

A logical block address may be specified by an `lb_addr` recorded in the format shown in figure 4/1.

RBP	Length	Name	Contents
0	4	Logical Block Number	UInt32 (1/7.1.5)
4	2	Partition Reference Number	UInt16 (1/7.1.3)

Figure 1 - `lb_addr` format

7.1.1 Logical Block Number (RBP 0)

This field specifies the logical block number relative to the start of the partition identified by the Partition Reference Number field. The value 0 shall refer to the first logical block in the partition.

7.1.2 Partition Reference Number (RBP 4)

This field contains the numeric identification of a partition within a logical volume (see 4/3.1).

7.2 Descriptor Tag

Certain descriptors specified in this Part of ISO/IEC 13346 have a 16 byte structure, or `tag`, at the start of the descriptor with the format given in figure 4/2.

NOTE 2 - There are two main motivations for using a general tag structure. The first is that most descriptors need a generic way to handle issues of CRCs and format versions. The second motivation is to support recovery after the medium has been damaged or corrupted in some (unspecified) way. With the tag described here, structures are self identifying and can be verified with very little context.

RBP	Length	Name	Contents
0	2	Tag Identifier	Uin16 (1/7.1.3)
2	2	Descriptor Version	Uin16 (1/7.1.3)
4	1	Tag Checksum	Uin8 (1/7.1.1)
5	1	Reserved	#00 byte
6	2	Tag Serial Number	Uin16 (1/7.1.3)
8	2	Descriptor CRC	Uin16 (1/7.1.3)
10	2	Descriptor CRC Length	Uin16 (1/7.1.3)
12	4	Tag Location	Uin32 (1/7.1.5)

Figure 2 - tag format

7.2.1 Tag Identifier (RBP 0)

This field shall specify an identification of the descriptor type. Type 0 shall specify that the format of this descriptor is not specified by this Part of ISO/IEC 13346. Types 1-7 and 9 are specified in Part 3. Type 8 is specified identically in Part 3 and this Part of ISO/IEC 13346. Types 256-265 are specified in this Part of ISO/IEC 13346. All other types are reserved for future standardisation. The descriptor types specified by this Part of ISO/IEC 13346 are shown in figure 4/3.

Type	Interpretation
8	Terminating Descriptor (3/10.9 and 4/14.2)
256	File Set Descriptor (4/14.1)
257	File Identifier Descriptor (4/14.4)
258	Allocation Extent Descriptor (4/14.5)
259	Indirect Entry (4/14.7)
260	Terminal Entry (4/14.8)
261	File Entry (4/14.9)
262	Extended Attribute Header Descriptor (4/14.10.1)
263	Unallocated Space Entry (4/14.11)
264	Space Bitmap Descriptor (4/14.12)
265	Partition Integrity Entry (4/14.13)

Figure 3 - Descriptor interpretation

7.2.2 Descriptor Version (RBP 2)

This field shall specify the version of this descriptor. The value 2 shall indicate the structure of this Part of ISO/IEC 13346.

7.2.3 Tag Checksum (RBP 4)

This field shall specify the sum modulo 256 of bytes 0-3 and 5-15 of the tag.

7.2.4 Reserved (RBP 5)

This field shall be reserved for future standardisation and shall be set to #00.

7.2.5 Tag Serial Number (RBP 6)

This field shall specify an identification of a set of descriptors. If the field contains 0, then no such identification is specified.

NOTE 3 - This field can be used to distinguish between groups of descriptors. For example, when reusing rewritable media, an implementation might choose a different serial number from the previous use when initialising a volume. Thus, a disaster recovery mechanism can avoid recovering prior and unintended data. The only alternative to this scheme would be to force volume initialisation to clear the volume.

7.2.6 Descriptor CRC (RBP 8)

This field shall specify the CRC of the bytes of the descriptor starting at the first byte after the descriptor tag. The number of bytes shall be specified by the Descriptor CRC Length field. The CRC shall be 16 bits long and be generated by the CRC-ITU-T polynomial (see ITU-T V.41):

$$x^{16} + x^{12} + x^5 + 1$$

NOTE 4 - As an example, the CRC of the three bytes #70 #6A #77 is #3299. Implementations can avoid calculating the CRC by setting the Descriptor CRC Length to 0, as then the Descriptor CRC shall be 0.

7.2.7 Descriptor CRC Length (RBP 10)

This field specifies how many bytes were used in calculating the Descriptor CRC.

7.2.8 Tag Location (RBP 12)

This field shall specify the number of the logical block, within the partition the descriptor is recorded on, containing the first byte of the descriptor.

NOTE 5 - The location of the tag may appear to be redundant but its primary purpose is to make it extremely likely that if the first 16 bytes of a logical sector or logical block is a consistent descriptor tag, then it is a descriptor tag.

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Section 2: Requirements for the medium for file structure

8 File structure

8.1 Volume set

Each volume in a volume set shall have an assigned volume sequence number as specified in 4/3.1.

8.2 Arrangement of information on a volume set

A logical volume and its related file sets shall be recorded on a volume set. Identification of the logical volumes (see 4/3.1) and related File Set Descriptors for all the logical volumes in a volume set shall be recorded in the volume with the highest volume sequence number in the volume set.

