DEC STANDARD 154

TITLE: Standard for Floppy Disk (RX01) Volume Identification and Data Interchange

ABSTRACT: This standard defines the data recording conventions to allow RX01 disks to be identified across all DEC systems* which support the Diskette. Each conforming system will be capable of writing and reading the volume identification. This volume I.D. will specify the origin and format of the data present on the volume. This standard applies when reading and writing diskettes intended for interchange.

INDEX: All systems will be capable of handling the standard universal interchange format. For interchange ASCII is the preferred code for volume identification, headers and data. However, systems are permitted to, but are not required to, support EBCDIC in addition to ASCII. EBCDIC is defined in the Appendix. Other native formats may exist and allow interchange.

*System includes terminals, CPU's or any Product which uses the floppy in its' configuration.

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1.0 INTRODUCTION

1.1 Motivation

1.1.1 Why Have This Standard

This standard will allow users to interchange a specified "Data Format" between all DEC Systems as well as IBM or other vendor systems which support the interchange recorded diskette. This data/volume interchange will allow easy, efficient exchange of data between systems.

A diskette used specifically as a "system device" will only be interchangable between equivalent DEC systems supporting the same file system and/or specific data formats, either directly or via a filex program.

1.1.2 Why Standardize Now

Bas level standards must be established to minimize retrofit in the present RX01 Hardware/Software development efforts. Likewise, future development and support costs can be minimized. User education and cost of data interchange can be reduced.

1.2 Goals of This Standard

To define a volume labeling and data recording format for floppy disk media to facilitate data interchange on floppy disks between DEC systems, IBM, and other vendors.

Establish a basic low level standard which is the same and only format for most systems. This basic format must build on the IBM hardware interchange standard, except that ASCII is preferred over EBCDIC as the character code for volume identification, headers and data. Since there is a one to one translation between ASCII and EBCDIC, support of EBCDIC is permitted in addition to ASCII. Provide a set of levels for adherence by small as well as large systems.

Specify an effective procedure for reliable volume identification without special operator mount information.

The data recording interchange objectives can be broken into steps or levels as follows:

1. Every conforming DEC system or terminal which writes a floppy disk will write a standard identification. Every DEC system or terminal which reads a floppy disk will be capable of

reading the standard disk identification.

2. The minimum and "universal interchange" format will be the IBM (ANSI when approved) standard interchange format.

3. Every DEC system or terminal which reads and/or writes a floppy disk will be able to read and/or write the universal interchange formatted floppy.

NOTE

Where performance or memory limitations prevail, then a system utility program (e.g., FILEX) is an acceptable (albeit inconvenient) method to satisfy (3).

4. Specify physical and logical recording and processing standards which will provide the greatest degree of DEC interchange with minimum conversion and a minimum of different file systems.

Non-Goal

Direct DEC TO DEC system interchange of data recorded in each systems own native format is not a subject for this standard. It is a subject for file/data interchange formats independent of the type of direct access device. (For example, if FILES-11 is used as the on-disk structure between two systems (e.g., RSX-11M and RSX11D), then this data is directly interchangeable between systems.)

1.3 Scope

This standard applies to all conforming DEC products which support the floppy disk as a removable data recording device.

This standard covers a basic "universal interchange" format specific to the floppy disk. General file/data interchange for direct access devices is not addressed.

This standard specifies levels or options for adherence. This standard covers data recording and software conventions. It does not address physical media and hardware specifications other than by reference.

1.4 History

None. This is the first standard for the floppy. This initial release (REV A) has been through two comment periods.

1.5 Related Standards

Industry Standards:

- The IBM Diskette for Standard Data Interchange- IBM Pub. No. GA-21-9182, date July 1973.
- American National Standards Institute - No existing standard for recorded file and data interchange. Standards are being proposed by IBM for physical media specifications including physical data recording and addressing. See IBM document number GA21-9190-1 (file no. GENL-19), July 1974.
- X3.4-1968 ASCII

DEC Standards:

- Proposed DEC Standard 167, Volume Identification for Removable Disk Pack Disk Systems" - Being expanded to address "Volume ID For Directory Devices". The RX01 Volume Identification does not conform because of compatibility with the IBM Interchange Standard, except for character code.
- DEC 051 Standard Coded Character Set (ASCII)

1.6 Future Standards Activities

Areas to be considered by this or related standards (e.g., Data Formats Record I/O,...) are:

- DEC interchange for files on the RX01 and other removable direct access devices.
- Industry standards for data interchange on diskettes and other removable direct access devices.

1.7 Known Incompatibilities With Current Software

Present file systems do not have a standard on disk structure for volume identification and data formats for interchange. Consequently some software will have to be modified, others developed to support this standard.

2.0 TERMINOLOGY

Address:	Location of a sector on the diskette consisting of a track and sector number (format-"TTOSS", where T=Track and S=Sector Number).
ASCII	A computer character code standardized by ANS X3.4 and DEC 051.
Blank	An equivalent term for the character Space. NOTE: Blank does not mean null (bit pattern of 0 in both EBCDIC and ASCII).
Byte	A series of eight binary digits (A byte used herein will mean 8 bits unless otherwise specified).
Data Set: (File)	A complete and related group of records (payroll, accounts receivable, etc.).
Data Set Label: (Directory Entry)	Data on index track of diskette that identifies a data set recorded on that disk by name and location, and shows whether or not the data set has been verified.
Diskette:	A flexible single surface cartridge disk enclosed in a jacket.
EBCDIC	A computer character code used by IBM and defined for Digital in the Appendix.
Floppy:	Affectionate name for a diskette.
Header, file	Preferred DEC term for Data Set Label.
Index Track:	The first track on the diskette (track 00); used for data set labels, volume label, and other system software data.
Initialization:	Process resulting in the diskette's original physical format (see IBM document GA21-9190-1).
Null	A bit pattern of all zeroes.
Record:	One or more data fields that form a unit of information. (1-128 bytes for universal interchange records).
Sector: *	A section in a track on the disk for a record (1024 bits).
Track: *	The portion of a moving storage medium, such as a tape or diskette, that is accessible to a given reading head position (26 sectors/track on a diskette).

Volume: * A single diskette (physically is 77 tracks).

* Note: Sizes specified can change with new hardware.

3.0 DEFINITION OF THE STANDARD

Although this standard specifies the software file/data recording and processing conventions, there are basic hardware and physical I/O standards referenced and required in the lowest level of the standard.

A number of levels have been specified to accomodate degrees of interchange. Steps that smaller, as well as, larger systems can implement are specified. Conformance to lower level standards provide a basis for conformance to other levels - presently or in the future.

Section 3.1 defines the diskette standard levels. Section 3.2 describes the recording components and processing conventions required to meet the specified levels. Section 3.3 indicates possible methods for adherence to this standard and a proposed level of adherence. Section 3.4 includes examples and suggestions for implementation of this standard.

Character codes are specified for each level. The character codes for volume identification, headers and data must be same. ASCII is the preferred character code and all systems must support ASCII. In addition, systems may also support EBCDIC in the Level 1 "universal Interchange". The "Universal interchange" format also requires the volume identification in level 0 to be recorded in the same character code.

This standard addresses itself to the prime known planned uses of the RX01. Specifically these uses are:

- Data Interchange, data entry
- Systems Device, system and user files (using native file systems)
- Software distribution media

NOTE

All values in this standard are decimal unless otherwise stated.

Quotation marks when used in tables, etc. where formats are being discussed, identify actual data content to be recorded.

3.1 Levels

There are three (3) levels for the diskette. The lowest level (level 0) is the base level and is common for all other levels.

Level 1 is specified for "Universal Interchange" which allows DEC to DEC and DEC to other vendor interchange (i.e., primarily IBM). This level is called the "Universal Interchange" level.

Level 2 applies to DEC native file usage only. This level, given higher level data file standards exist, will allow direct DEC to DEC native system file/data interchange. For example with FILES-11 on disk data structures RSX-11M and 11D will have direct file interchange via the diskette. (See level 2 for specific details).

See Figure 1 for the diskette standard levels and degree of interchange.

Figure 1

LEVELS FOR DISKETTE STANDARD

```
                L0  ---------------
                    !  BASIC HW    !
                    !    AND       !
                    ! PHYSICAL IO  !
                    !--------------!
                    !   VOLUME     !
                    !     ID       !
                    ---------------
                           !------------
                           !           !
        L1  ---------------            !
            !              !   L2 ------------
            !  "UNIVERSAL  !      !  BASIC     !
            ! INTERCHANGE" !      !  DEC       !
            !   FORMAT     !      !  NATIVE    !
            ---------------       !  FORMATS   !
                                  ------------
```

Figure 1

LEVEL/DEGREE OF INTERCHANGE

LEVEL 0

A floppy may be exchanged physically between systems. No interpretation is applied to the data itself. Standard volume identification which may be in ASCII (preferred) or EBCDIC.

LEVEL 1

Allows interchange of data files and record formats between systems (DEC to DEC and DEC to IBM/other). Volume ID, file headers, and data must be in the same code which may be ASCII (preferred) or EBCDIC.

LEVEL 2

Allows diskette interchange between DEC systems which support compatible (same) file/data formats. Volume ID, file headers, and data must be in ASCII.

LEVEL 0:

Volume ID and Basic physical I/O compatibility

Level 0 must support:

1. IBM diskette hardware compatibility, except ASCII rather than EBCDIC is the preferred character code.

2. The software will read and write every bit (1024), in every sector (26) on all tracks (77)

3. Read and Write sectors on a 1 to 1 interlace (i.e., contiguously)

4. Write a standard system Volume ID in bytes 1-4 at address 00007. (see section 3.2.2 for authorized Volume Identification codes)

5. Read & process the standard Volume ID (bytes 1-4, in address 00007). The processing of the Vol. ID will vary by system. The minimum requirement is to display the value on request via a utility.

6. No interpretation is applied to the data.

LEVEL 1:

"Universal Interchange"

Supports all attributes of Level 0 plus: *

1. Read and/or write additional Volume ID Information (80 bytes at address 00007.*

   a. pos. 1-4 "VOL1" - Specifies Universal Interchange

   b. pos. 5-10 users External Volume Label (name)

   c. pos. 11 access code

   d. pos. 38-51 owner ID

   e. pos. 77-78 sector sequence

   f. pos. 80 standard label version

   (A full description of these fields is in APPENDIX A and section 3.2.2)

---

* All positions not specified are reserved for future systems use and must be written blank and ignored on read.

2. Software support of the ERMAP (sector 05, track 00) for bad tracks. (See APPENDIX A and Section 3.2.5).)

3. Must support the file header information below. (See APPENDIX B for detail)

   a. pos. 1-4 "HDR1" Data Set Header Indicator

   b. pos. 6-13 User name for data set

   c. pos. 23-27 Block/Record size

   d. pos. 29-33 Beginning of extent (BOE) - Starting track/sector address for the data file

   e. pos. 35-39 End of Extent (EOE) - Last address reserved for this data file

   f. pos. 43 The value "P" means read only. Blank allows read and write

   g. pos. 44 Must be blank . A blank indicates intended for interchange

   h. pos. 45 Indicates single or multiple volume file. A blank indicates single volume. A "C" indicates continued and "L" specifies the last volume in a volume set.

   i. pos. 46-47 Multi volume sequence identifiers

   j. pos. 75-79 End of Data (EOD). Indicates the address of the next unused sector.

4. Support at least a single file Volume on output (i.e., one file per volume). Support multiple files on multi-volumes on input. File attributes described in header label. The maximum number of files is 19.

5. Block/Record length is fixed (can be between 1-128 bytes)

6. Support DEC and ANSI ASCII code for headers and data.

7. In addition it is an implementor option to provide EBCDIC support for headers and data.

8. Padding of the rest of the record is done using the Null character (0 in both ASCII and EBCDIC).

NOTE

The complete layout of Volume, Error map, and Data Set Label formats is given in APPENDIX A and B. Track 00 is the "Index Track" which contains this basic

ID and directory data.

LEVEL 2:

DEC Volume ID and Native Formats

Support all attributes of Level 0 plus:

1. DEC standard 167, Volume Identification for Removable Disk Pack Disk Systems (See Section 1.5 of this standard).

2. Accomodate a sector interlace of 2:1 (i.e., Read or Write every other sector in a single block IO transfer). The track to track offset (skew) is six (6) sectors. Virtual Block 7 (in appendix C) is mapped with the 2:1 interlace and 6 sector track to track offset. (See APPENDIX C for the specific mapping).

3. Virtual blocks are 512 bytes in length (4 physical sectors)

4. Support standard DEC ASCII characters in volume ID, file header, and data. EBCDIC is not permitted in level 2.

5. Documentation defining approved "Native DEC" file formats for use on the Floppy Disk is identified in appendix "E" of this standard. Any "Native DEC" file format to be supported on the floppy disk must be registered with the Standards Committee so that it can be ECO'd into appendix "E". Registration is initiated by presenting the proposed native file format to the Standards Administrator and requesting it be put on the Standards Committee's agenda for approval to be made a part of appendix "E". Attendance at the Standards meeting which will address this agenda item may be required.

It is strongly recommended that prior to defining a new native format, the ones identified in appendix "E" be evaluated for use rather than creating a new one. This evaluation should take place early in the product development phase so that the product won't be impacted in later stages by file format issues. The Standards Committee is not likely to approve a new native format until all existing ones have been evaluated for possible use.

3.2 Recording And Processing Specifications

This section gives a precise statement of what happens during the processing steps concerning initialization, Volume ID, data set

directory operations, data access, error handling and device handling. The actual recording specifications are identified throughout this section and the Appendices. The processing of "levels" will be properly differentiated where necessary.

3.2.1 Physical/Logical Layout

The physical organization is the standard IBM Interchange Diskette Format. APPENDIX D shows the complete layout.

The logical layout varies depending on primary use (i.e., Interchange vs native Systems Device).

UNIVERSAL INTERCHANGE:

The overall layout for "universal interchange" is described in APPENDIX A.

SYSTEM/NATIVE:

The RX01 when used as a native files device will be functionally the file system of the system on which it resides. A DEC "Universal" file format is subject for another standard.

3.2.2 Volume Initialization and ID

Volume initialization and Identification becomes more detailed in higher levels of the standard. Initialization (or reinitialization) requires a floppy that has already been formatted according to IBM's specification GA21-9190-1. This standard does not cover the recording of addresses, and so on.

Level 0 - Basic

Every system must write a system ID in sector 07 of track 00. This Volume ID is a four (4) byte code in positions 1-4 of diskette address 00007.

The code for the "Universal Interchange" is "VOL1". In ASCII (preferred), the 8-bit octal equivalents are 126, 117, 114, 61. In EBCDIC, the 8 bit octal equivalents are 345, 326, 323, 361. If the EBCDIC is printed as ASCII after stripping off the left most (high order) bit, the result is "eVSq". The actual character codes to be written are 8 bit in all cases. On reading a diskette the software can determine whether the diskette is using ASCII or EBCDIC by looking for the 345, 326, 323, 361 character codes. If these character codes are not present, ASCII is to be assumed.

The code to be recorded for any other formatted floppy other than "Universal Interchange" must be registered with this standard. In

such cases ASCII only is permitted. Authorized additional formats and Volume ID codes are: (always represented in ASCII)

- RT11 -RT-11 File Structure
- F-11 -FILES-11 File Structure
- OS/8 -OS 8 File Structure
- SCR -Scratch software such as diagnostics must write this code.
- DIAG -Diagnostic Software
- C300 -COS300 Systems

* These formats are official only after they have been authorized by the Standards Committee and included in Appendix E of this standard.

All Volume ID codes must be "PRINTABLE" ASCII codes (i.e., they must use characters in the 41-135 octal value range after stripping bit 8, the left most (high order) bit).

Every system must be able to read and process the basic four byte Volume ID. The minimum requirement is to print out this ID. It is required for systems with mount or similar commands to also indicate their ability to process the volume and continue automatically if the volume is acceptable. Output shall go to the operator's console. This Volume identification must take place without any operator information or assistance. The Volume ID function should be performed automatically as a part of the mount function.

Level 1 - Universal Interchange

The "Universal Interchange" Volume ID Label is fully specified in APPENDIX A. The specific fields are called out per level in section 3.1.

Figure 2 depicts the specific values and level of support for Universal Interchange. The purpose and steps for initialization are as follows:

Disk Initialization

All disks are initialized before they are shipped to a customer. Reinitializing should be avoided if possible; it is required only if:

1. Data in the "Index Track" has been lost.

2. A sector sequence other than the sequence existing on the disk is desired. See Figure 2 in this section for information on how to specify the desired sector sequence.

NOTE

It is not necessary to reinitialize when a diskette is to be re-used for new files/data.

The purpose of initialization is:

1. To write a record in each sector of each active track. All records are filled with the blank character (EBCDIC) except in track 00.

NOTE

In the future, if DEC provides hardware to perform initialization, Nulls rather than spaces will be written. This is because most of our character oriented hardware and software strip out nulls.

2. To write 80-character Volume and File header records in track 00.

After the index track is written, sectors 1 through 4 and 6 contain 80 blanks each. Sector 5 positions 1-5 contain the characters "ERMAP" followed by 75 blank characters. If one or two bad tracks were specified, the number of the first bad track will be in positions 7 and 8 of sector 5 with a zero in position 9, the number of the second bad track will be in positions 11 and 12 of sector 5 with a zero in position 13*.

* Limited or no support. Support on read only. (See Figure 2 below).

Sector 7 contains "VOL1" in positions 1 through 4, the volume ID in positions 5 through 10, the sector sequence code is in positions 77 and 78, a "W" in position 80, and blanks in all remaining positions of the first 80.

Sector 8 contains the following data set label:

- "HDR1" is positions 1-4
- "DATA" in positions 6-9
- "80" in positions 25-27
- "01001" in positions 29-33
- "73026" in positions 35-39
- "01001" in positions 75-79
- blanks in all other positions

Sectors 9 through 26 contain deleted File header records (See Section 3.2.5 for explanation) with the following content:

- "DDR1" in positions 1-4
- "DATA" in positions 6-9
- Sector number in positions 10-11
- "80" in positions 25-27
- "74001" in positions 29-33
- "73026" in positions 35-39
- "74001" in positions 75-79
- Blanks in all other positions

As a final step, disk initialization checks the disk to see that it is written correctly.

Figure 2

INDEX TRACK LAYOUT

Sector	Contents	Level
1	Reserved for system use (80 blanks)	0
2	" " " " (")	0
3	" " " " (")	0
4	" " " " (")	0
5	positions 1-5 = ERMAP positions 7 and 8 = First bad track positions 11 and 12 = Second bad track positions 9 and 13 contain zeroes (Remaining positions are blank) All positions except 1-5 will be blank if there are no bad tracks.	1
6	Reserved (80 blanks)	0
7	Volume Label:	
	positions 1-4 = VOL1 in EBCDIC or ASCII (for Universal Interchange), or other authorized 4 byte codes (ASCII only) which uniquely identify the format of this diskette (e.g. "RT11" for RT11 system disk format)	0
	positions 5-10 specifies the ID of this specific volume. Comes from IBM when new as "IBMIRD". If reinitialized it will either be blanked or will contain a user specified ID.	1
	position 11 = "Accessibility". Blank indicates available for processing. Any non-blank character means disk is not accessible.	1
	positions 38-51 = owner ID.	1
	positions 77-78 = "Sector Sequence Code". 01 - A one to one interlace (i.e. sectors are processed 1, 2, 3,... 25,26) 02 - A two to one interlace (i.e. sectors are processed 1, 3, 5... 23, 25, 2, 4... 14,26) 77 - DEC 11 Interlace. A two to one interlace with a 6 sector track to track offset. Actual layout and specification is in Appendix C.	1
	position 80 = "W" The "W" stands for standard label processing. This field must be "W" for Interchange	1
7	all other positions in the Volume Label are blank	1
8-26	DATA SET LABELS	1

position 1-4 = "HDR1" or "DDR1". Sector 8 is initialized to "HDR1" and 9-26 to "DDR1", "DDR1" indicates a non-existent or deleted data set, because of the "D" in position 1 of the sector.

Level 2 - Digital Native

Diskettes initialized for "native" system file use need not adhere to all the initialization specifications of level 1. The only requirement is to meet the level 0 volume ID specification using the ASCII rather than the EBCDIC character code.

3.2.3 Directory Operations/Data Set Labels

Data Set Labels (DSL) must be processed according to the the recording specifications of each level and APPENDIX B. Level 0 does not recognize Data Set Labels.

Level 1 - UNIVERSAL INTERCHANGE

Section 3.1 (levels) indicates what DSL functions are supported. Certain features such as creation and expiration dates are not supported. The user must be capable of creating, modifying and deleting Data Set Labels. These data Set Labels are properly updated during user data set accessing functions (i.e. OPEN, CLOSE, READ, WRITE, etc.).

Fields in a Data Set Label (e.g. End of Data (EOD) must be updated during data access processing. Others are set during creation of a file (e.g. BOE, and EOE, data set name, and so on).

Level 2

This Level provides for basic standard physical and block level compatible I/O. The interlace and (virtual) block size have been chosen primarily to satisfy the PDP-11 system.

The intent of level 2 is to identify a minimum (one is ideal) set of DIGITAL native file formats for structured native file system usage of the Diskette with the broadest degree of DEC to DEC interchange.

3.2.4 Data Recording/Access

Every system shall read and write every bit in every sector on the media with no interlace and/or data structure assumed.

Level 1

Read/Write support of fixed length records from 1-128 bytes will be provided. Minimum support is sequential access. The data records are

unblocked with no control information (except possibly format effectors and for error processing. See next Section - 3.2.5). The recording mode for IBM interchange, VOL ID = "VOL1" is EBCDIC. The normal file access functions apply.

Level 2

Data Access is specified under each level in the DEC native recording specifications (see Appendix E)

3.2.5 Error Mapping and Processing

Level 1

The ERMAP processing as defined in the "Universal Interchange" format implies both software and/or hardware support. If hardware can initialize addresses it should completely skip a given bad track and reassign addresses to the next track in sequence toward the center of the disk. The hardware should fill the track with bad track codes. (Present RX01 hardware does not support the above).

The software must set the address(s) of either one or two bad tracks in the proper positions of sector 5, track 0 if hardware support exists for readdressing.

If more than two bad tracks exist, the diskette (after recovering existing good data) should be discarded.

All conforming DEC systems supporting Level 1 or above of this standard must at least recognize the ERMAP information on READ and indicate support or non-support. If there are bad tracks marked and the system does not handle them, this must be so indicated. WRITE support need not be provided (write support requires hardware support).

The "DELETED DATA" (DD) mark is used in level 1 as both a deleted physical data indicator and as logical data delete. If the deleted data mark is set then the first byte of the 128 byte sector is interpreted as follows:

	Value	Meaning
(1)	"D" (ASCII or EBCDIC)	the record has been logically deleted. As an example, the data set labels in sectors 9-12 of sector 0 contain a "D" in position 1 when the floppy is initialized and files do not yet exist.
(2)	"F" (ASCII or EBCDIC)	indicates a surface defect and the record

which was to have been written here was displaced to the next sequential sector.

3.3 CONFORMANCE

All systems must support Level 0.

As a minimum all conforming systems which will use the floppy for interchange must support this standard at level 1. Level 0 applies, for example, to stand-alone diagnostic software . All systems which plan for a native file syster use of the floppy must support level 2 of the standard either directly or via a file transform program. All file formats to be used on the floppy must be registered with this standard.

Specific support levels and dates for support are a subject for another document. It is recommended that all conforming systems support level 1, at least with ASCII with direct I/O. Exceptions can be made, but must be approved by the Software Standards committee to allow conformance via such mechanisms as a "file conversion" or to allow deviation from the standard as such.

3.4 EXAMPLES, SUGGESTIONS

Device handlers should themselves be designed to accomodate varying sector sequences. Once this is accomplished, the direct support of the floppy in either "Universal Interchange" or "Native" formats can be handled via a higher level file support function.

The attached appendices and referenced IBM standards documents, as well as the IBM specifications on the 3741 and 3540 give sufficient examples of usage, functional descriptions, and so on of the diskette. Also useful background information are the DIGITAL specifications (Engineering spec. for the RX01, M8357 RX8E OMnibus interface, and M7846 RX11 Unibus interface).

APPENDIX G

EBCDIC and ASCII

Conversion Tables

CHARACTER	ASCII CODE	EBCDIC CODE
NUL	000	000
SOH	001	001
STX	002	002
ETX	003	003
EOT	004	067
ENQ	005	055
ACK	006	056
BEL	007	057
BS	010	026
HT	011	005
LF	012	045
VT	013	013
FF	014	014
CR	015	015
SO	016	016
SI	017	017
DLE	020	020
DC1	021	021
DC2	022	022
DC3	023	023
DC4	024	074
NAK	025	075
SYN	026	062
ETB	027	046
CAN	030	030
EM	031	031
SUB	032	077
ESC	033	047
FS	034	034
GS	035	035
RS	036	036
US	037	037
SPACE	040	100
!	041	117
"	042	177
#	043	173
$	044	133
%	045	154
&	046	120
'	047	175
(	050	115
)	051	135
*	052	134
+	053	116
,	054	153
-	055	140

.	056	113
/	057	141
0	060	360
1	061	361
2	062	362
3	063	363
4	064	364
5	065	365
6	066	366
7	067	367
8	070	370
9	071	371
:	072	172
;	073	136
<	074	114
=	075	176
>	076	156
?	077	157
@	100	174
A	101	301
B	102	302
C	103	303
D	104	304
E	105	305
F	106	306
G	107	307
H	110	310
I	111	311
J	112	321
K	113	322
L	114	323
M	115	324
N	116	325
O	117	326
P	120	327
Q	121	330
R	122	331
S	123	342
T	124	343
U	125	344
V	126	345
W	127	346
X	130	347
Y	131	350
Z	132	351
[	133	112
\	134	340
]	135	132
^	136	137

_	137	155
`	140	171
a	141	201
b	142	202
c	143	203
d	144	204
e	145	205
f	146	206
g	147	207
h	150	210
i	151	211
j	152	221
k	153	222
l	154	223
m	155	224
n	156	225
o	157	226
p	160	227
q	161	230
r	162	231
s	163	242
t	164	243
u	165	244
v	166	245
w	167	246
x	170	247
y	171	250
z	172	251
{	173	300
|	174	152
}	175	320
~	176	241
DEL	177	007

NOTE

Conversions from EBCDIC to ASCII which are not defined here should result in the ASCII Substitute (SUB=032). i.e., Control Z. See ANSI X3.4 and DEC 051 standards. Systems which use Control Z to mean End of File, should use Reverse Slant (134) instead of SUB.

