ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-54

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

January 1978

Free copies of this **ECMA** standard are available from
ECMA European Computer Manufacturers Association
114 Rue du Rhône - 1204 Geneva (Switzerland)

ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-54

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

January 1978

BRIEF HISTORY

Technical Committee TC19 of ECMA began work on flexible disk cartridges in 1974. As a first task it was decided to produce a standard for 200 mm flexible disk cartridges using double frequency recording on one side. This work has led to the present Standard. In its compilation 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 the Standard in its present form to meet the needs of users and industry; it is intended that these aspects shall be reviewed for the next edition of the Standard.

This Standard is technically identical to the ISO Draft Proposal processed by ISO/TC97/SC11. It has been passed as Standard ECMA-54 at the General Assembly of Dec. 13, 1977.

TABLE OF CONTENTS

SCOPE

This Standard ECMA-54 specifies the characteristics of flexible disk cartridges 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 currently under preparation, this track format provides for full data interchange between data processing systems.

SECTION I

GENERAL DESCRIPTION AND DEFINITIONS

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 A up,
- Fig. 2 is a cross- section, along line II-II in Fig. 1,
- Fig. 3 shows a protective envelope with cartridge, Side B up.

1.2 Main Elements

The main elements of this flexible disk cartridge are :

- the recording disk
- the liner
- the jacket
- the 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 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: It is expected that a Master Standard for Signal Amplitude will be established by the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany and by the National Bureau of Standards (NBS) in Washington. Secondary Reference Flexible Disk Cartridges would then also be made 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 track # 00 and track # 76 respectively. The first of these currents shall be used for recording on tracks # 00 to # 43. The second current shall be used for recording on tracks # 44 to # 76 (see also 5.2).

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 density obtained when writing with 250 000 ftps on track # 00 and with 500 000 ftps on track # 76 using the appropriate Test Recording Current for the track under test (see also 5.2).

1.5.9 Average Signal Amplitude

The Average Signal Amplitude 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 A.

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 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 °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 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 °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: Cartridges which have been exposed to temperatures and humidities exceeding the operating 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 :	: 3 % 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 magneti material (e.g. γ-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 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 $90^{\circ} \pm 30'$ and a side length

$$l_1 = 203{,}2 \text{ mm} \pm 0{,}4 \text{ mm}$$

3.1.2 Thickness

In an area defined by

$$r_1 = 60 \text{ mm}$$

$$r_2 = 85 \text{ mm}$$

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) :

$1{,}2 \text{ mm} < e_2 < 2{,}1 \text{ mm}$, 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

$$d_1 = 58{,}40 \text{ mm} \pm 0{,}15 \text{ mm}$$

The position of their centre is defined by

$$l_2 = 101{,}6 \text{ mm} \pm 0{,}3 \text{ mm}$$

3.1.4 Index windows

Location

The centre of the index windows shall be defined by

$$l_3 = 96{,}50 \text{ mm} \pm 0{,}25 \text{ mm}$$

$$l_4 = 139{,}40 \text{ mm} \pm 0{,}25 \text{ mm}$$

Diameter

The diameter of the index windows shall be

$$d_2 = 7{,}7 \text{ mm} \pm 0{,}1 \text{ mm}$$

3.1.5 Head windows

Location

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

$$l_5 = 3{,}70 \text{ mm} \pm 0{,}25 \text{ mm}$$

Dimensions

The width of the head windows shall be

$$l_6 = 12{,}7 \text{ mm} \pm 0{,}1 \text{ mm}$$

The nominal radius of their ends shall be

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

Their length shall be

$$l_7 = 52{,}60 \text{ mm} \pm 0{,}25 \text{ mm}$$

3.1.6 Reference Edge Profile

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 0,5 mm minimum.

3.1.7 Construction of the jacket

If the jacket utilizes flaps, their width shall be

$$l_9 = 14 \text{ mm max.}$$

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 :

$$l_{10} = 81{,}6 \text{ mm min}$$
$$l_{11} = 94{,}6 \text{ mm max}$$
$$l_{12} = 108{,}6 \text{ mm min}$$
$$l_{13} = 121{,}6 \text{ mm max}$$
$$l_{14} = 2{,}0 \text{ mm max}$$

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

$$d_3 = 200,2 \text{ mm} \pm 0,2 \text{ mm}$$

The inner diameter of the disk shall be

$$d_4 = 38,100 \text{ mm} \pm 0,025 \text{ mm}$$

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

$$r_4 = 38,1 \text{ mm} \pm 0,1 \text{ mm}$$

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

$$r_5 = 51,3 \text{ mm max.}$$

$$r_6 = 92,0 \text{ mm min.}$$

3.3.5 Sides

For convenience of description two sides are defined.

Side A is the side on which the disk is recorded and accessed through Side A of the jacket.
Side B is the other side.

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

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

4.3 Coefficient of linear hygroscopic expansion of the disk

The coefficient of hygroscopic expansion of the disk shall be

$$11.10^{-6} \text{ per \% RH maximum.}$$

4.4 Opacity

4.4.1 Opacity of the jacket

The jacket shall have a light transmittance of less than 1% using a tungsten lamp as the radiation source and of less than 0,5% using a 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 1% using a tungsten lamp as the radiation source and of less than 0,5% using a 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 cartridge is in operation at a rotation speed of 360 rpm ± 7 rpm, with a pressure pad of 690 mm^2 ± 10 mm^2 surface applied with a force of 1,50 N ± 0,05 N and located parallel to the head window as defined in Fig. 8 by

$$l_{15} = 62,0 \text{ mm}$$

$$l_{16} = 75,0 \text{ mm}$$

$$l_{17} = 10,0 \text{ mm}$$

$$l_{18} = 64,0 \text{ mm}$$

the torque necessary to rotate the disk shall be between 0,028 N.m and 0,088 N.m.

SECTION III

A.

A.

MAGNETIC CHARACTERISTICS

OF THE UNRECORDED FLEXIBLE DISK CARTRIDGE

5.1 Track geometry

5.1.1 Number of tracks

There shall be 77 discrete concentric tracks in the recording area (3.3.5).

