

# ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

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## STANDARD ECMA-41

### MAGNETIC TAPE CASSETTE LABELLING AND FILE STRUCTURE FOR INFORMATION INTERCHANGE

December 1973

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December 1973

## FOREWORD

The aim of this Standard ECMA- 41 is to make possible the interchange of information recorded on magnetic tape cassettes between different users and different data processing and data capture equipment.

This is accomplished by the arrangement of magnetically recorded separators and labels, to structure and identify the files.

To provide for the wide range of equipment and applications using magnetic tape cassettes, three arrangements are specified, of increasing complexity.

It is possible to distinguish between the three systems by reading the first block recorded on a particular volume.

In order that a cassette which carries more sophisticated labelling may be copied on unsophisticated equipment, the terminating conditions for end of track and end of data within a cassette are identical in all three of these systems. Thus, support of the Basic System is a necessary requirement to ensure data interchangeability from simple data preparation devices to more complex data processing systems.

The third system is provided only for use in the most sophisticated environment, where Standard ECMA-13 for magnetic tape labelling is already employed.

Adopted by the General Assembly of ECMA on December 13, 1973.

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## 1. SCOPE

This Standard ECMA-41 specifies file structures for data interchange on magnetic tape cassettes.

To provide for the range of sophistication in equipment and applications three systems are specified.

The BASIC System employs only hardware-defined separators to structure the files.

The COMPACT System employs special data blocks with information content (labels), which are capable of being recorded using only numeric equipment.

The EXTENDED System employs the magnetic tape labelling system described in Standard ECMA-13 together with new labels, to define a more comprehensive labelling system. This Standard is not limited to the 3,81 mm magnetic tape cassette described in Standard ECMA-34, but could also be applied to higher capacity cassettes or cartridges.

## 2. REFERENCES

- ECMA-6      7-bit Input/Output Coded Character Set
- ECMA-13     Magnetic Tape Labelling and File Structure for Information Interchange
- ECMA-34     Data Interchange on 3,81 mm  
              Magnetic Tape Cassette (32 bpmm phase encoded).

## 3. DEFINITIONS

For the purposes of this Standard the following terms have the meanings indicated. For a better explanation, the concepts have, where appropriate, been listed separately as logical and physical. The definition of a term that is used in an ECMA Standard related to this subject conforms to its usage in that Standard; the definition of a term that is in common use in a context related to this Standard conforms to that common usage.

LOGICAL	PHYSICAL
<p><u>file</u></p> <p>A collection of information consisting of records pertaining to a single subject.</p> <p>EXAMPLES. In the context of business data, a payroll file, an inventory file.</p> <ul style="list-style-type: none"> <li>- The delineation of a file may be arbitrary.</li> <li>- A file may be recorded on all or part of a track or volume, or on more than one volume.</li> </ul>	<p><u>volume</u></p> <p>A dismountable physical unit of storage media, e.g. a complete cassette consisting of either</p> <ul style="list-style-type: none"> <li>- two tracks used serially and sequentially for data interchange as described in Standard ECMA-34</li> <li>or</li> <li>- a single track (number 1, side A) used serially for data interchange with the use of track number 2, side B, defined by agreement between the interchange parties as described in Standard ECMA-34.</li> </ul>
<p><u>file section</u></p> <p>That part of a file that is recorded on a single track of a cassette.</p> <ul style="list-style-type: none"> <li>- The sections of a file in a volume shall not have sections of other files interspersed.</li> </ul>	
<p><u>file set</u></p> <p>A collection of one or more related files, recorded consecutively on a volume set.</p>	<p><u>volume set</u></p> <p>A collection of one or more volumes on which a file set is recorded.</p>

Block: A group of characters written or read as a unit.

Label: A block, at the beginning or at the end of a volume, of a track or of a file, that identifies, characterizes and delimits that volume, track or file. A label is not considered to be part of a file.



Label Identifier : One or more characters recorded in the label to identify the label.

Characters used in a Label : Only a subset of the characters of the 7-bit code defined in Standard ECMA-6 is used in the label. The allowable characters are described in the following way:

"n" characters : any numeric character from 0 to 9.

"a" characters : any numeric, alphabetic or special character of the centre four columns of the code table except position 5/15 and those positions where there is provision for alternative graphic representation.

Tape Mark : A delimiter used to indicate the boundary between file data and labels, and also between certain labels. In the Basic System it is used to separate files.

Note : The Tape Mark configuration is specified in the relevant Standard for Data Interchange on Magnetic Tape Cassettes (See ECMA-34, section 7.10)

In the whole of this Standard the tape mark is indicated as an asterisk (\*)

Double Tape Mark : A delimiter consisting of two consecutive tape marks that is used to indicate the end of a volume or of a file set.

Note : Except in the Basic System two consecutive tape marks also occur when an empty file section or an empty file exists on a volume, in which case they are not interpreted as a double tape mark but rather as two single tape marks framing an empty file section. In this context "empty" means that no blocks are present between the tape mark following the header label and the tape mark preceding the end of volume, end of track or end of file label of that file section or file.

## 4. BASIC SYSTEM

### 4.1 Introduction

The Basic System permits the structuring of one or more files on one volume by means of hardware separators (tape marks) only. Each volume is independent: multi-volume files are not provided. No magnetically recorded labels are used. The procedures for recording and detecting end of data on a track are defined in the relevant media Standards (see also the Appendix).

### 4.2 Use of tape marks

Tape marks are used with the following significance to indicate the structure of volumes and files.