The above conversions were obtained from ANSI X3.26-1970, Hollerith Punched Card Code. (Table B1 in Appendix B).

APPENDIX A

UNIVERSAL INTERCHANGE
DISK LAYOUT AND INDEX TRACK/
VOLUME LABEL

IBM PUBLICATION No. GA21-9182, dated- July 1973

Disk Layout and Addressing

Perhaps the easiest way to describe the layout of the diskette disk is to compare it with items familar to you - phonograph records and record players.

First, assume that you have placed a magnetic-coated disk that is shaped like a phonograph record onto your record player. Then, assume that you have modified your record player:

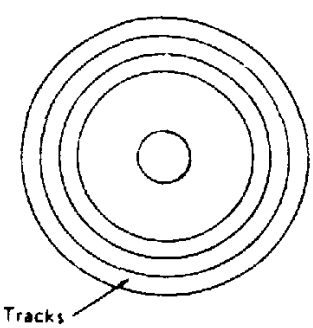
- Instead of the tone arm (the arm holding the needle) moving freely as the disk turns, the arm remains motionless at any spot to which it has been moved.

- You have devised a way to mve the arm to any one of 77 possible locations along the radius of the disk (that is, along a line extending from the outer edge of the disk to the center of the disk) and have numbered these locations consecutively from 0, starting at the outer edge of the disk.

- You have replaced the needle usually held by the tone arm with a read/write head similar to the one used on tape recorders.

The device you would have built would be similar in principle to the device used to read and write data onto the disk in a diskette.

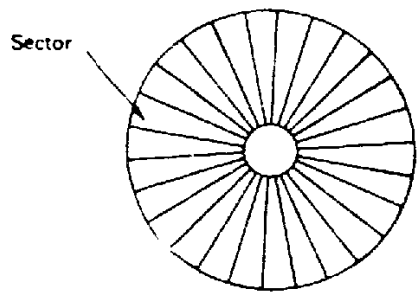
Consider what would happen as the disk on your record player turned. At each location, a band the width of the read/write head would pass under the head, forming a circular band (track) when the disk had made one complete revolution. These tracks would be concentric, and could be identified by the same numbers assigned to each arm location. Therefore, moving the arm to location 0 would always place the read/write head over track 00, moving the arm to position 5 would always place the head over track 05, and so on. The disk would have been divided effectively into 77 separate tracks that we could identify by number and to which we could move the head whenever we desired. Data could be recorded onto or read from the track as it passed under the head.



Now assume that:

- The disk surface is divided into 26 equal equal-size wedges.
- The wedges are each assigned a different number, from 01 through 26, and are called sectors.
- The numbering always starts with sector number 01.

You have now devised a method of dividing the disk into 77 distinct, addressable tracks and 26 distinct, addressable sectors. A combination of the two divides the disk into a total of 2002 distinct and discrete recording areas, each of which can be located by specifying both the track number and the sector number.



From 1 to 128 characters can be stored in each sector. Data stored in a sector is called a record.

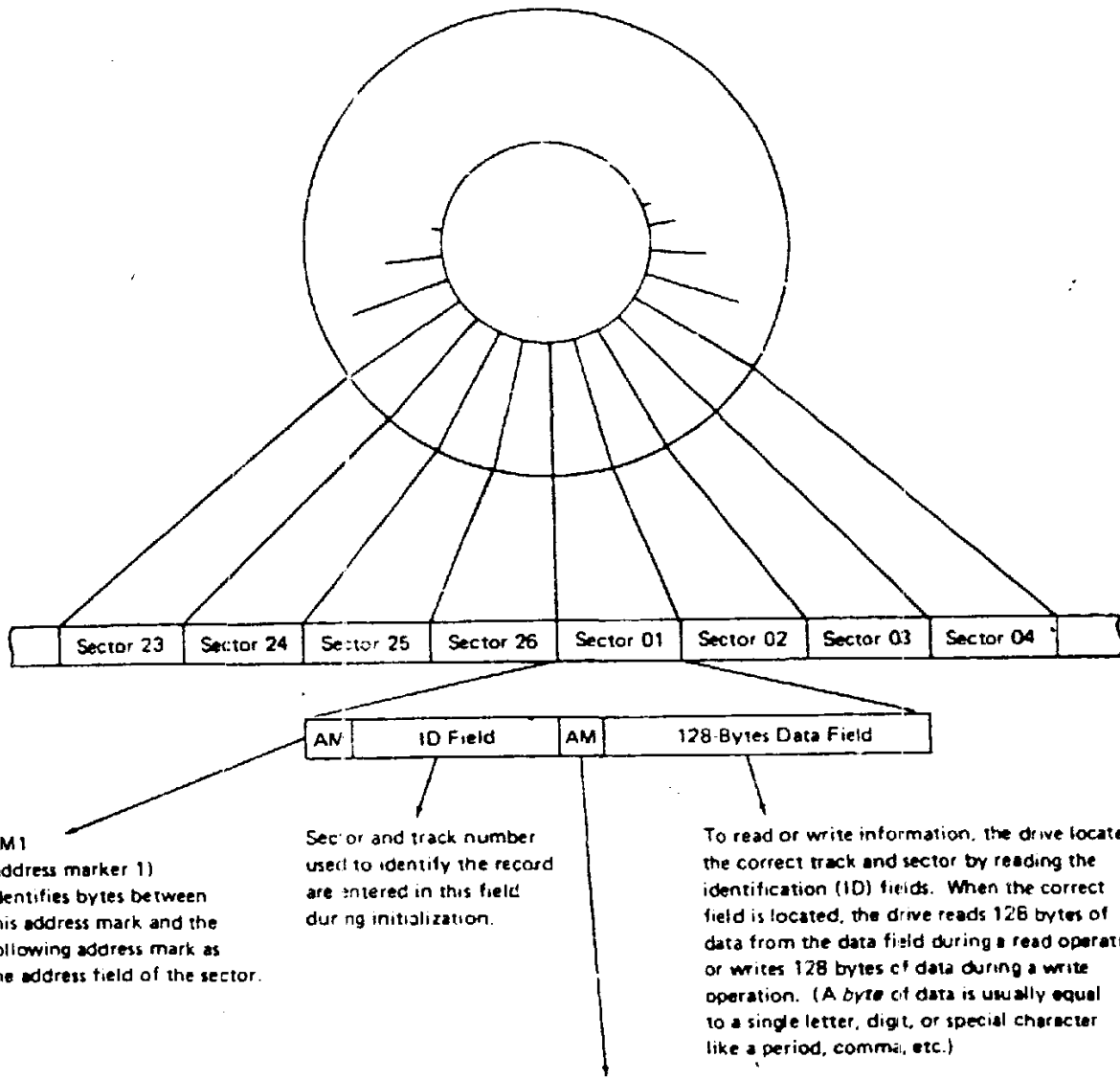
To locate information, the machine locates the record address, that is, the track and sector number.

