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MAGNETIC TAPE LABELLING AND FILE STRUCTURE FOR INFORMATION INTERCHANGE

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BRIEF HISTORY

The ISO Recommendation R 1001, *Magnetic tape labelling and file structure for information interchange,* was drawn up by Technical Committee ISO/TC 97, *Computers and information processing,* the Secretariat of which is held by the American National Standards Institute (ANSI).

Work on this question led to the adoption of a Draft ISO Recommendation.

In September 1967, this Draft ISO Recommendation (No. 1323) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	Israel	Sweden
Belgium	Italy	Switzerland
Canada	Japan	Turkey
Czechoslovakia	Korea, Rep. of	U.A.R.
Denmark	Netherlands	United Kingdom
France	New Zealand	U.S.A.
Germany	Portugal	

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in March 1969, to accept it as an ISO RECOMMENDATION.

ISO Recommendation | R 1001 | March 1969

MAGNETIC TAPE LABELLING AND FILE STRUCTURE FOR INFORMATION INTERCHANGE

INTRODUCTION

The basic reason for producing an ISO Recommendation for magnetic tape labelling is to give protection, via an operating system, against procedural and human errors in handling data from magnetic tape. When a tape is read a check can be made of the identification on the tape against that supplied by the operator/programmer and writing or reading stopped before any damage has been done.

In producing this ISO Recommendation cognizance has been taken of the fact that the data on tape may be sent from tape to data link and the control characters have been excluded from the characters allowable in labels. However, it should be noted that no restriction has been placed upon the information that may be recorded in data blocks and that, in particular, if the record length is given in binary, control characters could be encountered.

It cannot be overstressed that this ISO Recommendation, in its present form, is a Recommendation for magnetic tape labelling. Even though other media, as the data transmission example above, have been considered, the Recommendation does not have universal applicability.

Although this ISO Recommendation was written to be used specifically with the ISO 7-bit code, the principles contained herein are equally applicable with other code structures.

1. SCOPE

This ISO Recommendation relates to information interchange utilizing magnetic tape, by providing magnetically recorded labels to identify and structure files, and by providing a standard structure for the blocks containing the records that constitute a file.

2. DEFINITIONS OF TERMS

As used in this ISO Recommendation, the following items have the meanings indicated. When a term is in common use in a context related to the subject-matter of this ISO Recommendation, the definition conforms to common usage; when a term has been used in related ISO Recommendations, the definition conforms to its usage there.

2.1 *Record.* Collection of related terms of data which for operating systems logic purposes is treated as a unit of information. Conceptually, a record corresponds (in the context of business data) to a transaction, a customer's account, etc. In other contexts, the delineation of a record may be relatively arbitrary, and is determined by the designer of the information formats.

2.2 *Block.* Group of contiguous characters recorded on and read from magnetic tape as a unit. A block may contain one or more complete records.

2.3 *File*. Major collection of information, consisting of all the records pertaining to a general subject. Conceptually, this term (in the context of business data) relates to such collections as a Payroll File, an Inventory File, etc. In other contexts, the delineation of a file may be relatively arbitrary.

2.4 *File set*. Collection of one or more related files recorded on one or more volumes. A file set may consist of

- one file recorded on a single volume,
- more than one file recorded on a single volume,
- one file recorded on more than one volume,
- more than one file recorded on more than one volume.

2.5 *Volume*. Physical unit of storage media. The word volume, as used in this ISO Recommendation, is completely synonymous with "reel of magnetic tape".

2.6 *Label*. Block at the beginning or end of a volume or a file which serves to identify and/or delimit that volume or file.

2.7 *Label Group*. Collection of contiguous labels of the same type (see clause 3.1.3 for label types).

2.8 *Tape Mark*. Special configuration recorded on magnetic tape, essentially indicating the boundary between files and labels, and also between certain label groups. The Tape Mark configuration is defined in the relevant ISO Recommendations for recorded magnetic tape.

2.9 *Operating System*. Programme or set of programmes, usually provided by the manufacturer, which, among other things, handles the functions of reading and writing blocks on tape, label handling and related functions.

3. LABELLING

3.1 Elements of the labelling scheme

3.1.1 *The labels*. Each label shall be an 80-character block.

3.1.2 *Classes of labels*. Labels are divided into the two following general classes :

- Operating System Labels and
- User Labels.

In addition, labels are classified as required or optional.

3.1.3 *Types of labels*

The two types of labels are

- Volume labels and
- File labels.