Start of Volume	*
File separator	*
Intermediate End of Track	*
Intermediate Start of Track	*
End of Data (and End of Volume)	**

It is not permitted for one File Separator to be immediately followed by another since this signifies End of Data; thus, there can be no empty file sections as described in the definition of "Double Tape Mark" in Section 3.

Two tape marks not signifying end of data may occur when an Intermediate Start of Track is immediately followed by a File Separator: this condition is explained in sections 4.4 and 4.5.

### 4.3 Structuring the files

Figure 1 illustrates the use of tape marks to establish the file structure according to the definitions of section 4.2. In this figure and figure 2 the beginning of the tape is at the left and the end of the track is at the right. Each box represents a track.

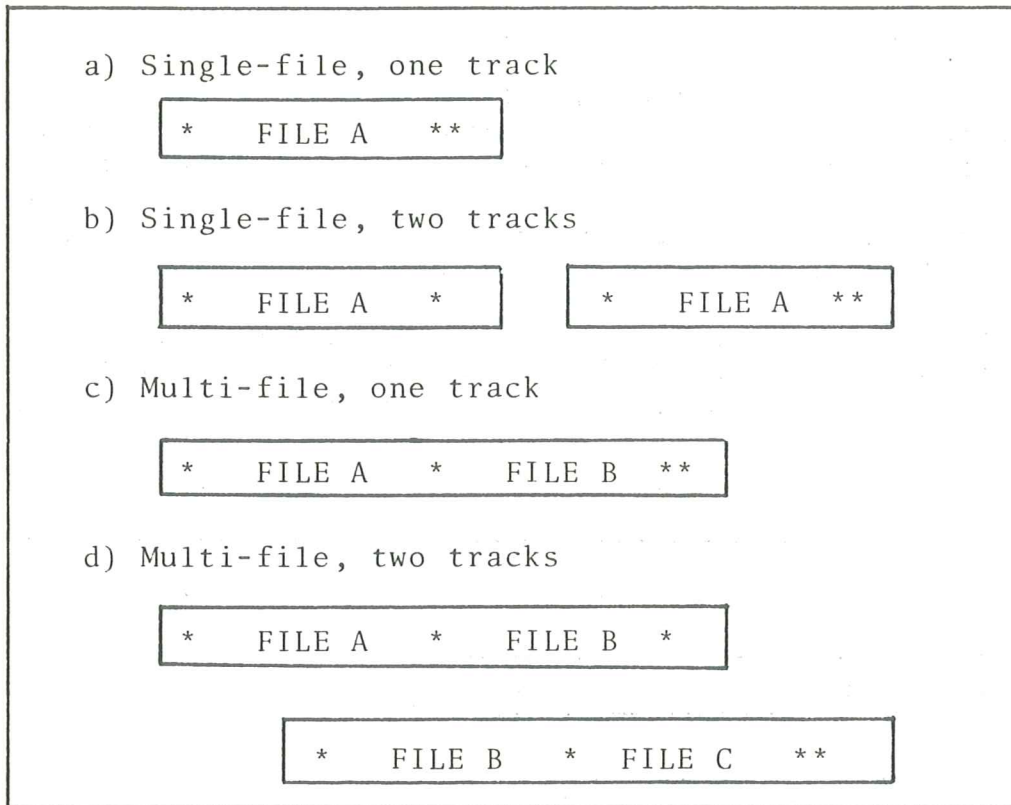


Fig. 1 - File Structures

4.4 Coincidence of end of file and intermediate start of track

This situation arises when the end-of-tape marker is recognised whilst the system is writing the last data block of the file. In this case the system will complete writing the data block, close the track with an Intermediate End of Track indicator and open the next track with an Intermediate Start of Track indicator as illustrated in Fig. 1 (b) and (d), except that no data blocks will be written on the next track but only a File Separator.

There are then two possibilities:

4.4.1 If the file is not the last file of the set, the resulting configuration will be as illustrated in Fig. 2 (a).

4.4.2 If the file is the last file of the set, the next track will be terminated by a third tape mark as illustrated in Fig. 2 (b); in this case the last two tape marks are to be interpreted as an End of Data indicator.

4.5 Coincidence of end of file and intermediate end of track

This situation arises when the end-of-tape marker is recognised whilst the system is writing the tape mark following a file.

file  
is  
and

There are then two possibilities:

- 4.5.1 If the file is not the last file of a set, the track is terminated at that point, so that the tape mark already written is now to be interpreted as an Intermediate End of Track indicator. The next track starts with an Intermediate Start of Track indicator, followed by a File Separator indicator, as illustrated in Fig. 2 (a).
- 4.5.2 If the file is the last file of a set, the system will write a second tape mark to complete the track with an End of Data indicator as illustrated in Fig. 1 (a) and (c).

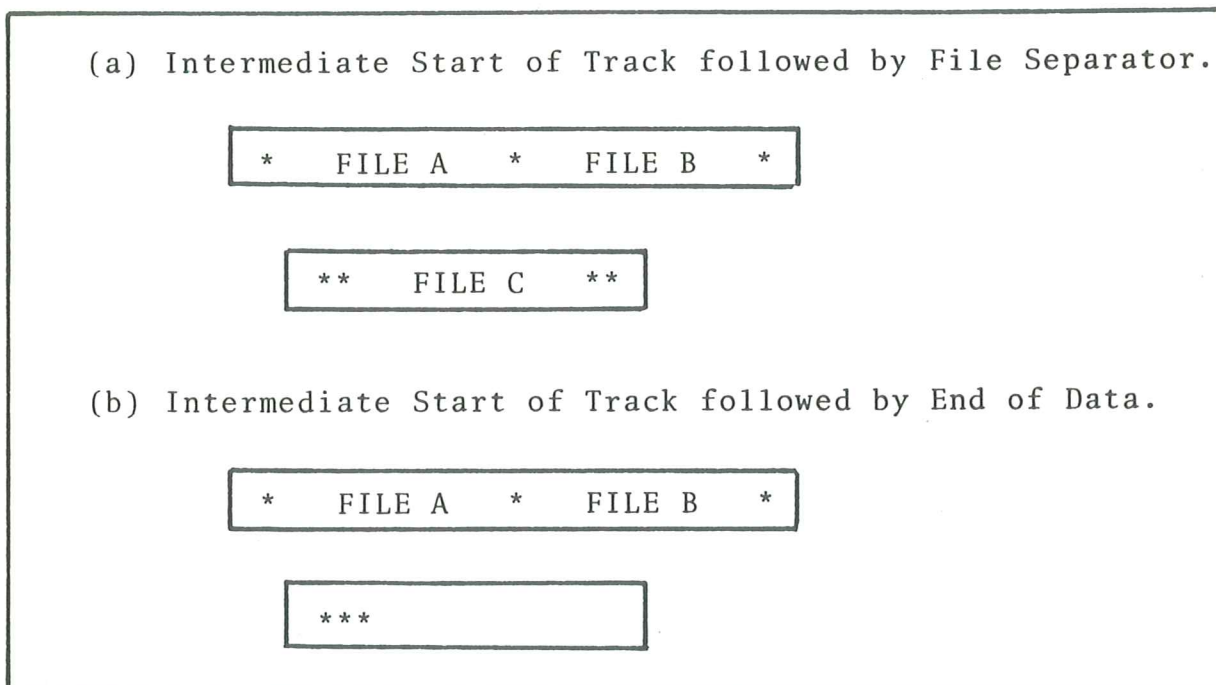


Fig. 2 - End of file coincides with intermediate start or end of track.

#### 4.6 End of available space

If the end-of-tape marker is recognised at the end of the last or only track on the volume which is available for recording, the file must be terminated with an End of Data indicator as illustrated in Fig. 1.

## 5. COMPACT SYSTEM

### 5.1 Introduction

The Compact System permits the structuring of one or more files on one or more volumes by means of magnetically recorded labels and tape marks. The labels are capable of being recorded by equipment which uses only "n" characters but provision is made for the use of "a" characters in appropriate fields.

The procedures for recording and detecting end of data on a track are defined in the relevant media Standards (see also the Appendix).

### 5.2 Use of tape marks

The tape mark is used to separate labels from file data and from other labels.

### 5.3 Formats and contents of labels

A label is a 32-character block, the character positions of which are numbered 1 - 32. They are classified into four types as given in table 1.

TYPE	NAME	MNEMONIC	IDENTIFIER
BEGINNING OF FILE OR OF FILE SECTION	FILE HEADER LABEL	HDR	1
END OF TRACK	END OF TRACK LABEL	ETR	3
END OF VOLUME	END OF VOLUME LABEL	EOV	7
END OF FILE OR OF LAST FILE SECTION	END OF FILE LABEL	EOF	9

Table 1 - Classification of labels.

Note: ETR and EOV both imply end of first or intermediate file section.

5.3.1 File Header Label (HDR)

CP	FIELD NAME	L	CONTENT
1	Label Identifier	1	1
2-5	Volume Identifier	4	"a" characters. Permanently assigned by the owner to identify the volume.
6-13	File Identifier	8	"a" characters. Assigned by the originator to identify the file.
14-15	File Section Number	2	"n" characters. Identifies the section among other sections of the file.
16-20	Creation Date	5	Two "n" characters for the year followed by three "n" characters for the day (001 to 366) within the year.
21-23	Retention Period	3	"n" characters. Specifies a number of days.
24-27	Block Count	4	0000
28	Data Code Indicator	1	"n" character. 1 means that the 7-bit code defined in Standard ECMA-6 is used for the data in the file.
29-32	Reserved for User Application	4	"a" characters.

5.3.2 End of Track Label (ETR)

CP	FIELD NAME	L	CONTENT
1	Label Identifier	1	3
2-23	Same as the corresponding fields in HDR	22	Same as the corresponding fields in HDR or 22 ZERO characters.
24-27	Block count	4	"n" characters.
28-32	Same as the corresponding fields in HDR	5	Same as the corresponding fields in HDR or 5 ZERO characters.

5.3.3 End of Volume Label (EOV)

CP	FIELD NAME	L	CONTENT
1	Label Identifier	1	7
2-23	Same as the corresponding fields in HDR	22	Same as the corresponding fields in HDR or 22 ZERO characters.
24-27	Block Count	4	"n" characters.
28-32	Same as the corresponding fields in HDR	5	Same as the corresponding fields in HDR or 5 ZERO characters.

5.3.4 End of File Label (EOF)

CP	FIELD NAME	L	CONTENT
1	Label Identifier	1	9
2-23	Same as the corresponding fields in HDR	22	Same as the corresponding fields in HDR or 22 ZERO characters.

CP	FIELD NAME	L	CONTENT
24-27	Block Count	4	"n" characters.
28-32	Same as the corresponding fields in HDR	5	Same as the corresponding fields in HDR or 5 ZERO characters.

#### 5.4 Processing of label fields

5.4.1 The Label Identifier must be written with the content as specified. Other fields may have the content as specified or a default value of the appropriate number of ZERO characters.

On reading, the fields may be treated as desired.

#### 5.4.2 Use of data in label fields

On input, the system may override data found in labels being processed by that system with new values of that data provided from other sources. The new values may be supplied before the file is processed (e.g., compiled values) or after the processing has begun (e.g., system control statement), at the option of the system implementors.

#### 5.4.3 File Section Number (HDR CP 14-15)

The number of the first section of a file is 01. This number is increased by 1 for each successive track or volume of the file.

#### 5.4.4 File Sequence Number

If a File Sequence Number is desired in a multi-file application, the last two positions of the File Identifier (HDR CP 6-13) may be used.

The File Sequence Number of the first file in a file set is 01. This number is increased by 1 for each successive file of the set. In all the labels for a given file, whether that file be single or multi-volume, this field contains the same number.

#### 5.4.5 Retention Period (HDR CP 21-23)

The Retention Period is a quantity to be added to the Creation Date to form the Expiration Date. The retention period may exceed one year.



A file is regarded as "expired" on a day the date of which is equal to, or later than the expiration date. When this condition is satisfied, the remainder of the volume set may be overwritten. To be effective on multi-file volumes, therefore, the expiration date of a file must be less than, or equal to the expiration dates of all previous files on the volume set.

#### 5.4.6 Block Count (ETR, EOY, EOF, CP 24-27)

The Block Count denotes only the number of data blocks since the preceding HDR label. This count excludes label blocks and tape mark blocks.

If the Block Count has the value zero, it is ignored.

This field is provided in order that when a magnetic tape cassette is read the system may ensure that no blocks have been skipped and no false blocks have been inserted. The particular error of equal numbers of skipped and false blocks may escape detection.

### 5.5 Structuring the files

Labels and tape marks are used to establish the file structure according to the following rules and as illustrated in the accompanying figures 3-8. In these figures the beginning of the tape is at the left and the end of the tape is at the right. Labels are represented by their mnemonic identifiers.

#### 5.5.1 Configurations of files within the tracks of a volume

The various configurations of files that can be formed according to these rules are illustrated in fig. 3. Each box represents a track.

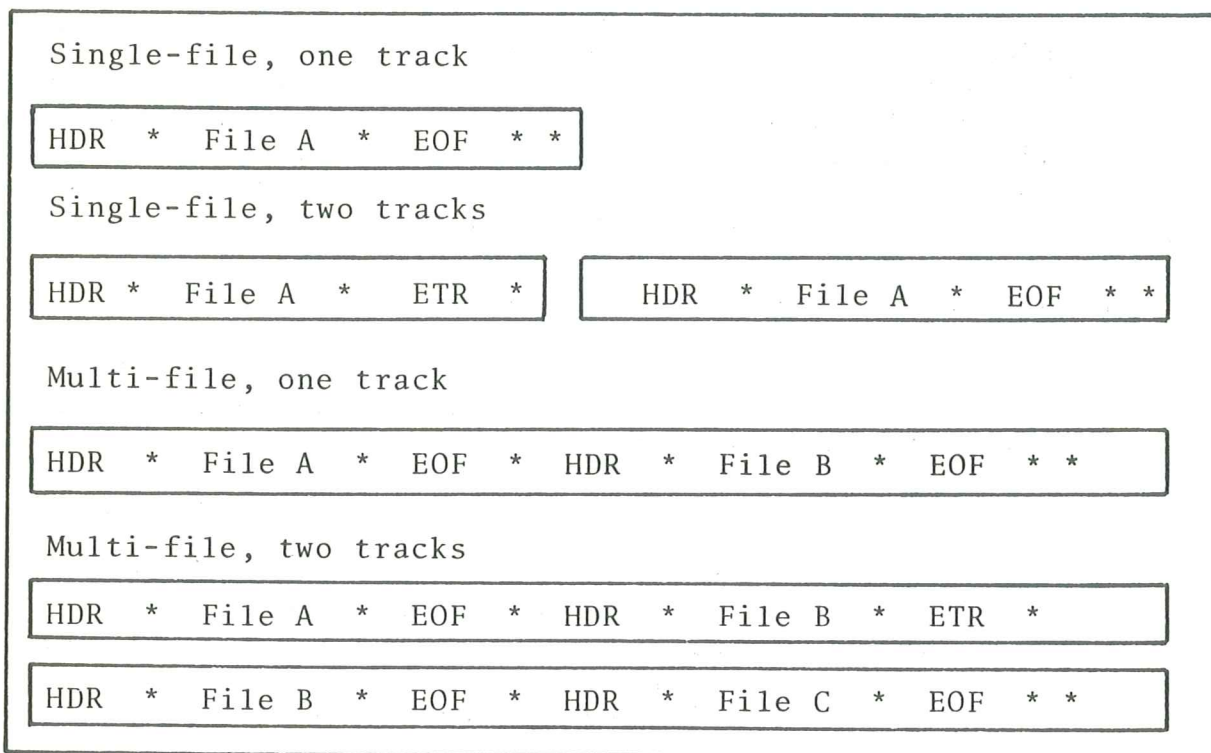


Fig. 3 - Single-volume file structure

### 5.5.2 Configurations of files in a multi-volume case

The two configurations of files that can be formed according to these rules are illustrated in Fig.4. The distinction between tracks within the volumes is not shown, and the configurations within the volumes are as given in Fig. 3. Each box represents a volume.

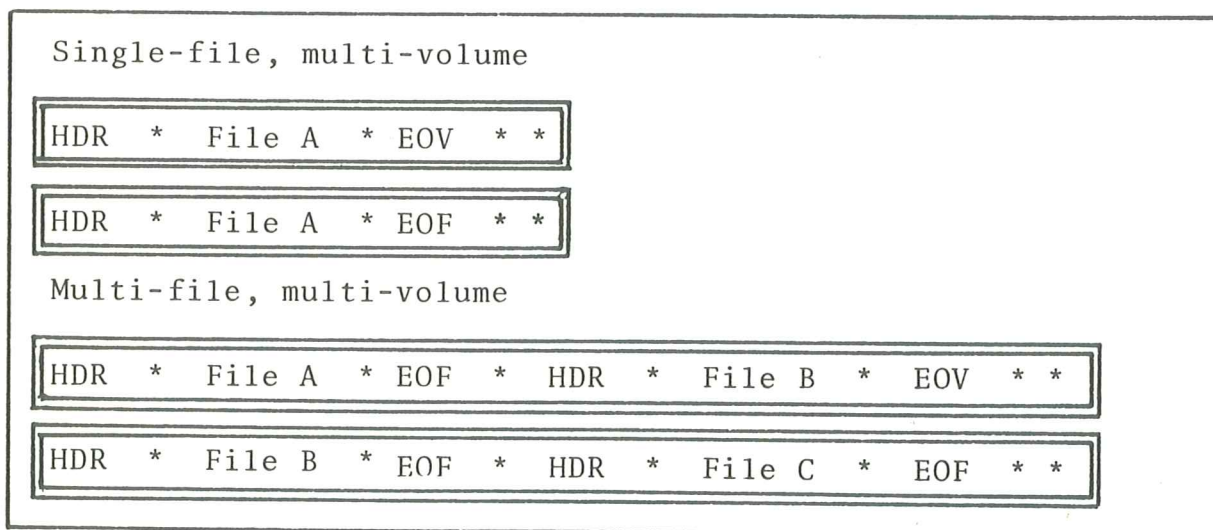


Fig. 4 - Multi-volume file structure

### 5.5.3 File Header Label

Each file shall be preceded by the File Header Label.

### 5.5.4 Data

File data shall follow the File Header Label and be separated from the label by a tape mark.

### 5.5.5 End of File Label

The End of File Label shall follow the last data block of the file and be separated from the file by a tape mark.

### 5.5.6 Tape mark after End of File Label

If the file ends within a volume, a tape mark shall immediately follow the End of File Label.

If the file is the last file of a file set, a double tape mark shall immediately follow the End of File Label.

### 5.5.7 End of Track Label

If the file extends over the end of a track, the End of Track Label shall follow the last data block on that track and be separated from that data block by a Tape mark. The End of Track Label shall always be followed by a single tape mark.

### 5.5.8 End of Volume Label

If the file extends over the end of a volume, the End of Volume Label shall follow the last data block on that track and be separated from that data block by a tape mark. The End of Volume Label shall always be followed by a double tape mark.

### 5.5.9 Empty file or file section

When an empty file or file section is present, the rules stated in 5.5.4, 5.5.5, 5.5.7 and 5.5.8 will cause two consecutive tape marks to be written between the File Header Label and the End of File, Track or Volume Label.

5.5.10 Continuation file section in a multi-track or multi-volume file.

The first data block of a continuation file section shall be preceded by a File Header Label as described in 5.5.3 and 5.5.4. This includes a copy of the last File Header Label on the previous track or volume, in which the File Section Number is increased by one and the Volume Identifier may be different.

5.5.11 Coincidence of end of file and end-of-tape marker

If the end of a file coincides with an intermediate end of track or the end of a volume, three situations are possible:

5.5.11.1 The end-of-tape marker is detected whilst the system is writing the last data block of the file. In this case the system will complete writing the data block and close the track or volume as described in 5.5.7 or 5.5.8 respectively and continue the file on the next track or volume as described in 5.5.10 except that no data blocks will be written on the next track or volume but an End of File Label as described in 5.5.5. Examples are given in Fig. 5 and 6.

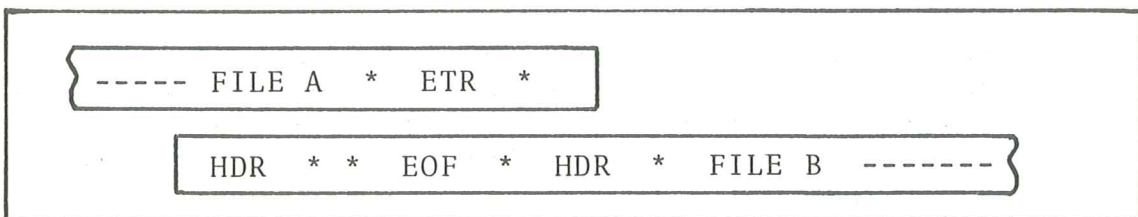


Fig. 5 - Empty file section at intermediate start of track

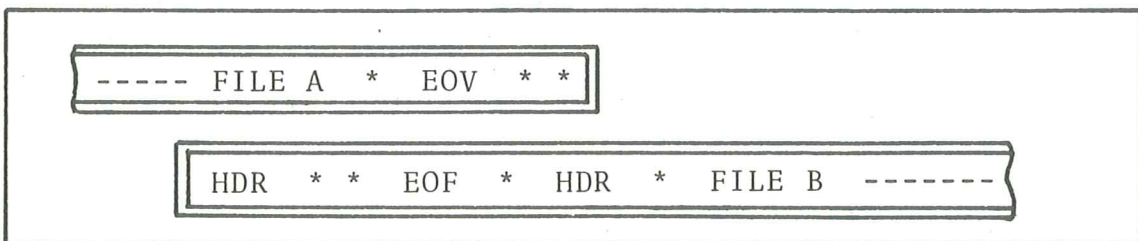


Fig. 6 - Empty file section at start of continuation volume

5.5.11.2 The end-of-tape marker is recognized whilst the system is writing the End of File Label or the tape mark which precedes or follows it, and the file is not the last of a set. In this case the system will complete the writing of the End of File Label and the tape mark following it. The File Header Label of the next file will then be written, followed by an empty file section, and the track or volume terminated by an End of Track or End of Volume Label respectively.

