# ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

## STANDARD ECMA-54

# DATA INTERCHANGE ON 200 mm FLEXIBLE DISK CARTRIDGES USING TWO-FREQUENCY RECORDING AT 13262 ftprad ON ONE SIDE

2nd Edition – January 1982

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European Computer Manufacturers Association
114 Rue du Rhône – 1204 Geneva (Switzerland)

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# BRIEF HISTORY

Technical Committee TC19 of ECMA began work on the standardization of flexible disk cartridges in 1974 and issued in January 1978 the first edition of this Standard ECMA-54. Several drafts for further standards were developed and submitted to ISO/TC97/SC11 as proposals for international standards. As a result ECMA has issued four more standards for different types of flexible disk cartridges:

ECMA-59 : Data Interchange on 200 mm Flexible Disk Cartridges using Two-Frequency Recording at 13262 ftprad on Both Sides

ECMA-66 : Data Interchange on 130 mm Flexible Disk Cartridges using Two-Frequency Recording at 7958 ftprad on One Side

ECMA-69 : Data Interchange on 200 mm Flexible Disk Cartridges using MFM Recording at 13262 ftprad on Both Sides

ECMA-70 : Data Interchange on 130 mm Flexible Disk Cartridges using MFM Recording at 7958 ftprad on Both Sides

They are technically identical with the corresponding ISO draft international standards. Together with two standards specifying labelling and file structure:

ECMA-58 : 200 mm Flexible Disk Cartridge Labelling and File Structure for Information Interchange

ECMA-67 : 130 mm Flexible Disk Cartridge Labelling and File Structure for Information Interchange

these standards provide for full data interchange on the specified types of flexible disk cartridges.

In the compilation of these standards it has been necessary to make studies of the dimensions and physical properties of the cartridge, the standardization and control of signal levels, the format along a track and for the whole disk, and the recognition of faulty areas. Whilst some aspects require further investigation it has been decided to publish these standards in their present form to meet the needs of users and industry; it is intended that these aspects shall be reviewed for the next editions. Nonetheless, it was felt that all advancements achieved in the past four years should already now be incorporated in a new edition of Standard ECMA-54. This 2nd Edition, together with the standards listed above, completes the set of standards issued by ECMA up to now.

This 2nd Edition of Standard ECMA-54 has been passed by the General Assembly of ECMA on Dec. 10, 1981. It supersedes the 1st Edition dated January 1978.

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SECTION I

# GENERAL DESCRIPTION AND DEFINITIONS

## SCOPE AND CONFORMANCE

### SCOPE

This Standard ECMA-54 specifies the mechanical, physical and magnetic characteristics of a 200 mm flexible disk cartridge recorded on one side to provide physical interchangeability between data processing systems. It also specifies the quality of the recorded signals, the track layout and the track format. Together with the labelling system specified in Standard ECMA-58, this track format affords for full data interchange between data processing systems.

### CONFORMANCE

A 200 mm flexible disk cartridge recorded on one side is in conformance with this Standard if it meets all mandatory requirements of this Standard.

## 1. GENERAL DESCRIPTION

### 1.1 General Figures

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

- Fig. 1 shows the cartridge seen from above, Side 0 up,
- Fig. 2 is a cross-section, along line II-II in Fig. 1,
- Fig. 3 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 sheets 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. See also Appendix E.

### 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/output 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 Reference Flexible Disk Cartridge for Recording Field and Signal Amplitude

A Reference Flexible Disk Cartridge selected as a standard for Recording Field and Signal Amplitude.

*NOTE 1:*

*The Master Standard for Signal Amplitude has been established by the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany. Secondary Reference Flexible Disk Cartridges can be ordered from PTB under number RM 5654 as long as available.*

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 of the Average Signal Amplitude when taken as a function of the Recording Field at the specified track and flux transition frequency of that flexible disk cartridge.

1.5.6 Reference Field

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

1.5.7 Test Recording Currents

The two recording currents between 145% and 155% of the currents which produce the Reference Field at 250 000 ftps on tracks 00 and 76 respectively. For each side, the first of these currents shall be used for recording on tracks 00 to 43 and the second shall be used for recording on tracks 44 to 76.

1.5.8 Standard Reference Amplitudes

The Standard Reference Amplitudes (SRA) are the Average Signal Amplitudes derived from the Signal Amplitude Reference Flexible Disk Cartridge. $SRA_{1f}$ is the Average Signal Amplitude from a recording on track 00 using 250 000 ftps and $SRA_{2f}$ is the Average Signal Amplitude from a recording on track 76 using 500 000 ftps.

1.5.9 Average Signal Amplitude

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 In Contact

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 Direction of Rotation

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

1.5.12 Formatting

Writing the proper control information establishing the 77 physical tracks and designating addresses of physical records on the flexible disk's surfaces.

1.5.13 Initialization

Writing of the Volume Label, the ERMAP label, and any other information initially required to be on the flexible disk cartridge, prior to the commencement of general processing or use.

SECTION II

# MECHANICAL AND PHYSICAL CHARACTERISTICS

# 2. GENERAL REQUIREMENTS

## 2.1 Environment and Transportation

### 2.1.1 Testing Environment

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

| | |
|---|---|
| Temperature | : (23 ± 2) °C |
| RH | : 40% to 60% |
| Conditioning before testing | : 24 hours minimum |

The temperature and the RH shall be measured in the air immediately surrounding the cartridge.

The stray magnetic field at any point on the disk surface including that resulting from the concentrating effect of the recording head, 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 °C to 50 °C |
| RH | : 20% to 80% |
| Wet bulb temperature | : less than 29 °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 °C per hour.

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

The stray magnetic field at any point on the disk surface, including that resulting from the concentrating effect of the recording head, 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 °C to 53 °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 2*

*Cartridges which have been exposed to 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 Transportation

Responsibility for ensuring that adequate precautions are taken during transport shall be with the sender. During the transport the cartridge shall be in its envelope, and in a protective package. The latter must be free from dust or extraneous matter. It must have a clean 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 that the following conditions should not be exceeded:

| | |
|---|---|
| Temperature | : -40 °C to 53 °C |
| Maximum rate of temperature change | : 20 °C per hour |
| RH | : 8% to 90% |

2.1.5 Handling

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 Materials

2.2.1 Jacket

The jacket may be constructed from any suitable material.

2.2.2 Liner

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

2.2.3 Disk

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. $\gamma$-$Fe_2O_3$).

2.2.4 Envelope

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

3. DIMENSIONAL CHARACTERISTICS

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

Fig. 4 shows the jacket,

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

Fig. 6 shows the disk,

Fig. 7 shows a cross-section of the disk.

All the 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

$\ell_1$ = 203,2 mm ± 0,4 mm

### 3.1.2 Thickness

3.1.2.1 In an area defined by

$r_1$ = 60 mm

$r_2$ = 85 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 mm ± 0,15 mm

3.1.2.2 The overall thickness of the cartridge shall be (see also 3.1.7):

1,2 mm < $e_2$ < 2,1 mm, measured according to Appendix B.

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

### 3.1.3 Central windows

The central windows shall have a diameter

$d_1$ = 58,40 mm ± 0,15 mm

The position of their centre is defined by

$\ell_2$ = 101,6 mm ± 0,3 mm

### 3.1.4 Index windows

Location

The centre of the index windows shall be defined by

$\ell_3$ = 96,50 mm ± 0,25 mm

$\ell_4$ = 139,40 mm ± 0,25 mm

Diameter

The diameter of the index windows shall be

$d_2$ = 7,7 mm ± 0,1 mm

3.1.5 Head windows

Location

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

$\ell_5$ = 3,70 mm ± 0,25 mm

Dimensions

The width of the head windows shall be

$\ell_6$ = 12,7 mm ± 0,1 mm

The nominal radius of their ends shall be

$r_3$ = 6,35 mm

Their length shall be

$\ell_7$ = 52,60 mm ± 0,25 mm

3.1.6 Reference Edge Profile

Within an area defined by

$\ell_8$ = 25 mm

the Reference Edge shall have a convex profile, e.g. be rounded off with one or more radii of 0,5 mm minimum.

