ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-66

DATA INTERCHANGE ON 130 mm FLEXIBLE DISK CARTRIDGES USING TWO-FREQUENCY RECORDING AT 7958 ftprad ON ONE SIDE

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BRIEF HISTORY

Technical Committee ECMA/TC19 for Magnetic Tape Cassettes and
Cartridges and Flexible Disk Cartridges has developed the present
Standard ECMA-66. It has also contributed its different drafts to
ISO/TC97/SC11 and the current ISO draft for an international stand-
ard (ISO/DP 6596) is technically identical with the present Stand-
ard.

The track format of this Standard is compatible with that of Stand-
ard ECMA-54 for 200 mm FDCs recorded on one side using 2-F record-
ing and with that of the 200 mm and 130 mm FDCs recorded on both
sides using MFM recording for which final drafts are already avail-
able within ECMA which will be published soon as ECMA standards.
Also these drafts have been contributed to ISO/TC97/SC11 and it
is not expected that the corresponding drafts for international
standards will differ from them.

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SECTION I

GENERAL DESCRIPTION AND DEFINITIONS

SCOPE

This Standard ECMA-66 specifies the characteristics of a magnetic flexible disk cartridge to provide physical interchangeability between data processing systems. It also specifies a standard track format. Together with the labelling system specified in another ECMA Standard, the track format in this Standard provides for full data interchange between data processing systems on 35 tracks. Appendix A gives information on the use of additional tracks for purposes not requiring interchange.

COMPLIANCE

A magnetic disk flexible cartridge is in compliance with this Standard when it satisfies to all mandatory clauses of the Standard.

1. GENERAL DESCRIPTION

1.1 General Figures

A typical flexible disk cartridge is represented in Figs. 1 to 3.

- Fig. 1   Flexible Disk Cartridge shows the cartridge seen from above, Side 0 up,

- Fig. 2   Section II-II, is a cross-section along line II-II in Fig. 1,

- Fig. 3   Protective Envelope with Cartridge, shows a protective envelope with cartridge, Side 1 up.

1.2 Main Elements

The main elements of this flexible disk cartridge are:

- the recording disk
- the liner
- the jacket.

The cartridge is stored in an envelope.

1.3 Description

The jacket shall have a square form. It includes a central window, an index window and a head window in both sides.

The liner is fixed to the inside of the jacket. It comprises two layers of material between which the disk is held. The liner has the same openings as the jacket.

The disk has only a central hole and an index hole.

1.4 Optional Features

The interchange characteristics of the jacket allow for variations of its construction. It may include flaps (e.g. three flaps as shown in the drawings, or none) and notches along the Reference Edge.

1.5 Definitions

For the purpose of this Standard the following definitions apply:

1.5.1 Flexible Disk

A flexible disk which accepts and retains on the specified side or sides magnetic signals intended for input/outpu and storage purposes of information data processing and associated systems.

1.5.2 Reference Flexible Disk Cartridge

A flexible disk cartridge arbitrarily selected for a given property for calibrating purposes.

1.5.3 Secondary Reference Flexible Disk Cartridge

A flexible disk cartridge intended for routine calibrating purposes, the performance of which is known and stated in relation to that of the Reference Flexible Disk Cartridge.

1.5.4 Signal Amplitude Reference Flexible Disk Cartridge

A Reference Flexible Disk Cartridge selected as a standard for recording field and signal amplitude.

NOTE:

A Master Standard for Signal Amplitude will be established by the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany. Secondary Reference Flexible Disk Cartridges will be made available by PTB.

1.5.5 Typical Field

The minimum recording field which, when applied to a flexible disk cartridge, causes a signal output equal to 95% of the maximum Average Signal Amplitude when taken as a function of the recording field at the specified track and flux transitions frequency of that flexible disk cartridge.

1.5.6 Reference Field

The Reference Field is the typical field of the Signal Amplitude Reference Flexible Disk Cartridge.

1.5.7 Test Recording Current

The Test Recording Current is the current between 145% and 155% of the current which produces the Reference Field at 125 000 ftps on track 00.

1.5.8 Standard Reference Amplitudes

The Standard Reference Amplitudes are the Average Signal Amplitudes derived from the Signal Amplitude Reference Flexible Disk Cartridge at the densities obtained when writing with 125 000 ftps on track 00 and with 250 000 ftps on track 34 using the Test Recording Current (see also 5.2).

1.5.9 <u>Average Signal Amplitude</u>

The Average Signal Amplitude for a track is the arithmetically averaged value of the output voltages measured peak-to-peak over the whole track.

1.5.10 <u>In Contact</u>

An operating condition in which the magnetic surface of the disk intended for data storage is in physical contact with the magnetic head.

1.5.11 <u>Direction of Rotation</u>

The direction of rotation shall be counterclockwise when looking at Side 0.

SECTION II

MECHANICAL AND PHYSICAL CHARACTERISTICS

2. GENERAL REQUIREMENTS

2.1 Environment and Transportation

2.1.1 Testing Environment

Tests and measurements made on the cartridge to check the requirements of this Standard shall be carried out under following conditions:

Temperature	: (23 ± 2) $^{\circ}$C
RH	: 40% to 60%
Conditioning be- fore testing	: 24 hours minimum

The temperature and the RH shall be measured in the air immediately surrounding the cartridge. The ambient stray magnetic field shall not exceed 4000 A/m.

2.1.2 Operating Environment

Cartridges used for data interchange shall be operated under the following conditions:

Temperature	: 10 $^{\circ}$C to 50 $^{\circ}$C
RH	: 20% to 80%
Wet bulb temperature	: less than 29 $^{\circ}$C

The temperature and the RH shall be measured in the air immediately surrounding the cartridge. It is recommended that the rate of change of the temperature should not exceed 20 $^{\circ}$C per hour.

There shall be no deposit of moisture on or in the cartridge. The ambient stray magnetic field shall not exceed 4000 A/m.

2.1.3 Storage Environment

During storage it is recommended that the cartridges are kept within the following conditions:

Temperature	: 4 $^{\circ}$C to 53 $^{\circ}$C
RH	: 8% to 80%

Each cartridge shall be in an envelope and in an upright position.

The ambient stray magnetic field shall not exceed 4000 A/m.

NOTE:

Cartridges which have been stored at temperatures and humidities exceeding the operating conditions but within the storage conditions may exhibit degraded performance characteristics. Such cartridges should be subjected to a conditioning period of not less than 24 hours within the operating environment prior to use.

2.1.4 <u>Transportation</u>

Responsibility for ensuring that adequate precautions are taken during transportation shall be with the sender. During transportation the cartridge shall be in its envelope and in a protective package. The latter shall be free from dust or extraneous matter. It shall have a clear interior and construction preventing ingress of dust and water. It is recommended that a sufficient space exists between cartridge and outer surface of the final container, so that risk of damage due to stray magnetic fields will be negligible.

It is recommended not to exceed the following conditions:

Temperature : -40 $^{\circ}$C to 53 $^{\circ}$C

Maximum rate of temperature change : 20 $^{\circ}$C per hour

RH : 8% to 90%

There should be no deposit of moisture on or in the cartridge.

2.1.5 <u>Handling</u>

The cartridge shall stay out of its envelope for the shortest time possible. When handling the cartridge the operator shall not touch the exposed magnetic surfaces of the disk and shall avoid exposing the cartridge to direct sunlight, moisture and dust.

2.2 <u>Materials</u>

2.2.1 <u>Jacket</u>

The jacket may be constructed from any suitable material.

2.2.2 <u>Liner</u>

The material of the liner shall be able to retain dust without damage to the disk.

2.2.3 <u>Disk</u>

The disk may be constructed from any suitable material (e.g. bi-axially oriented polyethylene terephthalate) coated at least on one side with a strong and flexible layer of magnetic material (e.g. γ-Fe$_2$O$_3$).

2.2.4 <u>Envelope</u>

The envelope may be manufactured from any suitable material (e.g. paper).

3. <u>DIMENSIONAL CHARACTERISTICS</u>

The dimensional characteristics listed in the following clauses are indicated in Figs. 4 to 7.

Fig. 4 - Jacket Dimensions, shows the jacket,

Fig. 5 - Cartridge Thickness, shows a partial cross-section of the jacket,

Fig. 6 - Disk Dimensions, shows the disk,

Fig. 7 - Disk Thickness, shows a cross-section of the disk.

All dimensions are referred to the Reference Edge of the cartridge (see Fig. 4).

3.1 Jacket

3.1.1 Form

The jacket shall have a square form with angles of $90^{o} \pm 30'$ and a side length

$$l_1 = 133,3 \text{ mm} \pm 0,4 \text{ mm}$$

3.1.2 Thickness

In an area defined by

$$r_1 = 35 \text{ mm}$$

$$r_2 = 50 \text{ mm}$$

and with a probe having a diameter of 15 mm applied against the cartridge with a force of 1 N, the thickness of the jacket wall and liner shall be

$$e_1 = 0,45 \text{ mm} \pm 0,15 \text{ mm}$$

The overall thickness of the cartridge shall be (see also 3.1.7): $1,2 \text{ mm} < e_2 < 2,1 \text{ mm}$, when measured according to Appendix B.

The cartridge shall fall freely through a gauge with a 2,6 mm wide opening having flat, vertical walls and a depth of 150 mm.

3.1.3 Central windows

The central windows shall have a diameter

$$d_1 = 39,7 \text{ mm} \pm 0,2 \text{ mm}$$

The position of their centre is defined by

$$l_2 = 66,65 \text{ mm} \pm 0,30 \text{ mm}$$

3.1.4 Index windows

Location

The centre of the index windows shall be defined by

$$l_3 = 42,10 \text{ mm} \pm 0,25 \text{ mm}$$

$$l_4 = 60,00 \text{ mm} \pm 0,25 \text{ mm}$$

Diameter

The diameter of the index windows shall be

$$d_2 = 6,35 \text{ mm} \pm 0,20 \text{ mm}$$

3.1.5 <u>Head windows</u>

<u>Location</u>

The location of the lowest point of the head windows shall
be defined by

$$l_5 = 3,30 \text{ mm} \pm 0,25 \text{ mm}$$

<u>Dimensions</u>

The width of the head windows shall be

$$l_6 = 12,7 \text{ mm} \pm 0,2 \text{ mm}$$

The nominal radius of their ends shall be

$$r_3 = 6,35 \text{ mm}$$

Their length shall be

$$l_7 = 35,00 \text{ mm} \pm 0,25 \text{ mm}$$

3.1.6 <u>Reference Edge Profile</u>

Within an area defined by

$$l_8 = 25 \text{ mm}$$

the Reference Edge shall have a convex profile, e.g. be
rounded off with one or more radii of 0,3 mm minimum.

3.1.7 <u>Construction of the jacket</u>

If the jacket utilizes flaps, their width shall not ex-
ceed

$$l_9 = 12 \text{ mm}$$

The total thickness e_2 of the cartridge with flaps shall
satisfy the conditions of 3.1.2.

3.1.8 <u>Notches</u>

Two notches may be provided along the Reference Edge. If
provided, they have to be entirely contained within areas
defined by:

$$l_{10} = 48 \text{ mm min.}$$
$$l_{11} = 58 \text{ mm max.}$$
$$l_{12} = 75 \text{ mm min.}$$
$$l_{13} = 85,5 \text{ mm max.}$$
$$l_{14} = 2,0 \text{ mm max.}$$

3.1.9 <u>Write-enable notch</u>

The position and size of the write-enable notch shall be
defined by

$$l_{19} = 96,5 \text{ mm} \pm 0,2 \text{ mm}$$
$$l_{20} = 102,8 \text{ mm} \pm 0,2 \text{ mm}$$
$$l_{21} = 3,8 \text{ mm} \pm 0,2 \text{ mm}$$

If the notch is covered by any means, writing of new information shall be inhibited.

3.2 Liner

The liner shall always cover the recording area (3.3.4). However, no part of the liner shall protrude by more than 0,5 mm into the openings of the jacket.

3.3 Disk

3.3.1 Diameters

The external diameter of the disk shall be

$$d_3 = 130,2 \text{ mm} \pm 0,2 \text{ mm}$$

The inner diameter of the disk shall be

$$d_4 = 28,570 \text{ mm} \pm 0,025 \text{ mm}$$

3.3.2 Thickness

The thickness of the disk shall be

$$e_3 = 0,080 \text{ mm} \pm 0,010 \text{ mm}$$

3.3.3 Index hole

Location

The location of the index hole shall be defined by

$$r_4 = 25,4 \text{ mm} \pm 0,1 \text{ mm}$$

Diameter

The diameter of the index hole shall be

$$d_5 = 2,54 \text{ mm} \pm 0,10 \text{ mm}$$

3.3.4 Recording area

The recording area shall be defined by

$$r_5 = 34 \text{ mm max.}$$
$$r_6 = 57,4 \text{ mm min.}$$

3.3.5 Sides

For convenience of description two sides are defined.

Side 0 is the side on which the disk is recorded and is accessed through side 0 of the jacket.

Side 1 is the other side.

4. PHYSICAL CHARACTERISTICS

4.1 Flammability

Disk, jacket and/or liner components which ignite from a match flame and when so ignited continue to burn in a still carbon dioxide atmosphere shall not be used.

4.2 <u>Coefficient of linear thermal expansion of the disk</u>

The coefficient of thermal expansion of the disk shall be

$$(17 \pm 8) . 10^{-6} \text{ per } {}^{\circ}C$$

4.3 <u>Coefficient of linear hygroscopic expansion of the disk</u>

The coefficient of hygroscopic expansion of the disk shall be

$$(0 \text{ to } 15) . 10^{-6} \text{ per } \% \text{ RH}$$

4.4 <u>Opacity</u>

4.4.1 <u>Opacity of the jacket</u>

The jacket shall have a light transmittance of less than 1% using an LED with a nominal wavelength of 900 nm as the radiation source when measured according to Appendix C

4.4.2 <u>Opacity of the disk</u>

The disk shall have a light transmittance of less than 1% using an LED with a nominal wavelength of 900 nm as the radiation source when measured according to Appendix C.

4.5 <u>Torque</u>

4.5.1 <u>Starting torque</u>

The starting torque, without head and pads loaded to the cartridge, shall not exceed 0,01 N.m.

4.5.2 <u>Running torque</u>

When the disk cartridge is tested at a rotation speed of 300 rpm $\pm$ 7 rpm, with a pressure pad of 280 mm^2 $\pm$ 10 mm^2 surface applied with a force of 0,70 N $\pm$ 0,05 N, and located parallel to the head windows as defined in Fig. 8 by:

$$l_{15} = 44 \text{ mm}$$
$$l_{16} = 55 \text{ mm}$$
$$l_{17} = 7 \text{ mm}$$
$$l_{18} = 35 \text{ mm}$$

the torque necessary to rotate the disk shall be between 0,01 N.m and 0,03 N.m.

SECTION III

MAGNETIC CHARACTERISTICS
_____

OF THE UNRECORDED FLEXIBLE DISK CARTRIDGE
_____

5. MAGNETIC CHARACTERISTICS

5.1 Track Geometry

5.1.1 Number of tracks

There shall be 35 discrete concentric tracks in the recording area (3.3.4) for data interchange.

5.1.2 Width of tracks

The recorded track width on the disk surface shall be

0,300 mm ± 0,025 mm

The area between the tracks shall be erased. The method of measuring effective track width is given in Appendix D.

5.1.3 Track location

5.1.3.1 Nominal locations

The nominal radius of the centrelines of all tracks shall be calculated by using the formula:

$$R_n = 57,150 \text{ mm} - \left(\frac{n}{48} \cdot 25,4 \right) \text{ mm}$$

n being the track number: n = 0 to 34 for data interchange.

5.1.3.2 Track location tolerance

The centrelines of the recorded tracks shall be within ± 0,025 mm of the nominal positions, when measured in the testing environment (2.1.1).

5.1.4 Track number

The track number shall be a two-digit decimal number (00 to 34) which identifies the tracks consecutively, starting at the outermost track (00).

5.1.5 Index

The Index is the point which determines the beginning and the end of a track. At the instant of having detected the leading edge of the Index hole, the Index is under the read-write gap.

5.2 Functional Testing

For the purpose of the following tests the same drive unit shall be used for writing and reading operations.

5.2.1 Surface tests

The magnetic properties of the data surface are defined by the testing requirements given below.

5.2.1.1 Test conditions

The disk shall be tested at 300 rpm ± 6 rpm. The test frequencies used shall be:

1f = 125 000 ftps ± 125 ftps

2f = 250 000 ftps ± 250 ftps

The frequency(ies) to be used is specified for each test.

5.2.1.2 Typical Field

The Typical Field of the disk under test shall be within ± 20% of the Reference Field. It shall be measured using 1f on track 00.

5.2.1.3 Average Signal Amplitude

When a disk has been recorded with the Test Recording Currents, then read back on a system which has been calibrated by means of a Signal Amplitude Reference Flexible Disk Cartridge, recorded under the same conditions, the Average Signal Amplitude of the disk under test shall be:

not more than 130% on track 00 using 1f,

not less than 80% on track 34 using 2f,

of the appropriate Standard Reference Amplitude.

5.2.1.4 Resolution

After recording, using the Test Recording Current, on track 34 the ratio:

$$\frac{\text{Average Signal Amplitude Using 2f}}{\text{Average Signal Amplitude Using 1f}}$$

shall be greater than 80% of the value of the same ratio for the Signal Amplitude Reference Flexible Disk Cartridge.

5.2.1.5 Overwrite

On track 00 after recording with the Test Recording Current, first using 1f and then overwriting with 2f for one revolution, the ratio:

$$\frac{\text{Residual Average Signal Amplitude at 1f after overwrite using 2f}}{\text{Average Signal Amplitude after first recording using 1f}}$$

shall be less than 150% of the value of the same ratio for the Signal Amplitude Reference Flexible Disk Cartridge. This test shall be performed with a frequency-selective voltmeter.

5.2.1.6 Modulation

Modulation shall be:

$$\left[\frac{\text{Maximum mean - Minimum mean}}{\text{Maximum mean + Minimum mean}} \right] 100\%$$

The maximum mean shall be the average value of the amplitude modulated output voltage in that part of the track with the maximum amplitudes, and the minimum mean shall be that in the respective part with the minimum

amplitudes. Output voltage shall be measured peak-to-peak, averaging shall be done over about 2000 consecutive flux transitions.

On track 00 using 1f and on track 34 using 2f, modulation shall be less than 10%.

5.2.2 Track quality tests

These tests shall be carried out over all 35 usable tracks at the defined positions.

5.2.2.1 Missing pulse

Write a track at 2f with the Test Recording Current. Any playback signal, when measured base-to-peak, which is less than 40% of half the arithmetically averaged value of the output voltages measured peak-to-peak over the preceding 2000 consecutive flux transitions, shall be a missing pulse.

5.2.2.2 Extra pulse

Write a track at 2f with the Test Recording Current, erase for one revolution with a constant direct current equivalent to the quiescent value of the Test Recording Current. Any playback signal, which when measured base-to-peak, including the statistical noise and the residual signal if the disk, exceeds 30% of half the Average Signal Amplitude of the track under test shall be an extra pulse.

5.2.3 Rejection criteria

5.2.3.1 Defective track

A track on which one or more missing and or extra pulses are detected in the same position(s) on consecutive passes shall be a defective track. The applicable number of consecutive passes shall be a matter for agreement between purchaser and supplier.

5.2.3.2 Requirements for tracks

As initially received from the medium supplier, the cartridge shall have no defective tracks.

5.2.3.3 Rejected cartridge

A cartridge which does not meet the requirements of 5.2.3.2 shall be rejected.

SECTION IV

TRACK FORMAT

6. TRACK FORMAT

6.1 General Requirements

6.1.1 Mode of recording

The mode of recording shall be two-frequency where the start of every bit cell is a clock flux transition. A ONE is represented by a data flux transition between two clock flux transitions.

6.1.2 Track location tolerance of the recorded flexible disk cartridge

The centrelines of the recorded tracks after initialization shall be within ± 0,030 mm of the nominal positions, when measured in the testing environment (2.1.1). Data shall be recorded within ± 0,085 mm of the nominal positions. This tolerance corresponds to twice the standard deviation.

6.1.3 Recording offset angle

At the instant of writing or reading a magnetic transition, the transition may have an angle of 0° ± 18' with the radius. This tolerance corresponds to twice the standard deviation.

6.1.4 Density of recording

6.1.4.1 The nominal density of recording shall be 7958 flux transitions per radian. The resulting nominal spacing between two clock flux transitions, the nominal bit cell length, is 251 micro-radians.

6.1.4.2 The long-term average bit cell length shall be the average bit cell length measured over a sector. It shall be within ± 3, 5% of the nominal bit cell length.

6.1.4.3 The short-term average bit cell length, referred to a particular bit cell, shall be the average of the lengths of the preceding eight bit cells. It shall be within ± 8% of the long-term average bit cell length.

6.1.5 Flux transition spacing

6.1.5.1 The spacing between two clock flux transitions surrounding a data flux transition or between two data flux transitions surrounding a clock flux transition shall be between 90% and 140% of the nominal bit cell length.

6.1.5.2 The spacing between two clock flux transitions not surrounding a data flux transition or between two data flux transitions surrounding a missing clock flux transition shall be between 60% and 110% of the nominal bit cell length.

6.1.5.3 The spacing between a data flux transition and the preceding clock flux transition (when not missing) or between a clock flux transition and the preceding data flux transition (when not missing) shall be between 45% and 70% of the nominal bit cell length.

6.1.6 Average Signal Amplitude

The Average Signal Amplitude on any non-defective track (5.2.3.1) of the interchanged flexible disk shall be not more than 160% of the Standard Reference Amplitude for track 00 and not less than 40% of the Standard Reference Amplitude for track 34.

6.1.7 Byte

A byte is a group of eight bit-positions, identified B_1 to B_8, with B_8 most significant and recorded first.

The bit in each position is a ZERO or a ONE.

6.1.8 Sector

Track 00 shall be divided into 16 sectors.
All other tracks shall be divided into 9 sectors.

6.1.9 Data capacity of a track

The data capacity of track 00 shall be 2048 bytes. The data capacity of all other tracks shall be 2304 bytes.

6.1.10 Hexadecimal notation

Hexadecimal notation is used to denote the following bytes:

(00)	for $(B_8$ to $B_1)$	=	00000000
(01)	for $(B_8$ to $B_1)$	=	00000001
(FF)	for $(B_8$ to $B_1)$	=	11111111
(FE)*	for $(B_8$ to $B_1)$	=	11111110

where the clock transitions of B_6, B_5 and B_4 are missing

(FB)*	for $(B_8$ to $B_1)$	=	11111011

where the clock transitions of B_6, B_5 and B_4 are missing

(F8)*	for $(B_8$ to $B_1)$	=	11111000

where the clock transitions of B_6, B_5 and B_4 are missing
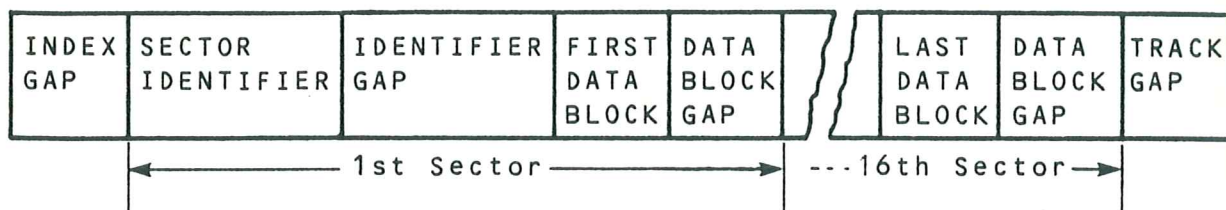
6.1.11 Error Detection Characters (EDC)

The two EDC-bytes are hardware-generated by shifting serially the relevent bits, specified later for each part of the track, through a 16-bit shift register described by the generator polynomial:

$$X^{16} + X^{12} + X^5 + 1$$

(See also Appendix E).

6.2 Detailed Description of the Layout of Track 00 after the First Initialization

After the first initialization there shall be 16 usable sectors on this track. The track layout shall be as follows:

INDEX GAP	SECTOR IDENTIFIER	IDENTIFIER GAP	FIRST DATA BLOCK	DATA BLOCK GAP	//	LAST DATA BLOCK	DATA BLOCK GAP	TRACK GAP

|←——————— 1st Sector ———————→|---16th Sector→|

6.2.1 Index Gap

At nominal density this field shall comprise 16 (FF)-bytes. Writing the Index Gap is started when the Index Hole is detected. Any of the first 8 bytes may be ill-defined due to over-writing.

6.2.2 Sector Identifier

This field shall be as follows:

IDENTIFIER MARK		ADDRESS		IDENTIFIER		
		T		S		EDC
6 Bytes (00)	1 Byte (FE)*	1 Byte	1 Byte (00)	1 Byte	1 Byte (00)	2 Bytes

6.2.2.1 Identifier Mark

This field shall comprise 7 bytes:

6 (00)-bytes
1 (FE)*-byte

6.2.2.2 Address Identifier

This field shall comprise 6 bytes.

6.2.2.2.1 Track Address (T)

The Track Address is the first byte of the Address Identifier. It shall always be a (00)-byte.

6.2.2.2.2 2nd byte of the Address Identifier

The 2nd byte shall be always a (00)-byte.

6.2.2.2.3 Sector Number (S)

The 3rd byte shall represent in binary notation the sector number from 01 for the 1st sector to 16 for the last sector.

the 16 sectors shall be recorded in the natural order 1,2,3,...,15,16.

6.2.2.2.4 4th byte of the Address Identifier

The 4th byte shall be always a (00)-byte.

6.2.2.2.5 EDC

These two bytes shall be generated as defined in 6.1.11 using the bytes of the Sector Identifier starting with the (FE)*-byte (6.2.2.1) of the Identifier Mark and ending with the 4th byte (6.2.2.2.4) of the Address Identifier.

6.2.3 Identifier Gap

This field shall comprise 11 initially recorded (FF)-bytes.

6.2.4 Data Block

This field shall be as follows:

DATA	MARK	DATA FIELD	EDC
6 Bytes (00)	1 Byte	128 Bytes	2 Bytes

6.2.4.1 Data Mark

This field shall comprise:

6 (00)-bytes
1 (FB)*-byte

6.2.4.2 Data Field

This field shall comprise 128 bytes. No requirements are implied beyond the correct EDC for the content of this field (see also 6.3.3.2.4.2).

6.2.4.3 EDC

These two bytes shall be generated as defined in 6.1.11 using the bytes of the Data Block starting with the 7th byte of the Data Mark (6.2.4.1) and ending with the last byte of the Data Field (6.2.4.2).
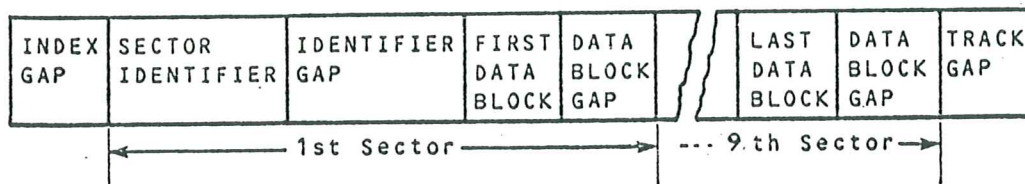
6.2.5 Data Block Gap

This field shall comprise 24 initially recorded (FF)-bytes It is recorded after each Data Block and it precedes the following Sector Identifier. After the last Data Block it precedes the Track Gap.

6.2.6 Track Gap

This field shall follow the Data Block Gap of the 16th Sector. At nominal density it shall comprise 149 (FF)-byte which may be ill-defined due to overwriting.

6.3 Detailed Description of the Layout of Tracks 01-34 after the First Initialization

After the first initialization there shall be 9 usable sectors on each track. The track layout shall be as follows:

INDEX GAP	SECTOR IDENTIFIER	IDENTIFIER GAP	FIRST DATA BLOCK	DATA BLOCK GAP		LAST DATA BLOCK	DATA BLOCK GAP	TRACK GAP
		←————————— 1st Sector —————————→				←··· 9.th Sector→		

6.3.1 Index Gap

At nominal density this field shall comprise 16 (FF)-bytes. Writing of the Index Gap is started when the Index Hole is detected. Any of the first 8 bytes may be ill-defined due to over-writing.

6.3.2 Sector Identifier

This field shall be as follows:

IDENTIFIER MARK		ADDRESS		IDENTIFIER		
		T		S		EDC
6 Bytes (00)	1 Byte (FE)*	1 Byte	1 Byte (00)	1 Byte	1 Byte (01)	2 Bytes

6.3.2.1 Identifier Mark

This field shall comprise 7 bytes:

6 (00)-bytes
1 (FE)*-byte

6.3.2.2 Address Identifier

This field shall comprise 6 bytes.

6.3.2.2.1 Track Address (T)

The Track Address is the first byte of the Address Identifier. It shall represent in binary notation the track address from 00 for the outermost track to 34 for the innermost track.

6.3.2.2.2 2nd byte of the Address Identifier

The 2nd byte shall be always a (00)-byte.

6.3.2.2.3 Sector Number (S)

The 3rd byte shall represent in binary notation the sector number from 01 for the 1st sector to 09 for the last sector.

The 9 sectors shall be recorded in the natural order: 1,2,3,...,8,9.

6.3.2.2.4 <u>4th byte of the Address Identifier</u>

The 4th byte shall be always a (01)-byte.

6.3.2.2.5 <u>EDC</u>

These two bytes shall be generated as defined in 6.1.11 using the bytes of the Sector Identifier starting with the (FE)*-byte (6.3.2.1) of the Identifier Mark and ending with the 4th byte (6.3.2.2.4) of the Address Identifier.

6.3.3 <u>Identifier Gap</u>

This field shall comprise 11 initially recorded (FF)-bytes.

6.3.4 <u>Data Block</u>

This field shall be as follows:

DATA	MARK	DATA FIELD	EDC
6 Bytes (00)	1 Byte	256 Bytes	2 Bytes

6.3.4.1 <u>Data Mark</u>

This field shall comprise:

6 (00)-bytes
1 (FB)*-byte

6.3.4.2 <u>Data Field</u>

This field shall comprise 256 bytes. No requirements are implied beyond the correct EDC for the content of this field (see also 6.4.3.2.4.2).

6.3.4.3 <u>EDC</u>

These two bytes shall be generated as defined in 6.1.11 using the bytes of the Data Block starting with the 7th byte of the Data Mark (6.3.4.1) and ending with the last byte of the Data Field (6.3.4.2).

6.3.5 <u>Data Block Gap</u>

This field shall comprise 38 initially recorded (FF)-bytes. It is recorded after each Data Block and it precedes the following Sector Identifier. After the last Data Block it precedes the Track Gap.

6.3.6 <u>Track Gap</u>

This field shall follow the Data Block Gap of the 9th Sector. At nominal density it shall comprise 166 (FF)-bytes which may be ill-defined due to overwriting.

6.4 Detailed Description of Track Layout of a Recorded Flexible Disk for Data Interchange

6.4.1 Representation of characters

Characters shall be represented by means of the 7-Bit Coded Character Set (Standard ECMA-6) and, where required, by its 7-bit or 8-bit extensions (Standard ECMA-35) or by means of the 8-Bit Coded Character Set (Standard ECMA-43).

Each 7-bit coded character shall be recorded in bit-positions B_7 to B_1 of a byte; bit position B_8 shall be recorded with bit ZERO.

The relationship shall be as follows:

Bits of the 7-bit combination	0	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Bit-positions in the byte	B_8	B_7	B_6	B_5	B_4	B_3	B_2	B_1

Each 8-bit coded character shall be recorded in bit-positions B_8 to B_1 of a byte.

The relationship shall be as follows:

Bits of the 8-bit combination	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Bit-positions in the byte	B_8	B_7	B_6	B_5	B_4	B_3	B_2	B_1

6.4.2 Good and bad tracks

A good track is a track which has been initialized according to 6.4.3.

A bad track is a track which has been handled according to 6.4.4.

Track 00 shall always be a good track.

There shall be at least 32 good tracks from track 01 to track 34.

6.4.3 Track layout of good tracks

References to sub-clauses of 6.2 are for track 00.
References to sub-clauses of 6.3 are for all other tracks.

6.4.3.1 Index Gap

Description: see 6.2.1 and 6.3.1.

6.4.3.2 Sector Identifier

6.4.3.2.1 Identifier Mark

Description: see 6.2.2.1 and 6.3.2.1.

6.4.3.2.2 Address Identifier

This field shall comprise 6 bytes.

6.4.3.2.2.1   Track Address (T)

This field shall specify in binary notation the track address from 00 for the outermost to 34 for the innermost track.

- If there is no bad track, the track address is identical to the track number.

- If there are one or two bad tracks, they are skipped and the track addressing continues sequentially with the next good track. In this case the track address differs by 1 (or 2) from the track number.

6.4.3.2.2.2   2nd byte of the Address Identifier

The 2nd byte shall be always a (00)-byte.

6.4.3.2.2.3   Sector Number (S)

The 3rd byte shall represent in binary notation the sector number from 01 for the 1st sector to 16 for the last sector on track 00 and to 9 for the last sector on tracks 01 to 34. All sectors shall be recorded in the natural order.

6.4.3.2.2.4   4th byte of the Address Identifier

Description: see 6.2.2.2.4 and 6.4.2.2.4.

6.4.3.2.2.5   EDC

Description: see 6.2.2.2.5 and 6.3.2.2.5.

6.4.3.2.3   Identifier Gap

This field shall comprise initially 11 (FF)-bytes. These bytes may subsequently become ill-defined due to the overwriting process.

6.4.3.2.4   Data Block

6.4.3.2.4.1   Data Mark

This field shall comprise:

6 (00)-bytes
1 byte

The 7th byte shall be:

(FB)* indicating that the data is valid and that the whole Data Field can be read.

(F8)* indicating that the first byte of the Data Field shall be interpreted according to Standard ECMA-.. (on labelling).

6.4.3.2.4.2   Data Field

This field shall comprise 128 bytes on track 00 and 256 bytes on all other tracks. If it comprises less than the prescribed number of data bytes, the remaining positions shall be filled with (00)-bytes.

Data Fields in track 00 are reserved for operating system use, including labelling.

6.4.3.2.4.3 EDC

Description: see 6.2.4.3 and 6.3.4.3.

If the 7th byte of the Data Mark is (F8)* and the 1st character of the Data Field is either CAPITAL LETTER F or FULL STOP, the EDC may or may not be correct, as the sector contains a defective area. If the 1st character is CAPITAL LETTER D, then the EDC shall be correct.

6.4.3.2.5 Data Block Gap

This field is recorded after each Data Block and it precedes the following Sector Identifier. After the last Data Block it precedes the Track Gap.

It comprises initially 24 (FF)-bytes on track 00 and 38 (FF)-bytes on all other tracks. These bytes may subsequently become ill-defined due to overwriting.

6.4.3.2.6 Track Gap

Description: see 6.2.6 and 6.3.6.

6.4.4 Layout of a bad track

6.4.4.1 Contents of the fields

The fields of a bad track should have the following contents.

6.4.4.1.1 Index Gap
This field should comprise 16 (FF)-bytes.

6.4.4.1.2 Sector Identifier

This field should comprise an Identifier Mark and an Address Identifier.

6.4.4.1.2.1 Identifier Mark

This field should comprise 7 bytes:

6 (00)-bytes
1 (FE)*-byte

6.4.4.1.2.2 Address Identifier

This field should comprise 6 bytes:

4 (FF)-bytes
2 EDC-bytes

These two EDC bytes shall be generated as defined in 6.1.11 using the bytes of the Sector Identifier starting with the (FE)*-byte (6.2.2.1 and 6.3.2.1) of the Identifier Mark and ending with the above 4 (FF)-bytes.

6.4.4.1.3 <u>Identifier Gap</u>

This field should comprise 11 (FF)-bytes.

6.4.4.1.4 <u>Data Block</u>

This field should comprise 256 (00) or (FF)-bytes.

6.4.4.1.5 <u>Data Block Gap</u>

This field should comprise 38 (FF)-bytes.

6.4.4.1.6 <u>Track Gap</u>

Description: see 6.3.6.

6.4.4.2 <u>Requirements for tracks</u>

Each bad track shall have at least one of its 9 Sector Identifiers with the content specified in 6.4.4.1.2. If this condition is not satisfied, the cartridge shall be rejected. All other fields of these tracks can be ill-defined.

SIDE 0

JACKET

CENTRAL HOLE

DISK

INDEX WINDOW

II   II   HEAD
                                        WINDOW

FIG. 1

or
If
be

JACKET

LINER   SIDE 0   FLAP

DISK
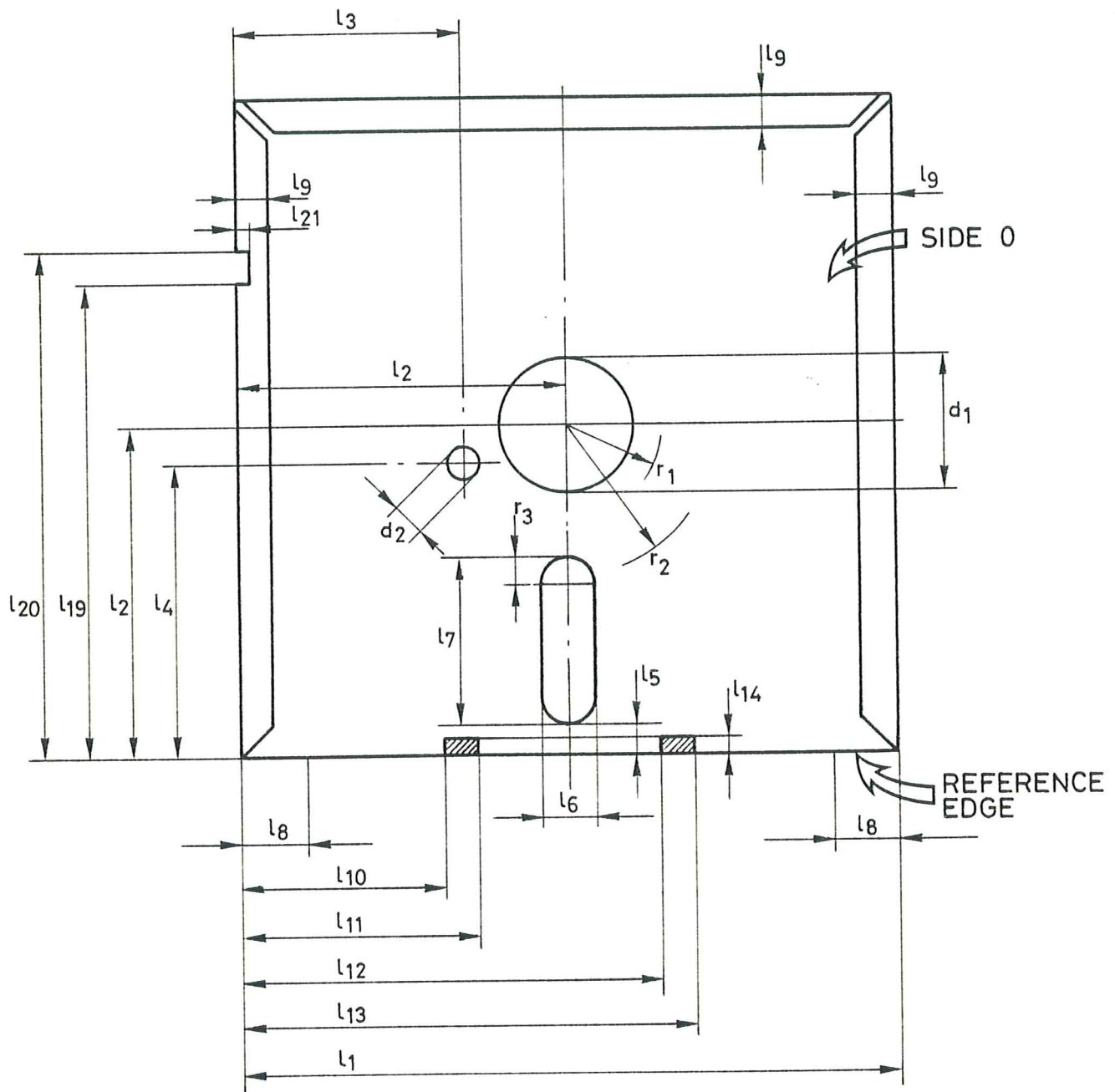
LINER   SIDE 1   JACKET   FIG. 2
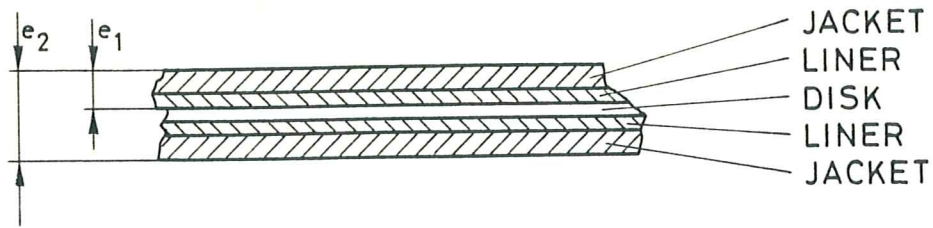
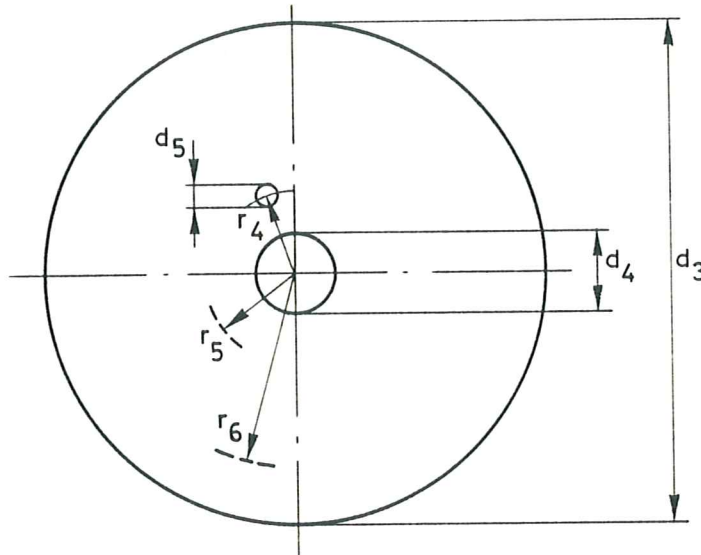LABEL AREA
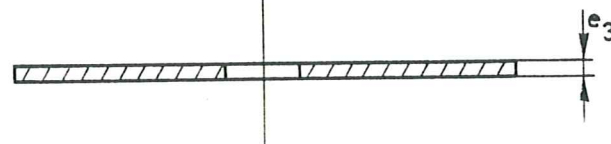
SIDE 1
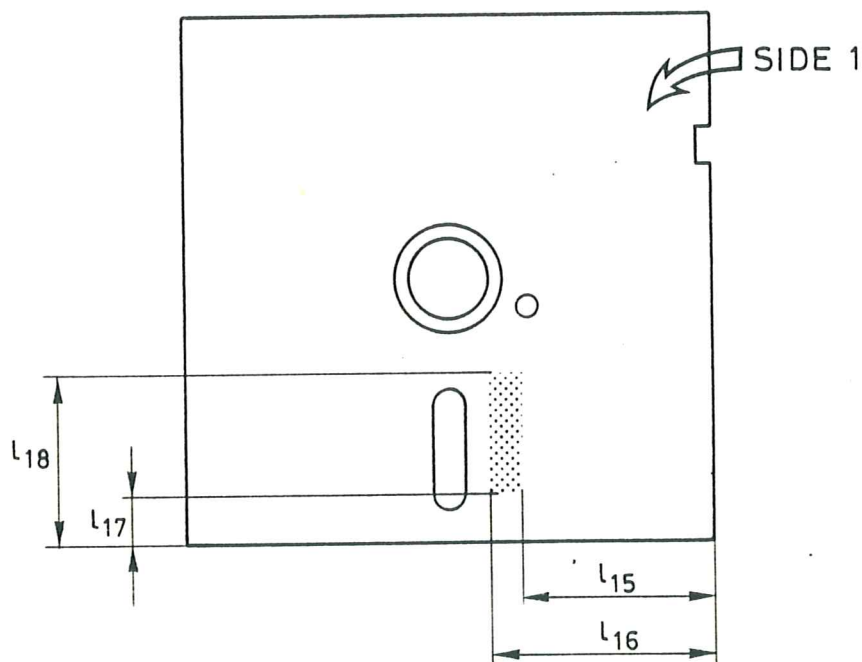
ENVELOPE
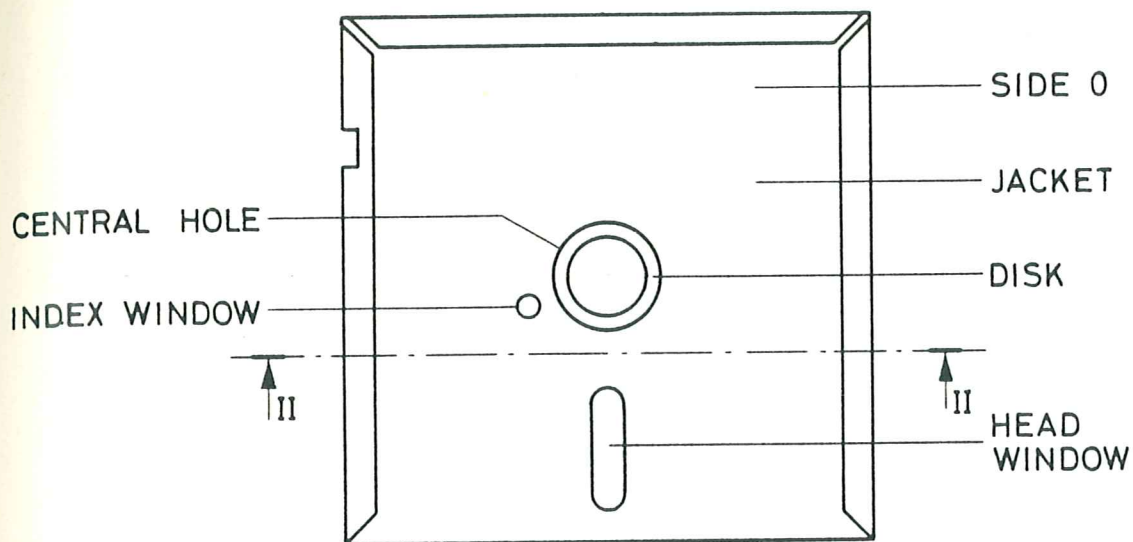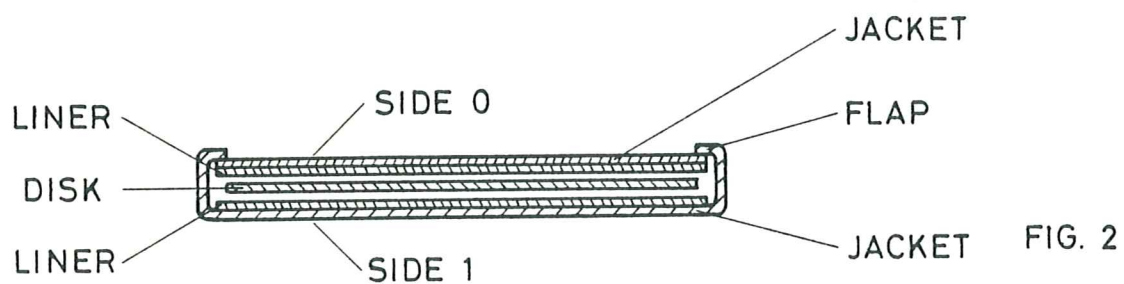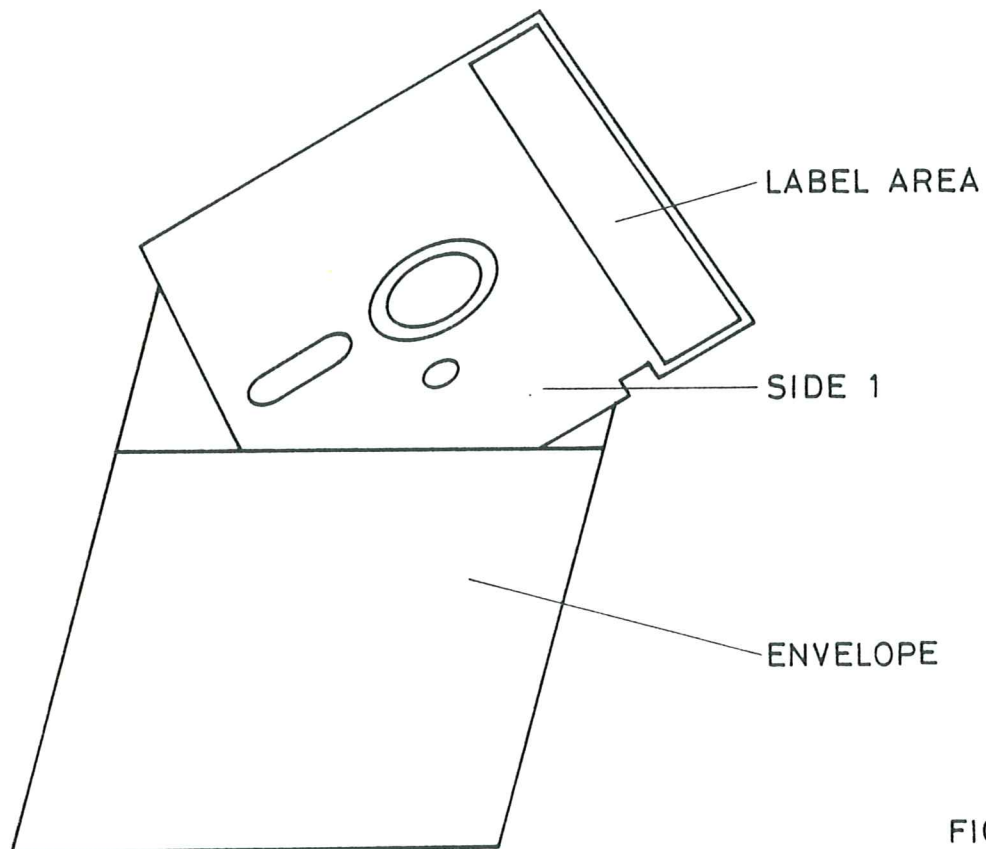
FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

APPENDIX A

USE OF ADDITIONAL TRACKS

The body of the Standard specifies the requirements for those tracks used for full data interchange, i.e. tracks 00 to 34. Additionally, tracks 35 to 39 may be used for purposes not requiring full data interchange. Dimension 1_7 is sufficient to give access to 40 tracks.

For these applications the text of the following clauses shall read:

A.1   5.1.1   Number of Tracks

There shall be 40 discrete concentric tracks in the recording area (3.3.4).