The File Header Label will then be rewritten at the start of the next track or volume.

Examples are given in Fig. 7 and 8.

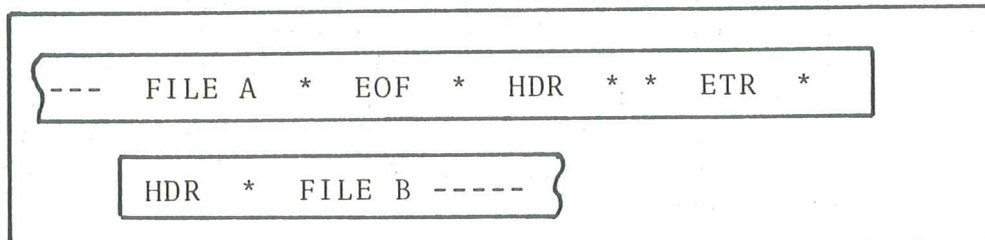


Fig. 7 - Empty file section at intermediate end of track

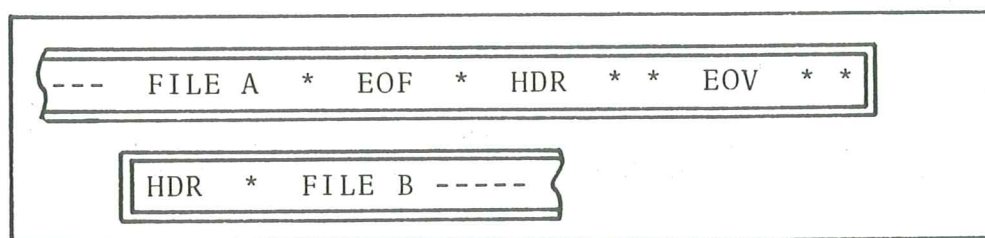


Fig. 8 - Empty file section at end of volume

5.5.11.3 The end-of-tape marker is recognized whilst the System is writing the End of File Label or the tape mark which precedes or follows it and the file is the last file of a set. In this case the system will complete the writing of the End of File Label and the tape mark following it and then close the volume with a second tape mark as described in 5.5.6.

#### 5.5.12 Coincidence of beginning of file and end-of-tape marker

If the end-of-tape marker is recognized whilst the system is writing the File Header Label or the tape mark following it, then the File Header Label will be followed by an empty file section and the track or volume terminated by an End of Track or End of Volume Label respectively. The File Header Label will then be rewritten at the start of the next track or volume. The resulting configurations are illustrated in Fig. 7 and 8.

## 6. EXTENDED System

### 6.1 Introduction

The Extended System provides the full range of facilities described in Standard ECMA-13 together with certain additional features to control the transition from track to track within the volume. The remainder of this chapter describes the format of the End of Track (ETR 1 and ETR 2) and Start of Track (STR 1) labels and the file structure resulting from their use.

The procedures for recording and detecting end of data on a track are defined in the relevant media Standards (see also the Appendix).

### 6.2 Use of Tape Marks

The use of tape marks is the same as in Standard ECMA-13 with the addition described in section 6.5.3.

### 6.3 Formats and contents of labels

#### 6.3.1 First End of Track Label (ETR 1)

CP	FIELD NAME	L	CONTENT
1-3	Label Identifier	3	ETR
4	Label Number	1	1
5-54	Same as the corresponding fields in HDR1, as specified in Standard ECMA-13	50	Same as the corresponding fields in HDR1, as specified in Standard ECMA-13.
55-60	Block Count	6	"n" characters. Denotes the number of data blocks since the preceding beginning of file label group. This count excludes label blocks and tape mark blocks.
61-80	Same as the corresponding fields in HDR1, as specified in Standard ECMA-13	20	Same as the corresponding fields in HDR1, as specified in Standard ECMA-13.

6.3.2 Second End of Track Label (ETR 2) (Optional)

CP	FIELD NAME	L	CONTENT
1-3	Label Identifier	3	ETR
4	Label Number	1	2
5-80	Same as the corresponding fields in HDR2, as specified in Standard ECMA-13	76	Same as the corresponding fields in HDR2, as specified in Standard ECMA-13.

6.3.3 Other optional labels (ETR3-9)

CP	FIELD NAME	L	CONTENT
1-3	Label Identifier	3	ETR
4	Label Number	1	3,4,5,6,7,8 or 9
5-80	Reserved for System Software Use	76	"a" characters.

6.3.4 Start of Track Label (STR1)

CP	FIELD NAME	L	CONTENT
1-3	Label Identifier	3	STR
4	Label Number	1	1
5-11	Same as the corresponding fields in VOL1, as specified in Standard ECMA-13	7	Same as the corresponding fields in VOL1, as specified in Standard ECMA-13.
12	Track Number	1	"n" character.
13-80	Same as the corresponding fields in VOL1, as specified in Standard ECMA-13	68	Same as the corresponding fields in VOL1, as specified in Standard ECMA-13.

#### 6.4 Processing of label fields

This section contains references only to the fields of ETR1 and STR1 and to those fields of other labels which are affected by the existence of track transitions.

