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STANDARD

ISO/IEC
13490-2

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**Information technology — Volume and file
structure of read-only and write-once
compact disk media for information
interchange —**

Part 2:

Volume and file structure

*Technologies de l'information — Structure de volume et de fichier de
supports disque compact à lecture seule et à écriture unique pour
l'échange d'information —*

Partie 2: Structure de volume et de fichier



Reference number
ISO/IEC 13490-2:1995(E)

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Foreword

ISO (the International Organisation for Standardisation) and IEC (the International Electrotechnical Commission) together form the specialised system for world-wide 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 the 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 as an International Standard requires approval by at least 75% of the national bodies casting a vote.

International Standard ISO/IEC 13490-2 was prepared by the European Association for Standardizing Information and Communication Systems, ECMA, (as ECMA-168) 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.

ISO/IEC 13490 consists of the following parts, under the general title *Information technology – Volume and file structure of read-only and write-once compact disk media for information interchange*

- *Part 1: General*
- *Part 2: Volume and File Structure*

Annex A forms an integral part of this part of ISO/IEC 13490. Annexes B and C are for information only.

Introduction

ISO/IEC 13490 can be used for both CD-ROM and CD-WO media for interchanging files. ISO/IEC 13490 is an enhancement of ISO 9660 for CD-ROM applications that has eliminated several restrictions and performance problems of ISO 9660.

ISO/IEC 13346 and ISO/IEC 13490 follow the same volume and file structure framework. ISO/IEC 13490 has common definitions with ISO/IEC 13346 regarding volume and boot block recognition, file attributes, registration procedures and record structure.

ISO/IEC 13490 is published in two parts. Part 1 - General - specifies references, definitions, notations and basic structures used in the other part. Part 2 - Volume and File Structure - specifies how to record various volume-related entities such as volumes and volume sets, and how to record and interpret files, both file data and file attributes, and file hierarchies within a volume set.

Information technology - Volume and file structure of read-only and write-once compact disk media for information interchange

Part 2:

Volume and file structure

Section 1: General

1 Scope

ISO/IEC 13490 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 between users of information processing systems using CD-WO (a write-once compact disk medium), hybrid CD-WO (a write-once compact disk with a read-only area) and CD-ROM disks.

NOTE 1 — CD-WO is an evolution of CD-ROM technology which allows the recording of information on a write-once compact disk medium.

The volume and boot block recognition is specified in ISO/IEC 13346-2 The record structure is specified in ISO/IEC 13346-5.

NOTE 2 — A volume set may be recorded that is in conformance with both ISO 9660 and ISO/IEC 13490. ISO/IEC 13490 is an enhancement of ISO 9660. ISO/IEC 13490 allows greater information interchange using CD-ROM. In addition, it supports incremental recording and updating of information stored on a CD-WO disk. Under certain restrictions (see 2/B.2.1), all of the files may be read by both a receiving system conforming to ISO 9660 and by a receiving system conforming to ISO/IEC 13490.

This part of ISO/IEC 13490 specifies a format and associated system requirements for volume and file structure by specifying:

- the attributes of a volume and the descriptors recorded on it;
- the relationship among volumes of a volume set;
- the attributes of a partition of a volume;
- the placement of files;
- the attributes of the files;
- the relationship among files of a file set;
- the relationship among file sets of a volume set;
- 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 13490.

2 Parts references

The first digit of a reference in ISO/IEC 13490 identifies the part. If the digit is preceded by “R”, the reference is to a part and clause of ISO/IEC 13346. For example, 2/5 refers to clause 5 in ISO/IEC 13490-2 and R2/5 refers to clause 5 in ISO/IEC 13346-2. If the reference is preceded by “figure”, the reference is to a figure. For example, figure 2/5 refers to figure 5 in ISO/IEC 13490-2. If the reference is preceded by “table”, the reference is to a table. For example, table 2/5 refers to table 5 in ISO/IEC 13490-2.

3 Cross - reference

This clause specifies the interface of this part of ISO/IEC 13490 to other standards or parts.

3.1 Input

This part of ISO/IEC 13490 requires the specification of the following by another standard or part:

- A standard for recording (see 1/5.13).
- A volume set of one or more volumes (see 2/9.2).
- For the purposes of ISO/IEC 13346-2, a volume recognition sequence (see R2/8.3.1) shall be recorded as specified in 2/9.1.7.
- For the purposes of ISO/IEC 13346-2, the volume recognition space (see R2/8.2) shall be as specified in 2/9.1.6.
- For the purposes of ISO/IEC 13346-2, the initial sector (see R2/3.1) of the volume shall be sector number 0 of the volume as specified in 2/9.1.1.1.

3.2 Output

This part of ISO/IEC 13490 specifies the following which may be used by other standards or parts:

- A volume space for a volume (see 2/9.1.4).
- A volume set of one or more volumes (see 2/9.2).
- An indication that a volume may have been recorded according to this part of ISO/IEC 13490 (see 2/9.1.7)
- Volume partitions (see 2/9.1.4.3).
- Sessions (see 2/9.1.3).
- Logical blocks of a fixed size for a volume set (see 2/9.1.4.1).
- The size of a logical block.
- Attributes of a volume.
- Attributes of a volume partition.
- Data space of a file (see 2/13.5.2).
- 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 13490 when it conforms to a standard for recording (see 1/5.13) and all information recorded on it conforms to the specifications of ISO/IEC 13490, ISO/IEC 13346-2 and ISO/IEC 13346-5, or to ISO/IEC 13490 and ISO/IEC 13346-2. A statement of conformance shall identify the parts of ISO/IEC 13346, and the levels of medium interchange (see R2/10 and 2/16) to which the contents of the medium conform

4.2 Conformance of an information processing system

An information processing system shall be in conformance with ISO/IEC 13490 if it meets the requirements specified in ISO/IEC 13490, ISO/IEC 13346-2 and ISO/IEC 13346-5, or in ISO/IEC 13490 and ISO/IEC 13346-2 either for an originating system (see R2/12, 2/18 and R5/11) or for a receiving system (see R2/13, 2/19 and R5/12) or for both types of system. A statement of conformance shall identify the parts of ISO/IEC 13346 and the levels of the requirements for the parts of ISO/IEC 13346 and ISO/IEC 13490 which can be met by the system

5 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 13490. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 13490 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 2022:1994, *Information technology — Character code structure and extension techniques.*

ISO/IEC 6429:1992, *Information technology — Control functions for coded character sets*.

ISO 9660:1988, *Information processing — Volume and file structure of CD-ROM for information interchange*.

ISO/IEC 9945-1:1990, *Information technology — Portable Operating System Interface (POSIX) — Part 1: System Application Program Interface (API) [C Language]*.

ISO/IEC 10149:1995, *Information technology — Data interchange on read-only 120 mm optical data disks (CD-ROM)*.