8.3 Arrangement of information on a logical volume

This Part of ISO/IEC 13346 takes a logical volume to be a set of partitions on one or more volumes. Each partition shall be considered as an extent of logical blocks, and shall have an identification as specified in the input parameters for this Part of ISO/IEC 13346 (see 4/3.1). An address within a logical volume has two parts; one part identifies a partition within the logical volume and the other part specifies a logical block number relative to the start of that partition.

8.3.1 File Set Descriptor Sequence

A File Set Descriptor Sequence shall be recorded as a sequence of extents within a logical volume. An extent of the File Set Descriptor Sequence shall be recorded according to the schema shown in figure 4/4.

```
[File Set Descriptor Sequence extent]{
  <File Set Descriptor>0+
  [Terminator]{
    <File Set Descriptor> ISO/IEC 13346-4:1995
    | <Terminating Descriptor> http://standards.iso.org/standards/catalog/standards/sist/483fe8ac-1930-43e6-9aa7-
    | <unrecorded logical block> acc1b5-4a273a/iso-iec-13346-4-1995
  } <trailing logical block>0+
} 0+
```

Figure 4 - File set descriptor sequence schema

The first extent of the sequence shall be identified by the input parameters (see 4/3.1) of this Part of ISO/IEC 13346. Each, if any, subsequent extent of the sequence shall be identified by the Next Extent field of a File Set Descriptor. An extent of the sequence shall be terminated by either an unrecorded logical block (see 4/3.1), a Terminating Descriptor (see 4/14.2), or by a File Set Descriptor whose Next Extent field identifies a subsequent extent of the sequence.

All File Set Descriptors shall have an assigned file set descriptor number. All File Set Descriptors with identical file set descriptor numbers shall have identical contents.

All file sets shall have an assigned file set number. Of the File Set Descriptors of a File Set Descriptor Sequence with identical file set numbers, the one with the highest file set descriptor number shall be used. This instance shall be referred to as the prevailing instance.

One of the File Set Descriptors of a File Set Descriptor Sequence shall have a file set number of 0.

A File Set Descriptor shall specify a file set identification. No prevailing instance of a File Set Descriptor shall specify the same file set identification as any other prevailing instance of a File Set Descriptor.

8.4 Arrangement of information on a partition

A means for identifying the location of the following for each partition of the logical volume on which a file set is recorded shall be specified by the input parameters (see 4/3.1) of this Part of ISO/IEC 13346.

- Unallocated Space Table and Unallocated Bit Map (see 4/10)
- Freed Space Table and Freed Bit Map (see 4/10)
- Partition Integrity Table (see 4/11)

8.5 File set

A file set shall be identified by a File Set Descriptor which identifies the root of a directory hierarchy (see 4/8.6) describing a set of files and certain attributes of the file set. A prevailing File Set Descriptor specifies

- the name of the logical volume it is recorded on
- the set of characters allowed in certain fields of descriptors associated with the file set identified by the File Set Descriptor
- an identification of the root of the directory hierarchy describing the files of the file set identified by the File Set Descriptor
- copyright and abstract information for the file set.

8.6 Directories

A directory contains zero or more file or directory identifications. A directory hierarchy shall be a set of directories descended from a single root directory.

A directory shall contain a set of directory descriptors, each of which identifies a parent directory or a component file or a component subdirectory. A directory descriptor that identifies a parent directory or a component file or subdirectory by specifying the address of an ICB (see 4/8.10.1) for that component shall be recorded as a File Identifier Descriptor (see 4/14.4). A directory descriptor that identifies a component file or subdirectory of the directory by specifying the pathname of the actual file or directory shall be referred to as an alias and shall be recorded as a File Identifier Descriptor specifying a file whose type is a symbolic link (see 4/14.6.6).

A directory identifying another directory by other than an alias shall be called a parent directory of the identified directory. The identified directory shall be called a subdirectory of the parent directory. Different directories may have the same parent directory. A directory shall have only one parent directory. The parent directory of the root directory shall be the root directory.

Each directory descriptor shall specify the name of a component file or the name of a component subdirectory, or identify the parent directory of the directory. The length, in bytes, of the name of a component file or subdirectory shall be greater than 0. Each directory descriptor shall contain an indication of whether the identified component is a directory. When the descriptor identifies an alias, this indication is contained in the directory descriptor for the file or directory identified by the pathname specified by the alias.

A directory shall be recorded according to the schema shown in figure 4/5.

```
{
    <File Identifier Descriptor>
} 0+
```

Figure 5 - Directory schema

For the descriptors in a directory

- there shall not be more than one descriptor with the same File Identifier (see 4/14.4.8) and File Version Number (see 4/14.4.2).
- a descriptor identifying a directory shall have a File Version Number of 1.
- there shall be exactly one File Identifier Descriptor identifying the parent directory (see 4/14.4.3).
- the descriptors shall be ordered according to 4/8.6.1 and 4/14.6.8.

A File Entry specifying a file in which a directory is recorded shall not specify a Character Set Information Extended Attribute.

NOTE 6 - The character set specifying the d-characters (1/7.2) used in the directory descriptors is specified in the File Set Descriptor for the directory hierarchy of which the directory is a member.

8.6.1 Order of directory descriptors

If the directory descriptors of a directory are sorted according to this Part of ISO/IEC 13346, they shall be ordered by the following criteria in descending order of significance: