SPECTRA 70

RADIO CORPORATION OF AMERICA • ELECTRONIC DATA PROCESSING

SPECTRA 70

ALL SYSTEMS

SYSTEMS STANDARDS REFERENCE MANUAL

RADIO CORPORATION OF AMERICA

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INTRODUCTION

SCOPE

◆ This manual describes, in general, conventions that apply to systems, data, and programs for Spectra 70 processors. For additional details, refer to the manuals describing a particular programming system.

PROCESSOR CODE

◆ The basic internal code representation for all processors in the Spectra 70 series is the Extended Binary-Coded-Decimal Interchange Code (EBCDIC). See Appendix A for graphic and bit representations. It is the user's responsibility to translate to and from EBCDIC code if another code is used.

GENERAL DEFINITIONS

◆ *Record*

A record is a collection of data items treated as a logical unit. Records may be fixed or variable in length.

Block

A block is a physical unit of data accessed by a single input/output operation. A block may contain one or more records and may be fixed or variable in length.

File

A file is a collection of data organized for reference.

Volume

A volume is a unit of storage media. One or more volumes may contain one or more files.

PUNCHED CARD CONVENTIONS

BLOCK

◆ Each punched card is transmitted to and received from the processor as one block of data.

LABELS

◆ Punched card files are treated as unlabeled files.

END OF FILE

◆ For all systems and processors except the 70/15, end of file for punched card files is indicated by the characters /* (slash asterisk) punched in columns 1 and 2 of the last card in the file with spaces (no punches) in the remaining columns.

For the 70/15 only, end of file for punched card files is indicated by the characters $EOF punched in columns 1 through 4 of the last card in the file with spaces (no punches) in the remaining columns.

ORGANIZATION OF FILES

◆ Punched card files are treated as unlabeled files contained on a single volume.

PAPER TAPE CONVENTIONS

BLOCK

◆ A paper tape block is defined as a string of characters punched in paper tape with one or more gap characters (no punch holes, sprocket holes only) at the beginning and at the end.

LABELS

◆ Paper tape files are treated as unlabeled files.

END OF FILE

◆ For all systems and processors except the 70/15, end of file for paper tape files is indicated by the characters /* (slash asterisk) in EBCDIC Translate Mode punched as a block on paper tape following the last data block.

For the 70/15 only, end of file for paper tape files is indicated by the characters $EOF in EBCDIC Translate Mode punched as a block on paper tape following the last data block.

ORGANIZATION OF FILES

◆ Paper tape files are treated as unlabeled files contained on a single volume.

Shaded area represents gap.
/* indicates end of file.

MAGNETIC TAPE CONVENTIONS

RECORD AND BLOCK FORMATS

Block

◆ A magnetic tape block is defined as the string of characters on magnetic tape between interblock gaps. A block may be fixed or variable in length and may contain one or more records that may in turn be fixed or variable in length. All blocks of data on magnetic tape (except the tape mark block) must contain a minimum of 12 bytes.

Interblock Gap

◆ An interblock gap is an area on magnetic tape devoid of logical data and is used to indicate the physical end of a block.

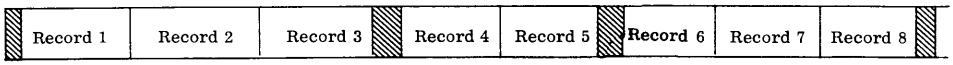
Formats

◆ Records on magnetic tape may be fixed or variable in length, blocked or unblocked, or undefined.

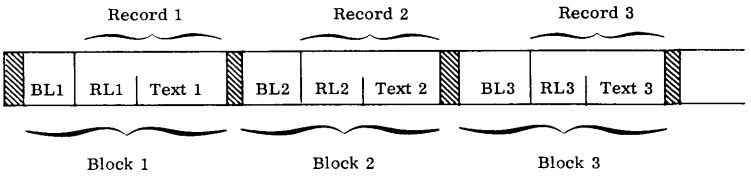
Fixed-Length Records, Unblocked.

Fixed-Length Records, Blocked (Fixed-Length Blocks).

Fixed-Length Records, Blocked (Variable-Length Blocks).



Variable-Length Records, Unblocked.



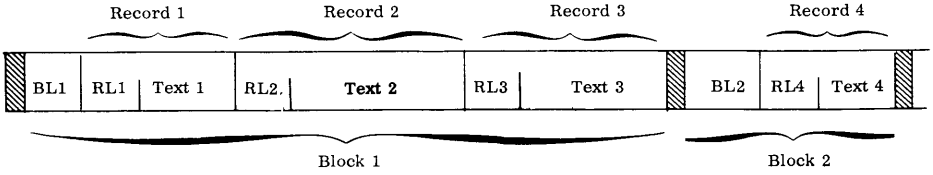
RL (Record Length) is a four byte binary count of the number of bytes in the record and is equal to 4 + the number of bytes of record text.

BL (Block Length) is a four byte binary count of the number of bytes between interblock gaps and is equal to 4 + 4 + the number of bytes of record text.

For an example of the format for variable-length records, see Figure 1.

Format *(Cont'd)*

Variable-Length Records, Blocked.



RL = 4 + number of bytes of record text.

BL = 4 + total number of bytes of all the records in the block, including 4 bytes for each Record Length field.

See Figure 1.

Undefined Records, Unblocked.

Records that do not conform to any of the described formats are classified as unblocked, undefined records.

On seven-channel tapes, data (blocked or unblocked) is written in the pack/unpack mode, with odd parity. Also, if this data is to be read in the reverse direction, it is the user's responsibility to ensure that the data is triad oriented, that is, the byte count of the block is divisible by three.

Volume

◆ A volume is a single reel of magnetic tape.

STANDARD TAPE LABELS

General Specifications

◆ There are two types of tape labels: volume labels and file labels.

Every volume (reel) contains a volume label as the first record.

Each file on a volume contains a file header label and a file trailer label. Header labels precede the data; trailer labels follow the data.

Tapes may also contain user labels which are optional and may be included at the discretion of the user.

When user labels are included, they occur after the file header labels and after the file trailer labels.

Any of the label types may have additional labels. A group of labels of the same type is referred to as a set. A set may consist of up to eight contiguous labels of the same type.

Each label is 80 characters in length.

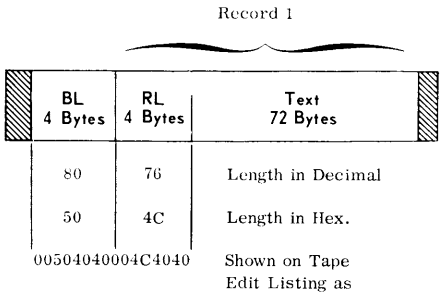
The first three characters of each label are the label type identifier. Each label of a label set contains the same label type identifier. The fourth character denotes the sequence of a label within a label set.

Only those characters of the EBCDIC code which have been assigned graphics are used for writing labels.

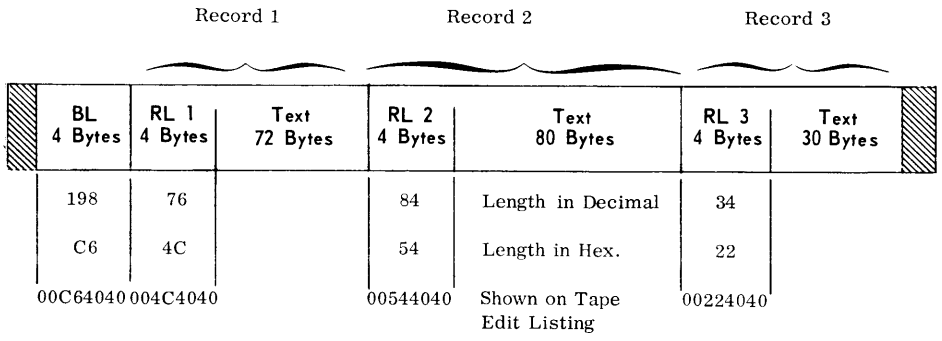
On seven-channel tapes, labels are written in Binary Coded Decimal, in the translate mode, with even parity.

When the records in a file are not all of the same length, the length of each record (the number of characters it contains) is recorded as the first field in the record. This four byte record length field is counted as part of the record length. The length of each block is recorded as the first field in the block. This four byte block length field is counted as part of the block length. The record length and block length fields are recorded in binary. The following examples illustrate the byte counts:

Variable-Length Records, Unblocked.



Variable-Length Records, Blocked.



The format for BL (Block Length field) and RL (Record Length field) is nnss, where nn is a 16-bit binary count and ss are two EBCDIC space characters (Hexadecimal 40).

Figure 1. Format for Variable-Length Records

Label Types

- Types of labels and their associated identifiers are:

Volume Label	VOL
File Labels:	
File Header Label	HDR
File Trailer Labels:	
End-of-File Trailer Label	EOF
End-of-Volume Trailer Label	EOV
User Labels:	
User Header Label	UHL
User Trailer Label	UTL

Label Sets

- *Volume Label Set.*

The first label in the set is called a standard volume label and is used to identify the volume and its owner. This may be followed by up to seven additional volume labels. Programming systems compare the volume serial number in the standard volume label with information supplied by the user. If the compare is unequal, a message is printed. Additional volume labels are bypassed.

File Header Label Set.

The first label in the set is called a standard header label and is used to identify and control data contained in a file. This may be followed by up to seven additional file header labels. The standard header label is verified by the programming systems. Additional file header labels are bypassed.

File Trailer Label Set.

The first label in the set is called a standard trailer label and is used to identify and control data contained in a file. This may be followed by up to seven additional file trailer labels. The standard trailer label is verified by the programming systems. Additional file trailer labels are bypassed.

The format for the standard trailer label is the same as for the standard header label except that the standard trailer label contains a block count of the number of data blocks in the file.

File trailer labels may be either end-of-file trailer labels or end-of-volume trailer labels. The formats are identical except that EOF is used to indicate the end of a file and EOV is used to indicate the end of a volume.

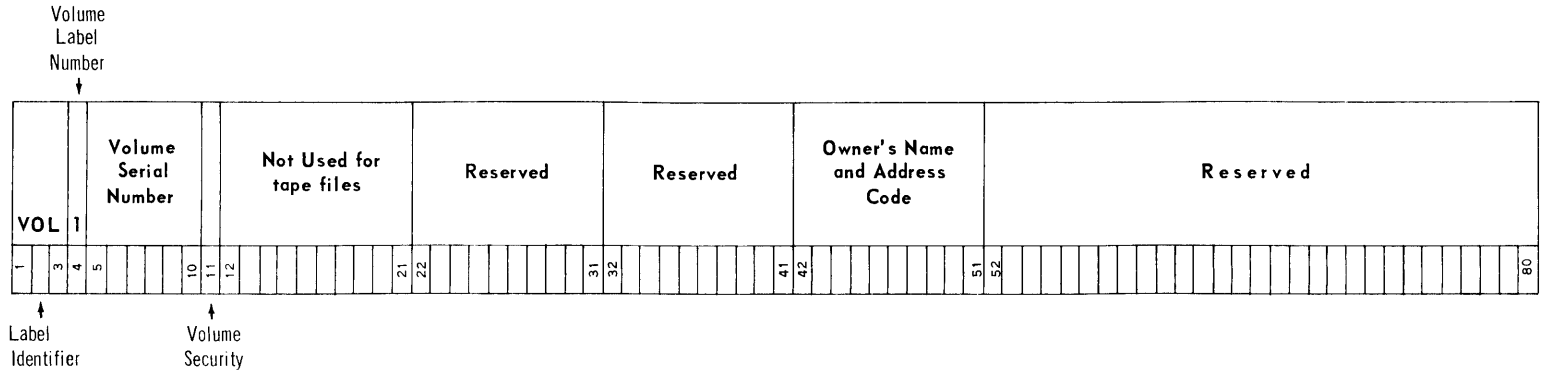
Note: The functions and formats for additional volume, header, and trailer labels have not been fully specified. At some future time when specifications are complete, RCA Programming Systems will be modified to process these *additional* labels. Until then, these labels will be bypassed on the logical level, although they may be processed on the physical level.

User Label Sets.

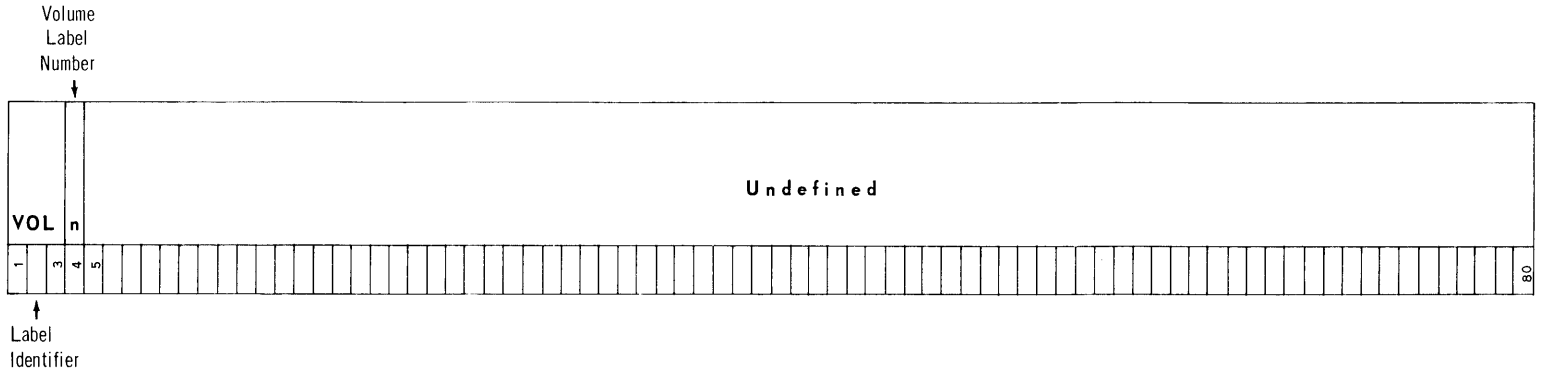
These label sets provide the user maximum flexibility. They may be used in any way the user wishes.

There are two types of user label sets: user header labels and user trailer labels. A file may contain either, both, or none.

Standard Volume Label



Additional Volume Label



Standard File Header Label

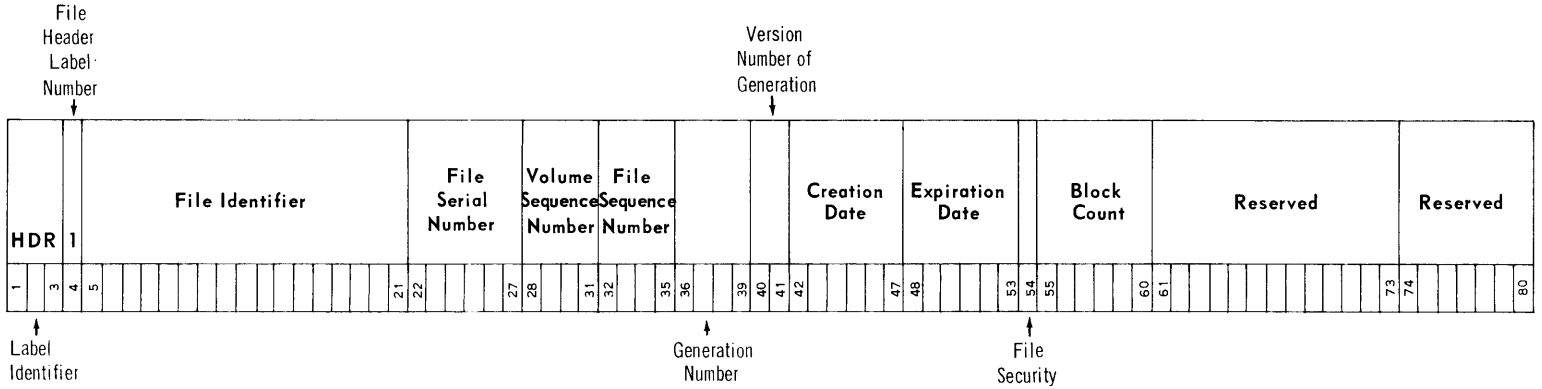
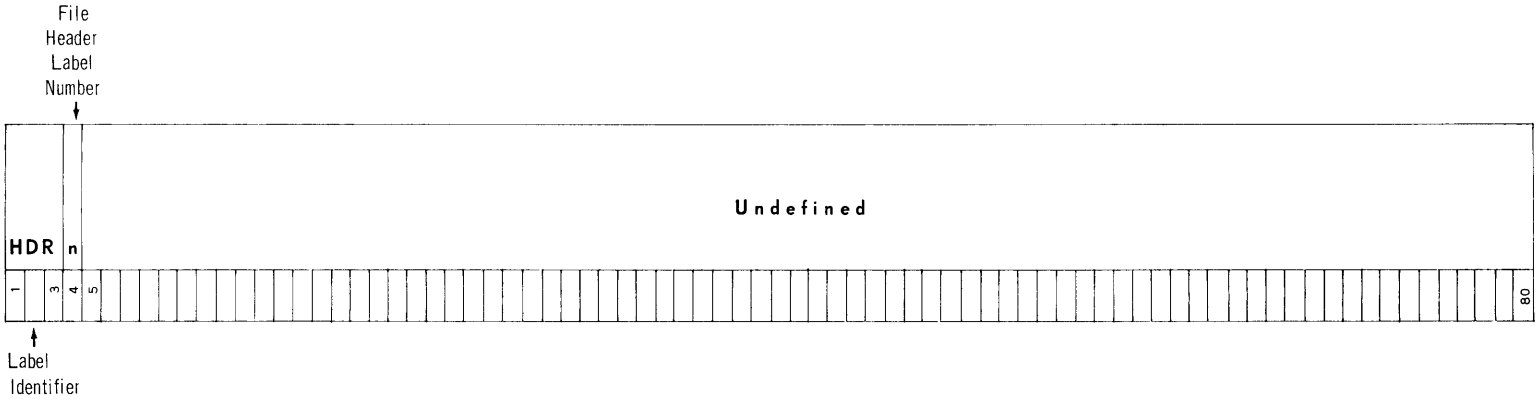
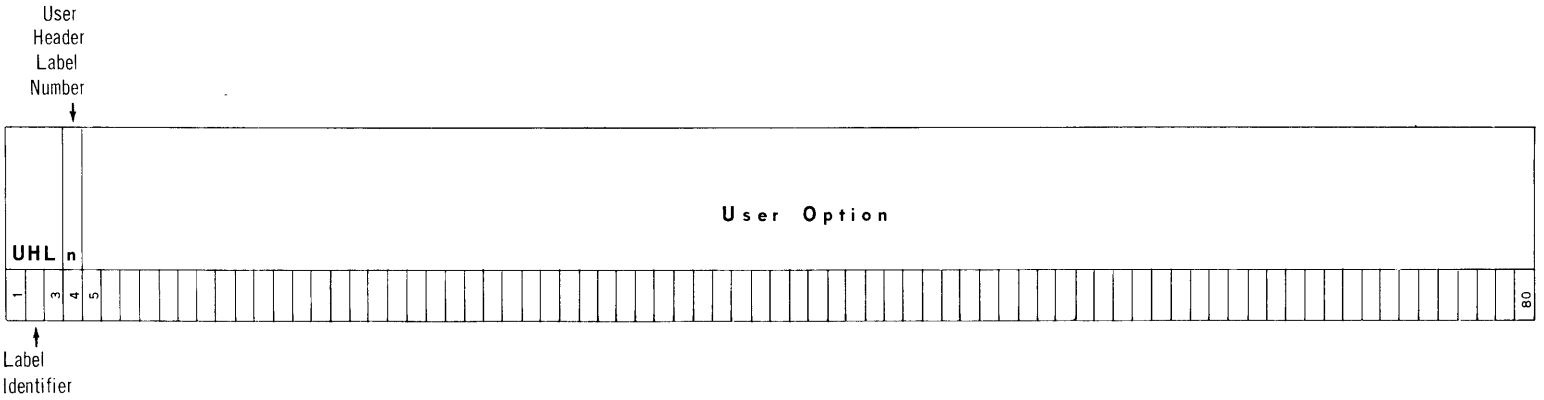


Figure 2. Magnetic Tape Label Formats

Additional File Header Label



User Header Label



Standard File Trailer Label

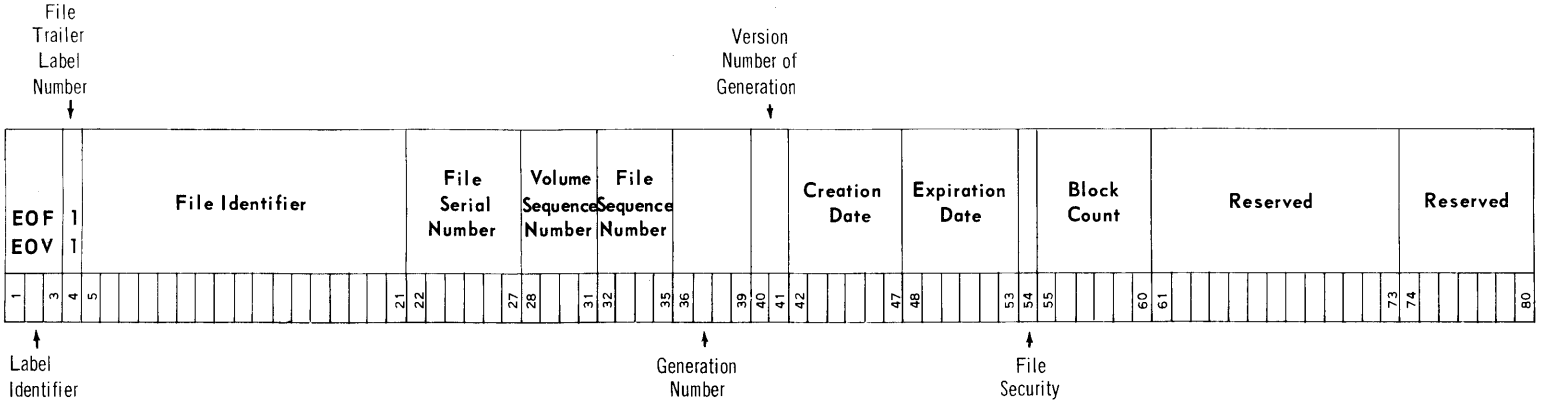
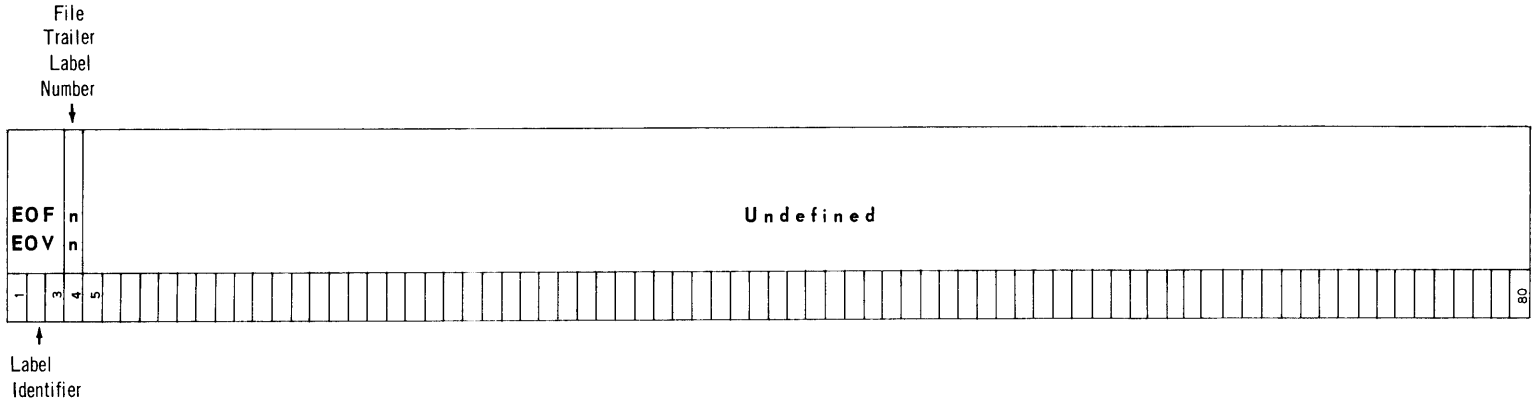


Figure 2. Magnetic Tape Label Formats *(Cont'd)*

Additional File Trailer Label



User Trailer Label

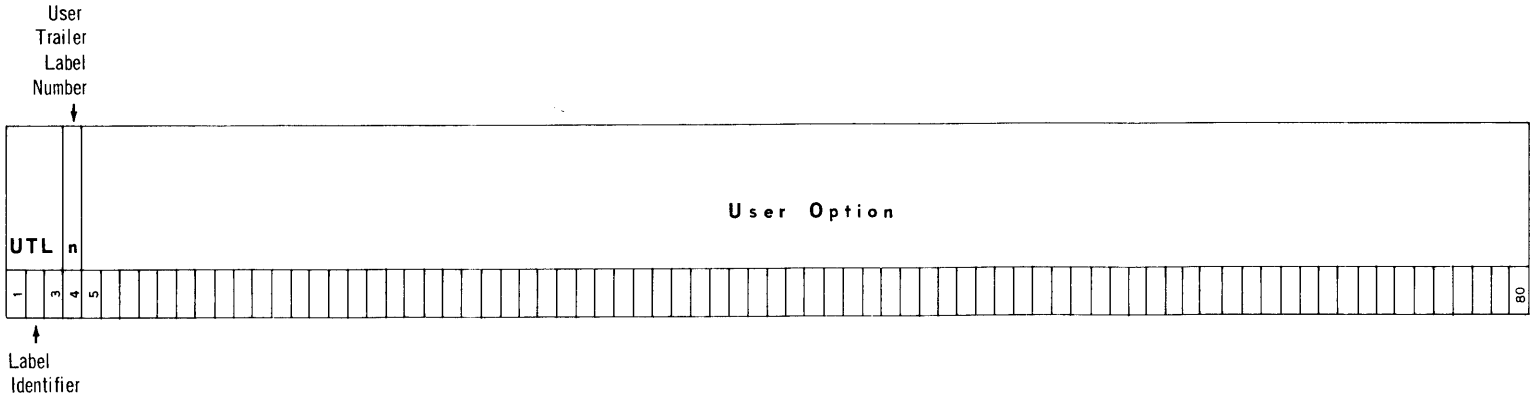


Figure 2. Magnetic Tape Label Formats *(Cont'd)*

Label Formats

◆ *Volume Label Format.*

1. Standard Volume Label.

   The first label of a volume label set has the following format:

Field	Character Position	Name	Length	Description
1	1-3	Label Identifier	3	VOL
2	4	Volume Label Number	1	1
3	5-10	Volume Serial Number	6	Identifies the volume (reel).
4	11	Volume Security	1	Zero or one 0 = No security protection. 1 = The volume has or had security protection.
5	12-21	Not used for tape files.	10	Ten spaces.
6	22-31	Reserved.	10	Ten spaces.
7	32-41	Reserved.	10	Ten spaces.
8	42-51	Owner's Name and Address Code.	10	Identifies the owner of the volume.
9	52-80	Reserved.	29	Twenty-nine spaces.

Note: Unused and reserved fields should be recorded as EBCDIC spaces (Hexadecimal 40).

Label Formats *(Cont'd)*

2. Additional Volume Label

The second through eighth labels of a volume label set have the following format:

Field	Character Position	Name	Length	Description
1	1-3	Label Identifier	3	VOL
2	4	Volume Label Number	1	2 through 8 in ascending sequence.
3	5-80	Undefined	76	May contain any characters the user wishes.

File Header Label Format.

1. Standard File Header Label.

The first label of a file header label set has the following format:

Field	Character Position	Name	Length	Description
1	1-3	Label Identifier	3	HDR
2	4	File Header Label Number	1	1
3	5-21	File Identifier	17	Identifies the entire file.
4	22-27	File Serial Number	6	Identifies a file/volume relationship. This field is identical to the volume serial number in the volume label (Field 3). On a multivolume file, this field is identical to the volume serial number on the first volume.
5	28-31	Volume Sequence Number	4	Indicates the sequence of a volume in a file (0001-9999). Used with multivolume files.
6	32-35	File Sequence Number	4	Indicates the sequence of a file in a multifile set (0001-9999).

Label Formats *(Cont'd)*

Field	Character Position	Name	Length	Description
7	36-39	Generation Number	4	Indicates the editions of the file (0001-9999).
8	40-41	Version Number of Generation	2	Indicates the version of a generation of a file (01-99).
9	42-47	Creation Date	6	Indicates the year and the day of the year the file was created. The format is: Position / Content / Meaning 1 / Space / None 2-3 / 00-99 / Year 4-6 / 001-366 / Day of the year (March 4, 1967 would be entered as Δ67063).
10	48-53	Expiration Date	6	Indicates the year and the day of the year the volume may be written on. This field has the same format as Field 9.
11	54	File Security	1	Zero or one. 0 = No security protection. 1 = This file has security protection.
12	55-60	Block Count	6	Six spaces. This field in the file header label is not used.
13	61-73	Reserved.	13	Thirteen Spaces
14	74-80	Reserved.	7	Seven Spaces

Label Formats *(Cont'd)*

2. Additional File Header Label

The second through eighth labels of a file header label set have the following format:

Field	Character Position	Name	Length	Description
1	1-3	Label Identifier	3	HDR.
2	4	File Header Label Number	1	2 through 8 in ascending sequence.
3	5-80	Undefined.	76	Reserved.

File Trailer Label Format.

1. Standard File Trailer Label.

A standard file trailer label contains the same data as the standard file header label for that file except for Field 1 (Label Identifier) and Field 12 (Block Count).

The first label of a file trailer label set has the following format:

Field	Character Position	Name	Length	Description
1	1-3	Label Identifier	3	EOF or EOV EOF = End-of-file Trailer Label. EOV = End-of-volume Trailer Label.
2	4	File Trailer Label Number	1	1
3-11	5-54	Same as corresponding fields in file header label.	50	Same as corresponding fields in file header label.
12	55-60	Block Count	6	Indicates the number of data blocks written on the file from the last file header label to the first file trailer label excluding tape marks and checkpoint records.
13	61-73	Same as corresponding fields in file header lable.	13	Same as corresponding fields in file header label.
14	74-80	Same as corresponding fields in file header label.	7	Same as corresponding fields in file header label.

Label Formats *(Cont'd)*

2. Additional File Trailer Label.

The second through eighth labels of a file trailer label set have the following format:

Field	Character Position	Name	Length	Description
1	1-3	Label Identifier	3	EOF or EOV EOF = End-of-file Trailer Label. EOV = End-of-volume Trailer Label.
2	4	File Trailer Label Number	1	2 through 8 in ascending sequence within the EOF set or EOV set.
3	5-80	Undefined.	76	Reserved.

User Label Format

All labels of a user header label set or a user trailer label set have the following format:

Field	Character Position	Name	Length	Description
1	1-3	Label Identifier	3	UHL or UTL UHL = User Header Label. UTL = User Trailer Label.
2	4	User Label Number	1	1 through 8 in ascending sequence within the UHL set or UTL set.
3	5-80	User Option	76	May contain any characters the user wishes.

Label Groups

◆ A label group is a collection of contiguous labels or label sets. There are two types of label groups: a header label group and a trailer label group. Volume labels are considered part of the header label group, which is the first label group on each volume. Each label group must be contained in total within a volume.

For an example of Label Grouping on magnetic tape, see Figure 3.

Label Groups
(Cont'd)

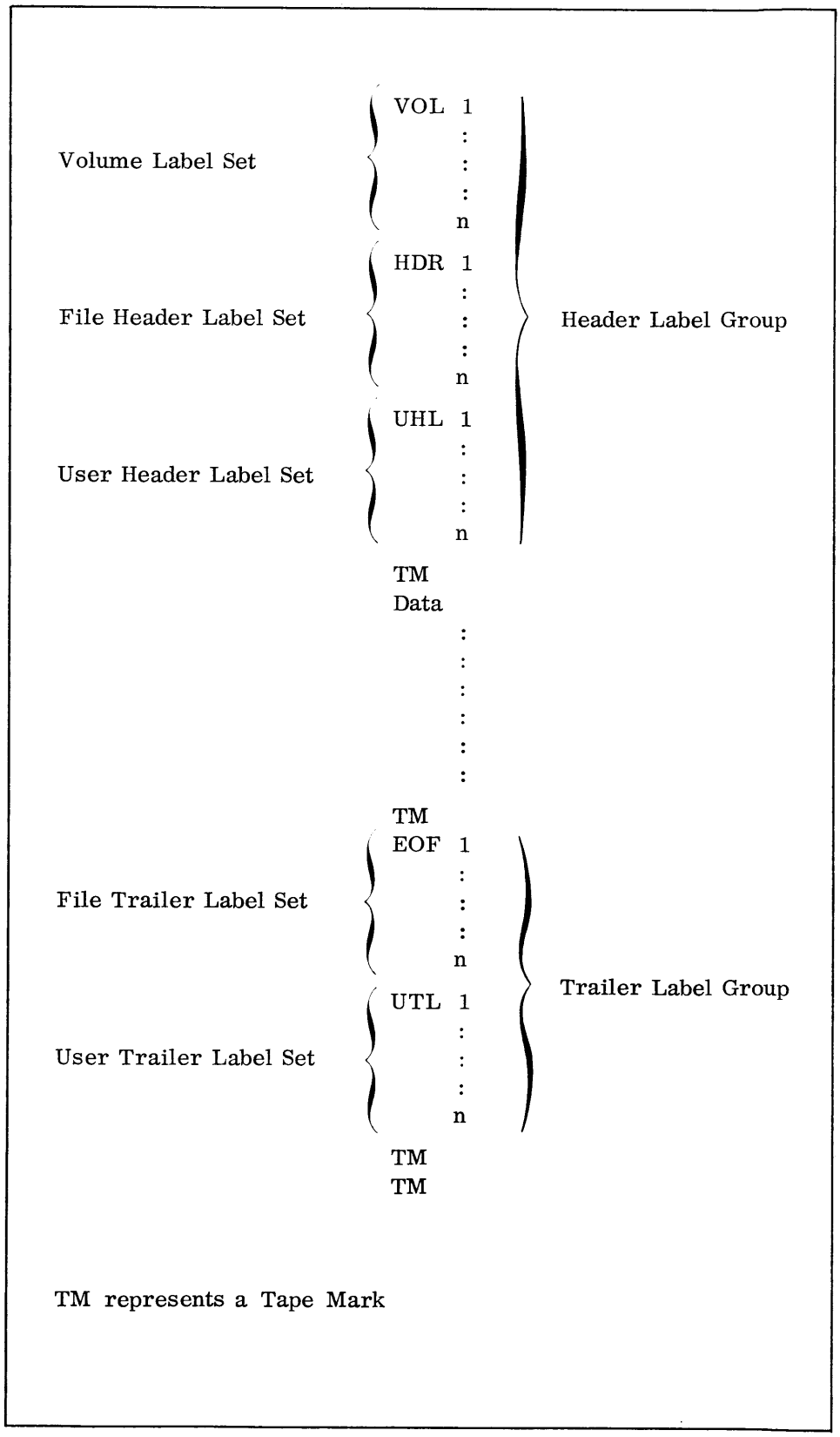


Figure 3. Label Organization on Magnetic Tape

TAPE MARK

◆ A tape mark is a one-byte block on magnetic tape. This control character is used to distinguish between label groups and data blocks, and to indicate the end of useful information on a volume of magnetic tape. It is represented as a $(13)_{16}$ on 9-channel magnetic tape, and as a $(17)_8$ on 7-channel magnetic tape. The tape mark should always be written using the Write Control command.

A tape mark follows every header label group. A tape mark precedes and follows every trailer label group.

Two tape marks following a trailer label group indicate the end of useful information on a volume.

END OF FILE

◆ The end of a file is indicated by an EOF trailer label group followed by *one* tape mark. When this is also the last file on the volume, the EOF trailer label is followed by *two* tape marks.

END OF VOLUME

◆ The end of a volume is indicated by an EOV trailer label group followed by *two* tape marks. This means that the file is continued on another volume.

LABEL FUNCTIONS

◆ Labeling information is used by the File Control Processor and/or the user to identify and control data on each volume.

Data Protection

◆ The File Control Processor checks the expiration date in the file header label against the current date to see if the volume may be written on. Any volume without a header label for the first file is considered usable.

Input Verification

◆ The File Control Processor verifies that the correct input volume is mounted. Fields 3 through 10 of the file header label are compared to information supplied by the user. If the compare is unequal, a message is typed.

Audit Control

◆ The File Control Processor checks the block count in the file trailer label to verify that the correct number of blocks were read.

ORGANIZATION OF FILES

General

◆ Files on magnetic tape may be written with standard labels, non-standard labels, or without labels.

In general, Spectra 70 Programming Systems will process standard labels, bypass additional labels, and transfer control to the user when user labels are encountered. Programming systems will also process unlabeled tapes.

Standard Labeled Files

◆ *Standard Labels.*

The minimum set of standard labels consists of:

1. One standard volume label preceding the first file on the volume (contains the identifier and label number VOL 1 in the first four character positions).
2. One standard file header label (HDR 1).
3. One standard end-of-file trailer label (EOF 1) or one standard end-of-volume trailer label (EOV 1).

Additional Labels.

Up to seven additional labels of each type are permitted:

1. Additional volume labels (VOL 2-8).
2. Additional file header labels (HDR 2-8).
3. Additional end-of-file trailer labels (EOF 2-8) or additional end-of-volume trailer labels (EOV 2-8).

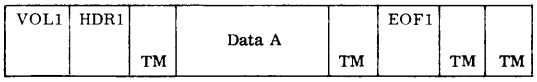
User Labels.

Up to eight user header labels (UHL 1-8) and up to eight user trailer labels (UTL 1-8) are permitted. When present, they occur after the file header label set and after the EOF or EOV trailer label set.

Tapes with Standard Labels

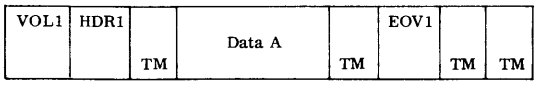
◆ There are four general classes of tape data organization which apply to standard labeled files. In the following illustrations, only the standard volume, header, and trailer labels are shown. Additional and user labels, which are also permitted but are omitted here for simplicity, are shown in the illustration following the next paragraph.

Single-file, single-volume.

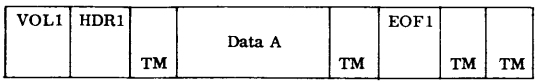


Single-file, multivolume.

First and intermediate volumes.

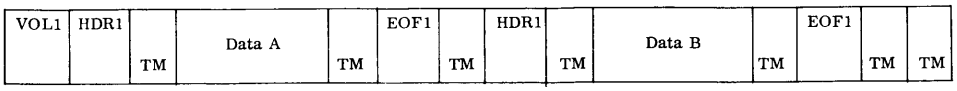


Final Volume



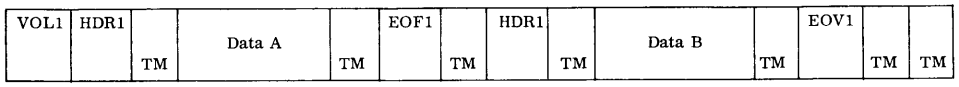
Tapes with Standard Labels *(Cont'd)*

Multifile, single-volume.

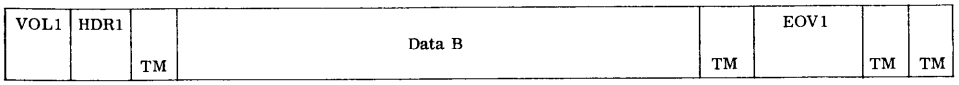


Multifile, multivolume.

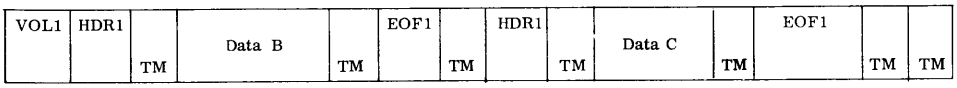
First Volume.



Second and intermediate volumes.

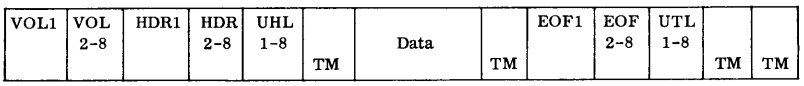


Final Volume.



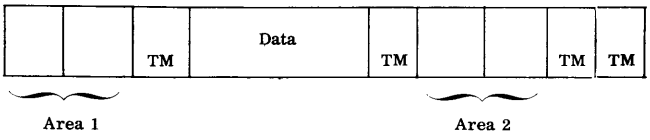
Tapes with Standard Labels, Additional Labels, User Labels

◆ The format is the same as shown in TAPES WITH STANDARD LABELS except that additional labels and user labels have been added.



Tapes with Nonstandard Labels

◆ Any labeled file that does not meet the minimum requirements for a standard labeled file is considered nonstandard and it is the user's responsibility to perform his own label reading, checking, and writing. Nonstandard labels may be any length. The following is an illustration of a magnetic tape with nonstandard labels.



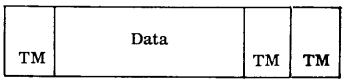
Area 1: Any number of nonstandard header labels.

Area 2: Any number of nonstandard trailer labels.

Note: The first tape mark in this illustration is normally written on output but may be omitted at programmer's option.

Tapes with No Labels

The following is an illustration of a magnetic tape with no labels.

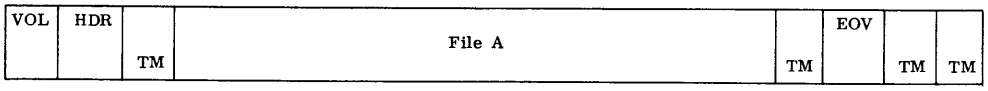


Note: The first tape mark in this illustration is normally written on output but may be omitted at programmer's option.

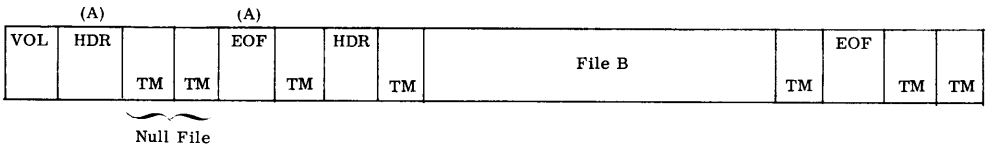
Null File

◆ The absence of data blocks or labels on magnetic tape may result in two adjacent tape marks and yet not signify the end of data on a volume. This produces what is called a null file. For example, on a standard labeled tape when the end-of-volume and end-of-file coincide, the labeling configuration may be as follows:

Volume 1 of 2.



Volume 2 of 2.



Note: (A) indicates labels are part of File A.

CHECKPOINT RECORDS

General

◆ Files on magnetic tape may contain checkpoint records.

The purpose of checkpoint is to preserve the status and environment of a user program so that it may be restarted after an interruption.

Checkpoint records contain sufficient information such as register values, memory contents, and position of magnetic tapes, to restart a run that was interrupted.

Checkpoints are usually used with programs that are expected to run for extended periods of time. Should an interruption in processing occur, the program can be restarted using the information contained in the checkpoint records of the last checkpoint, rather than at the beginning of the program.

Checkpoint records appear only in the data portion of a file.

General *(Cont'd)*

RCA Programming Systems will write checkpoint records with the following characteristics:

On nine-channel magnetic tapes, they are written in EBCDIC.

On seven-channel magnetic tapes, they are written in the pack/unpack mode, but may not be produced on a magnetic tape containing data written in the translate mode.

The maximum length of one checkpoint data record is 32,767 bytes.

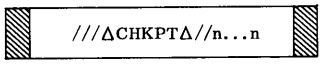
Checkpoint Identifier

◆ The beginning and end of a checkpoint record set is identified by the following twelve characters:

///Δ CHKPT Δ//

Header Format

◆ The first record of a checkpoint record set is the header record and contains the checkpoint identifier and a series of bytes (indicated as n . . . n) containing information to identify the set of checkpoint records, and information used by the restart program.

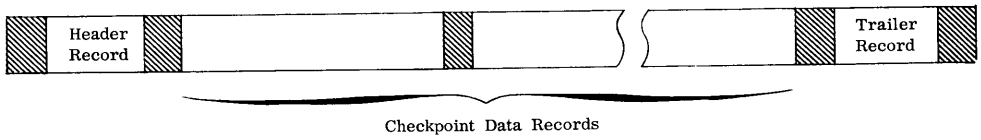


Trailer Format

◆ The last record of a checkpoint record set is the trailer record.

Checkpoint Formats

◆ Each set of checkpoint records consists of one checkpoint header record, one or more checkpoint data records, and one checkpoint trailer record. All records are separated by interblock gaps.



RANDOM ACCESS CONVENTIONS

◆ This section describes random access conventions that apply to the Tape Operating System (TOS) and the Tape-Disc Operating System (TDOS). Random access conventions that apply to the Time Sharing Operating System (TSOS) will be issued later.

RECORD AND BLOCK FORMATS

Logical Record

◆ A logical record is a collection of data items treated as a logical unit. Logical records may be fixed or variable in length.

Block

◆ A block is a physical unit of data accessed by a single input/output operation. A block may contain one or more logical records and may be fixed or variable in length.

Physical Record

◆ A physical record is a physical unit consisting of a logical record or a block of logical records called a data field, a key field which is optional, and certain nondata information required for identification and control. The fields of a physical record are separated by gaps.

Gap

◆ A gap is an area on a track devoid of logical data. Gaps are used to separate physical records as well as to separate the count, key, and data fields within a physical record.

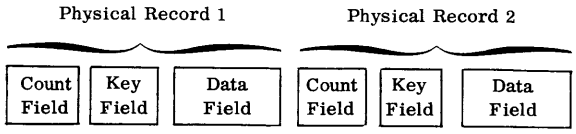
Track

◆ A track is the total recording surface on a random access device for the storage of data over which one read/write head can be positioned at any one time.

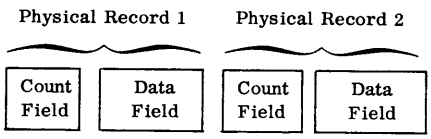
Formats

◆ Records on random access devices may be fixed or variable in length, blocked or unblocked, or undefined. All of these types may be written with or without key fields.

Fixed-Length Records Unblocked, with Key Field

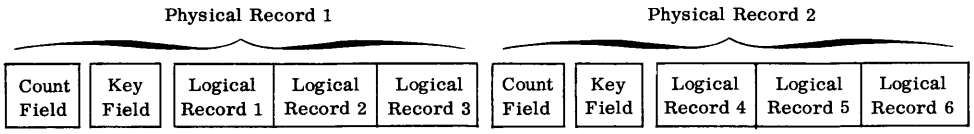


Fixed-Length Records Unblocked, without Key Field

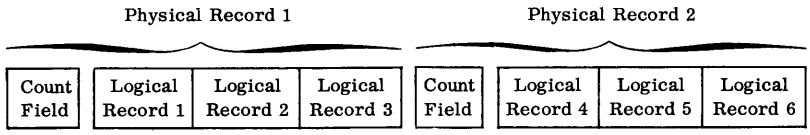


Formats *(Cont'd)*

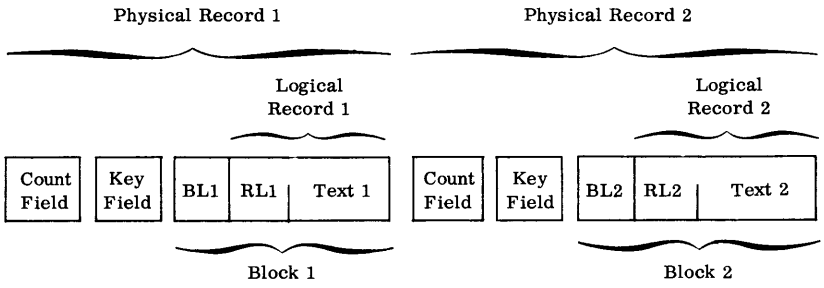
Fixed-Length Records Blocked, with Key Field



Fixed-Length Records Blocked, without Key Field



Variable-Length Records Unblocked, with Key Field

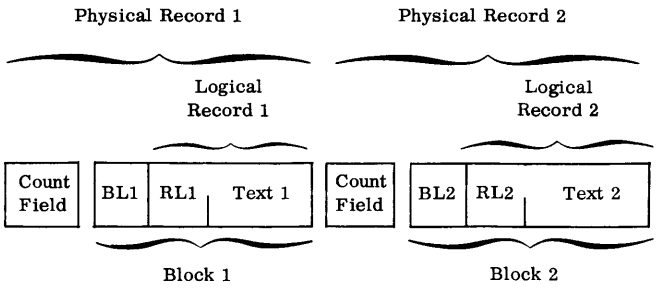


RL (Record Length) is a four byte binary count of the number of bytes in the record and is equal to 4 + the number of bytes of record text.

BL (Block Length) is a four byte binary count of the number of bytes between gaps and is equal to 4 + 4 + the number of bytes of record text.

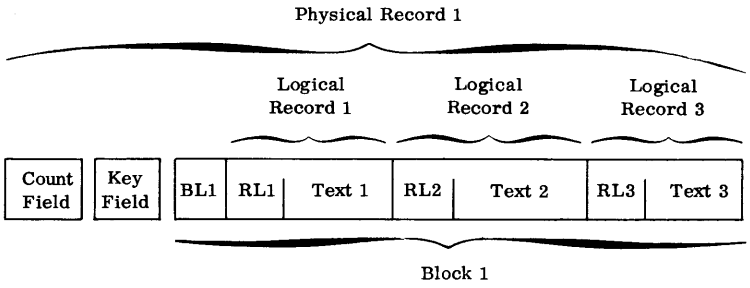
For an example of the format for variable-length records, see Figure 1.

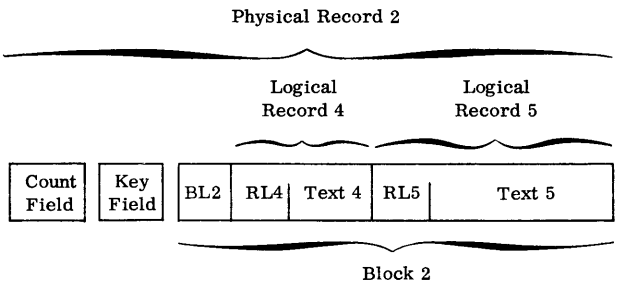
Variable-Length Records Unblocked, without Key Field



Formats *(Cont'd)*

Variable-Length Records Blocked, with Key Field



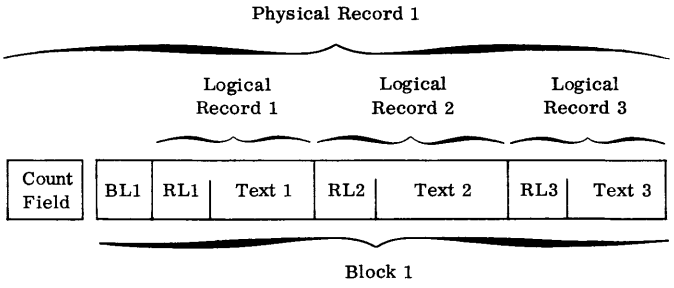


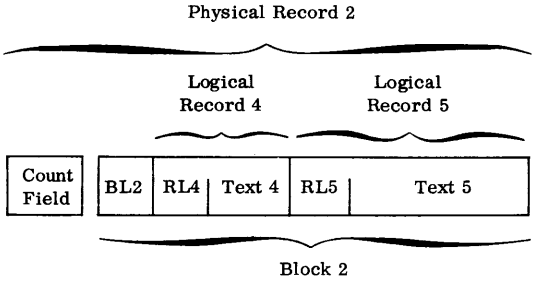
RL = 4 + number of bytes of record text.

BL = 4 + total number of bytes of all the records in the block, including 4 bytes for each Record Length field.

See Figure 1.

Variable-Length Records Blocked, without Key Field





Formats (Cont'd)

Undefined Records Unblocked

Records that do not conform to any of the described formats are classified as unblocked, undefined records. These records may be written with or without a key field.

Cylinder

◆ A cylinder consists of the total number of tracks that can be accessed without repositioning the read/write head(s). (On the drum memory unit, there is a read/write head for each track; therefore, no head repositioning is required for a cylinder change. Groups of eight adjacent tracks each have been designated as cylinders.)

Extent

◆ An extent is any single logically continuous area within a volume. Its boundaries are expressed in terms of a pair of seek addresses consisting of the beginning cylinder and track numbers and the ending cylinder and track numbers.

File

◆ A file is a set of records occupying from 1 to 16 extents per volume.

Volume

◆ A volume is one disc pack, or one drum complement (one to four drums on one drum attachment), or one mass storage magazine.

TRACK FORMAT

◆ Track format is described in detail in the Random Access Devices Reference Manual, No. 70-06-500. For convenience, some of the material is repeated here.

All random access devices have the same track format. Every track has a descriptive region which consists of an Index Marker, a Home Address, and a Track Descriptor Record. These are followed by one or more physical records for data storage which are called Data Records. However, on the mass storage unit, only one data record is written per track.

A typical track format is shown in figure 4.

The contents of the key field and the data field of Data Records are described on the following pages. The remainder of the track (shown in figure 4 printed in grey) is generated by hardware or by the operating system, and is not covered in this manual.

STANDARD RANDOM ACCESS LABELS

General Specifications

◆ Files on random access devices, to be processed by Spectra 70 Programming Systems, must be written with standard labels.

There are two types of standard system labels for files on random access devices: volume labels and file labels.

There is a standard volume label for every volume (disc, drum, or magazine). The standard volume label is stored on cylinder 0, track 0. Optionally, up to seven additional volume labels may be present but they must be written and read by the user.

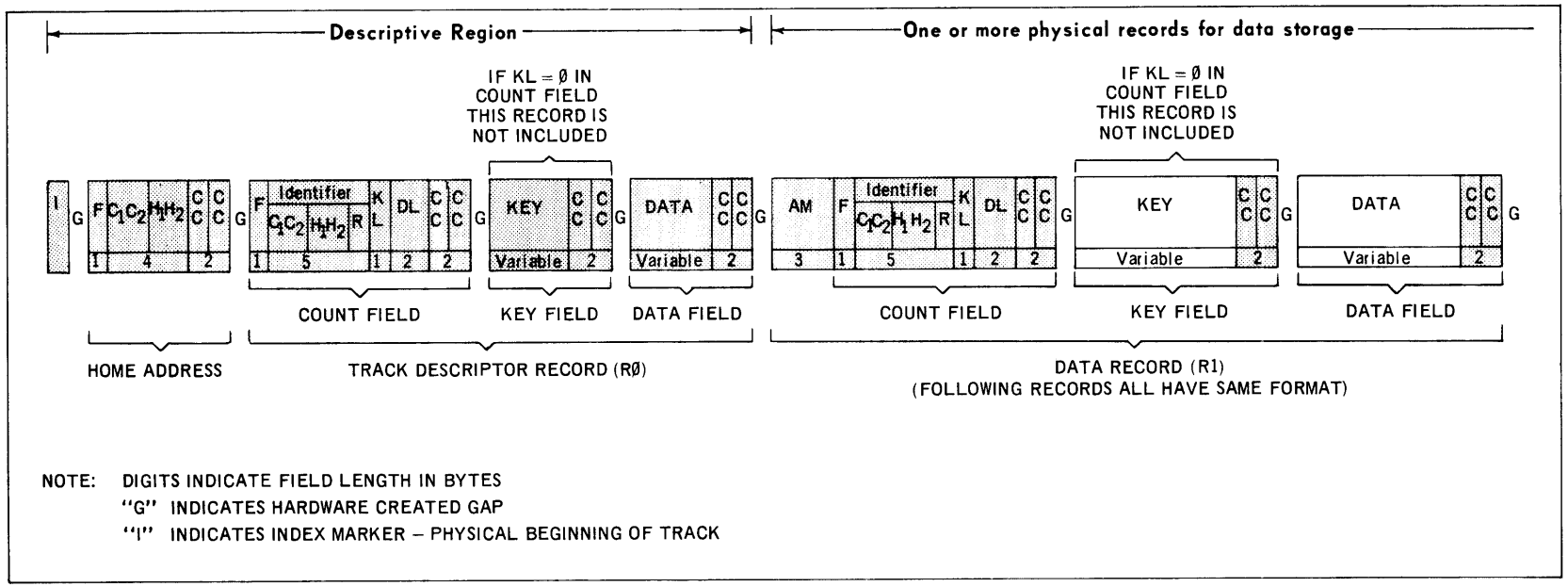


Figure 4. Track Format

General Specifications *(Cont'd)*

File labels are grouped and stored together. This group of labels is called the volume table of contents (VTOC). The first label record in the VTOC defines the VTOC area itself. The remainder of the VTOC consists of labels that define each file and one or more labels that indicate those extents which are available for allocation to a data file.

Files may also contain user labels, which are optional and may be included at the discretion of the user. Up to eight user header labels and up to eight user trailer labels may be included for a file. The first track of the first extent of a file is always reserved for user labels. If user labels are not present, the track contains all binary zeros and is not used. User labels may be employed when files are organized and processed sequentially.

Volume label records, user header label records, and user trailer label records have a 4-byte key field and an 80-byte data field (a total of 84 bytes for each label record). The first three characters of the key field and the first three characters of the data field are the label type identifier. The fourth character of the key field and the fourth character of the data field denote the sequence of a label within a label set.

File label records have a 44-byte key field and a 96-byte data field (a total of 140 bytes for each label record). The format of a file label record is identified by the value in the first byte of the data field.

All key fields are separated from data fields by a gap.

Label Types

◆ Types of labels and their associated identifiers are:

Volume Label	VOL
File Labels:	
Format 1	1
Format 3	3
Format 4	4
Format 5	5
User Labels:	
User Header Label	UHL
User Trailer Label	UTL

Label Functions

◆ *Volume Label*

The standard volume label is used to identify the volume and its owner. The operating system compares the volume serial number in the standard volume label with information supplied by the user, thus ensuring that the correct volume has been mounted. Additional volume labels are bypassed.

Label Functions *(Cont'd)*

There must be a standard volume label for a volume. Additional volume labels are optional.

Note: The functions and formats for additional volume labels have not been fully specified. At some future time when specifications are complete, RCA Programming Systems will be modified to process these additional labels. Until then, these labels will be bypassed on the logical level, although they may be processed on the physical level.

The format of the standard random access volume label is identical to the standard tape volume label format except for field 5 which contains the address of the VTOC.

File Labels

Volume Table of Contents (VTOC)

All standard random access file labels are grouped together and stored in a specific area on the volume. Because each file label contains file limits, the group of file labels acts as a directory of the data records on the volume. This group of labels is called the volume table of contents (VTOC).

Four formats for file labels are provided. These are referred to as format 1, 3, 4, and 5, and are described on the following pages.

The VTOC itself is a file of label records consisting of one or more standard label records for each file (formats 1 and 3) and has its own file label (format 4). The VTOC also contains one or more format 5 labels indicating the addresses of available extents.

The format 4 label is the first label record in the VTOC and is pointed to by the standard volume label.

Format 1

The format 1 label is used as a file label for all logical files.

It identifies the logical file (by File Name assigned by the user, in the key field) and contains file specifications and the addresses of three extents allocated to the file. If the file occupies more than three extents on one volume, a continuation label (format 3) is also required to define the 4th to 16th extent. In this case, the format 1 label points to the format 3 label.

There is a format 1 label for each logical file on the volume. If a logical file is recorded on more than one volume, a format 1 label is present for that file in the VTOC of each volume.

Label Functions *(Cont'd)*

Format 3

The format 3 label is used as a continuation label for a format 1 label.

It contains the addresses of the additional extents on a volume if a logical file occupies more than three extents on the volume. It is pointed to by the format 1 label for the file. The format 3 label is used for extent information only, and provides for the addresses of 13 additional extents (four in the key field and nine in thedata field).

There can be only one format 3 label to a file. It is not created unless a file has more than three extents.

Format 4

The format 4 label is used as a file label for the VTOC.

It defines the VTOC itself and also contains the location and number of available tracks in the alternate track area (substitute tracks allocated to be used if bad tracks are encountered while attempting to write).

There is one format 4 label to a volume. It is always the first label in the VTOC and is followed by the first format 5 label for the file.

Format 5

The format 5 label is used for space management.

It indicates those extents which are available for allocation to a data file. Each format 5 label provides for the addresses of 26 available extents (8 in the key field and 18 in the data field).

There is at least one format 5 label to a volume, and it is stored following the format 4 label in the VTOC. If there are additional format 5 labels, each points to the next format 5 label for the volume. Additional format 5 labels may be stored anywhere in the remainder of the VTOC.

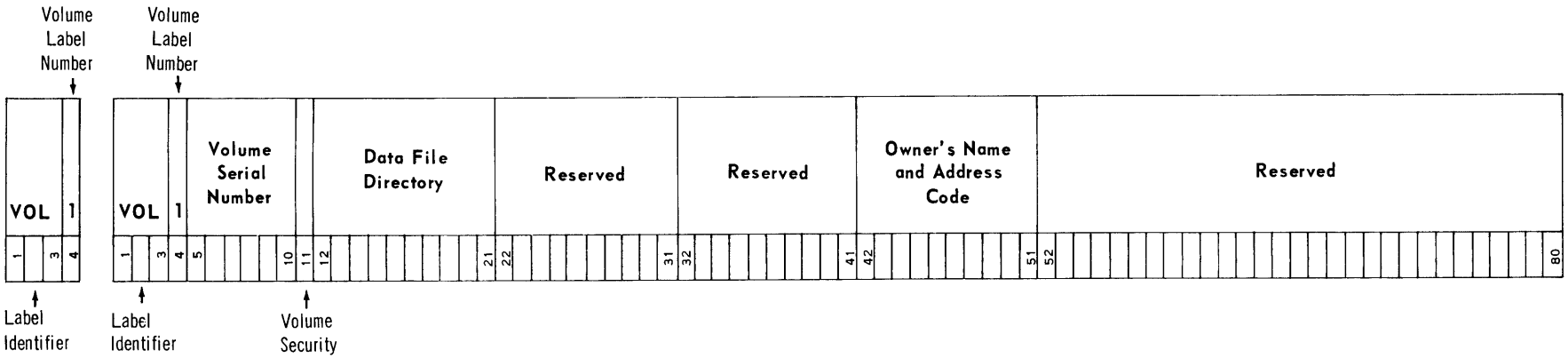
User Labels

Files may also contain user header labels and user trailer labels which may be used in any way the user wishes.

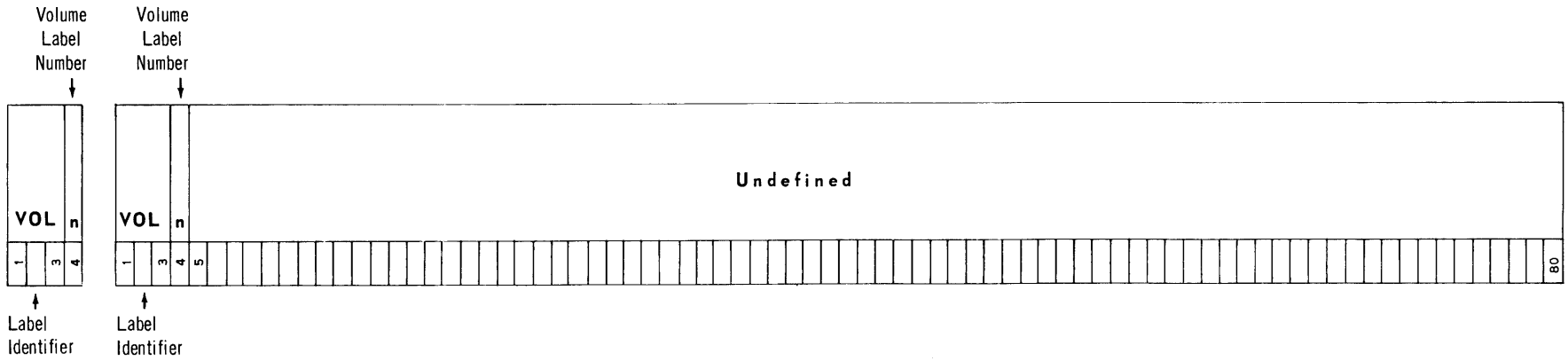
The record following a set of user labels (header or trailer) is an end-of-file record. (This is a record with a data length of zero. The record consists of a count field, a key field, but no data field.)