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. An appropriate 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 centrelines of all tracks shall be calculated by using the formula:

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

n being the track number: n = 0 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 Physical track identification

The physical track identification 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 purposes of the following tests the same drive unit shall be used for the 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 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 using 1F on track # 00 and on track # 76.

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 calibreated 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 # 76 using 2F,

of the appropriate Standard Reference Amplitude.

5.2.1.4 Resolution

On track # 76, after recording with the appropriate Test Recording Current, the ratio: Average Signal Amplitude using 2F divided by the 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 appropriate 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 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

$$\left[\frac{\text{Maximum mean}}{\frac{\text{Maximum mean + minimum mean}}{2}} - 1 \right] \quad 100\%$$

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 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 # 76 using 2F, 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 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 35% 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 Weak 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 45% of half the arithmetically averaged value of the output voltages measured peak-to-peak over the preceding 2000 consecutive flux transitions, and which is not a missing pulse, shall be a weak pulse.

5.2.2.3 Extra pulse

When a track has been recorded with a constant recording current equivalent to the appropriate Test Recording Current, any playback signal, when measured base-to-peak which exceeds 20% 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 Weak track

A track on which one or more weak pulses are detected in the same position(s) on consecutive passes and which is not a defective track, shall be a weak track. The applicable number of consecutive passes shall be a matter for agreement between purchaser and supplier.

5.2.3.3 Requirements for tracks

As initially received from the medium supplier, the cartridges shall have no defective tracks. Track # 00 shall not be weak. There shall be not more than four weak tracks from track # 01 to track # 76.

5.2.3.4 Rejected cartridge

A cartridge which does not meet the requirements of 5.2.3.3 shall be rejected.

SECTION IV

TRACK FORMAT

6.1 General Requirements

6.1.1 Mode of recording

The mode of recording shall be double 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 transition shall 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 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. It shall be within ± 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 # 76.

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 is divided into 26 sectors.

6.1.9 Data capacity of a track

The data capacity of a track is 3328 bytes.

6.1.10 Hexadecimal notation

Hexadecimal notation is used 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)

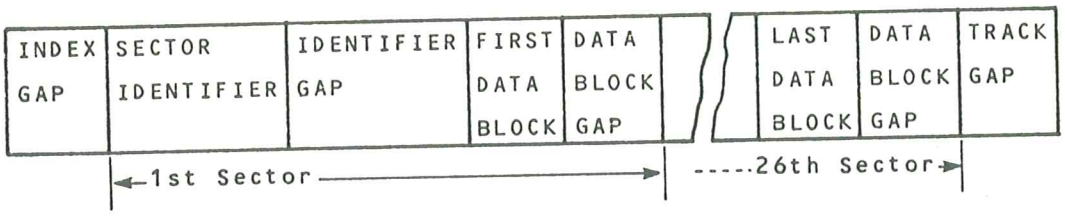
The two EDC-bytes are hardware generated by shifting serially the relevant bits, specified later for each part of the track through a 16-bit shift register described by the generator polynomial :

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

(See also Appendix D).

6.2 Detailed Description of Track Layout after the First Initialization

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



6.2.1 Index Gap

This field shall comprise 73 bytes nominally and shall have one of the following four possible contents :

i) 40 (00)-bytes, 7 (00)-bytes, 26 (00)-bytes

ii) 40 (FF)-bytes, 7 (FF)-bytes, 26 (FF)-bytes

iii) 40 (00)-bytes, 6 (00)-bytes, 1 (FC)*byte, 26 (00)-bytes

iv) 40 (FF)-bytes, 6 (00)-bytes, 1 (FC)*byte, 26 (FF)-bytes

Writing the Index Gap is started when the Index hole is detected. Any of the first 20 bytes may be ill-defined due to subsequent overwriting.

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 represent 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 of the Address Identifier

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

6.2.2.2.3 Sector Address (S)

The 3rd byte shall represent in binary notation the sector address from 01 for the 1st sector to 26 for the last sector.
The 26 sectors shall be recorded in the natural order: 1,2,3,....,25,26.

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 (00) or (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 6.3.2.2.4.2).

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 (00) or (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 26th Sector. At nominal density it should comprise 247 (00) or (FF)-bytes. Writing of the Track Gap takes place until the Index hold is detected, unless it has been detected during writing of the last Data Block Gap, in which case there shall be no Track Gap.

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-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

6.3.2 Good and bad tracks

A good track is a track which has been initialized according to 6.3.3.

A bad track is a track which has been initialized according to 6.3.4.

Track # 00 shall always be a good track.

There shall be at least 74 good tracks from track # 01 to track # 76.

6.3.3 Track layout of good tracks

6.3.3.1 Index Gap

Description: see 6.2.1.

6.3.3.2 Sector Identifier

6.3.3.2.1 Identifier Mark

Description: see 6.2.2.1.

6.3.3.2.2 Address Identifier

This field shall comprise 6 bytes.

6.3.3.2.2.1 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 76 for the innermost track.

- If there is no bad track, the Track Address is identical to the Physical Track Identification (5.1.4),
- if there are one or two bad tracks, they are skipped and the Track Address numberation continues sequentially with the next good track. In this case the Track Address differs by 1 (or 2) from the Physical Track Identification.

6.3.3.2.2.2 2nd byte of the Address Identifier

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

6.3.3.2.2.3 Sector Address (S)

The 3rd byte shall represent in binary notation the sector address from 01 for the 1st sector to 26 for the last sector.