3.1.4 *Label Identifiers*. The identifiers and numbers (4 characters) for the various classes and types of labels are shown in the following chart. The labels are also classified to show which labels are required by this ISO Recommendation and which additional labels are permissible (optional).

Type	Class		
	Operating System		User
Volume	VOL1 EOV1	(None) EOV2-9	UVL1-9 UTLx
File	HDR1 EOF1	HDR2-9 EOF2-9	UHLx UTLx
	Required	Optional	

x = any "a" character as defined in clause 3.3

3.1.5 *Tape Mark*. Tape Marks shall be used only where specified in this ISO Recommendation.

3.2 Structuring the file

3.2.1 *Use of Required Label and Tape Marks*. Required Labels and Tape Marks shall be used to establish the file structure according to the following rules, as illustrated in Figure 1. In that Figure, the beginning of the tape is at the left, and the end of the tape is at the right. Required Labels are indicated by the first three characters of their identifiers, and Tape Marks are indicated by asterisks (*).

The rules and the Figure are presented as though there were no Optional Operating System Labels or User Labels. Rules for using these optional classes of labels are set forth in clauses 3.2.3 to 3.2.8.

Single-Volume File

VOL HDR * --- Data Blocks --- * EOF **

Multi-Volume File

VOL HDR * --- First Volume Data --- * EOV **

VOL HDR * --- Last Volume Data --- * EOF **

Multi-File Volume

VOL HDR * -- File A -- * EOF * HDR * --- File B --- * EOF **

Multi-Volume Multi-File

VOL HDR * -- File A -- * EOF * HDR * -- File B --- * EOV **

VOL HDR * --- Continuation of File B -------- * EOV **

VOL HDR * -- End of File B -- * EOF * HDR * -- File C -- * EOF **

FIG. 1 – **Structure of Magnetic Tape Files**
(* means Tape Mark)

VOLUME HEADER LABEL. Every volume shall have a Volume Header Label as the first block in the volume. The Volume Header Label shall not be used at any other place in the volume.

FILE HEADER LABEL. Every file shall be preceded by a File Header Label. Whenever a volume ends within a file, the continuation of that file in the next volume shall also be preceded by a File Header. Every File Header shall be immediately followed by a Tape Mark. (See clause 3.2.6.)

END OF FILE LABEL. The last block of every file shall be followed by an End of File Label. A Tape Mark shall immediately precede, and another Tape Mark shall immediately follow, every End of File Label. The End of File Label that appears at the end of the last (or only) file in a volume set shall be followed by two Tape Marks, rather than one. (See clause 3.2.6.)

END OF VOLUME LABEL. Whenever a volume ends within a file, the last block of the file in that volume shall be followed by an End of Volume Label. One Tape Mark shall immediately precede, and two Tape Marks shall immediately follow, every End of Volume Label. (See clause 3.2.6.)

3.2.2 *Coincidence of End-of-Volume and End-of-File*. Whenever end-of-volume and end-of-file coincide, the labelling configuration shall be one of the following :

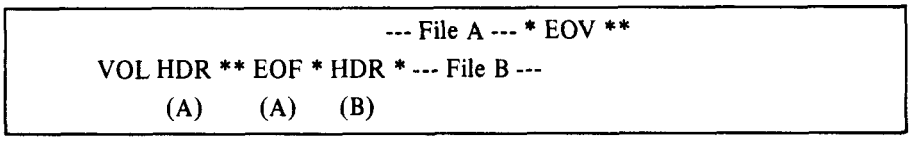

FIG. 2

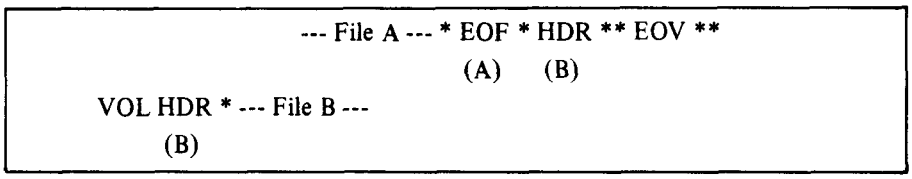

FIG. 3

3.2.2.1 By agreement between the interchange parties, it is allowable to arrange that any file of a set may start at the beginning of a volume. If this procedure is used the labelling configuration shall be as set out in clause Z.2.6 of the Appendix.

3.2.3 *Fitting Optional Labels with the File Structure*. Optional Operating System Labels and User Labels shall be fitted into the file structure as described in clauses 3.2.4 to 3.2.8, without otherwise modifying the relationship between the Required Labels and the files. When these optional classes of labels are used, any reference to a label within clause 3.2 shall be construed to mean the entire label group.

3.2.4 *Optional Operating System Labels*. Optional Operating System Labels of a given type, when used, shall directly follow a Required Label of the same type. The fourth character of consecutive Optional Operating System Labels in a group shall be the numbers 2, 3, 4, 5, 6, 7, 8 and 9 respectively.

3.2.5 *User Labels*. User Labels of a given type, when used, shall directly follow a consecutive group of Operating System Labels of the same type. When no Optional Operating System Labels are used in the label group, the User Labels shall directly follow a Required Label of the same type.

3.2.6 *No Tape Mark within a Label Group*. There shall be no Tape Mark within a group of labels. Wherever Figures 1, 2, 3, and the descriptions in clauses 3.2.1 and 3.2.2, indicate a Tape Mark following a Required Label, that Tape Mark shall actually follow the last label of the entire group.

3.2.7 *Label Group complete on one Volume*. Every label group shall be completed on the volume where the first label of the group was recorded.

3.2.8 *Example of the Grouping of Optional Labels*

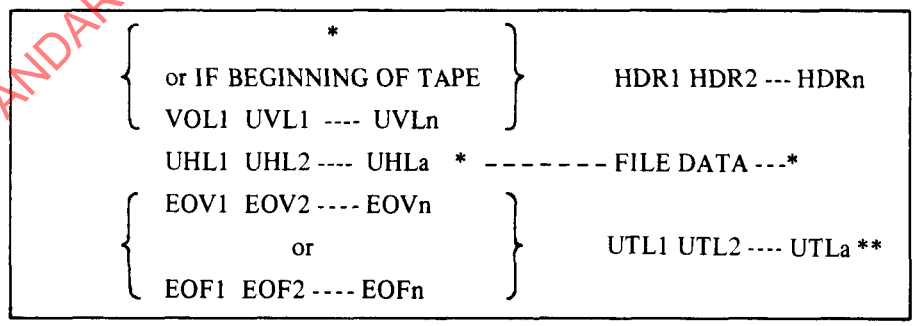

FIG. 4

3.3 Format and contents of labels

In this ISO Recommendation, "n" means any numeric digit 0 to 9. An "a" means any of the characters occupying the central four columns of the ISO 7-bit code table, except position 5/15 and those positions where there is provision for alternative graphic representations.

The limitation on "a" characters is intended as a guide to provide maximum interchangeability and consistent printing especially when international interchange is a possibility. Checking for conformity to this limitation is not implied.

The word "optional" is sometimes used in the name or description of fields in this ISO Recommendation. When used, "optional" means that the field may, but need not, contain the information described. If an optional field does not contain the designated information, it shall contain spaces (or zeros if so indicated).

Fields which are not described as "optional" are considered to be "mandatory". "Mandatory" fields must be written as specified.

Although this ISO Recommendation does not require any particular label processing on reading, certain desirable processing is implied.

3.3.1 *Volume Header Label*

Field	Name	Length	Description
1	Label Identifier	3	Must be VOL.
2	Label Number	1	Must be 1.
3	Volume Serial Number	6	Six "a" characters permanently assigned by the owner to identify this physical volume (i.e. reel of tape).
4	Accessibility	1	An "a" character which indicates any restrictions on who may have access to the information in the volume. A "space" means unlimited access; any other character means special handling, in a manner agreed between the interchange parties.
5	Reserved for future standardization	20	Must be "spaces".
6	Reserved for future standardization	6	Must be "spaces".
7	Owner Identification	14	Any "a" characters, identifying the owner of the physical volume.
8	Reserved for future standardization	28	Must be "spaces".
9	Label Standard Level	1	1 means the labels and data formats on this volume conform to the requirements of this ISO Recommendation. "Space" means the labels and data formats on this volume require the agreement of the interchange parties.

3.3.1.1 Anyone recording on a magnetic tape that he does not own must preserve the entire Volume Header Label unchanged, except as authorized by the owner. This is not intended to preclude the rewriting, unchanged, of the Volume Header Label.