The first track, track 00, is called the index track and is reserved for descriptive information about the data on the disk. This information on the index track is very comparable to the table of contents of a book. The index track contains labels which are simply names associated with the different data sets, (batches of records or files) on the disk. The data set is comparable to a chapter in a book and the label to the chapter title. Associated with these labels are addresses, comparable to the page numbers in a book. Instead of a page number, though, data on a disk has a track and sector number, written TTOSS, where TT stands for the track number and SS stands for the sector number. A zero separates the track and sector number. These addresses are called extents. Extents simply tell what track and sector numbers mark the beginning and end of each data set on the disk. Beginning of extent (BOE) tells the machine where to find the beginning of the data set, and end of extent (EOE) tells the machine that the data set cannot extend beyond that location. The data set may, however, not fill the space reserved for it and end before EOE. EOD (end of data) tells the machine where the data set actually ends.

Although the disk has 77 tracks, the IBM 3741, 3742, 3747, and 3540 cannot use more than 74 tracks at a time. Two of the tracks are used, by means of the diskette being reinitialized by the 3741 or 3742, as

alternate tracks for bad track replacement, In such cases, bad tracks are filled with bad track codes by the initializing feature, and the next track toward the center of the disk takes the number previously assigned to the bad track. Track 74 on the diskette is not used by the 3741, 3742, 3747, or 3540. Therefore, only tracks 00 through 73 are used in normal operation.

TRACK FORMAT



Note: The ID field and the data field each have two cyclic redundancy check (CRC) characters that the drive uses for automatic error checking.

INDEX TRACK (TRACK 00) LABEL INFORMATION AND INITIAL CONTENT

Use this chart in conjunction with the reference manual for the device or devices using the diskette.

Sector	Use	Initialized To
01	Reserved	
02	Reserved	
03	Reserved.	
04	Reserved	
05	Positions 1 through 13 are used to record the identity of error tracks. Positions 1-5 = ERMAP (ERMAP identifies the sector as an error map.) Position 6 is reserved. Positions 7 and 8 hold the identification of the only bad track, or, if two tracks are the identification of the lower-numbered bad track. If no bad tracks are identified, positions 7 and 8 = b. Position 9 = b if no bad track has been identified in this field. If at least one bad track has been identified, position = 0. Position 10 is reserved. Positions 11 and 12 contain the number of the higher-numbered bad track if two bad tracks have been identified, otherwise, these positions contain blanks. Position 13 = 0 if two bad tracks have been identified, otherwise, position 13 contains a blank. Positions 14 through 22 are reserved. Position 23 is a defect flag position, which is normally initialized to b. A 3540 using IBM programming support, puts a D in this position if the 3540 detects a surface defect in the data field of any sector of any track. All other positions on the sector are reserved.	1-5 = ERMAP 7 - 8 = b 9 = b 11 - 12 = b 13 = b 23 = b
06	Reserved	
07	This sector is called the volume label. Various fields in this sector identify the diskette, the diskette format, diskette owner identification, and whether or not the diskette uses standard labels. Positions 1 - 4 VOL1 (VOL1 identifies the sector as a volume label.) Positions 5 - 10 are called the volume ID field. This field can contain the data written on the permanent diskette label to identify the diskette. The ID consists of one to six numeric digits or letters. These characters must be left-justified in the field (that is, the first character must be in position 5 of the sector), and any unused positions in the field to the right of the ID data must contain space characters (blanks). No blanks are allowed between digits or letters in this field. Position 11 is the volume accessibility field. A blank (space character) in this field permits access to the disk. Any non-blank character in this field means that the disk is not accessible or has restricted access per system definition. Positions 12 - 37 are reserved. Positions 38 - 51 are called the owner ID field. This field is not used by all systems. Positions 52 - 76 are reserved. Positions 77 - 78 are called the record sequence field. This field holds the sector sequence code assigned to the tracks on this diskette. Position 79 is reserved. Position 80 is the standard label version field. The W Character indicates that IBM standard labels are used on the diskette. All diskettes used on the IBM 3540, 3741, 3742, and 3747 use standard labels, so this field should contain a W.	1 - 4 = VOL1 11 = b 38 - 51 = b 77 78 = b 80 = W
08 through [illegible]	These sectors are used to record the data set labels that define data sets (files of information) recorded on tracks 01 through 73 of the diskette. (See *Data Set Label Layout and Initial Content*.)	See *Data Set Label Layout and Initial Content*

APPENDIX B

"UNIVERSAL INTERCHANGE"

DATA SET LABELS

IBM Publication No. GA21-9182, dated- July 1973

Position by Position Representation of Data on the Index Track in Any One Sector of Sectors 08 26.			Field in Unused New Diskette Contains this Data	
Field Name	**Position**	**Purpose**	**Sector 8**	**Sectors 9 through 26**
Write protect	43	If this field contains a P, the data set can be read only. This field must be a blank to allow both reading and writing.	ƀ	ƀ
Interchange type indicator	44	Must be blank. A blank indicates the data set can be used for data interchange.	ƀ	ƀ
Multivolume Indicator	45	A blank in this field indicates a data set is wholly contained on this diskette; a C indicates a data set is continued on another diskette, an L indicates the last diskette on which a continued data set resides.*	ƀ	ƀ
Volume sequence number**	46-47	Volume sequence specifies the sequence of volumes in a multivolume data set. The sequence must be consecutive, beginning with 01 (to a maximum of 99). Blanks indicate that volume sequence checking is not to be performed.	ƀƀ	ƀƀ
Creation date**	48-53	May be used to record the date the data set was created. The format is digits representing YYMMDD, where YY is low-order 2 digits of year, MM is 2-digit representation of month, and DD is 2-digit representation of day of the month.	ƀƀƀƀƀƀ	ƀƀƀƀƀƀ
	54-66	Reserved		
Expiration date**	67-72	May be used to contain the date that the data set (and its label) may be purged. The format is as specified for creation date.	ƀƀƀƀƀƀ	ƀƀƀƀƀƀ
Verify mark	73	This field must contain a V or a blank. V indicates the data set has been verified.	ƀ	ƀ
	74	Reserved		
End of data (EOD)	75-79	Identifies the address of the next unused sector within the data set extent.	01001	74001
	80	Reserved		

* When preparing data for conversion by the 3747, check the *IBM 3747 Data Converter Reference Manual*, GA21-9153, for the interpretation of the multivolume bytes.