##### 6.4.1 File Section Number (HDR1 CP 32-35, also in ETR1, EOVI, EOF1)

The number of the first section of a file is 0001. This number is increased by 1 for each successive track or volume of the file.

##### 6.4.2 Track Number (STR1 CP 12)

The numbering of the tracks commences at 1. However because the first STR1 label appears on the second track of the volume, the value of Track Number in that label is 2.

#### 6.5 Structuring the files

Labels and tape marks are used to establish the file structure according to the following rules and as illustrated in the accompanying figures 9 to 12. In these figures the beginning of the tape is at the left, and the end of the tape is at the right. The figures show only the required labels in each label group.

##### 6.5.1 Configurations of files within the tracks of a volume

The various configurations of files that can be formed according to these rules are illustrated in fig. 9. Each box represents a track.



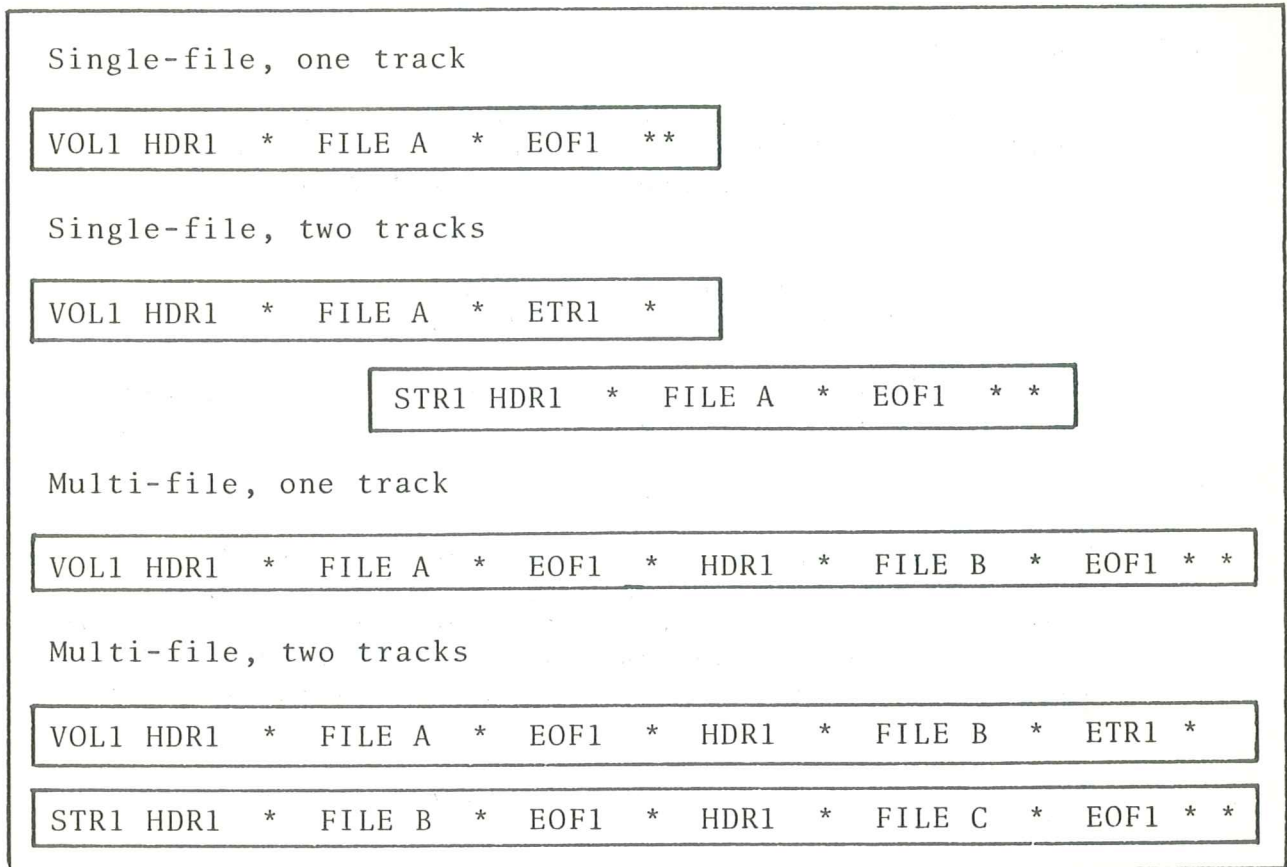


Fig. 9 - Single-volume file structures

### 6.5.2 Configurations of files in a multi-volume case

The two configurations of files that can be formed according to these rules are illustrated in fig. 10. Each box represents a volume. The distinction between tracks is not shown. The configurations within the volume are as in fig. 9.