3.3.2 *First File Header Label*

Field	Name	Length	Description
1	Label Identifier	3	Must be HDR.
2	Label Number	1	Must be 1.
3	File Identifier	17	Any "a" characters agreed on between the interchange parties.
4	Set Identification	6	Any "a" characters to identify the set of files of which this is one. This identification must be the same for all files of a multi-file set.
5	File Section Number	4	The File Section Number of the first Header Label of each file is 1. This applies to the first or only file on a volume and to subsequent files on a multi-file volume. This field is incremented by one on each subsequent volume of the file.
6	File Sequence Number	4	Four "n" characters denoting the sequence (i.e. 0001, 0002, etc.) of files within the volume or set of volumes. In all the labels for a given file, this field will contain the same number.
7	Generation Number (optional)	4	Four "n" characters denoting the current stage in the succession of one file-generation by the next. When a file is first created, its generation number is 1.
8	Generation Version Number (optional)	2	Two "n" characters distinguishing successive iterations of the same generation. The generation version number of the first attempt to produce a file is 0 (zero).
9	Creation Date	6	A "space" followed by two "n" characters for the year, followed by three "n" characters for the day (001 to 366) within the year.
10	Expiration Date	6	Same format as field 9. This file is regarded as "expired" when today's date is equal to, or later than the date given in this field. When this condition is satisfied, the remainder of this volume may be over-written. To be effective on multi-file volumes therefore, the expiration date of a file must be less than, or equal to the expiration date of all previous files on the volume.
11	Accessibility	1	An "a" character which indicates any restrictions on who may have access to the information in this file. A "space" means unlimited access; any other character means special handling, in a manner agreed between the interchange parties.
12	Block Count	6	Must be "zeros".
13	System Code (optional)	13	Thirteen "a" characters identifying the Operating System that recorded this file.
14	Reserved for future standardization	7	Must be "spaces".

3.3.3 *Second File Header Label (optional).* Further explanations concerning the fields in this label are given in Section 4.

Field	Name	Length	Description
1	Label Identifier	3	Must be HDR.
2	Label Number	1	Must be 2.
3	Record Format	1	F = Fixed length. D = Variable with the number of characters in the record specified in decimal. V = Variable with the number of characters in the record specified in binary. U = Undefined.
4	Block Length	5	Five "n" characters specifying the maximum number of characters per block.
5	Record Length	5	Five "n" characters specifying : – If "Record Format" is F, Record Length; – If D or V, Maximum Record Length including any countfield; – If U, undefined.
6	Reserved for Operating Systems	35	Reserved for Operating Systems use. Any "a" characters.
7	Buffer Offset (optional)	2	Two "n" characters specifying the length in characters of any additional field inserted before a data block (viz. Block Length). This length is included in the block length (Field 4).
8	Reserved for future standardization	28	Must be "spaces".

3.3.4 *First End of File Label*

Field	Name	Length	Description
1	Label Identifier	3	Must be EOF.
2	Label Number	1	Must be 1.
3 to 11	Same as corresponding fields in the first File Header Label (all optional)	Total 50	Same as corresponding fields in the first File Header Label.
12	Block Count	6	Six "n" characters denoting the number of data blocks (exclusive of labels and Tape Marks) since the preceding HDR Label Group.
13 and 14	Same as corresponding fields in the first File Header Label (optional)	Total 20	Same as corresponding fields in the first File Header Label.

3.3.5 *Second End of File Label (optional).* A second End of File Label containing EOF2 as the Label Identifier and Label Number and containing the same information in fields 3 to 8 (all optional) as in HDR2.

3.3.6 *First End of Volume Label*

Field	Name	Length	Description
1	Label Identifier	3	Must be EOV.
2	Label Number	1	Must be 1.
3 to 11	Same as corresponding fields in the first Header Label (all optional)	Total 50	Same as corresponding fields in the first File Header Label.
12	Block Count	6	Six "n" characters denoting the number of data blocks (exclusive of labels and Tape Marks) since the preceding HDR Label Group.
13 and 14	Same as corresponding fields in the first File Header Label (optional)	Total 20	Same as corresponding fields in the first File Header Label.

3.3.7 *Other Optional Operating Systems Labels*

Field	Name	Length	Description
1	Label Identifier	3	Must be the appropriate 3-letter code, according to the type of Operating System Label. (See clause 3.1.4.)
2	Label Number	1	Must be consecutively numbered up to 9 within a group of Operating System Labels.
3	Operating System Option	76	Any "a" characters.