A.2   In the following three clauses the figure 34 must be replaced by 39:

5.1.3.1 Nominal locations

5.1.4 Track number

6.4.3.2.2.1 Track Address

APPENDIX B

MEASUREMENT OF THE CARTRIDGE THICKNESS

B.1 MAXIMUM THICKNESS

This value shall be measured for all edges using the gauge of Fig. 1. The cartridge shall be capable of entering the gauge for at least 15 mm when a force of 1 N max is applied on the opposite edge.
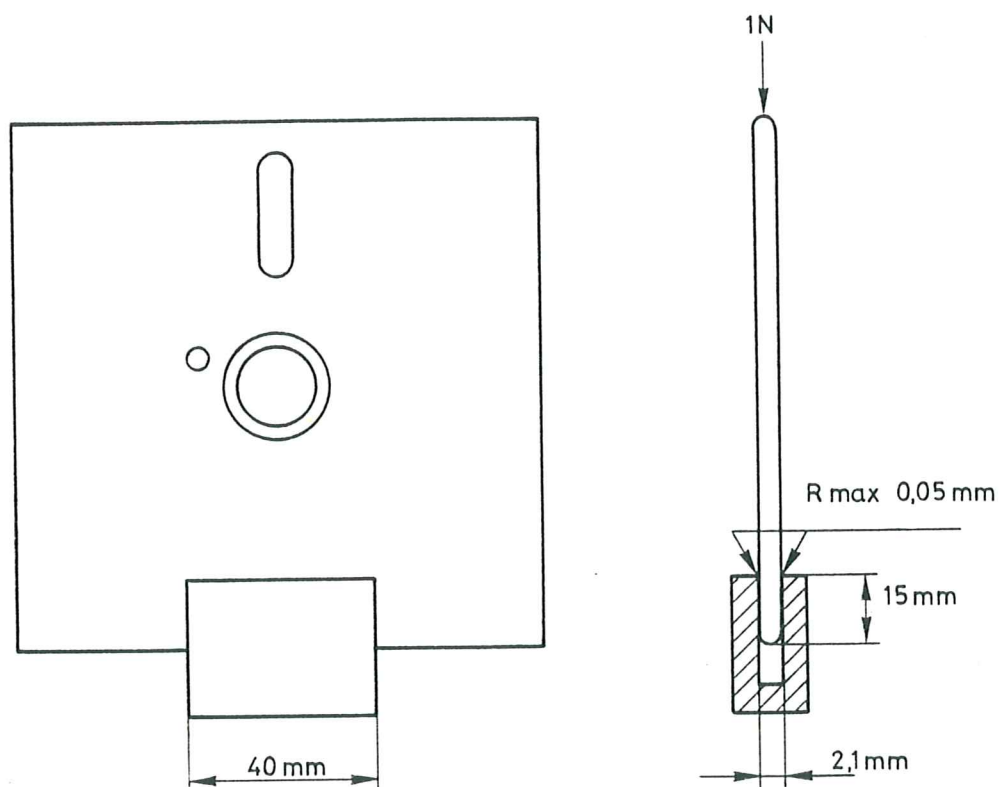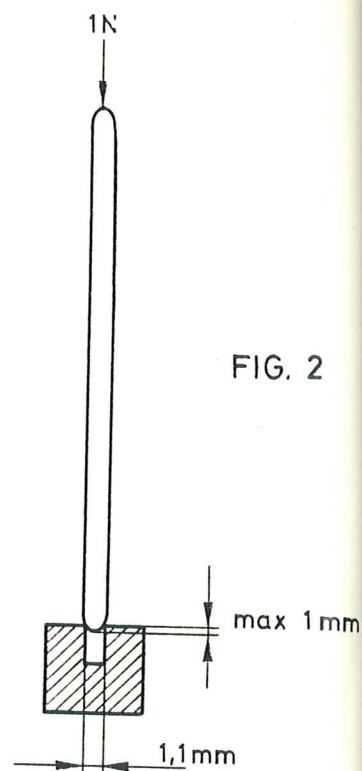

FIG. 1

B.2   MINIMUM THICKNESS

This value shall be measured for all
edges using the gauge of Fig. 2.
When submitted to a force of 1 N the
cartridge shall enter the slot by
less than 1 mm.

FIG. 2

max 1 mm

1,1 mm

B.3   THICKNESS OF THE FLAPS (IF ANY)

This thickness shall be measured with the stylus of Fig. 3.
The cartridge shall be placed on a horizontal surface with
flaps facing upwards.

The stylus is put on the flap, its axis being perpendicular
to the cartridge edge. The stylus is loaded with a force of
1 N. The total thickness is measured with a dial gauge. The
stylus is then moved radially to the nearest internal zone
of the cartridge and the thickness is measured again. The
difference between the two values measured is the contribu-
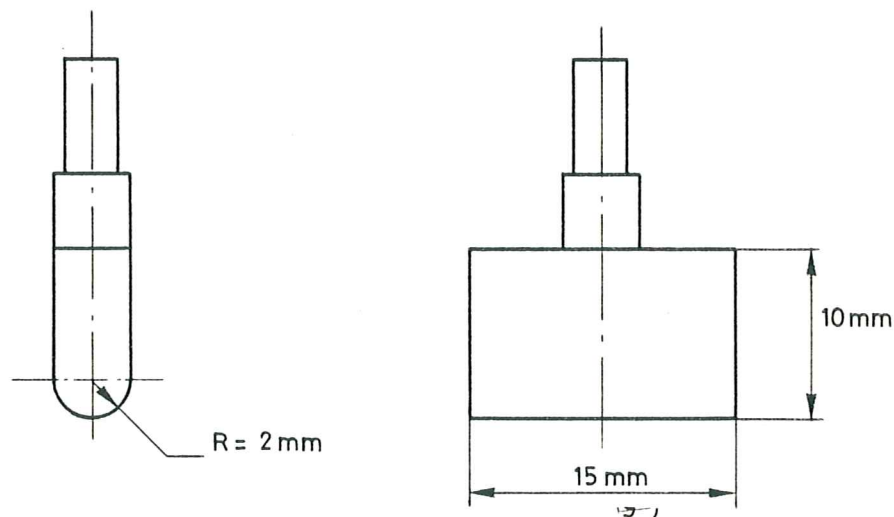tion of the flap to the total thickness of the cartridge.

R = 2 mm

10 mm

15 mm

FIG. 3

APPENDIX C

MEASUREMENT OF LIGHT TRANSMITTANCE

C.1   INTRODUCTION

The following description outlines the general principle of the measuring equipment and the measuring method to be applied when measuring the radiation (light) transmittance of the jacket and of the magnetic disk.

For the purpose of this Standard "light transmittance" is defined by convention as the relationship between the reading obtained from the test device with the sample inserted and the reading obtained when no sample is present. The transmittance value is expressed as the percentage ratio of the two readings.

The essential elements of the measuring equipment are:

- the radiation source
- the photo diode
- the optical path
- the measuring circuitry

C.2   DESCRIPTION OF THE MEASURING EQUIPMENT

C.2.1 Radiation Source

An infra red light-emitting diode (LED) with the following parameters shall be used:

Wavelength at peak emission λ_{peak} = 900 nm ± 10 nm

Half-power band width b = ± 25 nm

C.2.2 Radiation Receiver

A flat silicon photo diode shall be used as the radiation receiver. It shall be operated in the short circuit mode. The active area of the diode shall be equal to, or at the most 20% larger than the open area of the aperture. This condition guarantees a linear dependency of the short circuit diode current on the light intensity.

C.2.3 Optical Path (Fig. 1 C)

The optical axis of the set up shall be perpendicular to the disk.
The distance from the emitting surface of the LED to the disk shall be:

$$L_1 = \frac{d_{max}}{2 \tan \alpha}$$

d_{max} is the maximum diameter of the index hole.

α is the angle where the relative intensity of the LED is equal to, or greater than, 95% of the maximum intensity in the optical axis.

The aperture shall have a thickness of 1,2 to 1,4 mm and a diameter given by:

$$D = (2 \, L_2 \tan \alpha) \text{ mm}$$

$$L_2 = (L_1 + 1,5) \text{ mm}$$

Its surfaces shall be matt black. The whole device should be enclosed within a light-tight casing.

C.2.4 Measuring Circuitry

Fig. 2 C shows the recommended circuitry with the following components:

E	:	regulated power supply with variable output voltage
R	:	current-limiting resistor
LED	:	light-emitting diode
D_i	:	Si photo diode
A	:	operational amplifier
R_{f0}, R_{f1}	:	feedback resistors
S	:	gain switch
V	:	voltmeter

The forward current of the LED and consequently its radiation power can be varied by means of the power supply E. D_i is working in the short circuitry mode. The output voltage of the operational amplifier is given by:

$$V_0 = I_k \cdot R_f$$

and is therefore a linear function of the light intensity. I_k is the short circuit current of D_i.

R_{f0} and R_{f1} shall be low-temperature drift resistors with an accuracy of 1%. The following ratio applies:

$$\frac{R_{f0}}{R_{f1}} = \frac{1}{50}$$

C.3   MEASURING METHOD

C.3.1 Measurement of the Disk

The measurements shall be taken within an annular band whose boundaries are tangent to the index hole.

- S is set to position 0. With the index hole on front of the photo diode, the voltmeter is set to full-scale reading (100% transmittance) by varying the output voltage of E.

- The disk is rotated until the photo diode is covered by
  the disk. S is set to position 1. Full deflection of
  the voltmeter new represents 2% transmittance.

The disk is rotated slowly for one revolution and the read-
ings of the voltmeter are observed.