A maximum of eight user header labels and eight user trailer labels are permitted, not including the end-of-file record. The user header label set is terminated by an end-of-file record, followed by the user trailer label set. The user trailer label set is terminated by an end-of-file record. If user header labels are not present, the header end-of-file record immediately follows the Track Descriptor Record (Record R0). If user trailer labels are not present, the trailer end-of-file record immediately follows the header end-of-file record.

Standard Volume Label



Additional Volume Label



File Labels

Format 1

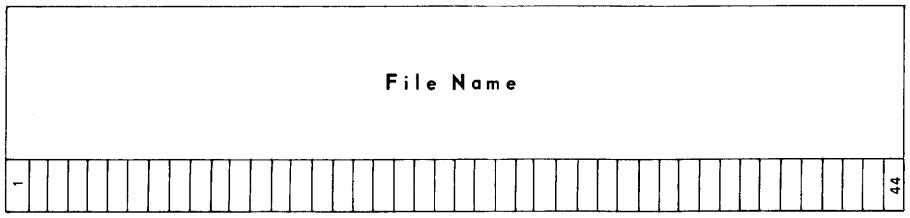
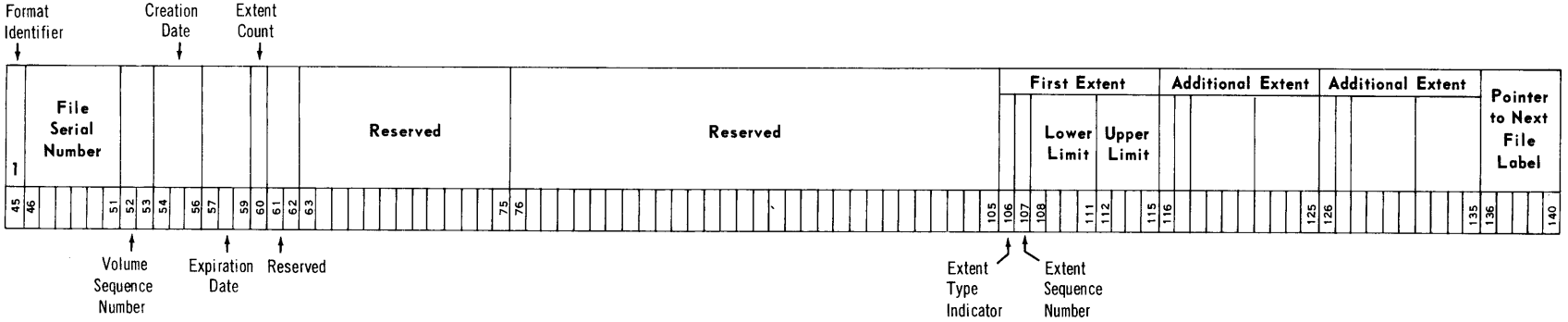
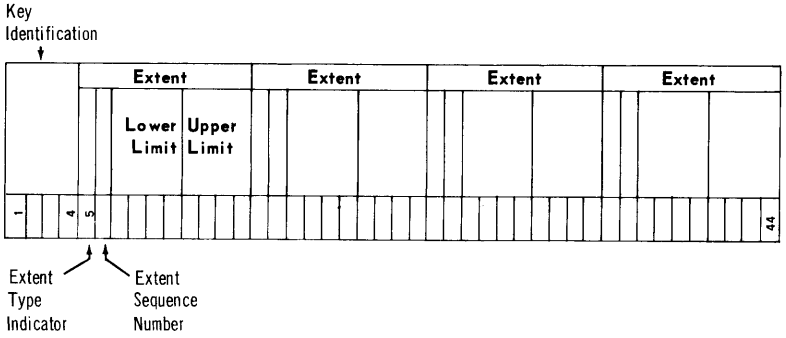


Figure 5. Random Access Label Formats

Format 1 (Cont'd)



Format 3



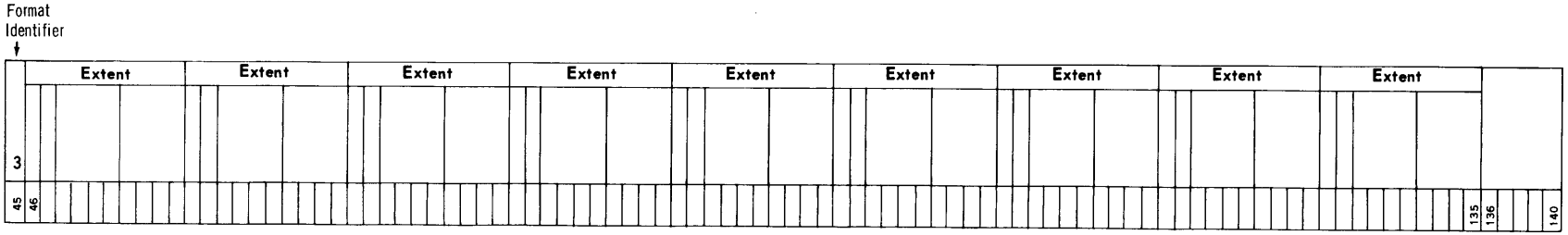
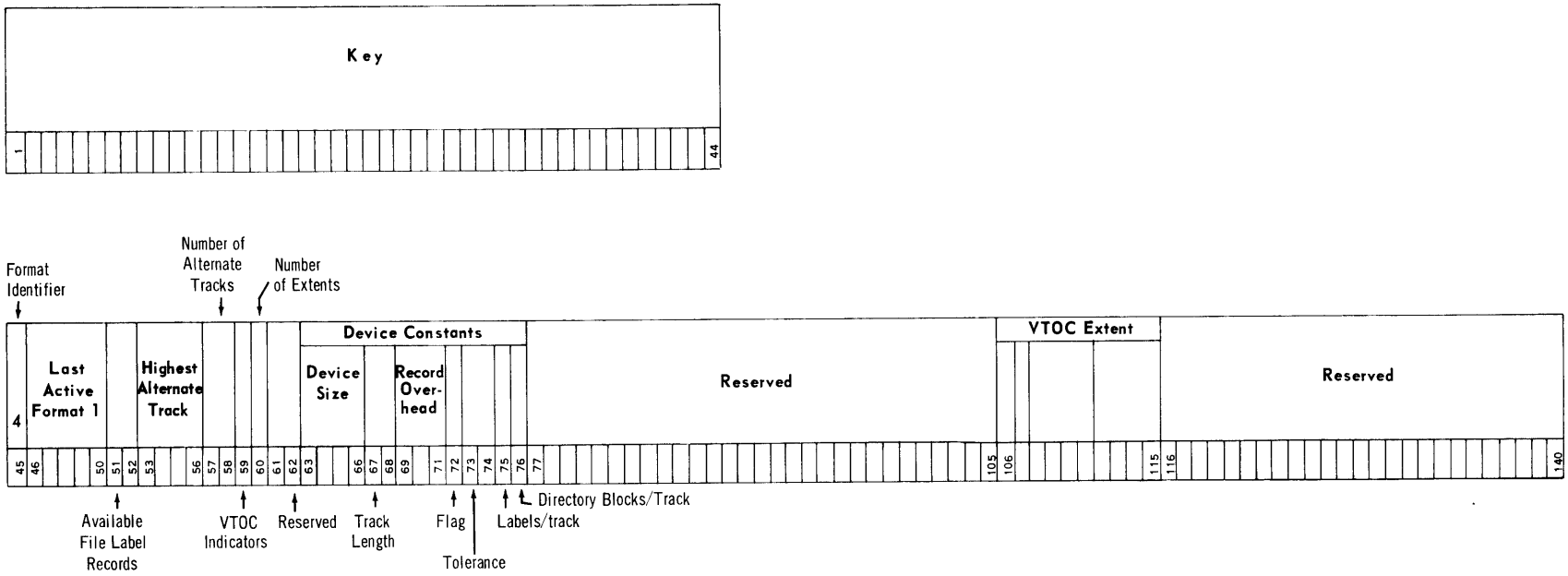


Figure 5. Random Access Label Formats *(Cont'd)*

Format 4



Format 5

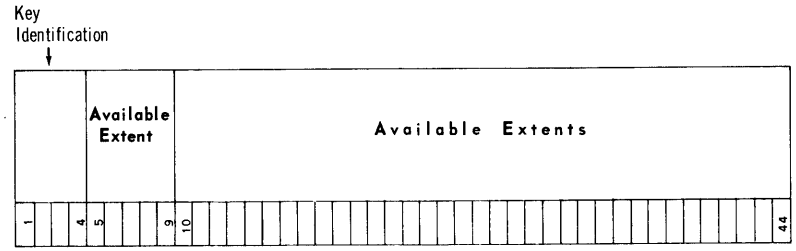
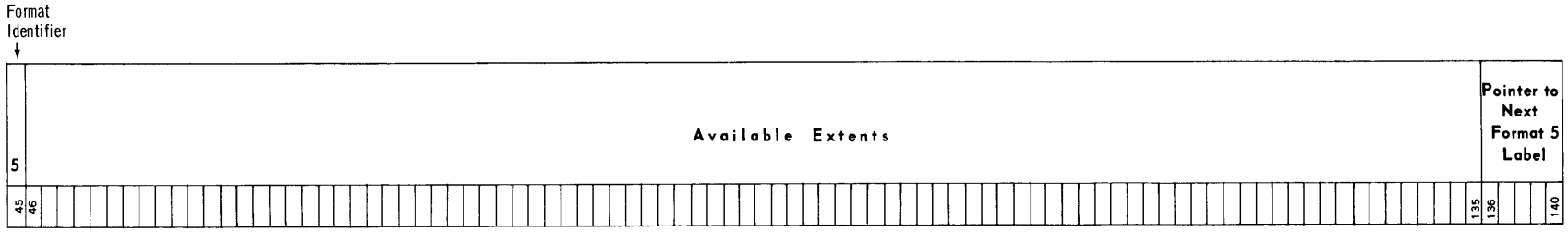


Figure 5. Random Access Label Formats *(Cont'd)*

File Labels (Cont'd)

Format 5 (Cont'd)



User Label

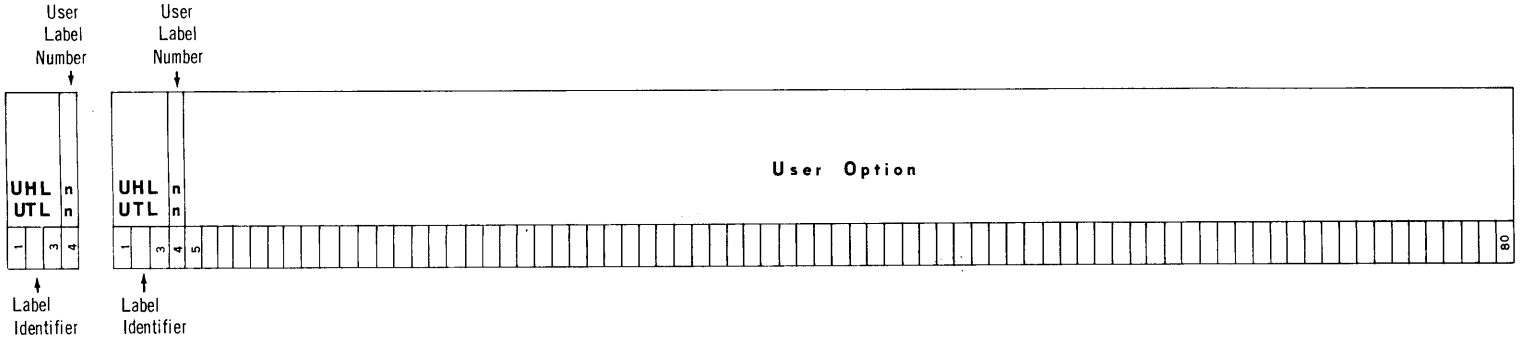


Figure 5. Random Access Label Formats *(Cont'd)*

Label Formats

◆ *Volume Label Format.*

1. Standard Volume Label

   (a) Key Field

   The key field of a standard volume label has the following format:

Field	Byte Position	Name	Length	Description
1	1-3	Label Identifier.	3	VOL
2	4	Volume Label Number.	1	1

   (b) Data Field.

   The data field of a standard volume label has the following format:

Field	Byte Position	Name	Length	Description
1	1-3	Label Identifier.	3	VOL
2	4	Volume Label Number.	1	1
3	5-10	Volume Serial Number.	6	Identifies the volume (disc, drum, or magazine).
4	11	Volume Security.	1	Zero or one. 0 = No security protection. 1 = The volume has or had security protection.
5	12-21	Data File Directory (binary).	10	Contains the starting address of the VTOC in the first five bytes (cylinder, track, and record number, format CCHHR). The last five bytes are EBCDIC spaces (Hexadecimal 40).

Label Formats *(Cont'd)*

Field	Byte Position	Name	Length	Description
6	22-31	Reserved.	10	Ten spaces.
7	32-41	Reserved.	10	Ten spaces.
8	42-51	Owner's Name and Address Code.	10	Identifies the owner of the volume.
9	52-80	Reserved.	29	Twenty-nine spaces.

Note: Unused and reserved fields should be recorded as EBCDIC spaces (Hexadecimal 40).

2. Additional Volume Labels.

(a) Key Field.

The key field of the second through eighth label of a volume label set has the following format:

Field	Byte Position	Name	Length	Description
1	1-3	Label Identifier.	3	VOL
2	4	Volume Label Number.	1	2 through 8 in ascending sequence.

(b) Data Field.

The data field of the second through eighth label of a volume label set has the following format:

Field	Byte Position	Name	Length	Description
1	1-3	Label Identifier.	3	VOL
2	4	Volume Label Number.	1	2 through 8 in ascending sequence.
3	5-80	Undefined.	76	May contain any character the user wishes.

Label Formats *(Cont'd)*

File Label Formats

Four formats for file labels are provided. These are referred to as format 1, 3, 4, and 5.

Format 1.

(a) Key Field.

The key field of a format 1 file label has the following format:

Field	Byte Position	Name	Length	Description
1	1-44	File Name.	44	Contains the file identification. It is a 1-44 character alphanumeric name assigned by the user to identify the file.

(b) Data Field.

The data field of a format 1 file label has the following format:

Field	Byte Position	Name	Length	Description
2	45	Format Identifier.	1	1 = format 1.
3	46-51	File Serial Number.	6	Identifies a file/volume relationship. This field is identical to the volume serial number in the volume label (Field 3). On a multivolume file, this field is identical to the volume serial number on the first volume.
4	52-53	Volume Sequence Number (binary).	2	Indicates the sequence of a volume in a file. Used with multivolume files.
5	54-56	Creation Date (binary).	3	Indicates the year and the day of the year the file was created. The format is: Position / Content / Meaning 1 / 0-99 / Year 2-3 / 1-366 / Day of the year
6	57-59	Expiration Date (binary).		Indicates the year and the day of the year the file may be written on. This field has the same format as Field 5.

Label Formats *(Cont'd)*

Field	Byte Position	Name	Length	Description
7a	60	Extent Count (binary).	1	Contains a count of the number of extents for this file on this volume.
7b	61-62	Reserved.	2	Two spaces.
8	63-75	Reserved.	13	Thirteen spaces.
9	76-105	Reserved.	30	Thirty spaces.
10	106	Extent Type Indicator, First Extent (binary).	1	Indicates the type of extent defined by the next three fields (Fields 11, 12, and 13) of the label. Hex Code 00 = the next three fields do not define any extent. 01 = the next three fields define the extent containing the user's data records.
11	107	Extent Sequence Number, First Extent (binary).	1	Indicates the sequence of an extent in a multi-extent file.
12	108-111	Lower Limit, First, Extent (binary).	4	Contains the address (format CCHH) of the starting point of this extent.
13	112-115	Upper Limit, First Extent, (binary).	4	Contains the address (format CCHH) of the ending point of this extent.
14	116-125	Additional Extent (binary).	10	This field has the same format as Fields 10-13.

Label Formats *(Cont'd)*

Field	Byte Position	Name	Length	Description
15	126-135	Additional Extent (binary).	10	This field has the same format as Fields 10-13.
16	136-140	Pointer to Next File Label within this Label Set (binary).	5	Contains the address (format CCHHR) of a continuation label (format 3 label) if this is needed to further describe the file. A format 3 label is required if the file uses more than three extents on the volume. If there is no format 3 label, this field contains all binary zeros.