ISO/IEC 10646-1:1993, *Information technology — Universal Multiple-Octet Coded Character Set (UCS) — Part 1: Architecture and Basic Multilingual Plane*.

ISO/IEC 13346-2:1995, *Information technology — Volume and file structure of write-once and rewritable media using non-sequential recording for information interchange — Part 2: Volume and boot block recognition*.

ISO/IEC 13346-4:1995, *Information technology — Volume and file structure of write-once and rewritable media using non-sequential recording for information interchange — Part 4: File structure*.

ISO/IEC 13346-5:1995, *Information technology — Volume and file structure of write-once and rewritable media using non-sequential recording for information interchange — Part 5: Record Structure*.

ISO/IEC 13490-1:1995, *Information technology — Volume and file structure of read-only and write-once compact disk media for information interchange — Part 1: General*.

ISO/IEC 13800¹⁾, *Information technology — Procedure for the registration of identifiers and attributes for volume and file structure*.

IEC 908:1987, *Compact disc digital audio system*.

6 Definitions

For the purposes of this part of ISO/IEC 13490, the definitions given in ISO/IEC 13490-1 (see 1/5), and the following definitions apply.

6.1 file set: A collection of files and directories.

6.2 group ID: An identification of a group of users.

6.3 logical block: The unit of allocation of a volume set.

6.4 user ID: An identification of a user.

7 Notation

The notation of ISO/IEC 13490-1 (see 1/6) applies to this part of ISO/IEC 13490.

8 Basic types

In addition to the basic types of ISO/IEC 13490-1 (see 1/7), the following basic types apply to this part of ISO/IEC 13490.

8.1 16-Bit unsigned numerical values with most significant byte first

A `Uint16MSB` value, represented by the hexadecimal representation `#wxyz`, shall be recorded in a two-byte field as `#wx #yz`.

NOTE 3 — For example, the decimal number 4 660 has #1234 as its hexadecimal representation and shall be recorded as #12 #34.

8.2 16-Bit signed numerical values with most significant byte first

An `Int16MSB` value, represented in two's complement form by the hexadecimal representation `#wxyz`, shall be recorded in a two-byte field as `#wx #yz`.

NOTE 4 — For example, the decimal number -30 875 has #8765 as its hexadecimal representation and shall be recorded as #87 #65.

¹⁾ To be published

8.3 16-Bit unsigned numerical values with both byte orders

A Uint16BOTH value, represented by the hexadecimal representation #wxyz, shall be recorded in a four-byte field as #yz #wx #wx #yz.

NOTE 5 — For example, the decimal number 4 660 has #1234 as its hexadecimal representation and shall be recorded as #34 #12 #12 #34.

8.4 32-Bit unsigned numerical values with most significant byte first

A Uint32MSB value, represented by the hexadecimal representation #stuvwxyz, shall be recorded in a four-byte field as #st #uv #wx #yz.

NOTE 6 — For example, the decimal number 305 419 896 has #12345678 as its hexadecimal representation and shall be recorded as #12 #34 #56 #78.

8.5 32-Bit signed numerical values with most significant byte first

An Int32MSB value, represented in two's complement form by the hexadecimal representation #stuvwxyz, shall be recorded in a four-byte field as #st #uv #wx #yz.

NOTE 7 — For example, the decimal number -559 038 737 has #DEADBEEF as its hexadecimal representation and shall be recorded as #DE #AD #BE #EF.

8.6 32-Bit unsigned numerical values with both byte orders

A Uint32BOTH value, represented by the hexadecimal representation #stuvwxyz, shall be recorded in a eight-byte field as #yz #wx #uv #st #st #uv #wx #yz.

NOTE 8 — For example, the decimal number 305 419 896 has #12345678 as its hexadecimal representation and shall be recorded as #78 #56 #34 #12 #12 #34 #56 #78.

8.7 Volume structure descriptor format

Volume structure descriptors specified in this part of ISO/IEC 13490 shall be recorded in the format shown in table 2/1.

Table 1 - CD-WO Volume structure descriptor format

BP	Length	Name	Contents
0	1	Structure Type	Uint8 (1/7.1.1)
1	5	Standard Identifier	bytes = "CDW02"
6	1	Structure Version	Uint8 (1/7.1.1) = 2
7	2 041	Structure Data	bytes

8.7.1 Structure Type (BP 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 13490. Types 1-6 and 255 are specified as shown in table 2/2. All other types are reserved for future standardisation by this part of ISO/IEC 13490.

Table 2 - Structure Type Interpretation

Type	Identification
1	Primary Volume Descriptor (see 2/10.1)
2	Supplementary Volume Descriptor (see 2/10.2)
3	File Set Descriptor (2/12.1)
4	Implementation Use Descriptor (see 2/12.2).
5	Volume Partition Descriptor (see 2/10.3)
6	End Transaction Descriptor (see 2/10.4)
255	Terminating Descriptor (see 2/10.5)

8.7.2 Standard Identifier (BP 1)

This field shall specify "CDW02".

8.7.3 Structure Version (BP 6)

This field shall specify the version of the volume structure descriptor. The value 2 shall indicate the structure of this part of ISO/IEC 13490.

8.7.4 Structure Data (BP 7)

The interpretation of this field shall be specified by the clause identified by the Structure Type field (see 2/8.7.1).

Section 2: Requirements for the medium for volume and file structure

9 Volume structure

9.1 Arrangement of information on a volume

9.1.1 Sectors

9.1.1.1 Sector numbers

Each sector of a volume shall be identified by a unique sector number. Sector numbers shall be consecutive integers assigned in an ascending sequence, in the order of ascending physical address of the volume as specified in the standard for recording (see 1/5.13). Sector number 0 shall be assigned to the sector having the lowest physical address of the volume as specified in the standard for recording.

9.1.1.2 Data space of a sector

The first 2^n bytes of a sector, where n is the largest integer greater than 0 such that 2^n is less than or equal to the number of bytes in the sector (see 1/5.12), shall be referred to as the data space of the sector. The length of the data space of a sector shall not be less than 2 048 bytes. The interpretation of the bytes, if any, in the sector after the data space is not specified by this part of ISO/IEC 13490.

9.1.1.3 Data sector

A data sector shall be a sector that is specified in the standard for recording as available for recording information specified by this part of ISO/IEC 13490.

9.1.1.4 Unrecorded sectors

A sector is unrecorded if the standard for recording allows detection that a sector has been unrecorded and if that sector is unrecorded. Any unrecorded sector shall be interpreted as containing all #00 bytes.

9.1.2 Track

The sectors of a volume shall be organised into one or more tracks. A track shall be a sequence of one or more sectors, the sector numbers of which form a continuous ascending sequence. No sector shall belong to more than one track.

NOTE 9 — There may be gaps between tracks; that is, the last sector of a track need not be adjacent to the first sector of the next track.

9.1.2.1 Track number

Each track of a volume shall be identified by a unique number. Track numbers shall be consecutive integers assigned in an ascending sequence starting with 1. Track number 1 shall be assigned to the track having sector number 0 as the first, or only, constituent sector. The numbering shall continue through successive tracks, each of which begins with a sector having a greater sector number than that of the last sector constituting the previous track of the volume. The track having the greatest assigned track number of a volume shall be the last track of the volume.

9.1.2.2 Data track

Data tracks are tracks that are designated to contain data sectors having the attributes specified in 2/A.1.

9.1.2.2.1 Recording mode of a data track

A data track shall be assigned to be recorded in either incremental mode (see 2/A.2) or track-at-once mode (see 2/A.3). A data track assigned to be recorded in incremental mode shall be assigned to contain either a sequence of variable-length packets (see 2/9.1.2.2.1.2), or a sequence of fixed-length packets (see 2/9.1.2.2.1.1).

A packet shall be a sequence of one or more data sectors, the sector numbers of which form a continuous ascending sequence. The length of a packet shall be the number of data sectors in the packet, and each packet shall be treated as if it is recorded as a unit.

9.1.2.2.1.1 Fixed-length packet

A fixed-length packet shall be a packet recorded in a data track assigned to contain packets that shall have the same length.

The sector number of the first data sector in a fixed-length packet shall be one greater than the sector number of the last data sector in the previous packet, if any, in the same track. The sector number of the first data sector in the first fixed-length packet in a data track shall be the sector number of the first data sector in the track.

9.1.2.2.1.2 Variable-length packet

A variable-length packet shall be a packet recorded in a data track assigned to contain packets that may have different lengths.

The sector number of the first data sector in a variable-length packet shall be n greater than the sector number of the last data sector in the previous packet in the same track, if any. The sector number of the first data sector in the first variable-length packet in a data track shall be n greater than the sector number of the first data sector in the track. The value n is specified in the standard for recording.

9.1.3 Session

The tracks of a volume shall be organised into one or more sessions as specified by the standard for recording. A session shall be a sequence of one or more tracks, the track numbers of which form a continuous ascending sequence.

Each session of a volume shall have an assigned session number. Session numbers shall be consecutive integers assigned in an ascending sequence starting with 1. Session number 1 shall be assigned to the session having track number 1 as the first, or only, constituent track. The numbering shall continue through successive sessions, each of which begins with the track having the next greater track number than that of the last track constituting the previous session of the volume.

The session having the greatest assigned session number of a volume shall be the last session of the volume.

9.1.4 Volume space

The set of all sectors in a volume whose sector numbers are less than or equal to the sector number of the last sector of the last track of the volume shall be referred to as the volume space of the volume. The information on a volume shall be recorded in the set of all data sectors of the volume space. The bytes in the volume space shall be numbered with consecutive integers assigned in an ascending sequence starting with 0. Let s be the number of bytes in the data space of a sector; then byte b of the volume space is byte $\text{rem}(b, s)$ of sector $\text{ip}(b/s)$.

NOTE 10 — Sectors not identified as being data sectors (see 2/9.1.1.3) are nevertheless part of the volume space. Thus, not necessarily all of the volume space can be used for recording information specified by this part of ISO/IEC 13490.

9.1.4.1 Logical block

The volume space shall be organised into logical blocks of equal length. The length of a logical block shall be referred to as the logical block size and shall be 2^n bytes, where n is an integer greater than or equal to 9, such that the logical block size is not greater than the length of the data space of any sector in any volume of the volume set (see 2/9.2). The logical blocks in the volume space shall be numbered with consecutive integers assigned in an ascending sequence starting with 0. Let lbs be the number of bytes in a logical block, then logical block number lbn of the volume space begins at byte $lbn \times lbs$ of the volume space. The logical block size of each volume in a volume set shall be the same.

NOTE 11 — A logical block ends in the same sector in which it begins.

9.1.4.2 Extent

An extent shall be 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 address of the first logical block in the sequence. An extent shall end in the same track in which it begins.

9.1.4.3 Volume partition

A volume partition shall be recorded over an extent. The first logical block of the extent shall have a logical block number which is the lowest logical block number in the sector that contains the logical block. The identification and attributes of a volume partition shall be recorded in a Volume Partition Descriptor (see 2/10.3). The interpretation of the contents of a volume partition is not specified by this part of ISO/IEC 13490.

NOTE 12 — Volume partitions may overlap. This allows media to be initialised with several predefined partition definitions of varying sizes and locations. A user can then simply select a set of nonoverlapping volume partitions to use.

9.1.5 Unallocated space of a volume

Sectors whose sector numbers are greater than the sector number of the last sector of the last track of a volume but less than, or equal to, the maximum sector number of the volume allowed by the standard for recording are referred to as unallocated sectors. Unallocated sectors do not belong to the volume space of a volume.

If allowed by the standard for recording, the unallocated sectors may be later added to the volume space of a volume by allocating them to any new track added to the volume.

9.1.6 Volume recognition space

The volume recognition space (see R2/8.2) of a volume shall be the part of the volume space starting at the first byte of the first data sector of the first recorded data track in the last session of the volume and ending with the last byte of the last sector of that track. The sectors containing the volume recognition space shall have the following attributes (see 2/A.1):

- all sectors shall have the Mode 1 attribute, or the first 16 sectors of the track shall have the Mode 2 Form 1 attribute;
- all the sectors shall be data sectors.

NOTE 13 — These restrictions ensure that the volume recognition area (see R2/8.3) begins in the seventeenth sector of a data track.

The first 16 sectors of the volume recognition space shall be designated as the reserved session area. This part of ISO/IEC 13490 does not specify the interpretation of any information recorded in the reserved session area.

9.1.7 Volume recognition sequence

At least one CD-WO Extended Area shall be recorded in each volume recognition sequence (see R2/8.3.1) of a volume according to the schema shown in figure 2/1.

Within a volume recognition sequence, the CD-WO Extended Area that begins in the sector with the highest sector number shall be referred to as the prevailing CD-WO Extended Area.

```
[CD-WO Extended Area]{
    <Beginning Extended Area Descriptor> 1+
    <Volume Descriptor Set>
    <File System Descriptor Set> 0+1
    <Terminating Descriptor> 1+
}
```

Figure 1 - CD-WO Extended Area schema

NOTE 14 — This part of ISO/IEC 13490 allows the creation of media which conform to both this part of ISO/IEC 134902 and ISO 9660.

9.2 Volume set

A volume set shall consist of one or more volumes having a volume set identification common to all volumes of the volume set. The volumes of a volume set shall be numbered with consecutive integers assigned in an ascending sequence starting from 1. This number shall be the assigned volume sequence number of the volume. The largest volume sequence number in the volume set shall be referred to as the assigned volume set size.

Each Primary Volume Descriptor (see 2/10.1) recorded on a volume specifies a volume set identification consisting of the contents of the Volume Set Identifier and Descriptor Character Set fields and a volume identification consisting of the contents of the Volume Identifier and Descriptor Character Set fields. The Primary Volume Descriptor in the prevailing Volume Descriptor Set (see 2/9.4.2) of each volume of a volume set shall specify the volume identification and the same volume set identification. The same volume identification shall not be specified by more than one volume of a volume set.