The 26 sectors can be recorded in 13 different orders, namely:

01	02	03	04	05	06	07	08	09	10	11	12	13
1	1	1	1	1	1	1	1	1	1	1	1	1
2	3	4	5	6	7	8	9	10	11	12	13	14
3	5	7	9	11	13	15	17	19	21	23	25	2
4	7	10	13	16	19	22	25	2	2	2	2	15
5	9	13	17	21	25	2	2	11	12	13	14	3
6	11	16	21	26	2	9	10	20	22	24	26	16
7	13	19	25	2	8	16	18	3	3	3	3	4
8	15	22	2	7	14	23	26	12	13	14	15	17
9	17	25	6	12	20	3	3	21	23	25	4	5
10	19	2	10	17	26	10	11	4	4	4	16	18
11	21	5	14	22	3	17	19	13	14	15	5	6
12	23	8	18	3	9	24	4	22	24	26	17	19
13	25	11	22	8	15	4	12	5	5	5	6	7
14	2	14	26	13	21	11	20	14	15	16	18	20
15	4	17	3	18	4	18	5	23	25	6	7	8
16	6	20	7	23	10	25	13	6	6	17	19	21
17	8	23	11	4	16	5	21	15	16	7	8	9
18	10	26	15	9	22	12	6	24	26	18	20	22
19	12	3	19	14	5	19	14	7	7	8	9	10
20	14	6	23	19	11	26	22	16	17	19	21	23
21	16	9	4	24	17	6	7	25	8	9	10	11
22	18	12	8	5	23	13	15	8	18	20	22	24
23	20	15	12	10	6	20	23	17	9	10	11	12
24	22	18	16	15	12	7	8	26	19	21	23	25
25	24	21	20	20	18	14	16	9	10	11	12	13
26	26	24	24	25	24	21	24	18	20	22	24	26

6.3.3.2.2.4 4th byte of the Address Identifier

Description: see 6.2.2.2.4.

6.3.3.2.2.5 EDC

Description: see 6.2.2.2.5.

6.3.3.2.3 Identifier Gap

This field shall comprise initially 11 (00) or (FF)-bytes. These bytes may subsequently become ill-defined due to the overwriting process.

6.3.3.2.4 Data Block

6.3.3.2.4.1 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).

6.3.3.2.4.2 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.

6.3.3.2.4.3 EDC

Description: see 6.2.4.3.

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.

6.3.3.2.5 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 27 (00) or (FF)-bytes. These bytes may subsequently become ill-defined due to the overwriting process.

6.3.3.2.6 Track Gap

Description: see 6.2.6.

6.3.4 Track layout of a bad track

Any of the following fields of a bad track can be ill-defined with the only exception that at least one of the 26 Address Identifier must have the content specified in 6.3.4.2.2. If none of the Address Identifiers of a bad track has this content, the cartridge shall be rejected.

6.3.4.1 Index Gap

This field should comrise 73 (00) or (FF)-bytes.

6.3.4.2 Sector Identifier

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

6.3.4.2.1 Identifier Mark

This field should comprise 7 bytes:

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

6.3.4.2.2 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.

6.3.4.3 Identifier Gap

This field should comprise 11 (00) or (FF)-bytes.

6.3.4.4 Data Block

This field should comprise 137 (00) or (FF)-bytes.

6.3.4.5 Data Block Gap

This field should comprise 27 (00) or (FF)-bytes.

6.3.4.6 Track Gap

Description: see 6.2.6.