3.1.7 Construction of the jacket

If the jacket utilizes flaps, their width shall be

$\ell_9$ = 14 mm max.

The total thickness $e_2$ of the cartridge with flaps shall satisfy the conditions of 3.1.2. The thickness of the flaps shall be at most 0,9 mm.

3.1.8 Notches

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

$\ell_{10}$ = 81,6 mm min

$\ell_{11}$ = 94,6 mm max

$\ell_{12}$ = 108,6 mm min

$\ell_{13}$ = 121,6 mm max

$\ell_{14}$ = 2,0 mm max

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 0,2 mm into the openings of the jacket.

## 3.3 Disk

### 3.3.1 Diameters

The external diameter of the disk shall be

$d_3$ = 200,2 mm ± 0,2 mm

The inner diameter of the disk shall be

$d_4$ = 38,100 mm ± 0,025 mm

### 3.3.2 Thickness

The thickness of the disk shall be

$e_3$ = 0,080 mm ± 0,010 mm

### 3.3.3 Index hole

Location

The location of the index hole shall be defined by

$r_4$ = 38,1 mm ± 0,1 mm

Diameter

The diameter of the index hole shall be

$d_5$ = 2,54 mm ± 0,10 mm

### 3.3.4 Recording area

The recording area shall be defined by

$r_5$ = 51,3 mm max

$r_6$ = 92,0 mm min

### 3.3.5 Sides

For convenience of description the two sides are defined as side 0 and side 1; they are shown in Figs. 1-4 and Fig. 8.

# 4. PHYSICAL CHARACTERISTICS

## 4.1 Flammability

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

## 4.2 Coefficient of linear thermal expansion of the disk

The coefficient of thermal expansion of the disk shall be

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

## 4.3 Coefficient of linear hygroscopic expansion of the disk

The coefficient of hygroscopic expansion of the disk shall be

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

## 4.4 Opacity

### 4.4.1 Opacity of the jacket

The jacket shall have a light transmittance of less than 0,5% using an LED with a nominal wavelength of 900 nm as the radiation source when measured according to Appendix A.

### 4.4.2 Opacity of the disk

The disk shall have a light transmittance of less than 0,5% using an LED with a nominal wavelength of 900 nm as the radiation source when measured according to Appendix A.

## 4.5 Torque

### 4.5.1 Starting torque

The starting torque, without head and pads loaded to the cartridge, shall not exceed 0,042 N.m.

### 4.5.2 Running torque

When the disk is rotating at a speed of 360 rpm ± 7 rpm with a pressure pad of 690 $mm^2$ ± 10 $mm^2$ surface applied to the cartridge with a force of 1,50 N ± 0,05 N and located parallel to the head window as defined in Fig. 8 by

$\ell_{15}$ = 62,0 mm

$\ell_{16}$ = 75,0 mm

$\ell_{17}$ = 10,0 mm

$\ell_{18}$ = 64,0 mm

the torque necessary to rotate the disk shall be between 0,028 N.m and 0,088 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 77 discrete concentric tracks on side 0 of the disk in the recording area (3.3.4).

### 5.1.2 Width of tracks

The recorded track width on the disk surface shall be

0,300 mm ± 0,020 mm

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

### 5.1.3 Track locations

#### 5.1.3.1 Nominal locations

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

$$R_n = 51{,}537 \text{ mm} + \left[\frac{76 - n}{48}\right] . 25{,}4 \text{ mm}$$

where n is the track number: n = 00 to 76

#### 5.1.3.2 Track location tolerance

The centrelines of the 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 76) which identifies the tracks consecutively, starting at the outermost track (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 following tests the same drive unit shall be used for the writing and reading operations both for the disk under test and for the Signal Amplitude Reference Flexible Disk Cartridge.

### 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 360 rpm ± 7 rpm. The test frequencies used shall be:

1f = 250 000 ftps ± 250 ftps

2f = 500 000 ftps ± 500 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 on track 00 and on track 76 using 1f.

5.2.1.3 Average Signal Amplitude

When the disk under test has been recorded with the first Test Recording Current on track 00 and with the second Test Recording Current on track 76, then read back and compared with the Signal Amplitude Reference Flexible Disk Cartridge recorded under the same conditions and on the same system, the Average Signal Amplitude shall be:

on track 00, using 1f : less than 130% of $SRA_{1f}$,

on track 76, using 2f : more than 80% of $SRA_{2f}$.

5.2.1.4 Resolution

After recording, using the second Test Recording Current, on track 76, the ratio:

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

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

5.2.1.5 Overwrite

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

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

shall be less than 100% 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:

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

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 of the minimum amplitudes. Output voltages shall be measured peak-to-peak; averaging shall be done over about 2000 consecutive flux transitions.

On track 00 using 1f and the first Test Recording Current, and on track 76 using 2f and the second Test Recording Current, modulation shall be less than 10%.

5.2.2 Track quality tests

These tests shall be carried out using 2f and over all 77 usable tracks at the defined positions. The appropriate Test Recording Currents shall be used.

5.2.2.1 Missing pulse

When a track has been recorded with the appropriate 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

When a track has been erased for five revolutions with a constant direct current equivalent to the quiescent value of the appropriate Test Recording Current, any playback signal, when measured base-to-peak, including the statistical noise and the residual signal of the disk, which exceeds 30% of half the Average Signal Amplitude at 2f 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 media 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 shall be within ± 0,085 mm of the nominal positions, when measured in the testing environment (2.1.1). 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 transitions may have an angle of $0^{o} \pm 18'$ 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 13262 flux transitions per radian. The resulting nominal spacing between two clock flux transitions, the nominal bit cell length, is 151 microradians.

6.1.4.2 The long-term average bit cell length shall be the average bit cell length measured over a sector.

6.1.4.2.1 As initially received from the media supplier, the flexible disk cartridge shall be formatted with a long-term average bit cell length within ± 1% of the nominal bit cell length.

6.1.4.2.2 For data interchange the long-term average bit cell length for each sector shall be within ± 3% of the nominal bit cell length.

*NOTE 3*

*It is recognized that at extremes of supply frequency encountered on computer sites the deviation may be ± 5% in exceptional circumstances. Successful data interchange may then still be possible provided that formatting of the cartridge and subsequent writing of data are not carried out at the opposite limits of this range. (See Appendix F.2).*

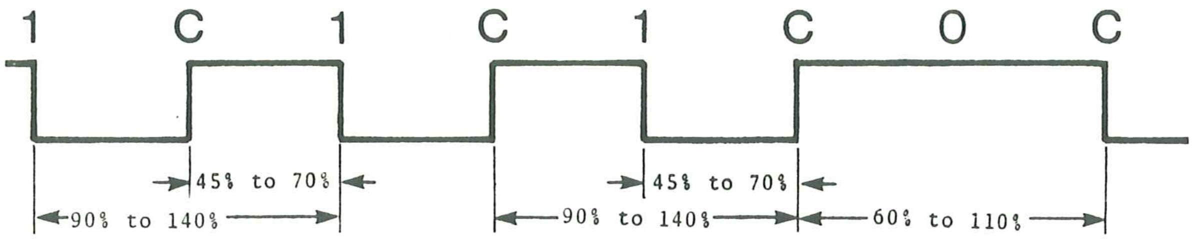
6.1.4.3 The short-term average bit cell length, referred to a particular bit cell, shall be the average of the lengths of the preceding eight bit cells. It shall be within ± 8% of the long-term average bit cell length.

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 cartridge shall be less than 160% of $SRA_{1f}$ and more than 40% of $SRA_{2f}$.

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

Each track shall be divided into 26 sectors.

6.1.9 Sector number

The sector number shall be a two-digit decimal number from 01 to 26 identifying each sector. Sectors may or may not be recorded in the natural order (see 6.3.4.2.2.3).

6.1.10 Hexadecimal notation

Hexadecimal notation is used hereafter to denote the following bytes:

(00) for ($B_8$ to $B_1$) = 00000000

(FF) for ($B_8$ to $B_1$) = 11111111

(FC)* for ($B_8$ to $B_1$) = 11111100

where the clock transitions of $B_6$ and $B_4$ are missing

(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)

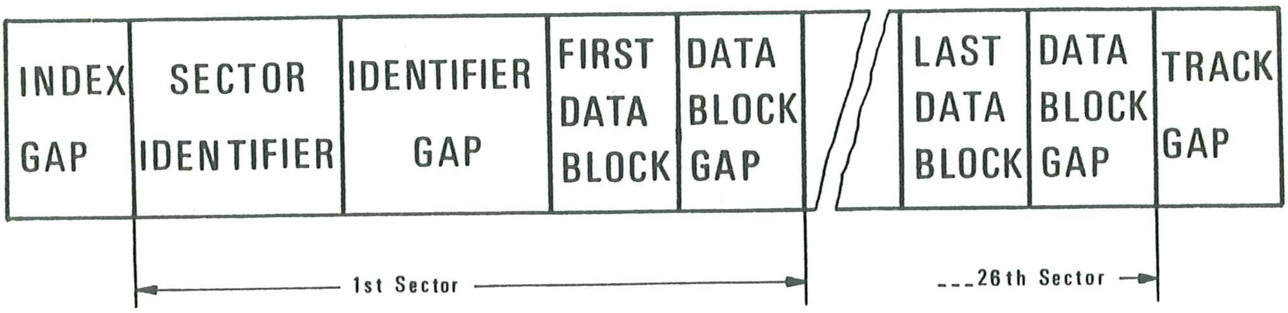
The two EDC-bytes are hardware generated by shifting serially the relevant bits, specified later for each part of the track through a 16-bit shift register described by the generator polynomial:

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

(See also Appendix D).

## 6.2 Detailed Description of Track Layout after First Formatting

After first formatting there shall be 26 usable sectors on each track. The layout of the track shall be as follows:




### 6.2.1 Index Gap

This field shall comprise 73 bytes as follows:

40 (FF) 6 (00) 1 (FC)* 26 (FF)

Writing the Index Gap commences when the Index hole is detected. Writing the track is terminated when the Index hole is detected for the second time.

Inconsistent detection and the finite time required to turn off the Write Current may result in any of the first 20 bytes being corrupted (see Appendix F.3).

6.2.2 Sector Identifier

This field shall be as follows:

| SECTOR IDENTIFIER | | | | | | |
|---|---|---|---|---|---|---|
| IDENTIFIER MARK | | ADDRESS IDENTIFIER | | | | |
| | | T | 2nd Byte | S | 4th Byte | EDC |
| 6 Bytes (00) | 1 Byte (FE)* | 1 Byte | (00) | 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)

This byte shall specify in binary notation the track address from 00 for the outermost track to 76 for the innermost track.

6.2.2.2.2 2nd Byte

This byte shall always be a (00)-byte.

6.2.2.2.3 Sector Number (S)

This byte shall specify in binary notation the sector number from 01 to 26.

The 26 sectors shall be numbered in the natural order: 1, 2, 3, ..., 25, 26.

6.2.2.2.4 4th byte of the Sector Address

This 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. (see Appendix F.4)

6.2.4 Data Block

This field shall be as follows:

| DATA BLOCK | | | |
|---|---|---|---|
| DATA MARK | | DATA FIELD | EDC |
| 6 Bytes (00) | 1 Byte (FB)* | 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 6.3.4.2.4.2).

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 27 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 (see Appendix F.5).

6.2.6 Track Gap

This field shall follow the Data Block Gap of the 26th sector. At nominal density it should comprise 247 (FF)-bytes. Writing of the Track Gap takes place until the Index hole is detected, unless it has been detected during writing of the last Data Block Gap, in which case there shall be no Track Gap (see Appendix F.6).

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

6.3.1 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-position $B_8$ 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 | $B_8$ | $B_7$ | $B_6$ | $B_5$ | $B_4$ | $B_3$ | $B_2$ | $B_1$ |

6.3.2 Good and bad tracks

A good track is a track which has been formatted according to 6.3.4.

A bad track is a track which has been formatted according to 6.3.5.

6.3.3 Requirements for tracks

Track 00 shall have no defective sectors, i.e. the 7th byte of the Data Mark of each sector shall be:

- a (FB)*-byte, or
- a (F8)*-byte, in which case the first character of the Data Field shall be CAPITAL LETTER D,

according to the use of the sectors as specified in Standard ECMA-58, 200 mm Flexible Disk Cartridge Labelling and File Structure for Information Interchange.

There shall be at least 74 good tracks between track 01 and track 76.

6.3.4 Layout of a good track

6.3.4.1 Index Gap
Description: see 6.2.1.

6.3.4.2 Sector Identifier

6.3.4.2.1 Identifier Mark

Description: see 6.2.2.1

6.3.4.2.2 Address Identifier

This field shall comprise 6 bytes.

6.3.4.2.2.1 Track Address (T)

This field shall specify in binary notation the track address from 00 for the outermost track to 76 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 address numbering continues sequentially with the next good track. In this case the subsequent track addresses differ by 1 (or 2) from the track number.

6.3.4.2.2.2 Byte

Description: see 6.2.2.2.2

6.3.4.2.2.3 Sector Number (S)

The 3rd byte shall specify in binary notation the sector number from 01 to 26. The 26 sectors can be numbered in one of the following 13 different sequences.

*NOTE 4*

*Each column of the table below is identified by a two-digit number from 01 to 13. Standard ECMA-58, Labelling and File Structure of 200 mm Flexible Disk Cartridges, specifies a field called Sector Sequence Indicator in character positions 77-78 of the VOL1 Label, in which this two-digit number identifying the order in which the sectors are numbered is to be entered.*

*NOTE 5*

*The table lists vertically the sector numbers of the sectors as they appear sequentially on the track. For example, for order 08, the first sector of the track bears sector number 01, the following one bears sector number 09, the third one bears sector number 17, and so on until the twenty sixth sector which bears sector number 24.*

*NOTE 6*

*After first formatting the sectors are numbered in the natural order, the use of the other possible 12 sequences requires reformatting.*

| | Sector Sequence Indicator | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 |
| Position of the sectors on the track | Sequence of the Sector Numbers | | | | | | | | | | | | |
| 1ST | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 | 01 |
| 2ND | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 |
| 3RD | 03 | 05 | 07 | 09 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 02 |
| 4TH | 04 | 07 | 10 | 13 | 16 | 19 | 22 | 25 | 02 | 02 | 02 | 02 | 15 |
| 5TH | 05 | 09 | 13 | 17 | 21 | 25 | 02 | 02 | 11 | 12 | 13 | 14 | 03 |
| 6TH | 06 | 11 | 16 | 21 | 26 | 02 | 09 | 10 | 20 | 22 | 24 | 26 | 16 |
| 7TH | 07 | 13 | 19 | 25 | 02 | 08 | 16 | 18 | 03 | 03 | 03 | 03 | 04 |
| 8TH | 08 | 15 | 22 | 02 | 07 | 14 | 23 | 26 | 12 | 13 | 14 | 15 | 17 |
| 9TH | 09 | 17 | 25 | 06 | 12 | 20 | 03 | 03 | 21 | 23 | 25 | 04 | 05 |
| 10TH | 10 | 19 | 02 | 10 | 17 | 26 | 10 | 11 | 04 | 04 | 04 | 16 | 18 |
| 11TH | 11 | 21 | 05 | 14 | 22 | 03 | 17 | 19 | 13 | 14 | 15 | 05 | 06 |
| 12TH | 12 | 23 | 08 | 18 | 03 | 09 | 24 | 04 | 22 | 24 | 26 | 17 | 19 |
| 13TH | 13 | 25 | 11 | 22 | 08 | 15 | 04 | 12 | 05 | 05 | 05 | 06 | 07 |
| 14TH | 14 | 02 | 14 | 26 | 13 | 21 | 11 | 20 | 14 | 15 | 16 | 18 | 20 |
| 15TH | 15 | 04 | 17 | 03 | 18 | 04 | 18 | 05 | 23 | 25 | 06 | 07 | 08 |
| 16TH | 16 | 06 | 20 | 07 | 23 | 10 | 25 | 13 | 06 | 06 | 17 | 19 | 21 |
| 17TH | 17 | 08 | 23 | 11 | 04 | 16 | 05 | 21 | 15 | 16 | 07 | 08 | 09 |
| 18TH | 18 | 10 | 26 | 15 | 09 | 22 | 12 | 06 | 24 | 26 | 18 | 20 | 22 |
| 19TH | 19 | 12 | 03 | 19 | 14 | 05 | 19 | 14 | 07 | 07 | 08 | 09 | 10 |
| 20TH | 20 | 14 | 06 | 23 | 19 | 11 | 26 | 22 | 16 | 17 | 19 | 21 | 23 |
| 21ST | 21 | 16 | 09 | 04 | 24 | 17 | 06 | 07 | 25 | 08 | 09 | 10 | 11 |
| 22ND | 22 | 18 | 12 | 08 | 05 | 23 | 13 | 15 | 08 | 18 | 20 | 22 | 24 |
| 23RD | 23 | 20 | 15 | 12 | 10 | 06 | 20 | 23 | 17 | 09 | 10 | 11 | 12 |
| 24TH | 24 | 22 | 18 | 16 | 15 | 12 | 07 | 08 | 26 | 19 | 21 | 23 | 25 |
| 25TH | 25 | 24 | 21 | 20 | 20 | 18 | 14 | 16 | 09 | 10 | 11 | 12 | 13 |
| 26TH | 26 | 26 | 24 | 24 | 25 | 24 | 21 | 24 | 18 | 20 | 22 | 24 | 26 |

6.3.4.2.2.4 4th byte of the Sector Address

Description: see 6.2.2.2.4

6.3.4.2.2.5 EDC

Description: see 6.2.2.2.5

6.3.4.2.3 Identifier Gap

Description: see 6.2.3. These bytes may subsequently become corrupted due to the overwriting process.

6.3.4.2.4 Data Block

6.3.4.2.4.1 Data Mark

This field shall comprise:

6 (00)-bytes
1 byte

The 7th byte shall be either:

(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-58, 200 mm Flexible Disk Cartridge Labelling and File Structure for Information Interchange.

6.3.4.2.4.2 Data Field

This field shall comprise 128 bytes

If it comprises less than 128 data bytes, the remaining positions shall be filled with (00)-bytes.

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

6.3.4.2.4.3 EDC

Description: see 6.2.4.3

If the last 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.

On Track 00, CAPITAL LETTER D, only, is allowed.

6.3.4.2.5 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 27 (FF)-bytes. These bytes may subsequently become corrupted due to the overwriting process.

6.3.4.2.6 Track Gap

Description: see 6.2.6

6.3.5 Layout of a bad track

6.3.5.1 Contents of the fields

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

6.3.5.1.1 Index Gap

This field should comprise 73 (FF)-bytes.

6.3.5.1.2 Sector Identifier

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

6.3.5.1.2.1 Identifier Mark

This field should comprise 7 bytes:

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

6.3.5.1.2.2 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 (6.3.4.2.1) of the Identifier Mark and ending with the above 4 (FF)-bytes.

6.3.5.1.3 Identifier Gap

This field should comprise 11 (FF)-bytes.

6.3.5.1.4 Data Block

This field should comprise 137 (FF)-bytes.

6.3.5.1.5 Data Block Gap

This field should comprise 27 (FF)-bytes.

6.3.5.1.6 Track Gap

Description: see 6.2.6

6.3.5.2 Requirements for bad tracks

At least one of the Sector Identifiers of a bad track shall have the content specified in 6.3.5.1.2. If this condition is not satisfied the cartridge shall be rejected. All other fields of these tracks can be corrupted.