NOTE 15 — ISO 9660 uses the term “volume group” to refer to volumes within a volume set that had their contents “established at the same time” and are consecutively numbered in the Volume Sequence Number field of the Primary Volume Descriptor. The volume sequence number of the volume that has the highest volume sequence number in the volume group is recorded as the assigned volume set size in the Volume Set Size field of the Primary Volume Descriptor for each volume of the volume group.

In ISO 9660, each volume of a volume group contains a description of all the directories and files that are recorded on those volumes of the volume set having a volume sequence number less than, or equal to, the assigned volume set size of the volume group.

It is important to note that the concept of a volume group does not exist in this part of ISO/IEC 13490.

9.3 Volume structure descriptors

Characteristics of a volume and a volume set shall be specified by volume structure descriptors. A volume structure descriptor shall be one of the following types: (see 2/8.7)

- Primary Volume Descriptor (see 2/10.1)
- Supplementary Volume Descriptor (see 2/10.2)
- Volume Partition Descriptor (see 2/10.3)

- End Transaction Descriptor (see 2/10.4)
- Terminating Descriptor (see 2/10.5)
- File Set Descriptor (see 2/12.1)
- Implementation Use Descriptor (see 2/12.2).

Volume structure descriptors shall be recorded as specified in 2/9.4, 2/9.6 and 2/11.2.

9.3.1 Recording of volume structure descriptors

Each volume structure descriptor shall be recorded starting at the first byte of a sector. The location, or address, of a volume structure descriptor shall be the sector number of the sector containing the first byte of the descriptor. All space, if any, after the end of a volume structure descriptor up to the end of the sector is reserved for future standardisation and shall be recorded as all #00 bytes.

9.4 Volume Descriptor Set

A Volume Descriptor Set shall be recorded according to the schema shown in figure 2/2 .

```
[Volume Descriptor Set]{
    <Primary Volume Descriptor>1+
    {
        <Supplementary Volume Descriptor> |
        <Volume Partition Descriptor> |
        <End Transaction Descriptor>
    }0+
    <Terminating Descriptor>1+
}
```

Figure 2 - Volume Descriptor Set schema

A Volume Descriptor Set shall begin with a sequence of one or more identical Primary Volume Descriptors. A Primary Volume Descriptor shall identify the volume, the volume set to which the volume belongs, the sequence number of the volume within the volume set, attributes of the volume, the character set used in recording the contents of certain fields within the Primary Volume Descriptor, and the rule for recording and locating the prevailing End Transaction Descriptor (see 2/9.6.3).

A Volume Descriptor Set may contain zero or more Supplementary Volume Descriptors, each recorded at least once. A Supplementary Volume Descriptor shall provide an alternate identification of the volume and the volume set to which it belongs. Each Supplementary Volume Descriptor shall have an assigned Supplementary Volume Descriptor Sequence Number (see 2/10.2.8). The set of all Supplementary Volume Descriptor Sequence Numbers in a Volume Descriptor Set shall form a continuous ascending sequence of integers starting from 1. All Supplementary Volume Descriptors with identical Supplementary Volume Descriptor Sequence Numbers shall have identical contents. Supplementary Volume Descriptors with different Supplementary Volume Descriptor Sequence Numbers shall not have the same contents in the Volume Identifier (see 2/10.2.6) and Descriptor Character Set (see 2/10.2.5) fields.

A Volume Descriptor Set may contain zero or more Volume Partition Descriptors, each recorded at least once. A Volume Partition Descriptor shall specify a partition (see 2/9.1.4.3) of the volume, and the attributes and identification of the volume partition. All the Volume Partition Descriptors with identical contents for their Descriptor Character Set (see 2/10.3.5) and Volume Partition Identifier (see 2/10.3.7) fields shall have identical contents.

A Volume Descriptor Set may contain zero or more End Transaction Descriptors. All the End Transaction Descriptors, except for their End Transaction Descriptor Location (see 2/10.4.6) fields, shall have identical contents.

The sequence shall be terminated by a sequence of one or more identical Terminating Descriptors (see 2/10.5).

9.4.1 Recording of Volume Descriptor Sets

The descriptors of a Volume Descriptor Set shall be recorded in a sequence of sectors having consecutive ascending addresses. The location of a Volume Descriptor Set shall be the location of the first descriptor in the Volume Descriptor Set. A Volume Descriptor Set shall end in the track in which it begins.

9.4.2 Prevailing Volume Descriptor Set

The Volume Descriptor Set contained in the prevailing CD-WO Extended Area (see 2/9.1.7) in the volume recognition sequence of a volume shall be referred to as the prevailing Volume Descriptor Set of the volume.

The information in the prevailing Volume Descriptor Set shall override the information in all other Volume Descriptor Sets of the volume on which the prevailing Volume Descriptor Set is recorded.

9.5 Volume space management

9.5.1 Volume Space Table

For each volume in a volume set, there shall be a Volume Space Table which shall specify the size and attribute information for each track in the volume and, optionally, a description of the unallocated sectors in the volume.

The Volume Space Tables Location Directory and all the Volume Space Tables identified by the Volume Space Tables Location Directory shall be recorded on the volume on which the prevailing End Transaction Descriptor is recorded.

9.5.2 Recording of Volume Space Tables

A Volume Space Table shall be recorded as a contiguous sequence of Track Specification Records (see 2/10.6) in a file. The Track Specification Records in a Volume Space Table shall be recorded in ascending order of the value of the Track Number field (see 2/10.6.2).

Each Track Specification Record in a Volume Space Table shall have a different track number in the Track Number field.

9.5.3 Identification of Volume Space Tables

Volume Space Tables shall be identified by the prevailing End Transaction Descriptor of the volume set (see 2/9.6.3). There shall be one Volume Space Table identified for each volume of the volume set having an assigned volume sequence number less than or equal to that of the volume on which the Volume Space Tables are recorded. Each Volume Space Table shall be recorded as the contents of a separate file as specified in 2/9.5.2.

A Directory Record (see 2/15.1) shall identify each such file as follows:

- the File Identifier field of the Directory Record shall contain the assigned volume sequence number of the volume to which the Volume Space Table applies. This field shall be a 4-byte field recorded as a `Uint16BOTH` (see 2/8.3).
- the Length of File Identifier field of the Directory Record shall be set to 4.
- the File Version Number field of the Directory Record shall be set to 1.

These files shall not be identified by any directory (see 2/13) of any file set (see 2/11.1) recorded in the volume set.

9.5.4 Volume Space Tables Location Directory

The Volume Space Tables Location Directory shall be recorded as a directory (see 2/13.1). The directory shall identify, as specified in 2/9.5.3, a file for each Volume Space Table.