** These fields are used only in conjunction with the 3540.

† Each sector contains one record. Standard interchange does not support blocking.

INITIALIZATION OF ID FIELDS ON NEW DISKETTES

Diskettes are shipped from IBM with the identification fields of all sectors preinitialized. Sectors are numbered in ascending numerical sequence from track 00, sector 01 through track 76, sector 26.

APPENDIX C - PART I.A

DEC 2:1 INTERLACE WITH SIX SECTOR TRACK OFFSET

(SAMPLE VIRTUAL BLOCK TO PHYSICAL SECTOR MAPPING)

VIRTUAL BLOCK #	TRACK AND SECTOR NUMBER (TTOSS)*			
1	01001	01003	01005	01007
2	01009	01011	01013	01015
3	01017	01019	01021	01023
4	01025	01002	01004	01006
5	01008	01010	01012	01014
6	01016	01018	01020	01022
7	01024	01026	02007	02009
8	02011	02013	02015	02017
9	02019	02021	02023	02025
10	02001	02003	02005	02008
.	02010	02012	02014	02016
.	02018	02020	02022	02024
.	02026	02002	02004	02006

TT = Two digit track # (00-76)

SS = Two digit sector # (01-26)

BLOCK = 512 (10) bytes

SECTOR = 128(10) bytes

4 SECTORS = 1 BLOCK

APPENDIX C - PART I.B

DEC 2:1 INTERLACE WITH NO TRACK OFFSET (used by OS/8)

(SAMPLE VIRTUAL BLOCK TO PHYSICAL SECTOR MAPPING)

VIRTUAL BLOCK #	TRACK AND SECTOR NUMBER (TTOSS)*			
1	01001	01003	01005	01007
2	01009	01011	01013	01015
3	01017	01019	01021	01023
4	01025	01002	01004	01006
5	01008	01010	01012	01014
6	01016	01018	01020	01022
7	01024	01026	02001	02003
8	02005	02007	02009	02011
9	02013	02015	02017	02019
10	02021	02023	02025	02002
.	02004	02006	02008	02010
.	02012	02014	02016	02018
.	02020	02022	02024	02026

* TT = Two digit track # (00-76)
SS = Two digit sector # (01-26)

BLOCK = 512 (10) bytes
SECTOR = 128(10) bytes
4 SECTORS = 1 BLOCK

APPENDIX C - PART I.C

DEC 3:1 INTERLACE (COS 310)

(SAMPLE VIRTUAL BLOCK TO PHYSICAL SECTOR MAPPING)

VIRTUAL BLOCK #	TRACK AND SECTOR NUMBER		
1	01001	01004	01007
2	01010	01013	01016
3	01019	01022	01025
4	01002	01005	01008
5	01011	01014	01017
6	01020	01023	01026
7	01003	01006	01009
8	01012	01015	01018
9	01021	01024	02001
10	02004	02007	02010
.	.	.	.
.			
.			

The COS 310 3:1 interlace without any offset appears above. Three (3) sectors form one block. The mapping of PDP-8, 12 bit words to the Diskette 8 bit sector bytes is as follows:

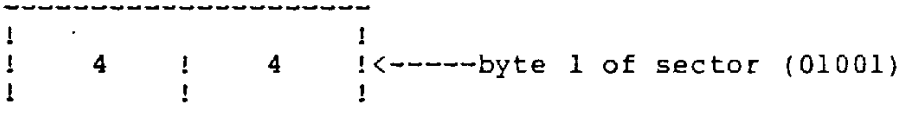
1. A block is 256, 12 bit words.

2. The first 4 bits (left or uppermost) are stripped from each of the 256 words and packed in 128, 8 bit bytes (i.e., the first sector out of three which will contain a block).

3. The remaining lower 8 bits of each word are written in the next two sectors using the 3:1 interlace.

4. From the above example, block 1 is mapped as follows:

   1. Upper 4 bits of 256 words are in sector 01001. The 4 bits are packed as follows:



from word 1	from word 2

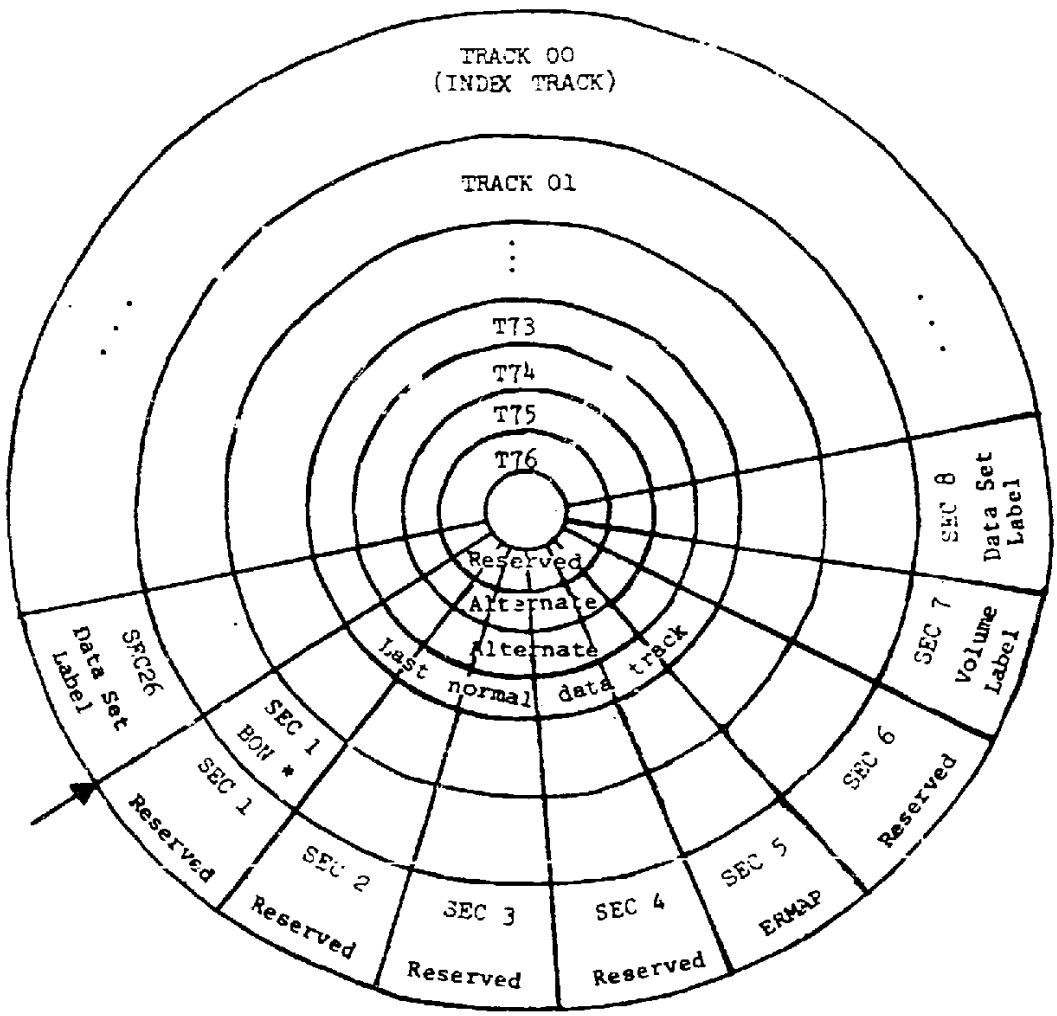
2. The lower 8 bits of the first 128 words are in sector (01004).