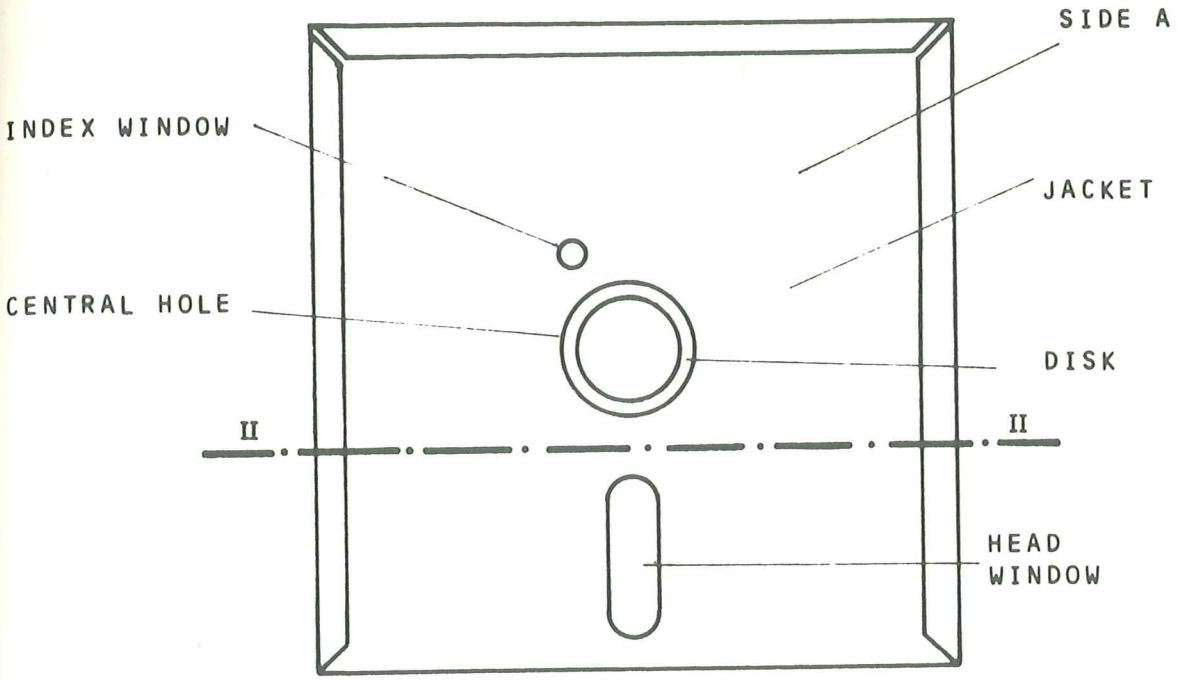


Fig. 1

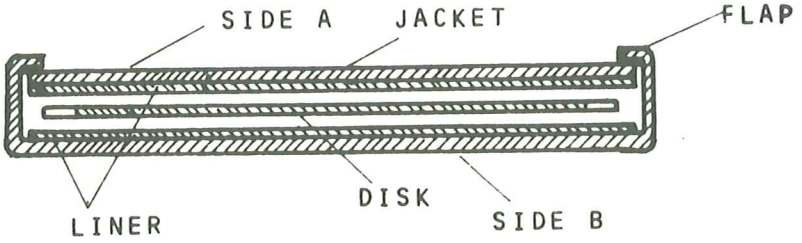


Fig. 2

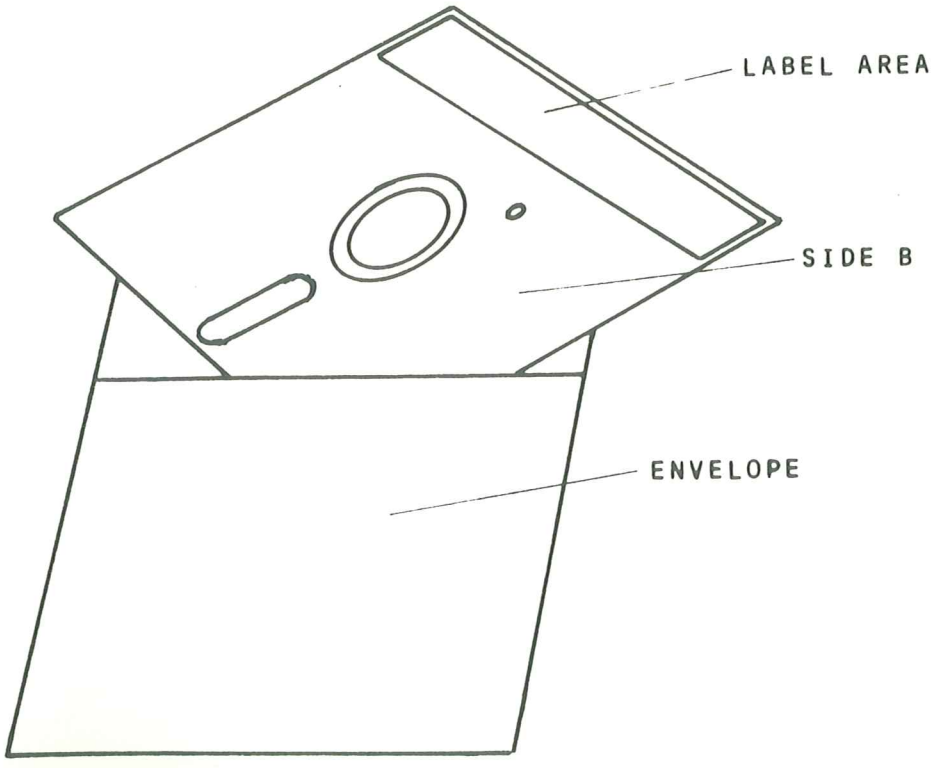


Fig. 3

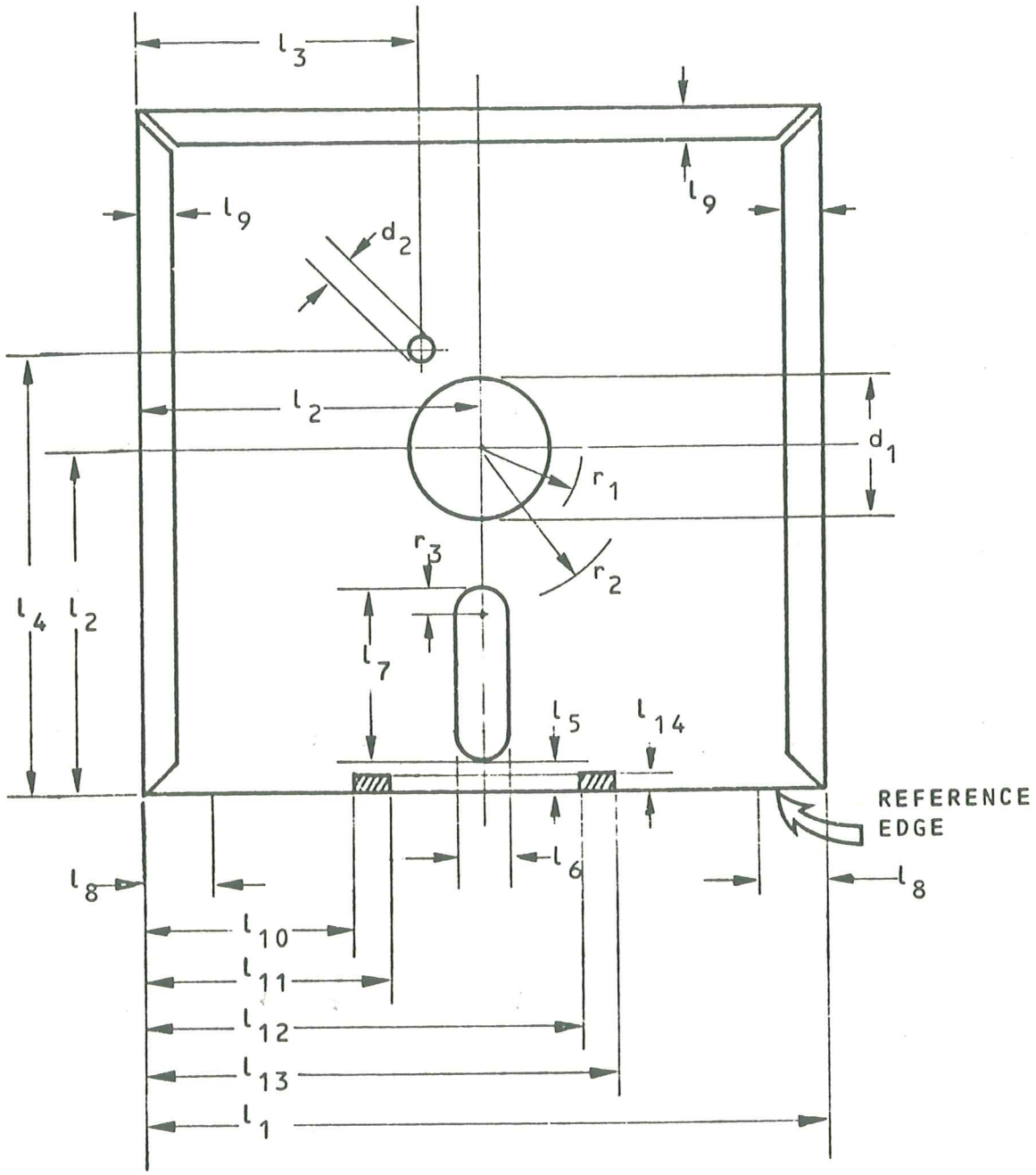

l3
l9
l9
d2
l2
d1
r1
r2
r3
l4
l2
l7
l5
l14
REFERENCE
EDGE
l8
l6
l8
l10
l11
l12
l13
l1