A Path Table Record (see 2/15.2) shall identify the directory as follows:

- the File Identifier field of the Path Table Record shall contain 0. This field shall be a 4-byte field recorded as a `Uint16BOTH` (see 2/8.3).
- the Length of File Identifier field of the Path Table Record shall be set to 4.
- the Parent Directory Number field of the Path Table Record shall be set to 0.

The Volume Space Tables Location Directory need not be recorded if there is only one volume in the volume set.

The Volume Space Tables Location Directory shall not be identified by any path table (see 2/13.3) of any file set (see 2/11.1) recorded in the volume set.

9.6 Transactions

The information on a volume set shall be recorded as a sequence of transactions. A transaction shall be recorded over one or more sectors of the volume set. The data sectors of the transaction need not have consecutive sector numbers and may be recorded on one or more volumes of the volume set.

The order of the recording of the data sectors in which the information of a transaction is contained shall be subject to the restrictions, if any, of the standard for recording.

9.6.1 Identification of a transaction

A transaction shall be identified by an End Transaction Descriptor. Each End Transaction Descriptor shall have an assigned End Transaction Descriptor transaction number. The set of all End Transaction Descriptor transaction numbers in a volume shall form a continuous ascending sequence of integers starting from 1. End Transaction Descriptors with identical End Transaction Descriptor transaction numbers in a volume shall have identical contents, except for the values of their End Transaction Descriptor Location fields (see 2/10.4.6).

9.6.2 End Transaction Descriptor

An End Transaction Descriptor shall identify:

- the assigned transaction number of the End Transaction Descriptor.
- the location of the prevailing Volume Descriptor Set of the volume at the time of recording the End Transaction Descriptor.
- the Volume Space Table recorded on the volume for each volume of the volume set having an assigned volume sequence number less than or equal to that of the volume on which the End Transaction Descriptor is recorded.
- the path tables (see 2/13.3) recorded on the volume for the file sets identified by all of the File Set Descriptors (see 2/12.1) identified by the prevailing File System Descriptor Set (see 2/11.2.2).
- the location of the prevailing File System Descriptor Set of the volume set at the time of recording the End Transaction Descriptor.
- the location of the End Transaction Descriptor, if any, of the volume whose transaction number is one less than the assigned transaction number of this End Transaction Descriptor.
- an indication that a volume has been added to the volume set of which the volume that the End Transaction Descriptor is recorded on is a member (see 2/10.4.12).

An End Transaction Descriptor shall be recorded one or more times after the recording of each transaction to identify the transaction. The End Transaction Descriptors so recorded shall have identical contents except for the values of their End Transaction Descriptor Location fields.

9.6.3 Prevailing End Transaction Descriptor

The End Transaction Descriptor with the greatest transaction number recorded on the volume having the greatest assigned volume sequence number of a volume set shall be the prevailing End Transaction Descriptor of the volume set. The prevailing End Transaction Descriptor of a volume set shall be the last recorded data sector of the track in which the prevailing End Transaction Descriptor is recorded.

9.6.4 End Transaction Track

A track of the volume having the greatest assigned volume sequence number of a volume set shall be the assigned End Transaction Track (see 2/10.6.5). The assigned End Transaction Track shall be the track in which the latest End Transaction Descriptor of the volume set is recorded and the track in which next End Transaction Descriptor shall be recorded.

NOTE 16 — Descriptors other than End Transaction Descriptors and data sectors of a transaction may be recorded on the End Transaction Track.

9.6.5 End Transaction Descriptor recording rule

The Primary Volume Descriptor recorded in the prevailing Volume Descriptor Set of the volume having the greatest volume sequence number of the volume set shall specify the rule (see 2/10.1.15) for recording the prevailing End Transaction Descriptor of the volume set.

The sector on which the prevailing End Transaction Descriptor of a volume set is recorded shall always be the last recorded data sector of the End Transaction Track.

NOTE 17 — The purpose of the End Transaction Descriptor recording rule is to expedite the process of locating the prevailing End Transaction Descriptor of a volume set by specifying where the prevailing End Transaction Descriptor shall be recorded. Some End Transaction Descriptor recording rules may allow finding the prevailing End Transaction Descriptor of a volume set quickly without having to read the last recorded data sector of every data track in the volume having the greatest volume sequence number of the volume set.

10 Volume data structures

10.1 Primary Volume Descriptor

The Primary Volume Descriptor shall identify a volume and certain attributes of that volume. It shall be recorded in the format shown in table 2/3.

Table 3 - Primary Volume Descriptor format

BP	Length	Name	Contents
0	1	Structure Type	UInt8 (1/7.1.1) = 1
1	5	Standard Identifier	bytes = "CDW02"
6	1	Structure Version	UInt8 (1/7.1.1) = 2
7	1	Reserved	#00 byte
8	64	Descriptor Character Set	charspec (1/7.2.1)
72	32	Implementation Identifier	regid (1/7.4)
104	32	Volume Identifier	dstring (1/7.2.12)
136	128	Volume Set Identifier	dstring (1/7.2.12)
264	4	Volume Set Size	UInt16BOTH (2/8.3)
268	4	Volume Sequence Number	UInt16BOTH (2/8.3)
272	8	Logical Block Size	UInt32BOTH (2/8.6)
280	4	Control Flags	UInt32 (1/7.1.5)
284	4	End Transaction Track	UInt16BOTH (2/8.3)
288	8	Prevailing End Transaction Descriptor Location	UInt32BOTH (2/8.6)
296	8	End Transaction Descriptor Recording Rule	UInt32BOTH (2/8.6)
304	4	Maximum Interchange Level	UInt16BOTH (2/8.3)
308	4	Maximum Character Set List	UInt32 (1/7.1.5)
312	12	Volume Set Creation Date and Time	timestamp (1/7.3.1)
324	12	Descriptor Recording Date and Time	timestamp (1/7.3.1)
336	512	Application Use	bytes
848	1 200	Reserved	#00 bytes

10.1.1 Structure Type (BP 0)

This field shall specify 1.

10.1.2 Standard Identifier (BP 1)

This field shall specify "CDW02".

10.1.3 Structure Version (BP 6)

This field shall specify the version of this descriptor. The value 2 shall indicate the structure of this part of ISO/IEC 13490.

10.1.4 Reserved (BP 7)

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

10.1.5 Descriptor Character Set (BP 8)

This field shall specify the d-characters (see 1/7.2) allowed in the Volume Identifier and Volume Set Identifier fields.

10.1.6 Implementation Identifier (BP 72)

This field shall specify an identification of an implementation which can recognise and act upon the contents of the reserved session area (see 2/9.1.6) of the volume. If this field contains all #00 bytes, then no such implementation is identified.

10.1.7 Volume Identifier (BP 104)

This field shall specify an identification of the volume.

10.1.8 Volume Set Identifier (BP 136)

This field shall specify an identification of the volume set of which the volume is a member.