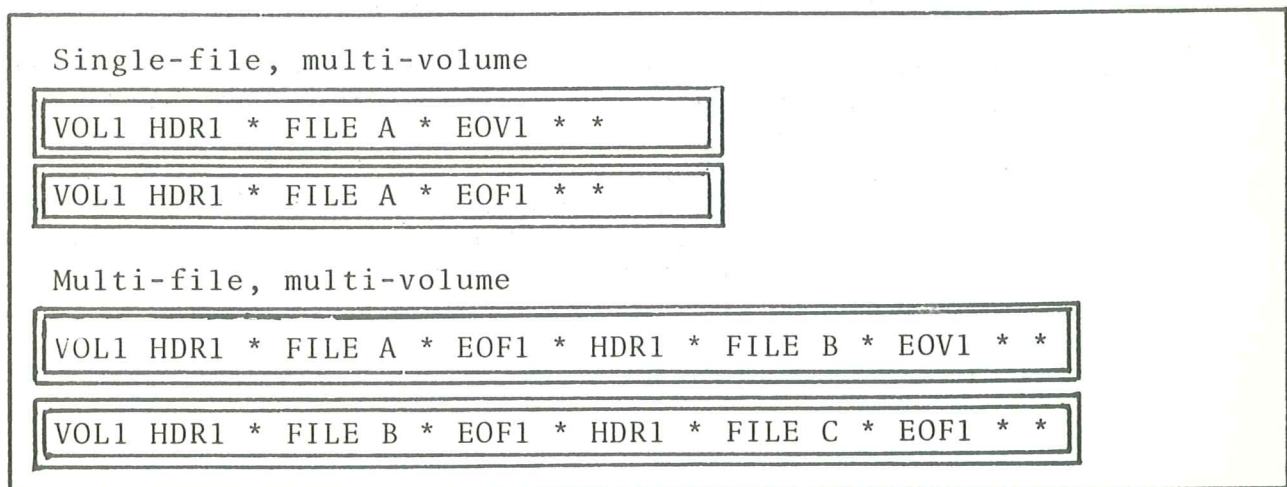


Fig. 10 - Multi-volume file structures

### 6.5.3 End of track labels

If the file extends over the end of a track, the End of Track Label (ETR1) shall follow the last data block on that track and be separated from that data block by a tape mark.

If other end of track labels (ETR2-ETR9) are used, they shall immediately follow the ETR1 label.

The last label of an end of track label group shall always be followed by a tape mark.

### 6.5.4 Intermediate Start of Track

Each track of the volume except the first shall commence with a Start of Track Label. This label shall be immediately followed by the file header label group of the next file section, as described in section 6.5.5. This label shall not appear at any other place on the track.

### 6.5.5 Continuation file section in a multi-track or multi-volume file

The first data block of a continuation file section shall be preceded by a beginning of file label group. This includes an exact copy of the last beginning of file label group on the previous track or volume except that the File Section Number which is on HDR1 is increased by 1 (see section 6.4.1).

### 6.5.6 Coincidence of end of file and intermediate end of track

If the end of a file coincides with an intermediate end of track, three situations are possible:

- 6.5.6.1 The end-of-tape marker is recognized whilst the system is writing the last data block of the file. In this case the system will complete writing the data block and close the track as described in 6.5.3 and continue the file on the next track or volume as described in 6.5.4 and 6.5.5 except that no data blocks will be written on the next track or volume but an end of file label group.

This is illustrated in fig. 11.

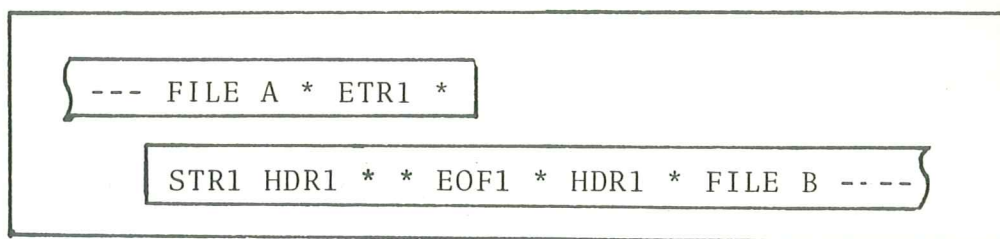


Fig. 11 - Empty file section at intermediate start of track.

6.5.6.2 The end-of-tape marker is recognized whilst the system is writing the end of file label group and the file is not the last file of a set. In this case the system will complete the writing of the end of file label group. The beginning of file label group of the next file will then be written followed by an empty file section, and the track will be terminated by an end of track label group. The beginning of file label group will then be rewritten at the start of the next track, following the STR1 label.

This is illustrated in fig. 12:

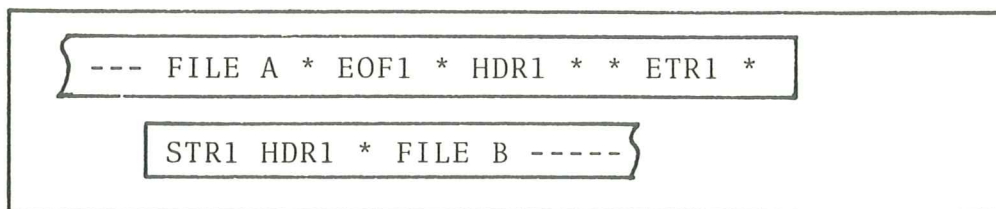


Fig. 12 - Empty file section at intermediate end of track

6.5.6.3 The end-of-tape marker is recognized whilst the system is writing the end of file label group and the file is the last file of a set. In this case the system will complete the writing of the end of file label group and the tape mark following it and then close the track with a second tape mark.

#### 6.5.7 Coincidence of beginning of file and of end-of-tape marker

If the end-of-tape marker is recognized whilst the system is writing the beginning of file label group, then this group will be followed by an empty file section and the track will be terminated by an end of track label group.

The beginning of file label group will then be rewritten at the start of the next track following the STR1 label. This is illustrated in fig. 12.

APPENDIX

Explanatory remarks concerning the end of data on a track

When the end of data in a track is reached during writing, after the last block at least 400 mm of tape shall be erased according to ECMA-34, 6.1.1 and 7.11.2.

If the physical end of the magnetic tape is reached within these 400 mm, then that part of the track shall be erased between the last block and the physical end of the magnetic tape.

When reading, end of data in a track is assumed when encountering an erased portion of tape which is longer than the maximum allowed interblock gap (as defined in Standard ECMA-34, paragraph 7.11.2) or encountering the physical end of magnetic tape.