Fig. 4

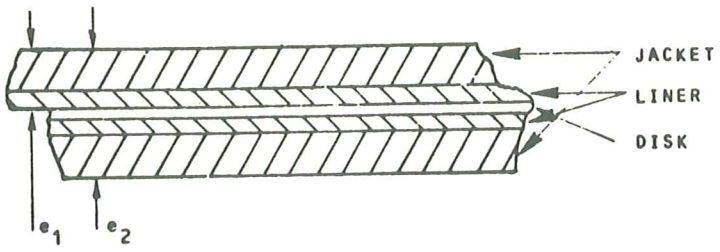


Fig. 5

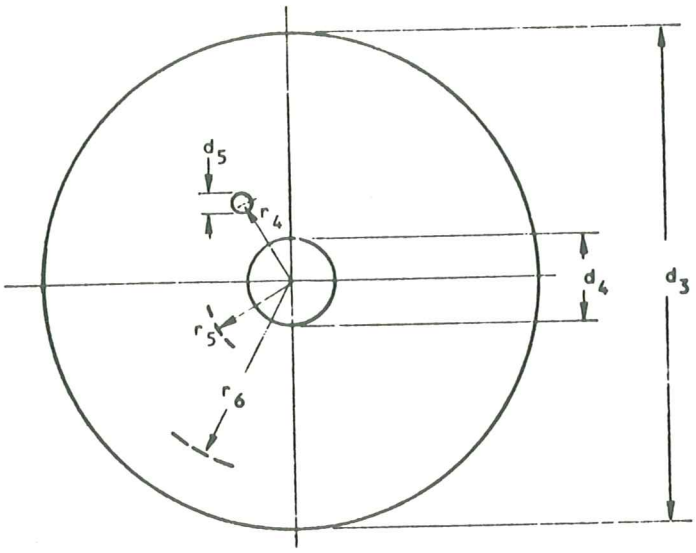


Fig. 6

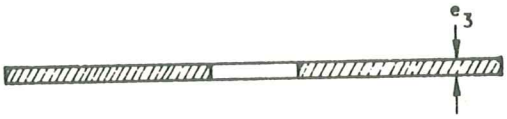


Fig. 7

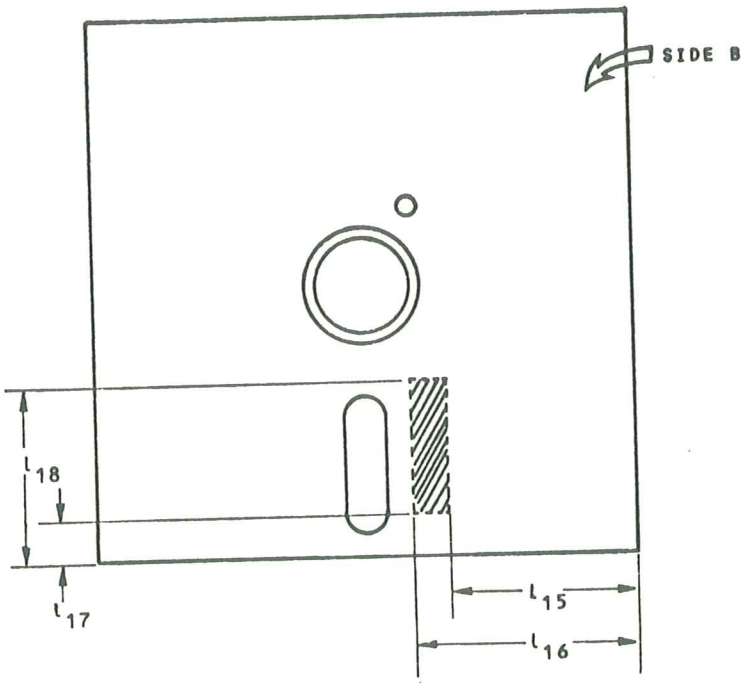


Fig. 8

APPENDIX A

MEASUREMENT OF LIGHT TRANSMITTANCE

A 1 INTRODUCTION

The description in the following paragraphs outlines the general principle of a test device and the test method to be employed when measuring the radiation (light) transmittance of magnetic disk material for each of two radiation sources.

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 test device are

the radiation sources
the optical path
the measuring mask
the photo cell
the measuring equipment

A 2 DESCRIPTION OF THE TEST DEVICE

A 2.1 Radiation Sources

A tungsten lamp is used as one radiation (light) source and should be operated in an under-run state.

The colour temperature should be 2000 K ± 200 K and a resulting illumination at the surface of the sample of about 5000 lux is recommended. A light emitting diode is used as the second radiation source. The output wavelength shall be 900 nm ± 50 nm.

A 2.2 Optical path

The radiation should be perpendicular to the sample and be of substantially uniform intensity. Typically the sample should be separated from the source by a distance of 150 mm.

A diaphragm of the form shown in Fig. 1 is recommended in order to sensibly ensure that scattered radiation does not enter the mask area.

A 2.3 Measuring Mask Geometry

The measuring mask shall be constructed in one piece according to the drawing shown in Fig. 2. A good matt black finish capable of absorbing infra-red radiation is necessary.

Special care must be taken to ensure that the sample to be measured is maintained flat in contact with the inner face of the mask.

A 2.4 Photocell

A flat silicon photocell should be used. Its dimensions must be such that the active area of the photocell exceeds the diameter of the mask orifice. It should be mounted parallel and in close proximity to the outer face of the mask.

A 2.5 Measuring Equipment

The measuring equipment should be connected directly across the photocell to measure the output current. In order to be able to set the measuring equipment to full scale deflection (100 %) a shunt potentiometer in the circuit must be provided or a fine adjustment of the lamp power supply voltage is required.