C.3.2 Measurement of the Jacket

The same procedure applies to the jacket measurement, ex-
cept that the jacket without the disk shall be rotated.

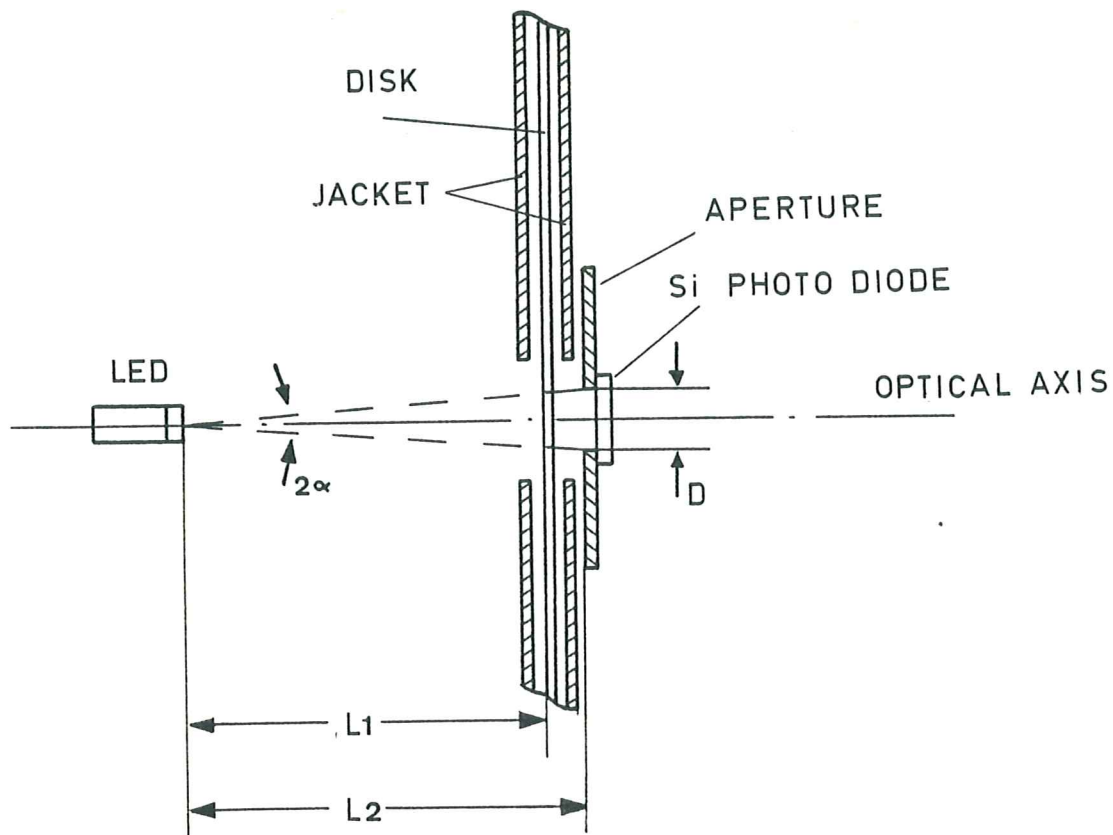FIG. 1   MEASURING DEVICE

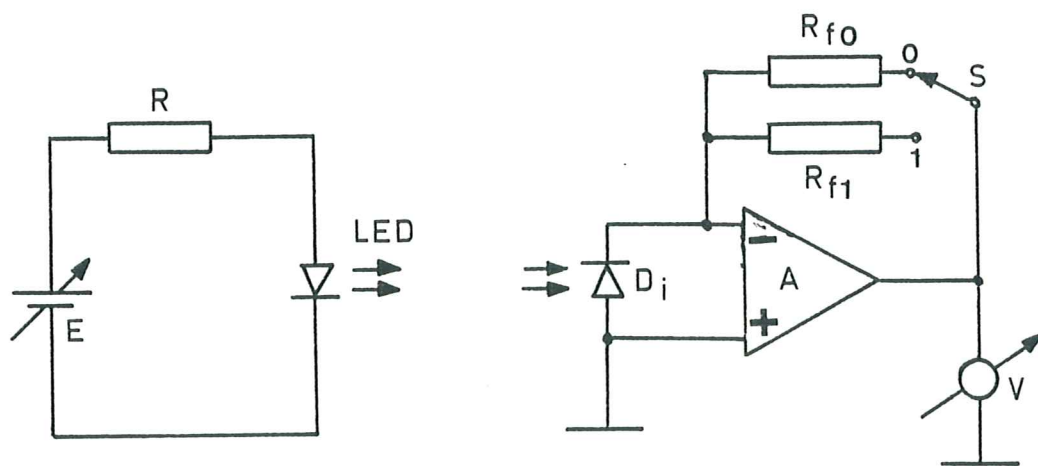FIG. 2   ELECTRONIC CIRCUITRY

APPENDIX D

METHOD FOR MEASURING THE EFFECTIVE TRACK WIDTH

A bandwidth equal to at least 7 track wide band is DC erased. In a track centred in the middle of the erased band a 250 000 ftps frequency pattern is recorded with the read/write head with tunnel erase active.

Then the head is moved radially over the disk in increments not greater than 0,01 mm to the left and to the right until the read back signal becomes zero. The read back signal amplitude is determined for each incremental move and its amplitude is plotted versus displacement. See diagram for reading the half track width, provided the gap width of the head used is not smaller than the effective track width.
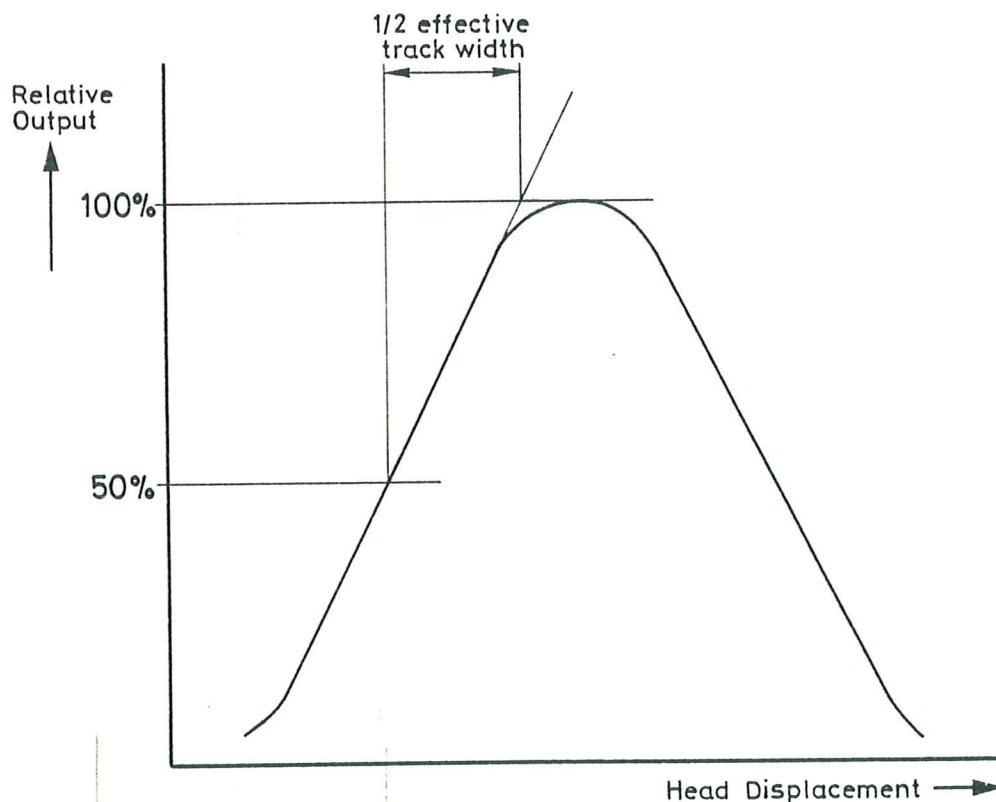
APPENDIX E

EDC IMPLEMENTATION

The figure below shows the feedback connections of a shift register which may be used to generate the EDC bytes.

Prior to the operation, all positions of the shift register are set to ONE. Input data are added (exclusive OR) to the contents of position C_{15} of the register to form a feedback. This feedback is in its turn added (exclusive OR) to the contents of position C_4 and position C_{11}.

On shifting, the outputs of the exclusive OR gates are entered respectively into positions C_0, C_5 and C_{12}. After the last data bit has been added, the register is shifted once more as specified above.

The register then contains the EDC bytes.

If further shifting is to take place during the writing of the EDC bytes, the control signal inhibits exclusive OR operations.

To check for errors when reading, the data bits are added into the shift register in exactly the same manner as they were during writing, After the data the EDC bytes are also entered into the shift register as if they were data. After the final shift, the register contents will be all ZERO if the record does not contain errors.