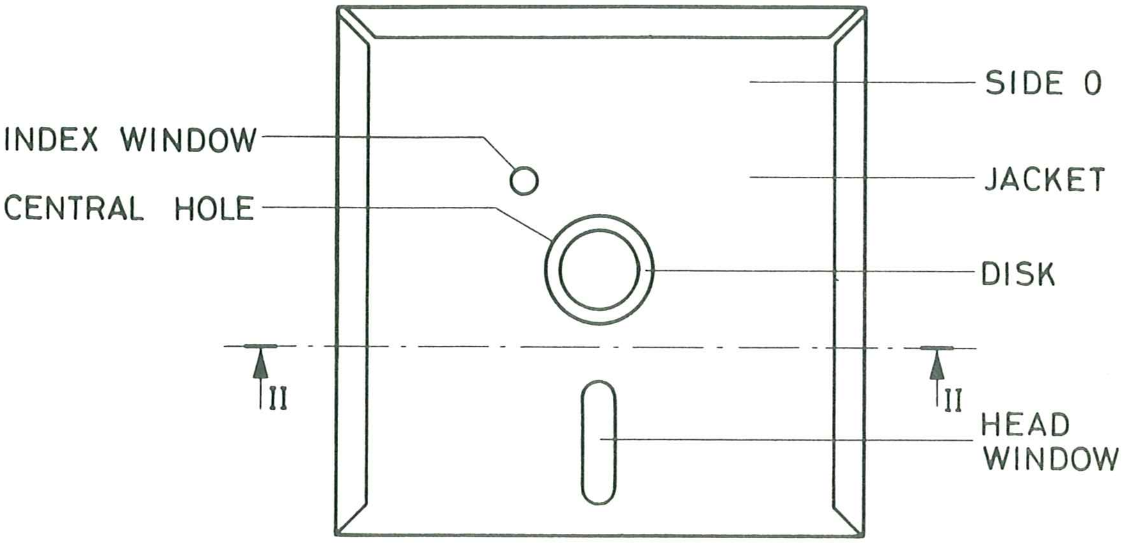



FIG. 1

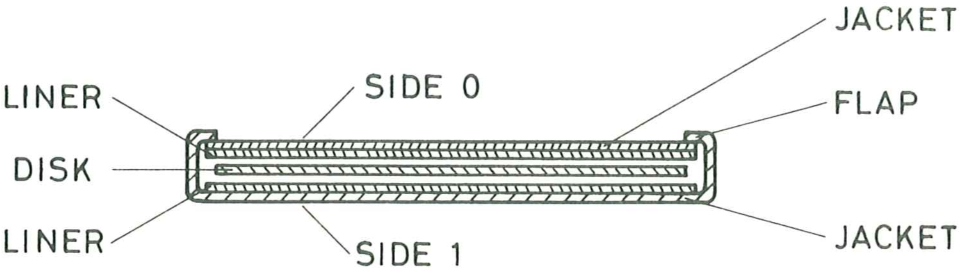



FIG. 2

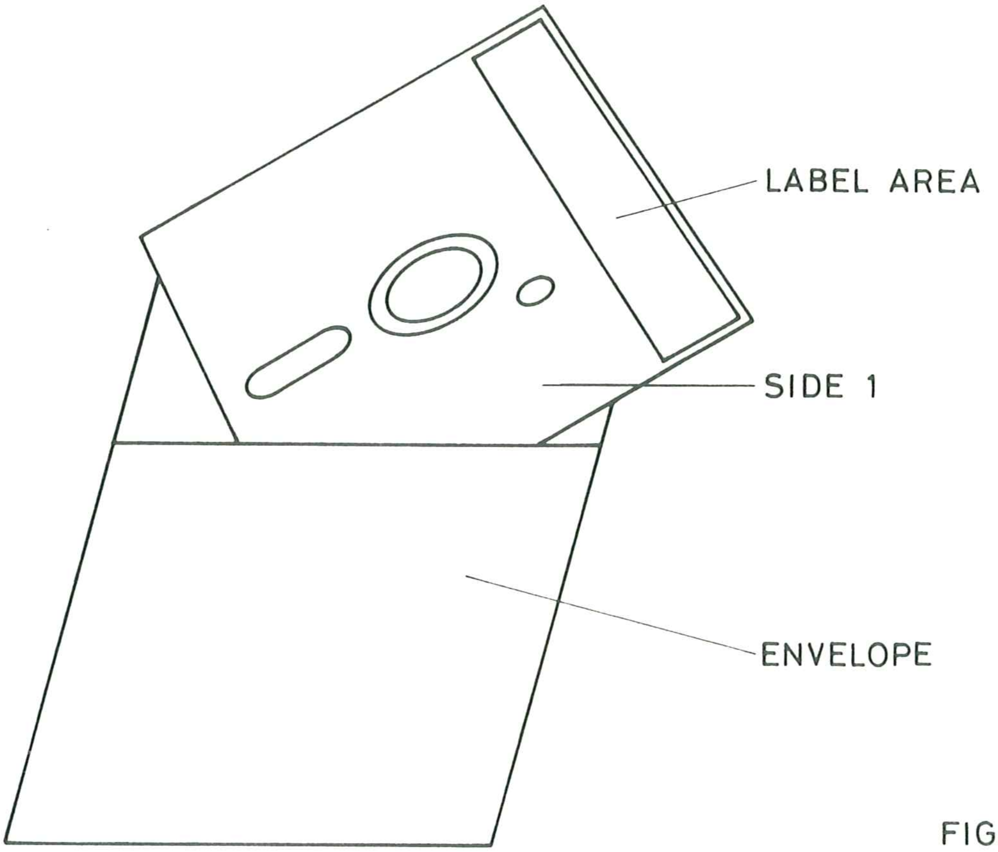
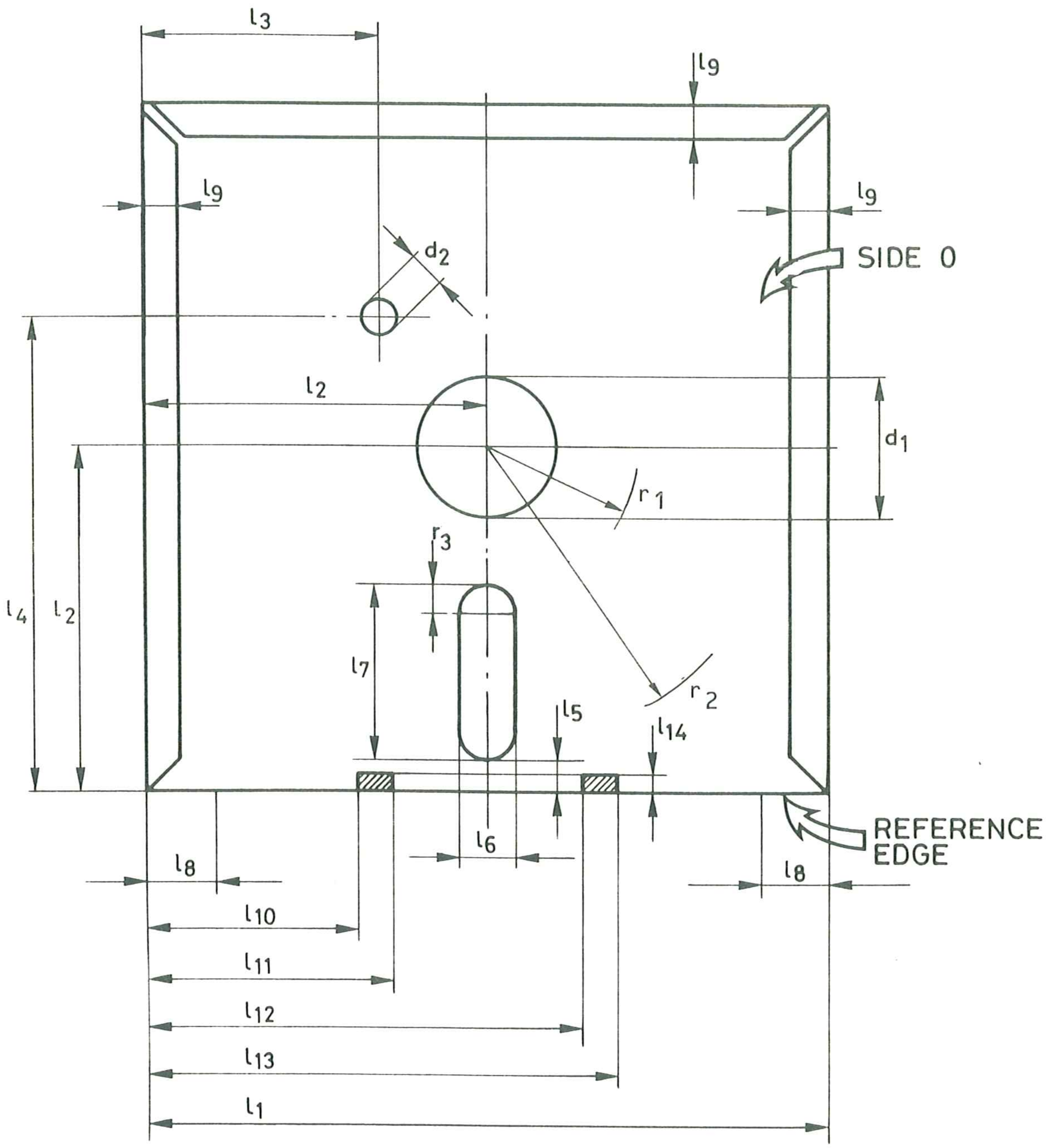



FIG. 3



l3
l9
l9
l9
d2
SIDE 0
l2
d1
r1
r3
l4
l2
l7
r2
l5
l14
l6
REFERENCE EDGE
l8
l8
l10
l11
l12
l13
l1