10.1.9 Volume Set Size (BP 264)

This field shall specify the assigned volume set size (see 2/9.2) of the volume when this descriptor is recorded.

10.1.10 Volume Sequence Number (BP 268)

This field shall specify the ordinal number of the volume in the volume set of which the volume is a member.

10.1.11 Logical Block Size (BP 272)

This field shall specify the size, in bytes, of a logical block.

10.1.12 Control Flags (BP 280)

This field shall specify the control attributes of the Primary Volume Descriptor as shown in table 2/4 .

Table 4 - Control Flags interpretation

Bit	Interpretation
0	If set to ONE, shall mean that each Volume Descriptor Set of the volume recorded after the recording of this Primary Volume Descriptor shall contain a Primary Volume Descriptor with contents identical to this Primary Volume Descriptor, except that the contents of the End Transaction Track, Prevailing End Transaction Descriptor Location and End Transaction Descriptor Recording Rule fields shall be recorded according to clauses 2/10.1.13, 2/10.1.14 and 2/10.1.15. If set to ZERO, shall mean that no such restriction is specified.
1-31	Reserved for future standardisation and shall be set to ZERO.

10.1.13 End Transaction Track (BP 284)

This field shall specify the track number of the assigned End Transaction Track (see 2/9.6.4) of this volume when this descriptor is recorded. A value of 0 shall mean no such track number is specified.

This field shall be non-zero if this descriptor is recorded in the prevailing Volume Descriptor Set on the volume having the greatest volume sequence number of the volume set, and if the value of the End Transaction Recording Rule field (see 2/10.1.15) is either 1 or 2.

10.1.14 Prevailing End Transaction Descriptor Location (BP 288)

This field shall specify the sector number of the sector in which the prevailing End Transaction Descriptor of the volume set is recorded when this Primary Volume Descriptor is recorded if the volume on which the Primary Volume Descriptor is recorded is the highest numbered volume of the volume set. A value of 0 shall mean no such sector number is specified.

This field shall be non-zero if this descriptor is recorded in the prevailing Volume Descriptor Set on the volume having the greatest volume sequence number of the volume set, and if the End Transaction Recording Rule field is 1. The sector number specified in this field shall be in the track specified in the End Transaction Track field (see 2/10.1.13) of this descriptor.

10.1.15 End Transaction Descriptor Recording Rule (BP 296)

If this descriptor is recorded in the prevailing Volume Descriptor Set on the volume having the greatest volume sequence number of the volume set, this field shall specify the recording rule to record the prevailing End Transaction Descriptor of the volume set (see 2/9.6.3). Otherwise, the information recorded in this field shall be ignored.

The End Transaction Descriptor recording rule shall be specified as shown in table 2/5.

Table 5 - End Transaction Descriptor Recording Rule interpretation

Rule	Interpretation
0	The location of the prevailing End Transaction Descriptor is not specified by this field. NOTE 18 — This rule requires reading the last recorded data sector in every data track on the volume on which the Primary Volume Descriptor is recorded to find the prevailing End Transaction Descriptor of the volume set.
1	The value in the prevailing End Transaction Descriptor Location field (2/10.1.14) in this descriptor shall be non-zero and shall identify, for the volume on which the Primary Volume Descriptor is recorded, the sector number of the prevailing End Transaction Descriptor of the volume set. NOTE 19 — This rule is intended to be used for read-only media. For performance reasons, the prevailing End Transaction Descriptor identified in the Prevailing End Transaction Descriptor Location field may be recorded in the same Volume Descriptor Set with this Primary Volume Descriptor, provided there is an End Transaction Descriptor recorded on the last recorded data sector of the End Transaction Track of the volume.
2	The prevailing End Transaction Descriptor shall be recorded in the track identified by the End Transaction Track field of this Primary Volume Descriptor. The End Transaction Track of the volume may be reassigned subject to the following rule: If the End Transaction Track (track number x) is reassigned to another track (track number y), the End Transaction Descriptor in the last recorded data sector of track number x shall specify the track number y in the End Transaction Descriptor Track field (2/10.4.11), and the prevailing End Transaction Descriptor shall be recorded in track number y . No further recording may occur in track number x unless track number x is again assigned to be the End Transaction Track.
3	The prevailing End Transaction Descriptor shall be recorded, on the volume on which the Primary Volume Descriptor is recorded, in a sector number that is higher than the sector number of all previously recorded End Transaction Descriptors of the volume. NOTE 20 — This rule is designed for track-at-once recording using the backward searching strategy.
4-2 047	Reserved for future standardisation.
2 048 and above	Reserved for implementation use.

10.1.16 Maximum Interchange Level (BP 304)

This field shall specify the maximum value that may be specified for the Maximum Interchange Level field of any File Set Descriptor (see 2/12.1) in the volume set.

10.1.17 Maximum Character Set List (BP 308)

This field shall identify the character sets that may be specified by any field, whose contents are specified to be a `charspec` (see 1/7.2.1), of any descriptor specified in this part of ISO/IEC 134902 (see 1/7.2.11) and recorded on the volume set identified by this Primary Volume Descriptor.

NOTE 21 — The Maximum Interchange Level and Maximum Character Set List fields permit an implementation to:

- determine whether it can process all of the information on the volume;
- restrict the recording of information on the volume so that the volume does not exceed the level given in the Maximum Interchange Level field;
- restrict the recording of information on the volume so that all character sets recorded belong to the Maximum Character Set List field.

This allows a user to create a volume that can be processed when it is returned to the user.

10.1.18 Volume Set Creation Date and Time (BP 312)

This field shall specify the date and time of the day of recording the first Primary Volume Descriptor recorded on the volume having the volume sequence number 1 in the volume set.

10.1.19 Descriptor Recording Date and Time (BP 324)

This field shall specify the date and time of the day when this descriptor is recorded.

NOTE 22 — If the recording of this descriptor is under the restrictions specified by bit 0 of the Control Flags field, this field shall contain the same value as recorded in the Descriptor Recording Date and Time field of the first Primary Volume Descriptor that set bit 0 of the Control Flags field to ONE.

10.1.20 Application Use (BP 336)

This field shall be used to store application use extended attributes (see 2/14). Application use extended attributes shall be recorded contiguously according to the extended attribute format (see 2/14.2). Any remaining bytes in this field shall be set to #00.

If this field contains all #00 bytes., then no such extended attributes are recorded.

NOTE 23 — The “CE” (see 2/15.3.9) extended attribute may be recorded in the Application Use field to provide an additional extended attribute area to store more application use extended attributes.

10.1.21 Reserved (BP 848)

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

10.2 Supplementary Volume Descriptor

The Supplementary Volume Descriptor shall specify an alternate identification of the volume and the volume set to which it belongs. It shall be recorded in the format shown in table 2/6.