3.3.8 *User Labels (Optional)*

Field	Name	Length	Description
1	Label Identifier	3	Must be the appropriate 3-letter code, according to the type of User Label. (See clause 3.1.4.)
2	Label Number	1	Must be 1, 2, 3, etc., consecutively within the user Volume Labels. In other user labels, any "a" characters.
3	User Option	76	Any "a" characters.

4. BLOCK STRUCTURE

4.1 Grouping records into blocks

(*a*) No explicit indication of the boundaries between records is required.

(*b*) There must be an integral number of records in a block.

(*c*) Any use of padding requires the agreement of the interchange parties. See section Z.5 of the Appendix.

(*d*) Truncated blocks are permitted.

4.1.1 *Fixed-Length Records*. When all the records in a file are of the same length, no indication of that uniform length is required within the file.

4.1.2 *Variable-Length Records*. When the records in a file are not all of the same length, the length of each record (i.e. the number of characters it contains) shall be recorded as the first field in each record. That field shall be counted as part of the record-length. The record-length shall be expressed as a decimal number, occupying the first four character-positions of each record.

4.1.2.1 Alternatively, by agreement between the interchange parties, the record-length may be expressed as a binary number, occupying the first two character-positions of each record length field. In this case, the following two characters may be used by the operating system.

4.1.3 *Undefined records*. When records do not meet the definitions of clauses 4.1.1 or 4.1.2, they are said to be undefined.

4.1.4 *By-pass or Check-point Records*. Only relevant data blocks shall be written on a tape used for interchange. Any by-pass or check-point records must be excluded or written elsewhere.

4.2 Block length

4.2.1 *Maximum Block Length*. For general information interchange, the maximum block length shall be 2048 characters. However, with the agreement of the interchange parties, larger blocks may be used.

4.2.2 *Minimum Block Length*. Minimum block length shall be as specified in the applicable ISO Recommendation for recorded magnetic tape.

4.2.3 *Block Sequence Indicator*. This optional checking facility, full details of which are given in section Z.4 of the Appendix, may only be used with the agreement of the interchange parties. The block length will not include the Block Sequence Indicator, if the latter is used.

APPENDIX

Z.1 CLASSES OF LABELS (See clause 3.1.2)

Z.1.1 Introduction

This ISO Recommendation defines two classes of labels. Its definitions distinguish between Operating System Labels and User Labels and, in addition, denote each as required or optional. In one sense, all labels are Operating System Labels, since Operating Systems normally provide for their reading and writing. The processing of Operating System Labels, however, is normally provided as a function of the Operating System, whereas the contents of User Labels are prescribed by the user and their processing is provided by a user routine. The following clauses provide additional clarity to the definitions used in the Recommendation.

Z.1.2 Optional Operating System Labels

These labels, when used, can be expected to contain information pertinent to labelling functions more specialized than those contemplated in the Recommendation. Such functions may be developed, defined, and implemented differently by the designers of different Operating Systems. Thus the nature of these labels makes them fundamentally incompatible between different systems, and these labels will be ignored in interchange.

Z.1.3 User Labels (UVL, UHL, UTL)

It will often be convenient to use these labels to contain summary information about a file being interchanged, such as control totals, statistical tabulations, and the like. In such a case, that information will be quite useful to the recipient of the file, so that the User Labels would then become part of the information being interchanged, with their contents agreed on between the parties. In the absence of such agreement, User Labels will be ignored in interchange.

Z.2 STRUCTURING THE FILE (See clause 3.2)

Z.2.1 Use of Tape Mark

The Tape Mark is used in the following way.

Z.2.1.1 Following file information, the Tape Mark indicates the boundary between file blocks and labels.

Z.2.1.2 Following a label group, the Tape Mark indicates the end of the label group (i.e. the end of all Operating System Labels and User Labels).

Z.2.2 File Header Labels in a Multi-Volume File Set

Z.2.2.1 The Set Identification (field 4) is identical in all HDR1 Labels throughout the entire file set.

Z.2.2.2 The HDR1 Label at the beginning of every volume except the first is an exact copy of the last HDR1 Label on the previous volume, except that the File Section Number (field 5) is augmented by 1 (except as provided in clause Z.2.6).

Z.2.3 **Use of double Tape Mark**

The double Tape Mark at the end of each reel (see Figure 1) permits the following procedure to be used in accomplishing the operation "Forward-space File" :

Having read HDR,

A – Index forward till three Tape Marks passed. Read the next block.
If HDR : One file has been indexed.
If Tape Mark : End of volume, Rewind.
If not end of set : Alternate, verify HDR on next volume, return to A.