Format 3

(a) Key Field

The key field of a format 3 file label has the following format:

Field	Byte Position	Name	Length	Description
1	1-4	Key Identification (binary).	4	Each byte of this field contains the Hexadecimal Code 03.
2-17	5-44	Extents (binary).	40	Four groups of fields which define the extents assigned to this file. These fields are identical in format to Fields 10-13 in the format 1 label.

(b) Data Field

The data field of a format 3 file label has the following format:

Field	Byte Position	Name	Length	Description
18	45	Format Identifier.	1	3 = format 3.
19-54	46-135	Extents (binary).	90	Nine groups of fields which define the extents assigned to this file. These fields are identical in format to Fields 10-13 in the format 1 label.
55	136-140	Reserved.	5	Five spaces.

Label Formats *(Cont'd)*

Format 4

(a) Key Field.

The key field of a format 4 file label has the following format:

Field	Byte Position	Name	Length	Description
1	1-44	Key Field (binary).	44	Each byte of this field contains the Hexadecimal Code 04.

(b) Data Field.

The data field of a format 4 file label has the following format:

Field	Byte Position	Name	Length	Description
2	45	Format Identifier.	1	4 = format 4.
3	46-50	Last Active Format 1 (binary).	5	Contains the address (format CCHHR) of the next format 5 label if one exists. If there are no additional format 5 labels, this field contains all binary zeros.
4	51-52	Available File Label Records (binary).	2	Contains a count of the number of unused records in the VTOC.
5	53-56	Highest Alternate Track (binary).	4	Contains the highest address (format CCHH) of a block of tracks allocated as alternates for bad tracks.
6	57-58	Number of Alternate Tracks (binary).	2	Contains the number of alternate tracks available.
7	59	VTOC Indicators (binary).	1	Bit 0 if on ($2^7 = 1$), indicates either no format 5 label, or the label does not reflect the true status of the volume. Bits 1-7 are not used.
8a	60	Number of Extents (binary).	1	Contains the Hexadecimal Code 01, indicating one extent in the VTOC.
8b	61-62	Reserved.	2	Two spaces.

Label Formats *(Cont'd)*

Field	Byte Position	Name	Length	Description
9	63-76	Device Constants (binary).	14	Contains constants describing the device on which the volume was mounted when the VTOC was created.
				The following describes each of the fields:
	63-66	Device Size.	4	The number of cylinders (CC) and tracks per cylinder (HH).
	67-68	Track Length.	2	The number of available bytes on a track exclusive of Home Address and Track Descriptor Record (R0). (Record zero is assumed to be a non-keyed record with an eight byte data field.)
	69-71	Record Overhead.	3	The number of bytes needed for gaps, check bits, and count field for each record. This value varies according to the record characteristics and is divided into three subfields: I - Overhead for a keyed record other than the last record on the track. L - Overhead for a keyed record that is the last record on the track. K - Overhead bytes to be subtracted from I or L if the record does not have a key field.
	72	Flag.	1	Further defines characteristics of the device. Bits 0-6 - Reserved. Bit 7 - If this bit is on ($2^0 = 1$), a tolerance factor must be applied to all but the last record on the track.

Label Formats *(Cont'd)*

Field	Byte Position	Name	Length	Description
9 (Cont'd)	73-74	Tolerance	2	A value used to determine the effective length of the record on the track. To calculate the effective length: 1. Add the key length to the data length of the record. 2. Test bit 7 in the flag byte: a. If bit 7 = 0, go to step 3 (skip steps b and c). b. If bit 7 = 1, multiply the value from step 1 by the tolerance factor. c. Shift the result nine bits to the right. 3. Add the overhead bytes to the result. Note: Step 2 is not required if the calculation is for the last record on the track.
	75	Labels/ Track.	1	A count of the number of labels that can be written on each track in the VTOC. (Number of full records of 44-byte key lengths and 96-byte data lengths that can be contained on one track of this device.)
	76	Directory Blocks/ Track.	1	A count of the number of directory blocks that can be written on each track. (Number of full records of 8-byte key lengths and 256-byte data lengths that can be contained on one track of this device.)
10	77-105	Reserved.	29	Twenty-nine spaces.

Label Formats *(Cont'd)*

Field	Byte Position	Name	Length	Description
11-14	106-115	VTOC Extent (binary).	10	These fields define the VTOC extent. They have the same format as Fields 10-13 of the format 1 label.
				The following describes each of the fields:
11	106	Extent Type Indicator (binary).	1	Hex Code 01 = prime area.
12	107	Extent Sequence Number (binary).	1	Hex Code 00.
13	108-111	Lower Limit (binary).	4	Contains the address (format CCHH) of the starting point of the VTOC.
14	112-115	Upper Limit (binary).	4	Contains the address (format CCHH) of the ending point of the VTOC.
15	116-140	Reserved.	25	Twenty-five spaces.

Format 5.

(a) Key Field.

The key field of a format 5 file label has the following format:

Field	Byte Position	Name	Length	Description
1	1-4	Key Identification (binary).	4	Each byte of this field contains the Hexadecimal Code 05.
2	5-9	Available Extent (binary).	5	Indicates an extent of space available for allocation to a data file. The format is: Position — Meaning 1-2 — Relative track address. 3-4 — Number of full cylinders included in the extent. 5 — Zero.
3-9	10-44	Available Extents (binary).	35	Seven fields identical in format to Field 2. They are in relative track address sequence.

Label Formats *(Cont'd)*

(b) Data Field.

The data field of a format 5 file label has the following format:

Field	Byte Position	Name	Length	Description
10	45	Format Identifier.	1	5 = format 5.
11-28	46-135	Available Extents (binary).	90	Eighteen fields identical in format to Field 2.
29	136-140	Pointer to Next Format 5 Label (binary).	5	Contains the address (format CCHHR) of the next format 5 label if one exists. If there are no additional format 5 labels, this field contains all binary zeros.

User Label Format

1. Header and Trailer Labels

All Labels of a user header label set or a user trailer label set, except the end-of-file record, have the following format:

(a) Key Field.

The key field of a user header label or a user trailer label has the following format:

Field	Byte Position	Name	Length	Description
1	1-3	Label Identifier.	3	UHL or UTL UHL = User Header Label. UTL = User Trailer Label.
2	4	User Label Number.	1	1 through 8 in ascending sequence within the UHL set or 0 through 7 in ascending sequence within the UTL set.

Label Formats *(Cont'd)*

(b) Data Field.

The data field of a user header label or a user trailer label has the following format:

Field	Byte Position	Name	Length	Description
1	1-3	Label Identifier.	3	UHL or UTL. UHL = User Header Label. UTL = User Trailer Label.
2	4	User Label Number.	1	1 through 8 in ascending sequence within the UHL set or 1 through 8 in ascending sequence within the UTL set.
3	5-80	User Option.	76	May contain any characters the user wishes.

2. End-of-File Record.

The end-of-file record comprises a count field and a key field; there is no data field (the data length in the count field equals zero). The key field of an end-of-file record has the same format as the key field of the regular header and trailer labels except that the user label number field is increased by one; for example:

UHL n + 1 (n = 1-8)
UTL n + 1 (n = 0-7)

ORGANIZATION OF LABELS

General

◆ Files on random access devices must be written with standard labels.

In general, Spectra 70 Programming Systems TOS and TDOS will process standard labels, bypass additional labels, and transfer control to the user when user labels are present. If desired, user labels may be bypassed.

Standard Labels

◆ The minimum set of standard labels consists of:

1. One standard volume label (contains the identifier and label number VOL 1 in the first four character positions of the key field and the data field).
2. At least three file labels (identified by the format type number in the first byte of the data field). These consist of:

   One format 4 label. This is the label for the VTOC for the volume.

   One format 5 label. This label defines the space (extents) available for this file. It defines up to 26 available extents. (Additional extents are defined in other format 5 entries.)

   One format 1 label for each file. This label defines the first three extents. (Additional extents (4th to 16th extent) require a format 3 label.)

Additional Labels

- Up to seven additional volume labels (VOL 2-8) are permitted.

User Labels

- A maximum of eight user header labels (identifier and label number UHL 1-8 for both the key field and the data field) and eight user trailer labels (identifier and label number UTL 0-7 for the key field and UTL 1-8 for the data field) are permitted. This does not include the end-of-file record (UHL or UTL n + 1 where n equals the key field user label number of the last label in the set) which follows a set of user header labels or user trailer labels.

STORAGE OF LABELS

- A volume contains a standard volume label and a minimum of two extents. The first extent is always used for the VTOC. The second and succeeding extents are available for file storage.

Volume Labels

- On the disc storage unit and drum memory unit, the standard volume label is always the fourth physical record (Data Record R3) on cylinder 0, track 0, and immediately follows the Track Descriptor Record R0, and two IPL (Initial Program Loader) Records.

  On the mass storage unit, the standard volume label is always the second physical record (Data Record R1) on cylinder 0, track 0, and immediately follows the Home Address and the Track Descriptor Record R0.

  Additional volume labels, if present on disc or drum, may follow the standard volume label or may be stored elsewhere on the volume. On the mass storage unit, additional volume labels may not follow the standard volume label because recording is limited to one data record per track.

File Labels

- The location and size of the VTOC is specified by the user when the volume is initialized, based upon the number of VTOC entries that will be required, although the VTOC must not exceed one cylinder. For the mass storage unit, the VTOC must start on cylinder 0, track 1.

  The VTOC is itself a file containing a minimum of two physical records defining the VTOC itself. The first physical record is the VTOC file label (format 4 label), and the second physical record (format 5 label) defines the number and address of unassigned extents (up to 26 for each format 5 label).

  A volume may contain one or more files. Each file must be assigned a minimum of 1 extent, and may be assigned a maximum of 16 extents on that volume. If the file has one to three extents, one format 1 label is required for that file. If the file has from 4 to 16 extents, a continuation label (format 3 label) is required.

User Labels

◆ These labels are not stored in the VTOC. Instead, they are written (following the Home Address and the Track Descriptor Record) on the first track (track 0) of the first extent allocated by the user for the file. This track is reserved for user labels. If there are no user labels, the track contains all binary zeros. If a file is written on two or more volumes, the first track of the first extent of each of the volumes are reserved as user label tracks.

APPENDIX A

EXTENDED BINARY-CODED-DECIMAL INTERCHANGE CODE (EBCDIC)

0123 ←		→ 4567															
HEX →		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
↓		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0	0000	NUL				PF	HT	LC	DEL								
1	0001					RES	NL	BS	IL								
2	0010					BYP	LF	EOB	PRE			SM					
3	0011					PN	RS	UC	EOT								
4	0100	SPACE										¢	.	<	(	+	|
5	0101	&										!	$	*	)	;	¬
6	0110	—	/									^	,	%	_	>	?
7	0111											:	#	@	'	=	"
8	1000		a	b	c	d	e	f	g	h	i						
9	1001		j	k	l	m	n	o	p	q	r						
A	1010			s	t	u	v	w	x	y	z						
B	1011																
C	1100		A	B	C	D	E	F	G	H	I						
D	1101		J	K	L	M	N	O	P	Q	R						
E	1110			S	T	U	V	W	X	Y	Z						
F	1111	0	1	2	3	4	5	6	7	8	9						¤

Bit Positions: 0 1 2 3 4 5 6 7

Significance: 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

Control Characters:

NUL — All Zero-Bits
PF — Punch Off
HT — Horizontal Tab
LC — Lower Case
DEL — Delete
RES — Restore
NL — New Line
BS — Backspace
IL — Idle
BYP — Bypass
LF — Line Feed
EOB — End of Block
PRE — Prefix
SM — Set Mode
PN — Punch On
RS — Reader Stop
UC — Upper Case
EOT — End of Transmission

APPENDIX B

KEYPUNCHING AND DOCUMENTATION CONVENTIONS

◆ Inputs to the programming system are in EBCDIC code and utilize only the standard graphics. The 64 EBCDIC characters that appear on the Spectra 70 series printer are shown below with the card punching combination for each character. The third column shows the symbol to be used to avoid confusion in coding and documentation.

Character	Printer Symbol	Written As	Keypunching Codes
Letter	A		A
Letter	B		B
Letter	C		C
Letter	D		D
Letter	E		E
Letter	F		F
Letter	G		G
Letter	H		H
Letter	I	I	I
Letter	J		J
Letter	K		K
Letter	L		L
Letter	M		M
Letter	N		N
Letter	O	O	O
Letter	P		P
Letter	Q		Q
Letter	R		R
Letter	S		S
Letter	T		T
Letter	U		U
Letter	V		V
Letter	W		W
Letter	X		X
Letter	Y		Y
Letter	Z	Z	Z

KEYPUNCHING AND DOCUMENTATION CONVENTIONS (Cont'd)

Character	Printer Symbol	Written As	Keypunching Codes
Numeral	0 (zero)	ø	0 (zero)
Numeral	1	1 or |	1
Numeral	2		2
Numeral	3		3
Numeral	4		4
Numeral	5		5
Numeral	6		6
Numeral	7		7
Numeral	8		8
Numeral	9		9
Cents	¢		12,8,2
Period	.		12,8,3
Less Than	<		12,8,4
Open Parenthesis	(		12,8,5
Plus	+		12,8,6
Vertical	|	↑	12,8,7
Ampersand	&		12
Exclamation	!		11,8,2
Dollar Sign	$		11,8,3
Asterisk	*		11,8,4
Close Parenthesis	)		11,8,5
Semicolon	;		11,8,6
Logical NOT	¬	¬	11,8,7
Minus	-	⊖	11
Slash	/		0,1
Logical AND	∧		12,11
Comma	,		0,8,3
Percent	%		0,8,4
Underline	_		0,8,5
Greater Than	>		0,8,6
Question Mark	?		0,8,7

KEYPUNCHING AND DOCUMENTATION CONVENTIONS (Cont'd)

Character	Printer Symbol	Written As	Keypunching Codes
Colon	:		8,2
Number Sign	#		8,3
At the rate of	@		8,4
Apostrophe	'		8,5
Equals	=		8,6
Quote	"		8,7
Lozenge	¤		12,11,0,9,8,7
Space		No Entry	No Punch

Note: The letter O (1101 0110) is written: O

The numeral zero (1111 0000) is written: ø

On coding sheets that have vertical rules, the character space (0100 0000) is indicated by leaving the column vacant.

On coding sheets that do not have vertical rules, or on other documents when it is necessary to show the position and number of spaces in a field, the character space is written: Δ

APPENDIX C

LANGUAGE PROCESSOR OUTPUT FORMATS

◆ The following formats apply to all programming systems and processors except the 70/15. For 70/15 formats refer to the 70/15 Programming System Information Manual (#70-15-501).

ESD Card (External Symbol Dictionary Card)

◆ The ESD cards will not necessarily be produced in consecutive order by ESID (External Symbol Identification Number).

The exact format of the ESD card is shown in table C-1.

Table C-1. ESD Card Format

Card Column	Value	Significance
1	Multiple punch (12-9-2). Hexadecimal value is 02.	
2-4	ESD	Positions 2-4 identify an ESD card explicitly.
5-10	Spaces	Not used.
11-12	Position 11 is $(00)_{16}$. Position 12 is a hexadecimal number whose decimal equivalent may not exceed 48.	Positions 11 and 12 designate the number of bytes of information contained in this card starting in position 17.
13-14	Spaces	Not used.
15-16	Position 15 is $(00)_{16}$. Position 16 is a hexadecimal number whose decimal equivalent is within the range 1-255.	Positions 15 and 16 contain the External Symbol Identification Number (ESID) of the first SD, PC, or ER on this card.
17-64	Positions 17-64 contains 1 to 3 items. Each item is 16 positions long and has the following form: a. 8 positions which contain the symbol name (left justified, space filled to the right).	

ESD Card (External Symbol Dictionary Card) *(Cont'd)*

Table C-1. ESD Card Format *(Cont'd)*

Card Column	Value	Significance
17-64 (Cont'd)	b. 1 position which contains the type code. $(F0)_{16}$ = SD or PC $(F1)_{16}$ = LD $(F2)_{16}$ = ER $(F3)_{16}$ = CM (Common) $(F4)_{16}$ = ER (V-type) c. 3 positions which contain an address as shown below: LD: assembled address of the symbol defined as an ENTRY. ER: $(000000)_{16}$ SD or PC: Assembled origin of the Control Section. d. 1 position which contains a space. e. 3 positions: SD, PC: Control section length in bytes expressed as a hexadecimal value. ER: Spaces. LD: ESID of the SD or PC containing the label.	
65-72	Spaces.	Not used.
73-80		May be used for program identification.