The load impedance across the photocell should be as low as possible and must not exceed 500 Ohm. The instrument should have a nominal accuracy of ± 0,05 %.

A 3 TEST PROCEDURE

A 3.1 The measurements shall be taken within an annular band whose boundaries are tangent to the Index hole.

- The measuring equipment is set to full scale reading representing (100%).
- The sample is inserted and 45 observations on different points along the sample are recorded.
- The sample is then withdrawn and full scale deflection (100%) is re-checked. If the reading lies outside the range of 99% to 101% the equipment is reset to 100% and a new set of 45 observations is recorded.

A 3.2 A statistical maximum value of light transmittance shall be determined according to the following formula:

$$T = \bar{x} + K \cdot \sigma$$

where x = mean value of n observations.

σ = accurate estimate of the lot standard deviation

K = constant specified by the selected plan of inspection

n = number of observations on the sample specified by the selected plan of inspection.

The T value so calculated is for use where inspection of lots of disks is by variables. Lot quality is judged in terms of percent defective and acceptance is lot by lot.

The plan is based upon single sampling (with σ known) and gives an

Acceptable Quality Level (AQL) of 0,5 % defective

and a

Lot Tolerance Percent Defective (LTPD) of 1,26 %.

The selected plan has a sample size letter of 0 and gives the values for

κ = 2,33 and
(*) n = 45

If T < T max, the lot is accepted,

If T > T max, the lot is rejected,

where T max = maximum value of transmittance permitted.

A 4 GUIDANCE ON CONSTRUCTION

A 4.1 Experience has shown that a projector lamp is most suited as the tungsten source. When selecting a lamp, care must be taken to avoid a lamp with optical inhomogenities in the glass envelope. Also, if mirrors or lenses are used in the optical path, they must be placed such that no filament image occurs in the proximity of the mask and photocell area. It is necessary to operate the radiation sources from a stabilized, regulated power supply.

A 4.2 Special attention must be paid to all surfaces parallel to the optical path and in close proximity to the mask and photocell to avoid reflection of light. Similarly, the method of inserting the tape must ensure that no ambient light leaks through any slot arrangement.

A 4.3 The accuracy of the measurement is dependent not only on attaining the dimensional tolerances shown in Fig. 2, but also on the subsequent coating of the surfaces with a high quality optical matt black paint. The mask should be checked after coating the ensure that the small hole remains in tolerance.

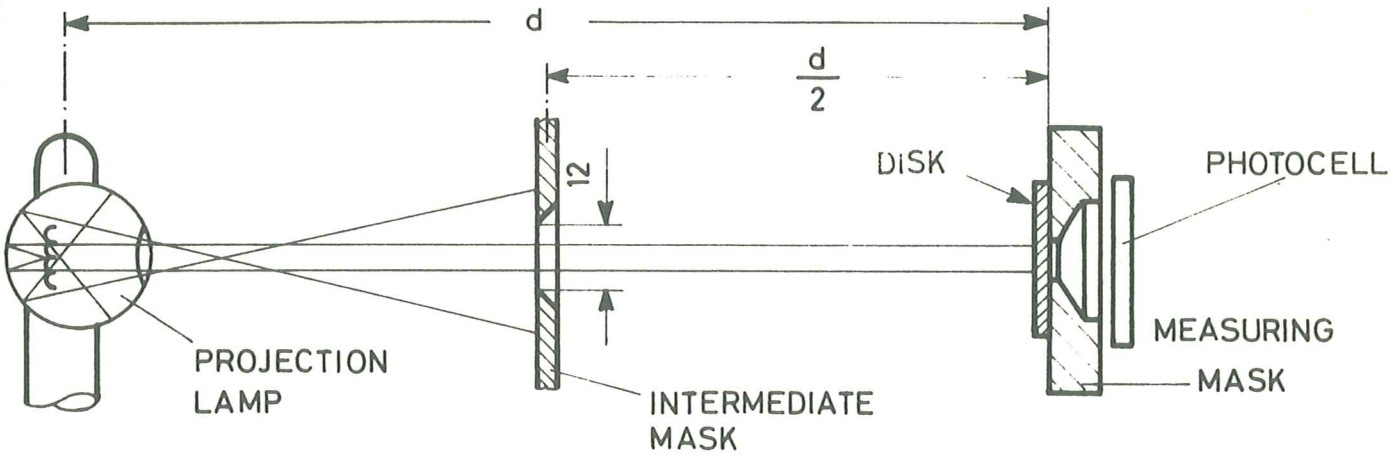
* *References:* *A.H. Bowker*
H.P. Goode
"Sampling Inspection by Variables"
Mc Graw-Hill 1952

The method of holding the sample must be such that it is maintained flat in contact with the face of the mask. However, it must allow the sample to be moved without physical damage or distortion.

A 4.4 The photocell must be mounted with care, taking special precaution that the photocell leads do not interfere with the mounting arrangement. It is advisable that the face of the photocell presses slightly on the outer face of the mask.

A 4.5 An effective means of providing periodical calibration should be incorporated by inserting an opaque object for 0 % light transmittance and a filter glass for 75 % light transmittance.

A 4.6 The test device should be cleaned periodically.



d = approx. 150 mm

FIG. 1 MEASURING DEVICE (DIAGRAM)