FIG. 4


FIG. 5

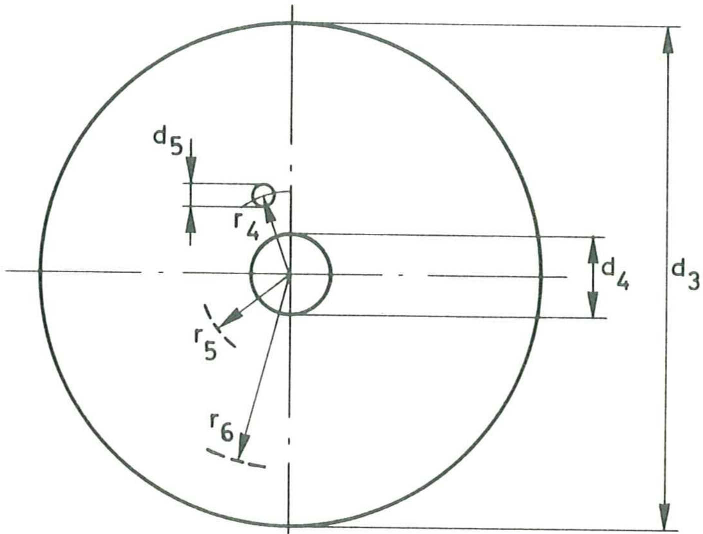



FIG. 6

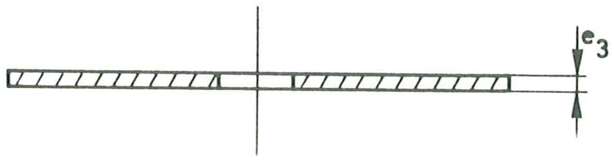



FIG. 7

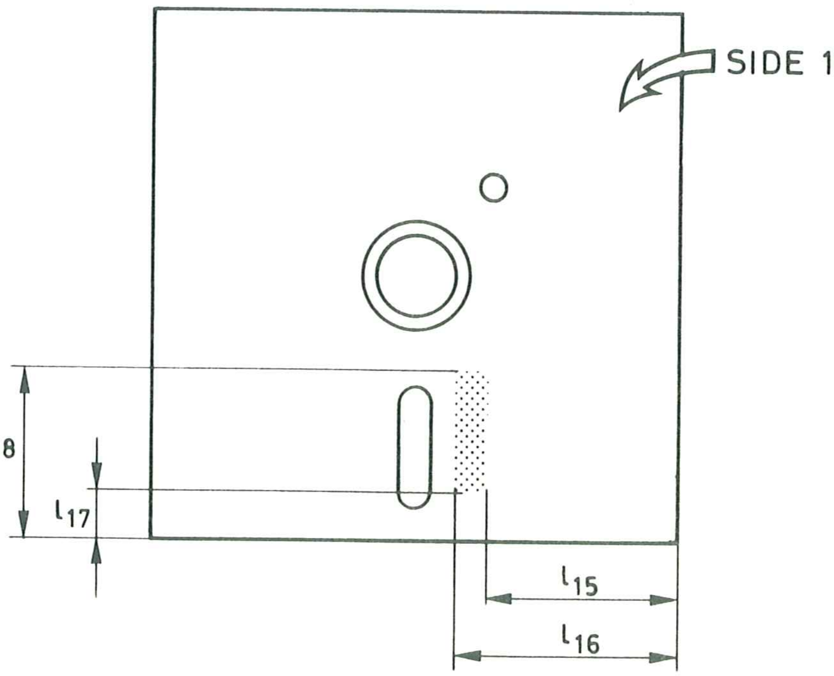



FIG. 8

# APPENDIX A

## MEASUREMENT OF LIGHT TRANSMITTANCE

### A.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 document "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.

### A.2 DESCRIPTION OF THE MEASURING EQUIPMENT

#### A.2.1 Radiation Source

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

| | | |
|---|---|---|
| Wavelength at peak emission | $\lambda_{peak}$ | = 900 nm ± 10 nm |
| Half-power band width | $b$ | = ± 25 nm |

#### A.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.

#### A.2.3 Optical Path (Fig. 1)

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

$$L_1 = \frac{d_{max}}{2 \, tg \, \alpha}$$

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

$\alpha$ 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

$$D = (2\ L_2\ \mathrm{tg}\ \alpha)\ \mathrm{mm}$$

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

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

A.2.4 Measuring Circuitry

Fig. 2 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:

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

## A.3 MEASURING METHOD

### A.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 in 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 now represents 2% transmittance.

The disk is rotated slowly for one revolution and the readings of the voltmeter are observed.

A.3.2 Measurement of the Jacket

The same procedure applies to the jacket measurement, except that the jacket without a disk must be rotated.

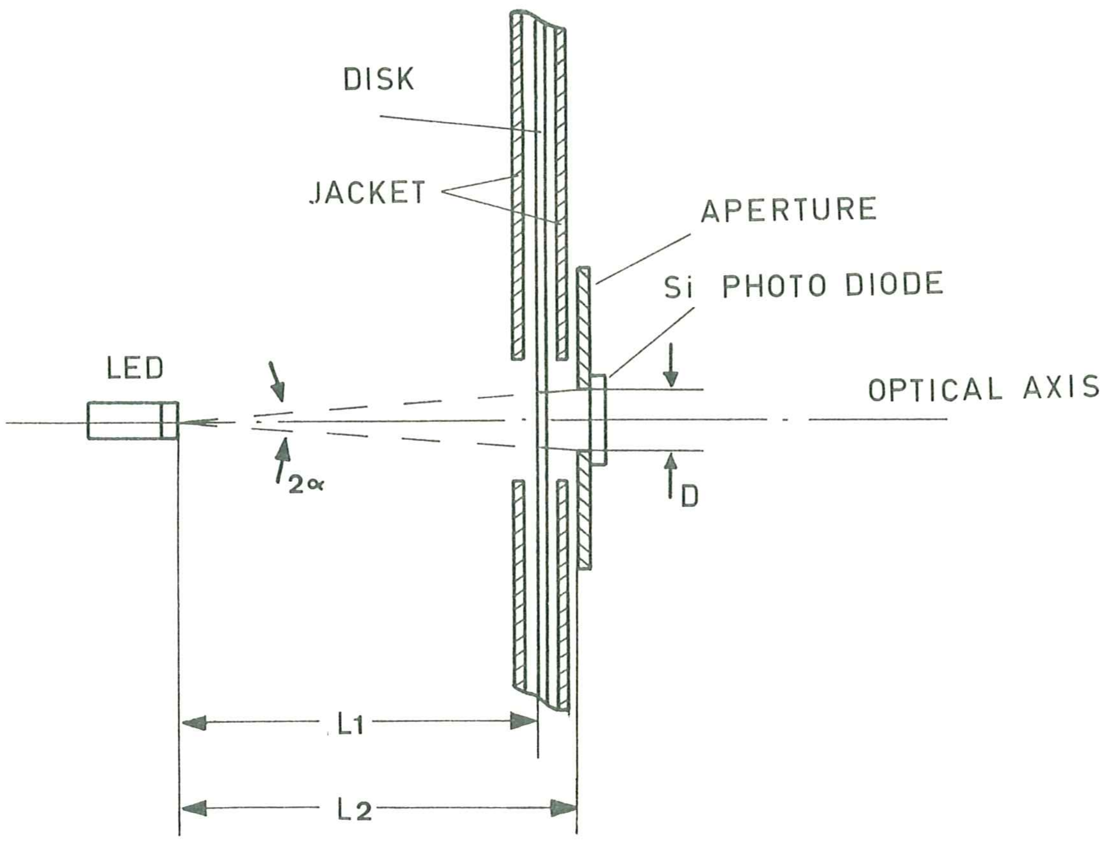



FIG. 1 MEASURING DEVICE

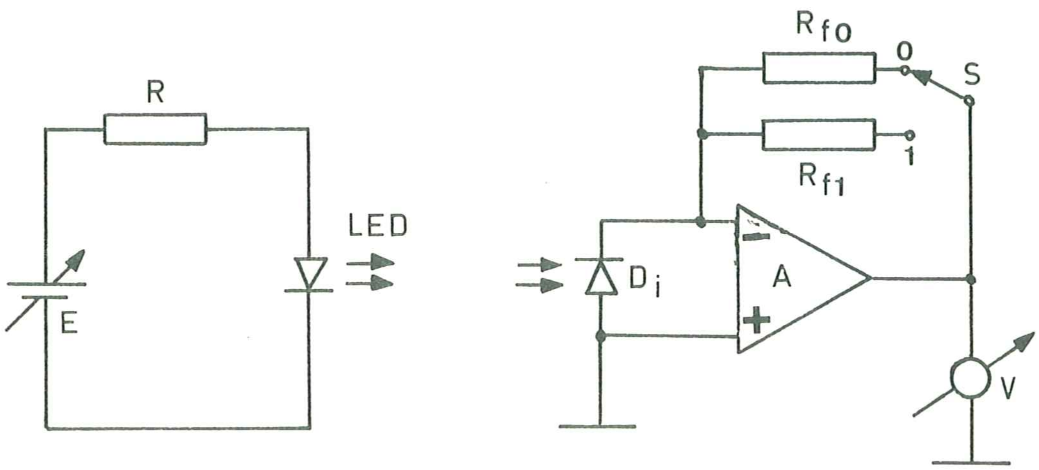



FIG. 2 ELECTRONIC CIRCUITRY

# 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 must be capable of entering the gauge for at least 15 mm when a force of 1 N max is applied on the opposite edge.