Note:

$(F3)_{16}$ and $(F4)_{16}$ are not produced on the 70/25.
SD denotes Section Definition (generated by CSECT, START, or COM).
PC denotes Private Code (generated by unnamed CSECT).
LD denotes Label Definition (generated by ENTRY).
ER denotes External Reference (generated by EXTRN).

TXT Card (Text Card)

◆ The TXT card contains the assembled object coding. The format is shown in table C-2.

Table C-2. TXT Card Format

Card Column	Value	Significance
1	Multiple Punch (12-9-2). Hexadecimal value is 02.	
2-4	TXT	Positions 2-4 identify a TXT card explicity.
6-8	Positions 6-8 contains the hexadecimal value of the assembled origin.	Positions 6-8 contains the address of the first byte of text on this card.
9-10	Spaces.	Not used.
11-12	Position 11 is $(00)_{16}$. Position 12 is a hexadecimal number whose decimal equivalent may not exceed 56.	Positions 11 and 12 designate the number of bytes of information contained in this card starting in position 17.
13-14	Spaces.	Not used.
15-16	Position 15 is $(00)_{16}$. Position 16 is a hexadecimal number whose decimal equivalent is within the range 1-255.	Positions 15-16 contain the External Symbol Identification Number (ESID) of the control section containing the text.
17-72	Positions 17-72 may contain up to 56 bytes of text.	
73-80		May be used for program identification.

RLD Card (Relocation Dictionary Card)

◆ The RLD cards will be produced in the same order as the physical input (source). The format of this card is shown in table C-3.

Table C-3. RLD Card Format

Card Column	Value	Significance
1	Multiple Punch (12-9-2). Hexadecimal value is 02.	
2-4	RLD	Positions 2-4 identify an RLD card explicitly.
5-10	Spaces.	Not used.
11-21	Position 11 is $(00)_{16}$. Position 12 is a hexadecimal number whose decimal equivalent may not exceed 56.	Positions 11 and 12 designate the number of bytes of information contained on this card starting in Column 17.
13-16	Spaces.	Not used.
17-72	Columns 17-72 contain variable information (from 1 to 13 items). The first item is 8 positions long and has the following form: a. 2 positions which contain the hexadecimal value of the ESID of the load constant. b. 2 positions which contain the hexadecimal value of the ESID of the control section in which the load constant appears. c. 1 position Flag which has the following bit format: 0000LLMC where: 0000 indicates 4 zero bits	

RLD Card (Relocation Dictionary Card) *(Cont'd)*

Table C-3. RLD Card Format *(Cont'd)*

Card Column	Value	Significance
17-72 (Cont'd)	LL is the length of the constant 00 - one byte 01 - two bytes 10 - three bytes 11 - four bytes M is a complement flag bit. 0 - add value of symbol. 1 - subtract value of symbol. C is a continuation code. 1 - next item is 4 bytes. 0 - next item is 8 bytes. d. 3 positions which contain the hexadecimal value of the assembled address of the load constant.	
73-80		May be used for program identification.

Subsequent items are 4 or 8 bytes in length. For example, if 5 consecutive RLD items have ESID numbers of 0102, 0102, 0102, 0301 and 0401, then items 1, 4 and 5 are 8 bytes in length; items 2 and 3 are 4 bytes and the continuation bit is set in items 1 and 2. Thus, 4-byte items are assumed to contain the ESID numbers of the previous item.

END Card

◆ The END card is always generated by the assembly. The format is shown in table C-4.

Table C-4. END Card Format

Card Column	Value	Significance
1	Multiple Punch (12-9-2). Hexadecimal value is 02.	
2-4	END	Positions 2-4 identify an END card explicitly.
5	Space.	Not used.
6-8	Positions 6-8 contain a hexadecimal address value or spaces.	Positions 6-8 contain the assembled origin of the operand specified in the END card. Spaces signify that an operand was not specified in the END card.
9-14	Spaces.	Not used.
15-16	Positions 15-16 contains the ESID number (hexadecimal value) or spaces.	Positions 15-16 contain the ESID of the control section or EXTRN to which the operand in the END statement refers. Spaces signify that an operand was not specified.
17-24	Positions 17-24 contain a symbolic operand or spaces.	Positions 17-24 contain the external symbol specified in the END card. Positions 17-24 contain spaces if no external symbol was specified in the END card.
25-72	Spaces.	Not used.
73-80		May be used for program identification.

XFR Card (Transfer Card)

◆ This card is only produced by the Assembler at the point in the text where specified by the "XFR" Assembler instruction. This card is only produced by the 70/25 and the POS Assembler.

The format of the XFR card is shown in table C-5.

Table C-5. XFR Card Format

Card Column	Value	Significance
1	Multiple Punch (12-9-2). Hexadecimal value is 02.	
2-4	XFR	Positions 2-4 identify the XFR card explicitly.
5	Space.	
6-8	Positions 6-8 contain a hexadecimal address value.	Positions 6-8 contain the assembled origin of the operand specified in the XFR card.
9-14	Spaces.	Not used.
15-16	Positions 15-16 contain the ESID (hexadecimal value).	Positions 15-16 contain the ESID of the control section or EXTRN to which the operand in the XFR statement refers.
17-24	Positions 17-24 contain a symbolic operand or spaces.	Positions 17-24 contain the external symbol specified in the XFR card.
25-72	Spaces.	
73-80		May be used for program identification.

APPENDIX D

CALENDAR DATE—DAY OF THE YEAR TABLE

Calendar Date	Day of Year	Calendar Date	Day of Year	Calendar Date	Day of Year	Calendar Date	Day of Year
Jan 1	001	Feb 1	032	Mar 1	060	Apr 1	091
2	002	2	033	2	061	2	092
3	003	3	034	3	062	3	093
4	004	4	035	4	063	4	094
5	005	5	036	5	064	5	095
6	006	6	037	6	065	6	096
7	007	7	038	7	066	7	097
8	008	8	039	8	067	8	098
9	009	9	040	9	068	9	099
10	010	10	041	10	069	10	100
11	011	11	042	11	070	11	101
12	012	12	043	12	071	12	102
13	013	13	044	13	072	13	103
14	014	14	045	14	073	14	104
15	015	15	046	15	074	15	105
16	016	16	047	16	075	16	106
17	017	17	048	17	076	17	107
18	018	18	049	18	077	18	108
19	019	19	050	19	078	19	109
20	020	20	051	20	079	20	110
21	021	21	052	21	080	21	111
22	022	22	053	22	081	22	112
23	023	23	054	23	082	23	113
24	024	24	055	24	083	24	114
25	025	25	056	25	084	25	115
26	026	26	057	26	085	26	116
27	027	27	058	27	086	27	117
28	028	28	059	28	087	28	118
29	029			29	088	29	119
30	030			30	089	30	120
31	031			31	090		

CALENDAR DATE—DAY OF THE YEAR TABLE (Cont'd)

Calendar Date	Day of Year	Calendar Date	Day of Year	Calendar Date	Day of Year	Calendar Date	Day of Year
May 1	121	Jun 1	152	Jul 1	182	Aug 1	213
2	122	2	153	2	183	2	214
3	123	3	154	3	184	3	215
4	124	4	155	4	185	4	216
5	125	5	156	5	186	5	217
6	126	6	157	6	187	6	218
7	127	7	158	7	188	7	219
8	128	8	159	8	189	8	220
9	129	9	160	9	190	9	221
10	130	10	161	10	191	10	222
11	131	11	162	11	192	11	223
12	132	12	163	12	193	12	224
13	133	13	164	13	194	13	225
14	134	14	165	14	195	14	226
15	135	15	166	15	196	15	227
16	136	16	167	16	197	16	228
17	137	17	168	17	198	17	229
18	138	18	169	18	199	18	230
19	139	19	170	19	200	19	231
20	140	20	171	20	201	20	232
21	141	21	172	21	202	21	233
22	142	22	173	22	203	22	234
23	143	23	174	23	204	23	235
24	144	24	175	24	205	24	236
25	145	25	176	25	206	25	237
26	146	26	177	26	207	26	238
27	147	27	178	27	208	27	239
28	148	28	179	28	209	28	240
29	149	29	180	29	210	29	241
30	150	30	181	30	211	30	242
31	151			31	212	31	243

CALENDAR DATE—DAY OF THE YEAR TABLE (Cont'd)

Calendar Date	Day of Year	Calendar Date	Day of Year	Calendar Date	Day of Year	Calendar Date	Day of Year
Sept 1	244	Oct 1	274	Nov 1	305	Dec 1	335
2	245	2	275	2	306	2	336
3	246	3	276	3	307	3	337
4	247	4	277	4	308	4	338
5	248	5	278	5	309	5	339
6	249	6	279	6	310	6	340
7	250	7	280	7	311	7	341
8	251	8	281	8	312	8	342
9	252	9	282	9	313	9	343
10	253	10	283	10	314	10	344
11	254	11	284	11	315	11	345
12	255	12	285	12	316	12	346
13	256	13	286	13	317	13	347
14	257	14	287	14	318	14	348
15	258	15	288	15	319	15	349
16	259	16	289	16	320	16	350
17	260	17	290	17	321	17	351
18	261	18	291	18	322	18	352
19	262	19	292	19	323	19	353
20	263	20	293	20	324	20	354
21	264	21	294	21	325	21	355
22	265	22	295	22	326	22	356
23	266	23	296	23	327	23	357
24	267	24	297	24	328	24	358
25	268	25	298	25	329	25	359
26	269	26	299	26	330	26	360
27	270	27	300	27	331	27	361
28	271	28	301	28	332	28	362
29	272	29	302	29	333	29	363
30	273	30	303	30	334	30	364
		31	304			31	365

Note:

This table is based on a year of 365 days. For Leap Years, insert 29 in February Calendar Date Column and 060 in February Day of Year Column. Then add one to each Day of Year Entry beginning with March 1.

APPENDIX E

HEXADECIMAL-DECIMAL NUMBER CONVERSION

General

◆ The table provides for direct conversion of hexadecimal and decimal numbers in these ranges:

Hexadecimal	*Decimal*
000 to FFF	0000 to 4095

Hexadecimal-Decimal Number Conversion Table

◆ In the table, the decimal value appears at the intersection of the row representing the most significant hexadecimal digits (16^2 and 16^1) and the column representing the least significant hexadecimal digit (16^0).

Example: $C21_{16} = 3105_{10}$

HEX	*0*	*1*	*2*
C0	3072	3073	3074
C1	3088	3089	3090
C2	3104	3105	3106
C3	3120	3121	3122

For numbers outside the range of the table, add the following values to the table figures:

Hexadecimal	*Decimal*	*Hexadecimal*	*Decimal*
1000	4,096	C000	49,152
2000	8,192	D000	53,248
3000	12,288	E000	57,344
4000	16,384	F000	61,440
5000	20,480	10000	65,536
6000	24,576	20000	131,072
7000	28,672	30000	196,608
8000	32,768	40000	262,144
9000	36,864	50000	327,680
A000	40,960	60000	393,216
B000	45,056	70000	458,752

Example: $1C21_{16} = 7201_{10}$

Hexadecimal	*Decimal*
C21	3105
+1000	+4096
1C21	7201

HEXADECIMAL-DECIMAL NUMBER CONVERSION TABLE (Cont'd)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00	0000	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010	0011	0012	0013	0014	0015
01	0016	0017	0018	0019	0020	0021	0022	0023	0024	0025	0026	0027	0028	0029	0030	0031
02	0032	0033	0034	0035	0036	0037	0038	0039	0040	0041	0042	0043	0044	0045	0046	0047
03	0048	0049	0050	0051	0052	0053	0054	0055	0056	0057	0058	0059	0060	0061	0062	0063
04	0064	0065	0066	0067	0068	0069	0070	0071	0072	0073	0074	0075	0076	0077	0078	0079
05	0080	0081	0082	0083	0084	0085	0086	0087	0088	0089	0090	0091	0092	0093	0094	0095
06	0096	0097	0098	0099	0100	0101	0102	0103	0104	0105	0106	0107	0108	0109	0110	0111
07	0112	0113	0114	0115	0116	0117	0118	0119	0120	0121	0122	0123	0124	0125	0126	0127
08	0128	0129	0130	0131	0132	0133	0134	0135	0136	0137	0138	0139	0140	0141	0142	0143
09	0144	0145	0146	0147	0148	0149	0150	0151	0152	0153	0154	0155	0156	0157	0158	0159
0A	0160	0161	0162	0163	0164	0165	0166	0167	0168	0169	0170	0171	0172	0173	0174	0175
0B	0176	0177	0178	0179	0180	0181	0182	0183	0184	0185	0186	0187	0188	0189	0190	0191
0C	0192	0193	0194	0195	0196	0197	0198	0199	0200	0201	0202	0203	0204	0205	0206	0207
0D	0208	0209	0210	0211	0212	0213	0214	0215	0216	0217	0218	0219	0220	0221	0222	0223
0E	0224	0225	0226	0227	0228	0229	0230	0231	0232	0233	0234	0235	0236	0237	0238	0239
0F	0240	0241	0242	0243	0244	0245	0246	0247	0248	0249	0250	0251	0252	0253	0254	0255

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
10	0256	0257	0258	0259	0260	0261	0262	0263	0264	0265	0266	0267	0268	0269	0270	0271
11	0272	0273	0274	0275	0276	0277	0278	0279	0280	0281	0282	0283	0284	0285	0286	0287
12	0288	0289	0290	0291	0292	0293	0294	0295	0296	0297	0298	0299	0300	0301	0302	0303
13	0304	0305	0306	0307	0308	0309	0310	0311	0312	0313	0314	0315	0316	0317	0318	0319
14	0320	0321	0322	0323	0324	0325	0326	0327	0328	0329	0330	0331	0332	0333	0334	0335
15	0336	0337	0338	0339	0340	0341	0342	0343	0344	0345	0346	0347	0348	0349	0350	0351
16	0352	0353	0354	0355	0356	0357	0358	0359	0360	0361	0362	0363	0364	0365	0366	0367
17	0368	0369	0370	0371	0372	0373	0374	0375	0376	0377	0378	0379	0380	0381	0382	0383
18	0384	0385	0386	0387	0388	0389	0390	0391	0392	0393	0394	0395	0396	0397	0398	0399
19	0400	0401	0402	0403	0404	0405	0406	0407	0408	0409	0410	0411	0412	0413	0414	0415
1A	0416	0417	0418	0419	0420	0421	0422	0423	0424	0425	0426	0427	0428	0429	0430	0431
1B	0432	0433	0434	0435	0436	0437	0438	0439	0440	0441	0442	0443	0444	0445	0446	0447
1C	0448	0449	0450	0451	0452	0453	0454	0455	0456	0457	0458	0459	0460	0461	0462	0463
1D	0464	0465	0466	0467	0468	0469	0470	0471	0472	0473	0474	0475	0476	0477	0478	0479
1E	0480	0481	0482	0483	0484	0485	0486	0487	0488	0489	0490	0491	0492	0493	0494	0495
1F	0496	0497	0498	0499	0500	0501	0502	0503	0504	0505	0506	0507	0508	0509	0510	0511

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
20	0512	0513	0514	0515	0516	0517	0518	0519	0520	0521	0522	0523	0524	0525	0526	0527
21	0528	0529	0530	0531	0532	0533	0534	0535	0536	0537	0538	0539	0540	0541	0542	0543
22	0544	0545	0546	0547	0548	0549	0550	0551	0552	0553	0554	0555	0556	0557	0558	0559
23	0560	0561	0562	0563	0564	0565	0566	0567	0568	0569	0570	0571	0572	0573	0574	0575
24	0576	0577	0578	0579	0580	0581	0582	0583	0584	0585	0586	0587	0588	0589	0590	0591
25	0592	0593	0594	0595	0596	0597	0598	0599	0600	0601	0602	0603	0604	0605	0606	0607
26	0608	0609	0610	0611	0612	0613	0614	0615	0616	0617	0618	0619	0620	0621	0622	0623
27	0624	0625	0626	0627	0628	0629	0630	0631	0632	0633	0634	0635	0636	0637	0638	0639
28	0640	0641	0642	0643	0644	0645	0646	0647	0648	0649	0650	0651	0652	0653	0654	0655
29	0656	0657	0658	0659	0660	0661	0662	0663	0664	0665	0666	0667	0668	0669	0670	0671
2A	0672	0673	0674	0675	0676	0677	0678	0679	0680	0681	0682	0683	0684	0685	0686	0687
2B	0688	0689	0690	0691	0692	0693	0694	0695	0696	0697	0698	0699	0700	0701	0702	0703
2C	0704	0705	0706	0707	0708	0709	0710	0711	0712	0713	0714	0715	0716	0717	0718	0719
2D	0720	0721	0722	0723	0724	0725	0726	0727	0728	0729	0730	0731	0732	0733	0734	0735
2E	0736	0737	0738	0739	0740	0741	0742	0743	0744	0745	0746	0747	0748	0749	0750	0751
2F	0752	0753	0754	0755	0756	0757	0758	0759	0760	0761	0762	0763	0764	0765	0766	0767