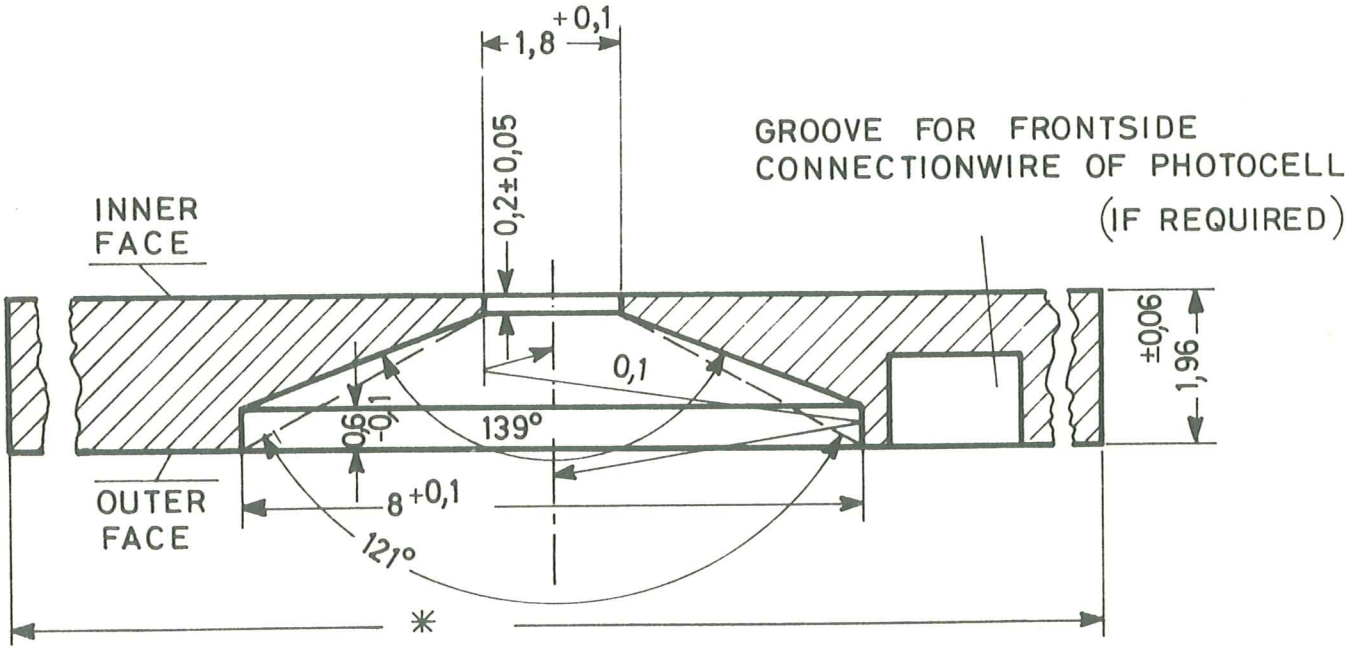


FIG. 2 MEASURING MASK

* DETERMINED BY USER

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.

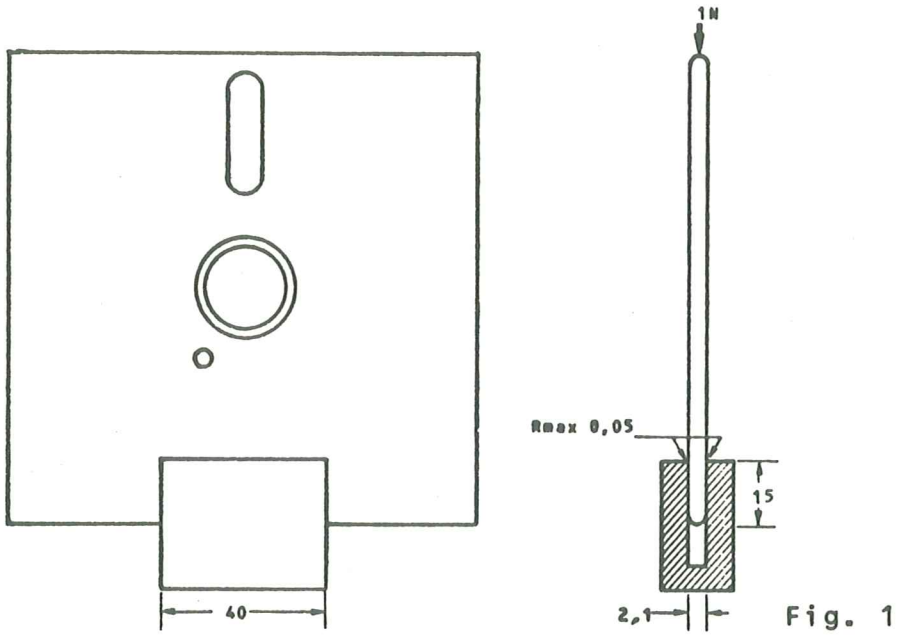


Fig. 1

B 2 MINIMUM THICKNESS

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

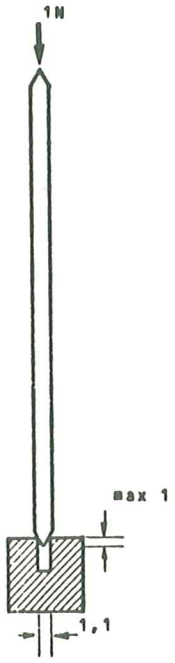


Fig. 2

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.