Table 6 - Supplementary Volume Descriptor format

BP	Length	Name	Contents
0	1	Structure Type	Uint8 (1/7.1.1) = 2
1	5	Standard Identifier	bytes = “CDW02”
6	1	Structure Version	Uint8 (1/7.1.1) = 2
7	1	Reserved	#00 byte
8	64	Descriptor Character Set	charspec (1/7.2.1)
72	32	Volume Identifier	dstring (1/7.2.12)
104	128	Volume Set Identifier	dstring (1/7.2.12)
232	4	Supplementary Volume Descriptor Sequence Number	Uint16BOTH (2/8.3)
236	4	Control Flags	Uint32 (1/7.1.5)
240	12	Descriptor Recording Date and Time	timestamp (1/7.3.1)
252	512	Application Use	bytes
764	1 284	Reserved	#00 bytes

10.2.1 Structure Type (BP 0)

The number in this field shall specify 2.

10.2.2 Standard Identifier (BP 1)

This field shall specify “CDW02”.

10.2.3 Structure Version (BP 6)

This field shall specify the version of this descriptor. The value 2 shall indicate the structure of this part of ISO/IEC 13490.

10.2.4 Reserved (BP 7)

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

10.2.5 Descriptor Character Set (BP 8)

This field shall specify the d-characters (see 1/7.2) allowed in the Volume Identifier and Volume Set Identifier fields.

10.2.6 Volume Identifier (BP 72)

This field shall specify an identification of the volume.

10.2.7 Volume Set Identifier (BP 104)

This field shall specify an identification of the volume set of which the volume is a member.

10.2.8 Supplementary Volume Descriptor Sequence Number (BP 232)

This field shall specify the assigned Supplementary Volume Descriptor Sequence Number (see 2/9.4) of this descriptor.

10.2.9 Control Flags (BP 236)

This field shall specify the control attributes of the Supplementary Volume Descriptor as shown in table 2/7.

Table 7 - Control Flags interpretation

Bit	Interpretation
0	If set to ONE, shall mean that each Volume Descriptor Set of the volume recorded after the recording of this Supplementary Volume Descriptor shall contain a Supplementary Volume Descriptor with contents identical to this Supplementary Volume Descriptor. If set to ZERO, shall mean that no such restriction is specified.
1-31	Reserved for future standardisation and shall be set to ZERO.

10.2.10 Descriptor Recording Date and Time (BP 240)

This field shall specify the date and time of the day when this descriptor is recorded.

NOTE 24 — If the recording of this descriptor is under the restrictions specified by bit 0 of the Control Flags field, this field shall contain the same value as recorded in the Descriptor Recording Date and Time field of the first Supplementary Volume Descriptor that set bit 0 of the Control Flags field to ONE.

10.2.11 Application Use (BP 252)

This field shall be used to store application use extended attributes (see 2/14). Application use extended attributes shall be recorded contiguously according to the extended attribute format (see 2/14.2). Any remaining bytes in this field shall be set to #00.

If this field contains all #00 bytes., then no such extended attributes are recorded.

NOTE 25 — The “CE” extended attribute may be recorded in the Application Use field to provide an additional extended attribute area to store more application use extended attributes.

10.2.12 Reserved (BP 764)

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

10.3 Volume Partition Descriptor

The Volume Partition Descriptor shall identify a volume partition within the volume space, an implementation which can recognise and act upon the contents of fields in the descriptor reserved for implementation use, the position and the size of the volume partition, and the version of the standard which applies to the Volume Partition Descriptor.

The Volume Partition Descriptor shall be recorded in the format shown in table 2/8.

Table 8 - Volume Partition Descriptor format

BP	Length	Name	Contents
0	1	Structure Type	Uint8 (1/7.1.1) = 5
1	5	Standard Identifier	bytes = "CDW02"
6	1	Structure Version	Uint8 (1/7.1.1) = 2
7	1	Reserved	#00 byte
8	64	Descriptor Character Set	charspec (1/7.2.1)
72	32	Implementation Identifier	regid (1/7.4)
104	32	Volume Partition Identifier	dstring (1/7.2.12)
136	8	Volume Partition Location	Uint32BOTH (2/8.6)
144	8	Volume Partition Size	Uint32BOTH (2/8.6)
152	1 896	Implementation Use	bytes

10.3.1 Structure Type (BP 0)

The number in this field shall specify 5.

10.3.2 Standard Identifier (BP 1)

This field shall specify "CDW02".

10.3.3 Structure Version (BP 6)

This field shall specify the version of this descriptor. The value 2 shall indicate the structure of this part of ISO/IEC 13490.

10.3.4 Reserved (BP 7)

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

10.3.5 Descriptor Character Set (BP 8)

This field shall specify the d-characters (see 1/7.2) allowed in the Volume Partition Identifier field.

10.3.6 Implementation Identifier (BP 72)

This field shall specify an identification of an implementation which can recognise and act upon the contents of the Implementation Use field. If this field contains all #00 bytes, then no such implementation is identified.

10.3.7 Volume Partition Identifier (BP 104)

This field shall specify an identification of the volume partition.

10.3.8 Volume Partition Location (BP 136)

This field shall specify the logical block number of the first logical block allocated to the volume partition.

10.3.9 Volume Partition Size (BP 144)

This field shall specify the number of logical blocks in the volume partition.

10.3.10 Implementation Use (BP 152)

This field shall be reserved for implementation use. The interpretation of this field is not specified by this part of ISO/IEC 13490.

10.4 End Transaction Descriptor

The End Transaction Descriptor shall identify a transaction and certain attributes of that transaction. It shall be recorded in the format shown in table 2/9.

Table 9 - End Transaction Descriptor format

BP	Length	Name	Contents
0	1	Structure Type	UInt8 (1/7.1.1) = 6
1	5	Standard Identifier	bytes = "CDW02"
6	1	Structure Version	UInt8 (1/7.1.1) = 2
7	1	End Transaction Flags	UInt8 (1/7.1.1)
8	64	Reserved	#00 bytes
72	8	End Transaction Descriptor Location	UInt32BOTH (2/8.6)
80	8	Prevailing Volume Descriptor Set Location	UInt32BOTH (2/8.6)
88	8	Prevailing File System Descriptor Set Location	UInt32BOTH (2/8.6)
96	8	Previous Prevailing File System Descriptor Set Location	UInt32BOTH (2/8.6)
104	8	Previous End Transaction Descriptor Location	UInt32BOTH (2/8.6)
112	4	End Transaction Track	UInt16BOTH (2/8.3)
116	4	Last Volume of Volume Set	UInt16BOTH (2/8.3)
120	8	Transaction Number	UInt32BOTH (2/8.6)
128	12	Descriptor Recording Date and Time	timestamp (1/7.3.1)
140	4	Number of File Set Descriptors	UInt16BOTH (2/8.3)
144	256	Volume Space Tables Information	bytes
400	256	Path Tables Information	bytes
656	1 392	Reserved	#00 bytes

10.4.1 Structure Type (BP 0)

The number in this field shall specify 6.

10.4.2 Standard Identifier (BP 1)

This field shall specify "CDW02".