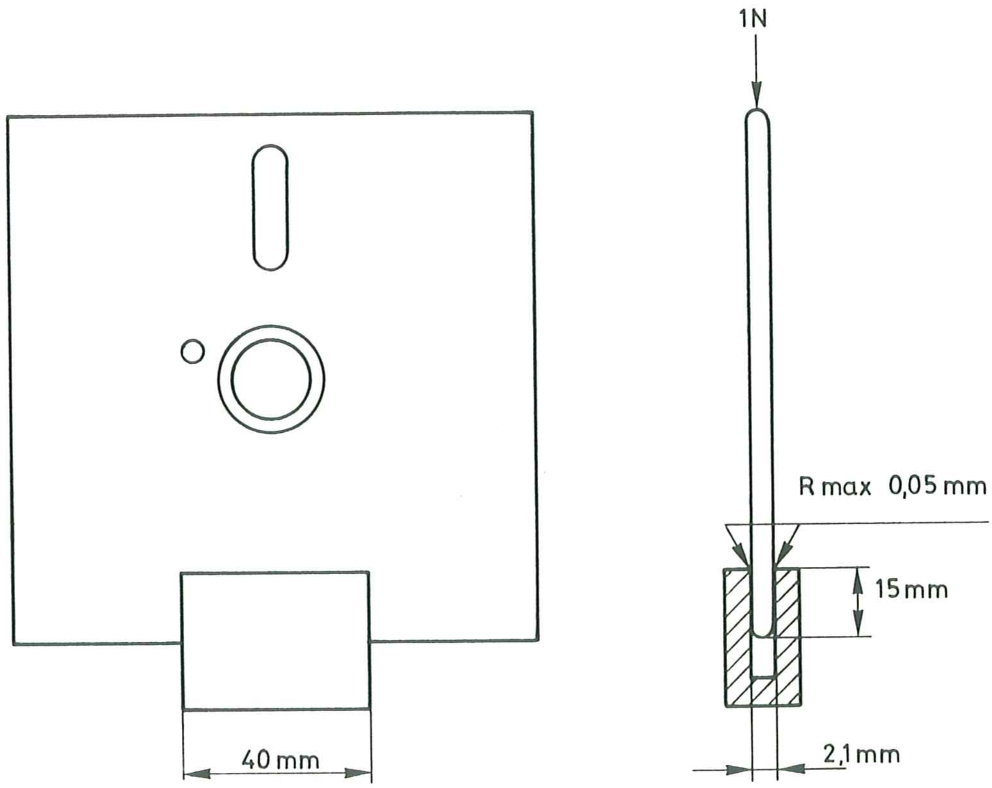



FIG. 1

## B.2 MINIMUM THICKNESS

This value shall be measured for all edges using the gauge of Fig. 2. This gauge has a length of 40 mm. When submitted to a force of 1 N the cartridge shall enter the slot by less than 1 mm.

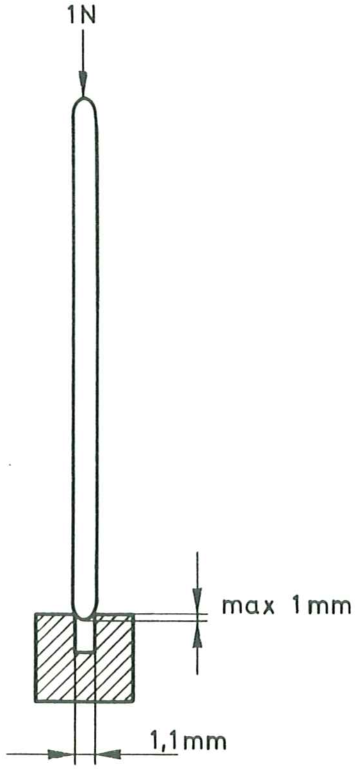



FIG. 2

## B.3 THICKNESS OF THE FLAPS (IF ANY)

This thickness shall be measured with the stylus of Fig. 3. The cartridge is placed on a horizontal surface with flaps opposite to the bottom surface.

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 contribution of the flap to the total thickness of the cartridge.