3. The lower 8 bits of the last 128 words (out of 256) are in sector (01007).

5. There is no track offset. A block will always begin at sector 01 of each track.

APPENDIX D

OVERALL PHYSICAL/LOGICAL DISK LAYOUT



*BON - "Beginning of Native" Digital file system space on a Diskette will normally contain the primary (initial boot when used as a "systems device". PDP 8/11 Systems boot from sector 1, track 1.

APPENDIX E

DIGITAL NATIVE FORMATS *

*Each developer must insure inclusion of their on-disk structure formats in this appendix.

APPENDIX E

1.0 INTRODUCTION

This appendix lists the approved "DEC NATIVE" file formats used on the Floppy Disk System. The major software system supporting the native file format, the documentation defining the format and the necessary ordering information for the documentation are defined for each format.

1.1 RT-11 Native File Format For Floppy Disks

Major software system(s) supporting this format:

1. RT-11

Name and order number of documentation defining the native format

1. RT-11 Software Support Manual (DEC-11-ORPGA-B-D-DN1)

1.2 OS/8

Major software systems(s) supporting this format:

1. OS/8
2. RTS/8

Name and order number of documentation defining the native format

1. OS/8 Software Support Manual (DEC-58-ORTMA-B-D)
2. RTS/8 User's Manual (DEC-08-ORTMA-B-D)

1.3 FILES-11

Major software system(s) supporting this format:

1. FILES-11

Name and order number of documentation defining the native format

1. FILES-11 On-Disk Structure Specification (*130-958-032-01)
   *Internal DEC Document Retrieval Number

1.4 COS 310

Major software system(s) supporting this format:

1. COS 310

Name and order number of documentation defining the native format

1. COS 300/310 System Reference Manual (DEC-08-OCOSA-F-D)

1.5 XXDP DIAGNOSTIC SOFTWARE

Major software system(s) supporting this format:

1. XXDP Diagnostics

Documentation defining the native format

1. XXDP Maintenance Documentation (*AUTOCAT-11-QZQXA-A-D)
   *Diagnostic Engineering ID number

APPENDIX F

Other Alternatives and Background Information on Specific Issues

This appendix attempts to summarize and highlight general issues relative to decisions and rejected alternatives in this standard. They will be covered in outline order of section 3 of this document.

LEVELS

Since this standard applies to all conforming systems supporting the floppy, it was determined that some degree of levels was necessary. Very small or special systems as well as large systems had to be addressed. The present breakout of three (3) levels appears to be the optimum. Other combinations considered and rejected were:

1. Combining level 0 and 1. This would preclude the application of the standard to support areas such as stand alone diagnostic software, software distribution, and so on.

2. Breaking level 1 and 2 into two (2) levels. This would allow a basic or minimum support as well as full or more comprehensive support at these levels. It was determined that this was not necessary and also difficult to segment.

VOLUME ID

With the required goal of a reliable, universal & singular volume ID capability - with no operator supplied info (i.e., self identifying), it was agreed that track 00 be left "sacrosanct" as per IBM specification. This then allows every system to treat sector 7 of track 0 as the single position to read and record volume ID. Any other alternative would be open to risk and compromise.

As a corollary to the above, the committee decided not to use any portions of track zero (even reserved areas) for things other than specified in the IBM interchange document. This decision covers all use of the diskette - including the "Native" uses. Consequently, things like boots begin in track 1, sector 1 and not track 0, sector 1. Although a floppy being used as a native systems device could use other portions of track 00 except sector 5 and 7, it seemed risky and with uncertain ramifications to all future systems adhering to this

standard. The decision to place the processor boot in sector 1 track 1 is arbitrary, yet this approach is clean. (Some decision had to be made. It could actually vary across systems and need not necessarily be required portion of this standard).

DATA SET LABELS

No issues other than a question concerning subsetting.

CHARACTER CODE FOR INTERCHANGE (LEVEL 1)

At first it was thought that EBCDIC should be only code for volume identification, headers and data for interchange format (level 1). However, this was rejected because many of our customers have no need to interchange with IBM. We would be doing them and ourselves a disfavor by only permitting EBCDIC. Secondly, we could have severe problems supporting an eventual ANSI floppy standard which specifies only ASCII if we had only EBCDIC. Finally, Digital is firmly committed to the support of ASCII both for interchange and internal processing.

The issue of having one, single floppy format is impractical. If in fact we wish to allow multiple uses of diskette (e.g., interchange, systems device, release media), must accomodate different formats. For Interchange there is only one - IBM as specified in this standard. For System use, there can be as many formats as there are file systems. This issue is to either control or disallow use of the floppy on certain systems, or reduce the number of systems, or require that certain systems support a system format other than their own (i.e., RSX support RT-11). Because of its size and a reasonable base for a minimum file sytem, RT-11 was chosen as the prime native format.

Also to control formats and use of the floppy in many native modes, they must be registered with this standard to be allowed. Level 0 does represent a single, common basic format at the lowest level.

ERROR PROCESSING/MAPPING

Since Digital hardware does not presently allow physically readdressing of the floppy, we cannot use the HW/SW alternate ERMAP scheme proposed by IEM with our present systems. It has also been noted, that once a floppy has a number or errors per track, the whole thing will soon "go to hell in a hand basket". We therefore do not expect much use of this feature in the industry (by IBM).

It is also true that any newly purchased floppies should not have any "bad tracks". This issue is addressed in the standard at this time, by insisting on recognition of this data (ERMAP sector 5) but no direct support on initialization.