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
30	0768	0769	0770	0771	0772	0773	0774	0775	0776	0777	0778	0779	0780	0781	0782	0783
31	0784	0785	0786	0787	0788	0789	0790	0791	0792	0793	0794	0795	0796	0797	0798	0799
32	0800	0801	0802	0803	0804	0805	0806	0807	0808	0809	0810	0811	0812	0813	0814	0815
33	0816	0817	0818	0819	0820	0821	0822	0823	0824	0825	0826	0827	0828	0829	0830	0831
34	0832	0833	0834	0835	0836	0837	0838	0839	0840	0841	0842	0843	0844	0845	0846	0847
35	0848	0849	0850	0851	0852	0853	0854	0855	0856	0857	0858	0859	0860	0861	0862	0863
36	0864	0865	0866	0867	0868	0869	0870	0871	0872	0873	0874	0875	0876	0877	0878	0879
37	0880	0881	0882	0883	0884	0885	0886	0887	0888	0889	0890	0891	0892	0893	0894	0895
38	0896	0897	0898	0899	0900	0901	0902	0903	0904	0905	0906	0907	0908	0909	0910	0911
39	0912	0913	0914	0915	0916	0917	0918	0919	0920	0921	0922	0923	0924	0925	0926	0927
3A	0928	0929	0930	0931	0932	0933	0934	0935	0936	0937	0938	0939	0940	0941	0942	0943
3B	0944	0945	0946	0947	0948	0949	0950	0951	0952	0953	0954	0955	0956	0957	0958	0959
3C	0960	0961	0962	0963	0964	0965	0966	0967	0968	0969	0970	0971	0972	0973	0974	0975
3D	0976	0977	0978	0979	0980	0981	0982	0983	0984	0985	0986	0987	0988	0989	0990	0991
3E	0992	0993	0994	0995	0996	0997	0998	0999	1000	1001	1002	1003	1004	1005	1006	1007
3F	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023

HEXADECIMAL-DECIMAL NUMBER CONVERSION TABLE (Cont'd)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
40	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039
41	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055
42	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071
43	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087
44	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103
45	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119
46	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135
47	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151
48	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167
49	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183
4A	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199
4B	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215
4C	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231
4D	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247
4E	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263
4F	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
50	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295
51	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311
52	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327
53	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343
54	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359
55	1360	1361	1362	1363	1364	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375
56	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	1386	1387	1388	1389	1390	1391
57	1392	1393	1394	1395	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407
58	1408	1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423
59	1424	1425	1426	1427	1428	1429	1430	1431	1432	1433	1434	1435	1436	1437	1438	1439
5A	1440	1441	1442	1443	1444	1445	1446	1447	1448	1449	1450	1451	1452	1453	1454	1455
5B	1456	1457	1458	1459	1460	1461	1462	1463	1464	1465	1466	1467	1468	1469	1470	1471
5C	1472	1473	1474	1475	1476	1477	1478	1479	1480	1481	1482	1483	1484	1485	1486	1487
5D	1488	1489	1490	1491	1492	1493	1494	1495	1496	1497	1498	1499	1500	1501	1502	1503
5E	1504	1505	1506	1507	1508	1509	1510	1511	1512	1513	1514	1515	1516	1517	1518	1519
5F	1520	1521	1522	1523	1524	1525	1526	1527	1528	1529	1530	1531	1532	1533	1534	1535

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
60	1536	1537	1538	1539	1540	1541	1542	1543	1544	1545	1546	1547	1548	1549	1550	1551
61	1552	1553	1554	1555	1556	1557	1558	1559	1560	1561	1562	1563	1564	1565	1566	1567
62	1568	1569	1570	1571	1572	1573	1574	1575	1576	1577	1578	1579	1580	1581	1582	1583
63	1584	1585	1586	1587	1588	1589	1590	1591	1592	1593	1594	1595	1596	1597	1598	1599
64	1600	1601	1602	1603	1604	1605	1606	1607	1608	1609	1610	1611	1612	1613	1614	1615
65	1616	1617	1618	1619	1620	1621	1622	1623	1624	1625	1626	1627	1628	1629	1630	1631
66	1632	1633	1634	1635	1636	1637	1638	1639	1640	1641	1642	1643	1644	1645	1646	1647
67	1648	1649	1650	1651	1652	1653	1654	1655	1656	1657	1658	1659	1660	1661	1662	1663
68	1664	1665	1666	1667	1668	1669	1670	1671	1672	1673	1674	1675	1676	1677	1678	1679
69	1680	1681	1682	1683	1684	1685	1686	1687	1688	1689	1690	1691	1692	1693	1694	1695
6A	1696	1697	1698	1699	1700	1701	1702	1703	1704	1705	1706	1707	1708	1709	1710	1711
6B	1712	1713	1714	1715	1716	1717	1718	1719	1720	1721	1722	1723	1724	1725	1726	1727
6C	1728	1729	1730	1731	1732	1733	1734	1735	1736	1737	1738	1739	1740	1741	1742	1743
6D	1744	1745	1746	1747	1748	1749	1750	1751	1752	1753	1754	1755	1756	1757	1758	1759
6E	1760	1761	1762	1763	1764	1765	1766	1767	1768	1769	1770	1771	1772	1773	1774	1775
6F	1776	1777	1778	1779	1780	1781	1782	1783	1784	1785	1786	1787	1788	1789	1790	1791

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
70	1792	1793	1794	1795	1796	1797	1798	1799	1800	1801	1802	1803	1804	1805	1806	1807
71	1808	1809	1810	1811	1812	1813	1814	1815	1816	1817	1818	1819	1820	1821	1822	1823
72	1824	1825	1826	1827	1828	1829	1830	1831	1832	1833	1834	1835	1836	1837	1838	1839
73	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855
74	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871
75	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887
76	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903
77	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
78	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
79	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
7A	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
7B	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
7C	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
7D	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
7E	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
7F	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047

HEXADECIMAL-DECIMAL NUMBER CONVERSION TABLE (Cont'd)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
80	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063
81	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079
82	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095
83	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111
84	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127
85	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143
86	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159
87	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175
88	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191
89	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207
8A	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223
8B	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239
8C	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255
8D	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271
8E	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287
8F	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
90	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319
91	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335
92	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351
93	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367
94	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383
95	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399
96	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415
97	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431
98	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447
99	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463
9A	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479
9B	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495
9C	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511
9D	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527
9E	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543
9F	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
A0	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575
A1	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591
A2	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607
A3	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623
A4	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639
A5	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655
A6	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671
A7	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687
A8	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703
A9	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719
AA	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735
AB	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751
AC0	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767
AD0	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783
AE0	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799
AF0	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
B0	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831
B1	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847
B2	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863
B3	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879
B4	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895
B5	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911
B6	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927
B7	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943
B8	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	2959
B9	2960	2961	2962	2963	2964	2965	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975
BA	2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987	2988	2989	2990	2991
BB	2992	2993	2994	2995	2996	2997	2998	2999	3000	3001	3002	3003	3004	3005	3006	3007
BC	3008	3009	3010	3011	3012	3013	3014	3015	3016	3017	3018	3019	3020	3021	3022	3023
BD	3024	3025	3026	3027	3028	3029	3030	3031	3032	3033	3034	3035	3036	3037	3038	3039
BE	3040	3041	3042	3043	3044	3045	3046	3047	3048	3049	3050	3051	3052	3053	3054	3055
BF	3056	3057	3058	3059	3060	3061	3062	3063	3064	3065	3066	3067	3068	3069	3070	3071

HEXADECIMAL-DECIMAL NUMBER CONVERSION TABLE (Cont'd)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
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C1	3088	3089	3090	3091	3092	3093	3094	3095	3096	3097	3098	3099	3100	3101	3102	3103
C2	3104	3105	3106	3107	3108	3109	3110	3111	3112	3113	3114	3115	3116	3117	3118	3119
C3	3120	3121	3122	3123	3124	3125	3126	3127	3128	3129	3130	3131	3132	3133	3134	3135
C4	3136	3137	3138	3139	3140	3141	3142	3143	3144	3145	3146	3147	3148	3149	3150	3151
C5	3152	3153	3154	3155	3156	3157	3158	3159	3160	3161	3162	3163	3164	3165	3166	3167
C6	3168	3169	3170	3171	3172	3173	3174	3175	3176	3177	3178	3179	3180	3181	3182	3183
C7	3184	3185	3186	3187	3188	3189	3190	3191	3192	3193	3194	3195	3196	3197	3198	3199
C8	3200	3201	3202	3203	3204	3205	3206	3207	3208	3209	3210	3211	3212	3213	3214	3215
C9	3216	3217	3218	3219	3220	3221	3222	3223	3224	3225	3226	3227	3228	3229	3230	3231
CA	3232	3233	3234	3235	3236	3237	3238	3239	3240	3241	3242	3243	3244	3245	3246	3247
CB	3248	3249	3250	3251	3252	3253	3254	3255	3256	3257	3258	3259	3260	3261	3262	3263
CC	3264	3265	3266	3267	3268	3269	3270	3271	3272	3273	3274	3275	3276	3277	3278	3279
CD	3280	3281	3282	3283	3284	3285	3286	3287	3288	3289	3290	3291	3292	3293	3294	3295
CE	3296	3297	3298	3299	3300	3301	3302	3303	3304	3305	3306	3307	3308	3309	3310	3311
CF	3312	3313	3314	3315	3316	3317	3318	3319	3320	3321	3322	3323	3324	3325	3326	3327

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D0	3328	3329	3330	3331	3332	3333	3334	3335	3336	3337	3338	3339	3340	3341	3342	3343
D1	3344	3345	3346	3347	3348	3349	3350	3351	3352	3353	3354	3355	3356	3357	3358	3359
D2	3360	3361	3362	3363	3364	3365	3366	3367	3368	3369	3370	3371	3372	3373	3374	3375
D3	3376	3377	3378	3379	3380	3381	3382	3383	3384	3385	3386	3387	3388	3389	3390	3391
D4	3392	3393	3394	3395	3396	3397	3398	3399	3400	3401	3402	3403	3404	3405	3406	3407
D5	3408	3409	3410	3411	3412	3413	3414	3415	3416	3417	3418	3419	3420	3421	3422	3423
D6	3424	3425	3426	3427	3428	3429	3430	3431	3432	3433	3434	3435	3436	3437	3438	3439
D7	3440	3441	3442	3443	3444	3445	3446	3447	3448	3449	3450	3451	3452	3453	3454	3455
D8	3456	3457	3458	3459	3460	3461	3462	3463	3464	3465	3466	3467	3468	3469	3470	3471
D9	3472	3473	3474	3475	3476	3477	3478	3479	3480	3481	3482	3483	3484	3485	3486	3487
DA	3488	3489	3490	3491	3492	3493	3494	3495	3496	3497	3498	3499	3500	3501	3502	3503
DB	3504	3505	3506	3507	3508	3509	3510	3511	3512	3513	3514	3515	3516	3517	3518	3519
DC	3520	3521	3522	3523	3524	3525	3526	3527	3528	3529	3530	3531	3532	3533	3534	3535
DD	3536	3537	3538	3539	3540	3541	3542	3543	3544	3545	3546	3547	3548	3549	3550	3551
DE	3552	3553	3554	3555	3556	3557	3558	3559	3560	3561	3562	3563	3564	3565	3566	3567
DF	3568	3569	3570	3571	3572	3573	3574	3575	3576	3577	3578	3579	3580	3581	3582	3583

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
E0	3584	3585	3586	3587	3588	3589	3590	3591	3592	3593	3594	3595	3596	3597	3598	3599
E1	3600	3601	3602	3603	3604	3605	3606	3607	3608	3609	3610	3611	3612	3613	3614	3615
E2	3616	3617	3618	3619	3620	3621	3622	3623	3624	3625	3626	3627	3628	3629	3630	3631
E3	3632	3633	3634	3635	3636	3637	3638	3639	3640	3641	3642	3643	3644	3645	3646	3647
E4	3648	3649	3650	3651	3652	3653	3654	3655	3656	3657	3658	3659	3660	3661	3662	3663
E5	3664	3665	3666	3667	3668	3669	3670	3671	3672	3673	3674	3675	3676	3677	3678	3679
E6	3680	3681	3682	3683	3684	3685	3686	3687	3688	3689	3690	3691	3692	3693	3694	3695
E7	3696	3697	3698	3699	3700	3701	3702	3703	3704	3705	3706	3707	3708	3709	3710	3711
E8	3712	3713	3714	3715	3716	3717	3718	3719	3720	3721	3722	3723	3724	3725	3726	3727
E9	3728	3729	3730	3731	3732	3733	3734	3735	3736	3737	3738	3739	3740	3741	3742	3743
EA	3744	3745	3746	3747	3748	3749	3750	3751	3752	3753	3754	3755	3756	3757	3758	3759
EB	3760	3761	3762	3763	3764	3765	3766	3767	3768	3769	3770	3771	3772	3773	3774	3775
EC	3776	3777	3778	3779	3780	3781	3782	3783	3784	3785	3786	3787	3788	3789	3790	3791
ED	3792	3793	3794	3795	3796	3797	3798	3799	3800	3801	3802	3803	3804	3805	3806	3807
EE	3808	3809	3810	3811	3812	3813	3814	3815	3816	3817	3818	3819	3820	3821	3822	3823
EF	3824	3825	3826	3827	3828	3829	3830	3831	3832	3833	3834	3835	3836	3837	3838	3839

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
F0	3840	3841	3842	3843	3844	3845	3846	3847	3848	3849	3850	3851	3852	3853	3854	3855
F1	3856	3857	3858	3859	3860	3861	3862	3863	3864	3865	3866	3867	3868	3869	3870	3871
F2	3872	3873	3874	3875	3876	3877	3878	3879	3880	3881	3882	3883	3884	3885	3886	3887
F3	3888	3889	3890	3891	3892	3893	3894	3895	3896	3897	3898	3899	3900	3901	3902	3903
F4	3904	3905	3906	3907	3908	3909	3910	3911	3912	3913	3914	3915	3916	3917	3918	3919
F5	3920	3921	3922	3923	3924	3925	3926	3927	3928	3929	3930	3931	3932	3933	3934	3935
F6	3936	3937	3938	3939	3940	3941	3942	3943	3944	3945	3946	3947	3948	3949	3950	3951
F7	3952	3953	3954	3955	3956	3957	3958	3959	3960	3961	3962	3963	3964	3965	3966	3967
F8	3968	3969	3970	3971	3972	3973	3974	3975	3976	3977	3978	3979	3980	3981	3982	3983
F9	3984	3985	3986	3987	3988	3989	3990	3991	3992	3993	3994	3995	3996	3997	3998	3999
FA	4000	4001	4002	4003	4004	4005	4006	4007	4008	4009	4010	4011	4012	4013	4014	4015
FB	4016	4017	4018	4019	4020	4021	4022	4023	4024	4025	4026	4027	4028	4029	4030	4031
FC	4032	4033	4034	4035	4036	4037	4038	4039	4040	4041	4042	4043	4044	4045	4046	4047
FD	4048	4049	4050	4051	4052	4053	4054	4055	4056	4057	4058	4059	4060	4061	4062	4063
FE	4064	4065	4066	4067	4068	4069	4070	4071	4072	4073	4074	4075	4076	4077	4078	4079
FF	4080	4081	4082	4083	4084	4085	4086	4087	4088	4089	4090	4091	4092	4093	4094	4095