10.4.3 Structure Version (BP 6)

This field shall specify the version of this descriptor. The value 2 shall indicate the structure of this part of ISO/IEC 13490.

10.4.4 End Transaction Flags (BP 7)

This field shall specify certain characteristics of this descriptor as shown in table 2/10.

Table 10 - End Transaction Flags interpretation

Bit	Interpretation
0	If set to ZERO, shall mean this volume may have the greatest volume sequence number of the volume set. If set to ONE, shall mean that this volume shall not have the greatest volume sequence number of the volume set. NOTE 26 — This identifies whether the volume is definitely not the last volume of the volume set at the time the End Transaction Descriptor is recorded.
1	If set to ZERO, shall mean the End Transaction Descriptor identifies a transaction (see 2/9.6) for which all information of the transaction has been recorded successfully on one or more volumes of the volume set having an assigned volume sequence number less than, or equal to, the assigned volume sequence number of the volume on which the End Transaction Descriptor is recorded. If set to ONE, shall mean the End Transaction Descriptor identifies a transaction for which some of the information of the transaction is to be recorded on one or more volumes with higher volume sequence numbers than the volume on which the End Transaction Descriptor is recorded. If this bit is set to ONE, bit 0 of this field shall also be set to ONE. NOTE 27 — The setting of this bit indicates the recording of a transaction was not completed on this volume, most likely caused by insufficient space on the volume. The completion of the recording of the transaction requires adding additional volumes to the volume set. The remaining information of the incomplete transaction is to be recorded and identified by another End Transaction Descriptor on a volume with a higher volume sequence number. If bit 1 of this field is set to ONE, bit 0 of this field shall also be set to ONE.
2	If set to ZERO, the track number in the End Transaction Track field (2/10.4.11) shall be the same as the track number of the track in which this End Transaction Descriptor is recorded. If set to ONE, shall mean that there shall be an End Transaction Descriptor with a higher End Transaction Descriptor transaction number recorded on a different track, the track number of which shall be specified by the End Transaction Track field. This bit shall be set to ZERO if the value of the End Transaction Recording Rule field in the Primary Volume Descriptor recorded in the prevailing Volume Descriptor Set is not set to 2 (2/10.1.15).
3-7	Reserved for future standardisation and shall be set to ZERO.

10.4.5 Reserved (BP 8)

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

10.4.6 End Transaction Descriptor Location (BP 72)

This field shall specify the sector number of the location of this descriptor.

10.4.7 Prevailing Volume Descriptor Set Location (BP 80)

This field shall specify the sector number of the location of the prevailing Volume Descriptor Set of the volume when this descriptor is recorded.

10.4.8 Prevailing File System Descriptor Set Location (BP 88)

This field shall specify the sector number of the location of the prevailing File System Descriptor Set of the volume when this descriptor is recorded.

10.4.9 Previous Prevailing File System Descriptor Set Location (BP 96)

This field shall specify the sector number recorded in the Prevailing File System Descriptor Set Location field of the End Transaction Descriptor whose transaction number is 1 less than the transaction number of this descriptor. This field shall be set to 0 if no such descriptor is recorded.

10.4.10 Previous End Transaction Descriptor Location (BP 104)

This field shall specify the sector number recorded in the End Transaction Descriptor Location field of the End Transaction Descriptor whose transaction number is 1 less than the transaction number of this descriptor. This field shall be set to 0 if no such descriptor is recorded.

10.4.11 End Transaction Track (BP 112)

If bit 2 of the End Transaction Flags (see 2/10.4.4) is ZERO, this field shall specify the track number of the End Transaction Track (see 2/9.6.4) of the volume when the End Transaction Descriptor is recorded.

If bit 2 of the End Transaction Flags is ONE, this field shall specify the track number of the newly assigned End Transaction Track of the volume when the End Transaction Descriptor is recorded. The track number of the newly assigned End Transaction Track shall not be the same as the track number of the track in which this End Transaction Descriptor is recorded.

10.4.12 Last Volume of Volume Set (BP 116)

This field shall specify the volume sequence number (see 2/9.2) of the volume having the greatest sequence number of the volume set when this descriptor is recorded.

NOTE 28 — If the number in this field is the same as the volume sequence number of the volume on which the End Transaction Descriptor is recorded, that does not mean that there are no further volumes in the volume set. It may not have been possible to add an End Transaction Descriptor to the volume to indicate the addition of more volumes to the volume set as there may have been insufficient space to do so or the media might be read-only.

10.4.13 Transaction Number (BP 120)

This field shall specify the transaction number (see 2/9.6.1) of the transaction identified by this descriptor.

10.4.14 Descriptor Recording Date and Time (BP 128)

This field shall specify the date and time of the day when this descriptor is recorded.

NOTE 29 — This field can be used to indicate the last modification date and time of this volume set.

10.4.15 Number of File Set Descriptors (BP 140)

This field shall specify the greatest assigned File Set Descriptor Sequence Number of the volume set when this descriptor is recorded.

10.4.16 Volume Space Tables Information (BP 144)

This field shall identify the Volume Space Tables of the volume set as follows starting at the first byte of this field:

If there is only one volume in the volume set, this field shall contain either a Directory Record (see 2/9.5.3) describing the Volume Space Table or a Path Table Record (see 2/9.5.4) describing the Volume Space Tables Location Directory.

If there is more than one volume in the volume set, this field shall contain a Path Table Record (see 2/9.5.4) describing the Volume Space Tables Location Directory.

NOTE 30 — Byte 25 of this field is the location of the File Flags field in both the Path Table and Directory Records. Bit 1 of the File Flags field is the Directory bit. The Directory bit of the File Flags field in a Path Table Record shall always be set to ONE (see 2/15.2.5).

Unused bytes in this field not occupied by the Directory Record or Path Table Record shall be set to #00.

10.4.17 Path Tables Information (BP 400)

This field shall identify the path tables of the file set identified by the prevailing File System Descriptor Set (see 2/11.2.2) as follows starting at the first byte of this field:

If there is only one file set identified by the prevailing File System Descriptor Set of the volume set, this field shall contain either a Directory Record (see 2/13.3.3) describing the path table or a Path Table Record (see 2/13.3.4) describing the Path Tables Location Directory.

If there is more than one file set identified by the prevailing File System Descriptor Set of the volume set, this field shall contain a Path Table Record (see 2/13.3.4) describing the Path Tables Location Directory.

NOTE 31 — Byte 25 of this field is the location of the File Flags field in both the Path Table and Directory Records. Bit 1 of the File Flags field is the Directory bit. The Directory bit of the File Flags field in a Path Table Record shall always be set to ONE (see 2/15.2.5).

Unused bytes in this field not occupied by the Directory Record or Path Table Record shall be set to #00.

10.4.18 Reserved (BP 656)

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

10.5 Terminating Descriptor

The Terminating Descriptor shall be recorded in the format shown in table 2/11.