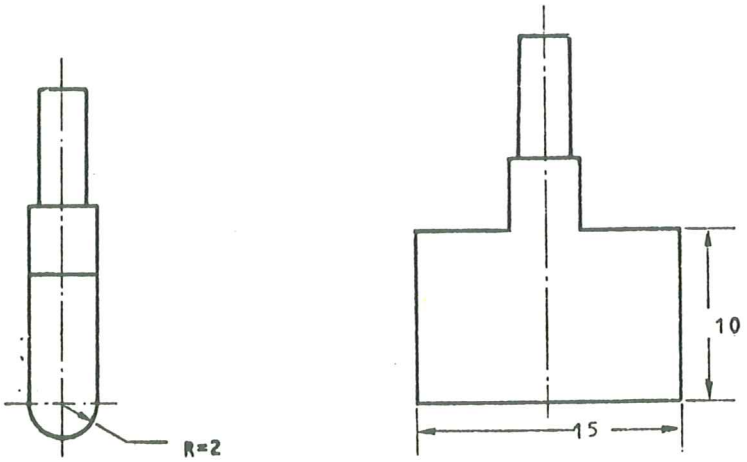


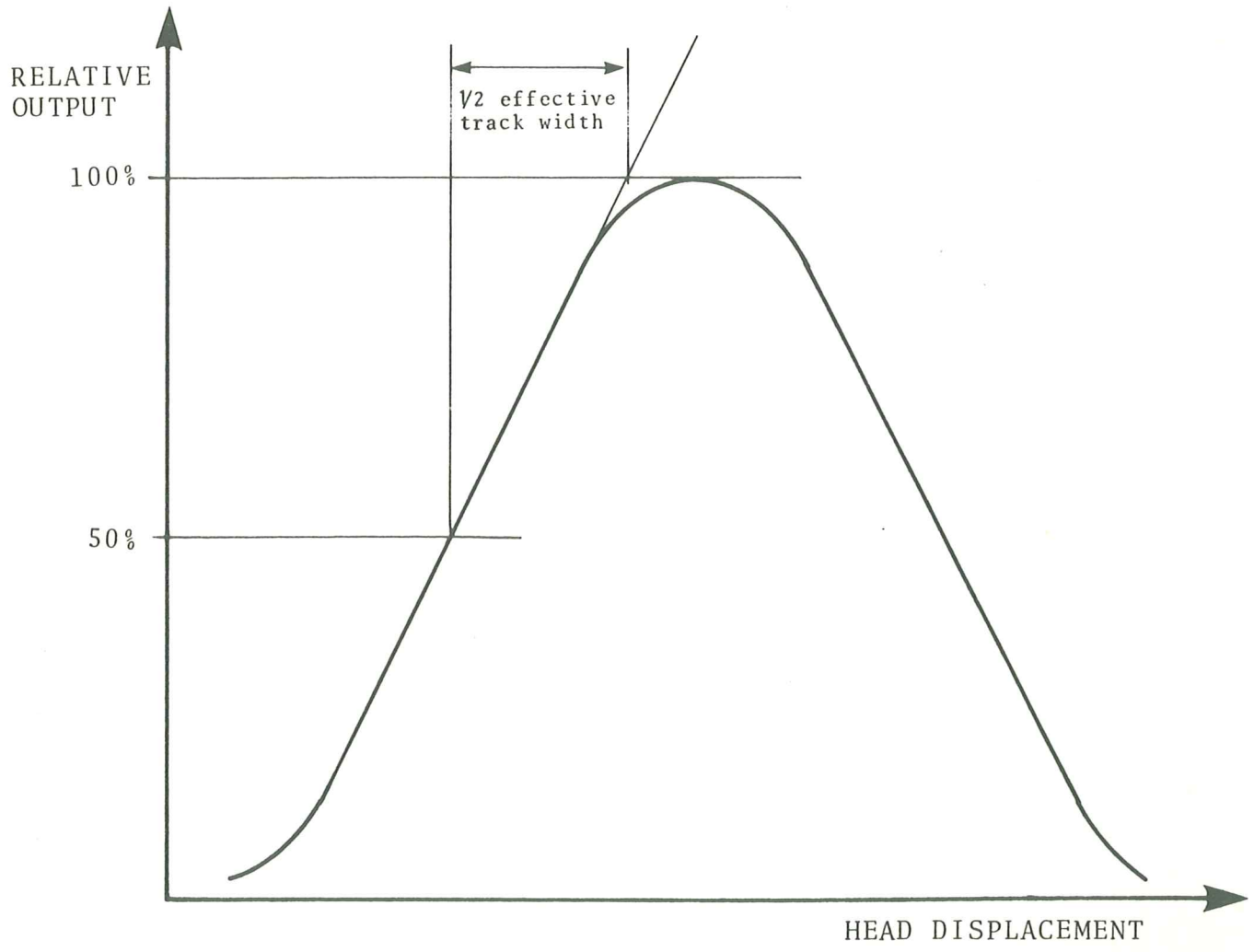
Fig. 3

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.

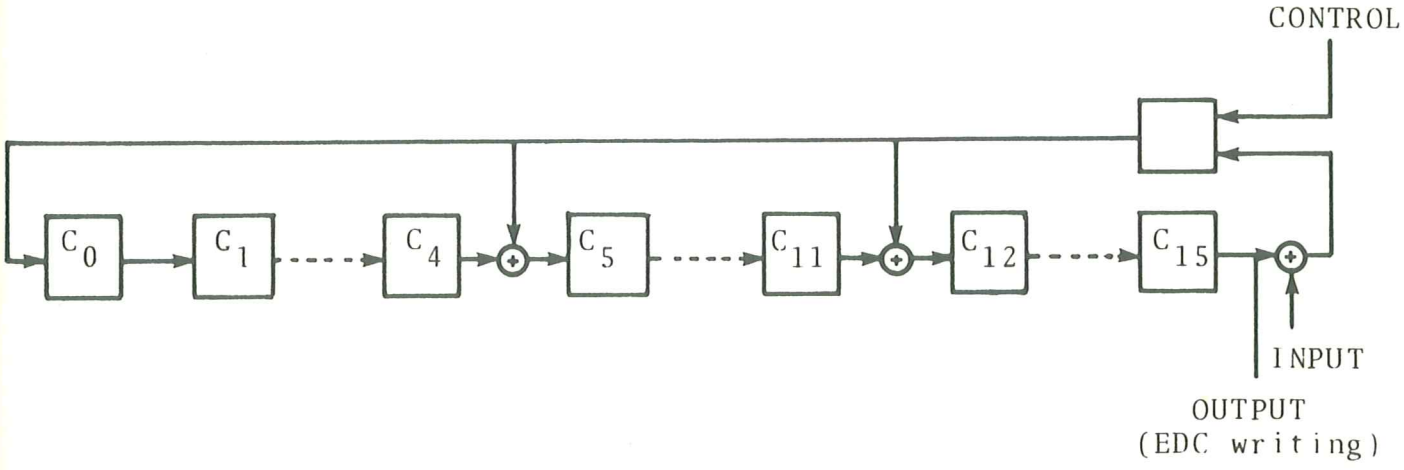
Prior to the operation, all positions of the shift register are set to ONE. Input data are added (exclusive OR) to the contents of position C_{15} of the register to form a feedback. This feedback is in its turn added (exclusive OR) to the contents of position C_4 and position C_{11}.

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-.. and of Standard ECMA-.. 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 write-inhibit purpose is strictly forbidden in data interchange.

ii) OTHER APPLICATIONS

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