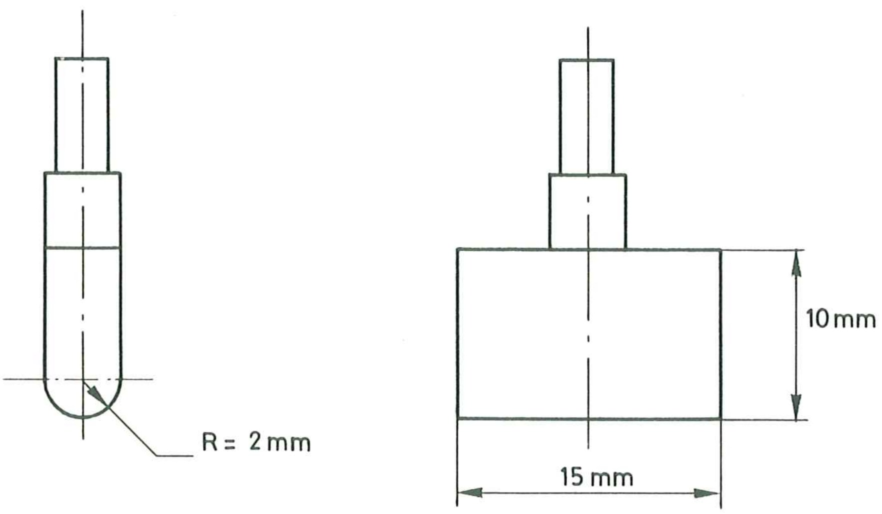


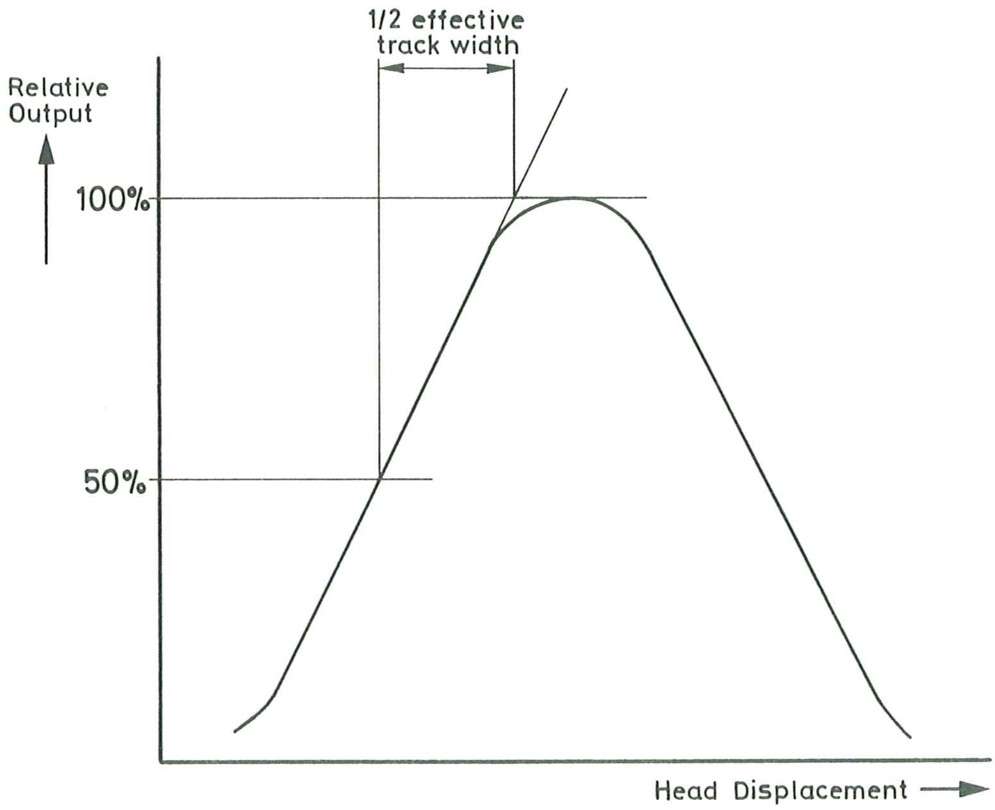

FIG. 3

# APPENDIX C

## METHOD FOR MEASURING THE EFFECTIVE TRACK WIDTH

A 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 D

## EDC IMPLEMENTATION

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

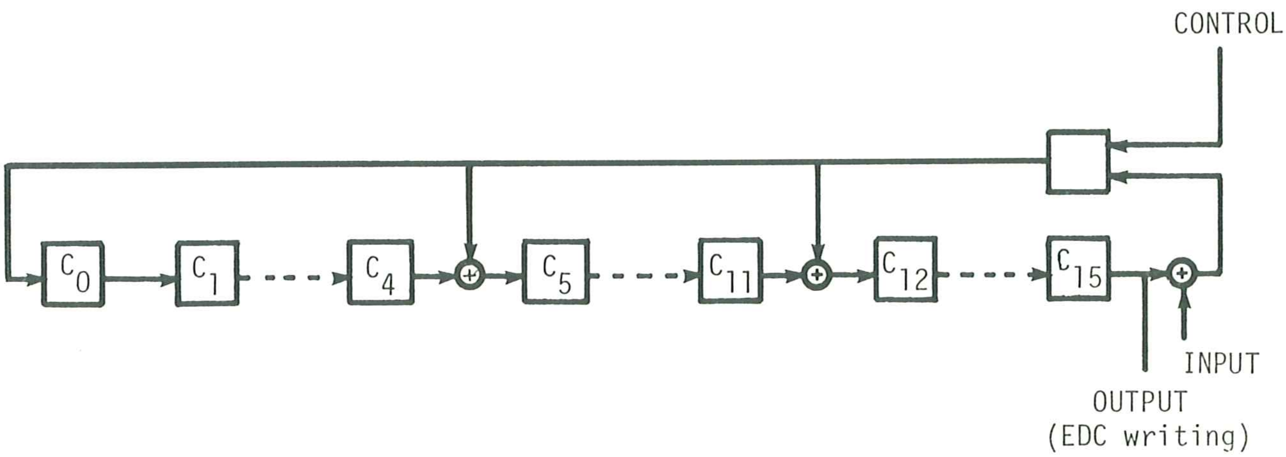
Prior to the operation, all positions of the shift register are set to ONE. Input data are added (exclusive OR) to the contents of position $C_{15}$ of the register to form a feedback. This feedback is in its turn added (exclusive OR) to the contents of position $C_4$ and position $C_{11}$.

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.



# APPENDIX E

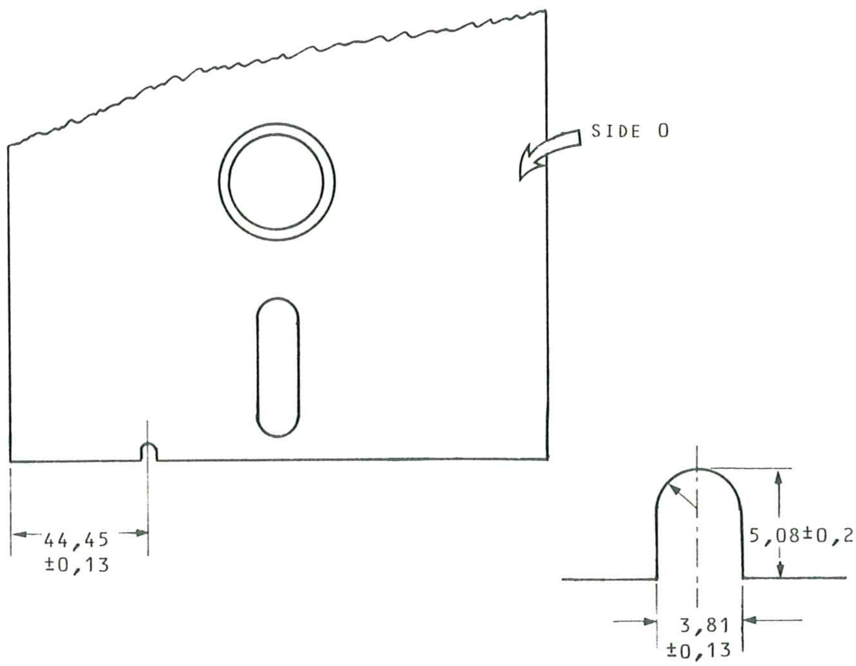
## WRITE-INHIBIT NOTCH

i) DATA INTERCHANGE

Full data interchange by means of flexible disks implies the implementation of this Standard ECMA-54 and of Standard ECMA-58 for flexible disk labelling. Write-inhibit situations are to be handled by means of the software features provided by the ECMA standard on flexible disk labelling. If a notch is present in the cartridge, the use of this hardware feature for the purpose of inhibiting writing is strictly forbidden in data interchange.

ii) OTHER APPLICATIONS

In other than data interchange applications, it might be desirable to have a hardware write-inhibit feature. In these cases it shall be a notch in the Reference Edge located and dimensioned as shown below.



# APPENDIX F

## DESCRIPTION OF THE GAPS ESTABLISHED WHEN FORMATTING, AND THE EFFECTS OF SUBSEQUENTLY WRITING DATA BLOCKS

This Appendix seeks to explain in general terms the derivation of the gap sizes and the limitations that must be observed when formatting disk cartridges and when subsequently writing data to them.

### F.1 GENERAL

The calculation of the track layout when formatting at normal disk speed is based on the following factors:

i) Disk rotational speed
ii) Write clock oscillator frequency
iii) Accuracy of detection of the Index hole
iv) Distance between Write/Read and tunnel Erase gaps
v) The effect of iv) at different radii
vi) Erase turn-on and turn-off delays
vii) Write current rise and decay times
viii) Differences between i) to vii) for the machines used when formatting a disk and when subsequently writing data.

Using a crystal oscillator (ii) may be ignored. All the other factors play a significant part in one or more of the calculations and are considered qualitatively below. Speed changes affect all parts of the calculations and are considered more quantitatively.

### F.2 EFFECTS OF DISK SPEED

Although Section 6.1 of the Standard defines the *density* of recording, it is more convenient here to consider the effects of changes in disk rotational *speed*.

Satisfactory operation is not entirely limited by the speed deviation when formatting or when subsequently writing the data, but by the *change* of speed between the two operations. This speed *change* is limited to ± 6% both for calculation of the format and to enable the PLO, where used, during reading to follow the change in data rate between Sector Identifier and Data Mark.

Thus, if the disk is formatted with a maximum deviation from nominal speed of ± 1%, then the data may be written with a deviation of ± 5%.

If the disk is formatted with a deviation of ± 3%, then data should never be written with a deviation of more than ± 3%.

F.3 INDEX GAP

Writing the format commences when Index is detected; the edges of the written track are then erased to ensure that any earlier recordings cannot interfere with the reading of the track. The erase gap trails behind the write gap.

Writing the format ceases when Index is again detected; erasing continues for a time long enough to ensure that all the track edges are erased.

As detection of the Index hole may be inconsistent, as turning off the write current takes a finite time, and as the effect of the delay of turning off the erase current changes with the track radius, the first few bytes of the Index Gap may be corrupted.

F.4 IDENTIFIER GAP

The writing of a Data Block is initiated by successfully reading the appropriate Sector Identifier. Write current must be turned on, and after a delay, Erase Current. The Identifier Gap is calculated to ensure that tolerances in disk speed, in erase turn-on delay, and in the distance between Write/Read and Erase gaps do not result in corruption of the Sector Identifier by the Erase gap.

F.5 DATA BLOCK GAP

The minimum distance between Sector Identifiers, which occur when the disk is running slowly during formatting, must be sufficient to accommodate a Data Block written when the disk is running fast. The Data Block Gap is calculated to be more than sufficient to accommodate this change in length. It ensures that data written when the long-term average bit cell length has the maximum value does not corrupt the following Sector Identifier.

F.6 TRACK GAP

The track layout, from Index Gap to the Data Block Gap for Sector 26, is calculated to be accommodated on a track when the disk is running fast during formatting. When formatting occurs at slower speeds surplus track capacity exists; this surplus capacity is filled with (FF)-bytes and constitutes the Track Gap. This ensures that, when formatting is carried out with the long-term average bit cell length having the maximum value, the last Data Block Gap does not corrupt the Index Gap.

F.7 WRITING DATA

The writing of data involves switching on Write current in the Identifier Gap, and turning it off in the Data Block Gap. This causes discontinuities in the gaps which are called Write

Splices. In addition, variations in rotational disk speed can cause the gaps to be shortened or lengthened, particularly in the case of the Data Block Gap.