An alternative procedure for that operation would be as follows :

Having read HDR,

A – Index forward till two Tape Marks passed. Read the next block.
If EOV : Rewind, alternate, verify HDR next volume, return to A.
If EOF : Index forward till one Tape Mark passed. Read next block.
If HDR : One file has been indexed.
If Tape Mark : End of set has been reached.

Thus, while the Recommendation requires that two Tape Marks be recorded at the end of each volume, it does not require that the second one be read (except at the end of the file-set, if there is no other indication which file is the last in the set).

Z.2.4 Two consecutive Tape Marks appear at the beginning of the second volume in Figure 2, and at the end of the first volume in Figure 3; yet they are not interpreted as double Tape Marks, but rather as framing a "null" section of file. Conventional processing can proceed as follows :

Read HDR Label.
Pass over any optional labels.
Read Tape Mark – switch to processing of file information.
Read Tape Mark – switch to processing of labels.
In Figure 2, read File-A EOF.
In Figure 3, read EOV occurring within File-B.

Z.2.5 In general, the pattern shown in Figure 2 will occur when the end-of-tape warning mark is reached while writing the last block of a file. Usually, the Operating System will not yet know that this is the last, and the EOV label group will be recorded at this time.

On the other hand, the pattern shown in Figure 3 will occur when the warning mark is reached after the EOF label group has been started.

Z.2.6 When it has been agreed between the interchange parties to start a file of a set at the beginning of a volume, the labelling configuration to be used is as follows :

-- File A -- * EOF * EOV **
(A)

VOL HDR * -- File B --
(B)

On this occasion, the block count (field 12) of the End of Volume Label will be undefined.

This method is compatible with the fact that the End of Volume Label always indicates that there is another volume of the set to follow.

Z.3 USE OF THE FIELDS IN THE LABELS

Z.3.1 Volume Header Label (see clause 3.3.1)

The Volume Header Label identifies the physical reel of magnetic tape, and the contents of that label relate to the identity of the volume. Since there is no Optional Operating System Volume Header Label, a User Volume Header Label will (if present) always be the second block on the tape.

Z.3.1.1 *Accessibility* (field 4). It is expected to refer to such categories of information as company confidential, proprietary, etc. This field is not intended to fulfil the requirements of National Security (which will probably be accommodated in a government-specified User Label), but this field might be used as an indicator in conjunction with such a User Label.

An "accessibility" field appears in both the Volume Header and File Header Labels, so that this function can be exercised either for the entire volume, or for each individual file, as desired.

Z.3.1.2 *Label Standard Level*. This field is used to indicate whether or not the information recorded on this volume conforms to the Recommendation. It may also indicate a deviation from the Recommendation for a particular interchange situation.

In some cases Operating Systems may need to distinguish between this Standard Labelling System and similar, related systems used parochially. This field is intended to facilitate this distinction. It also provides a means for extending the Recommendation in the future, should the need arise, with minimum conflict between the future Recommendation and parochial practice that may develop in the meantime. It is intended to distinguish among future Standard Levels by the use of numerals in this field (to the extent possible), rather than letters.

Z.3.1.3 *Owner Identification* (field 8). It is likely that, in time, a standard method of identifying the Owner will be defined.

In the absence of such a standardization, the parties should agree among themselves to choose identifiers so that each party will be identified uniquely within the specific interchange environment.

Z.3.2 First File Header Label (see clause 3.3.2)

Z.3.2.1 *Set Identification* (field 4). It is desirable that a unique identification be established. In most cases, this objective may be satisfied by duplicating Field 3 (Volume Serial Number) of the VOL1 Label of the first or only volume of the set.

Z.3.2.2 *File Section Number* (field 5). There are occasions when it is desired to read selectively one or more of the files within a multi-volume multi-file set. Through error, an attempt might be made to begin by reading an incorrect volume : one that happens to start in the middle of the file. The actual beginning of a file may be identified by "0001" in this field.

Z.3.2.3 *Generation Version Number* (field 8). This field denotes the successive attempts to produce a new generation of a file or part of a file. That is to say, each time it is necessary to reprocess data the generation version number of each output section is increased by one. The generation version number of the first attempt to produce this file is zero.

The generation version number is used to differentiate output data which has been produced by repeated processing operations and which in all other respects would bear the same identification.

This field is used to distinguish between a partial file recorded during an aborted run, and the new copy of the same information recorded after return to a rescue point.

For interchange purposes this field has no significance to the recipient.