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International Standard



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**Information processing — Data interchange on 200 mm (8 in) flexible disk cartridges using two-frequency recording at 13 262 ftprad on one side — Part 1 : Dimensional, physical and magnetic characteristics**

*Traitement de l'information — Échange d'information sur cartouches à disquette de 200 mm (8 in) utilisant un enregistrement à double fréquence à 13 262 ftprad sur une face — Partie 1 : Caractéristiques dimensionnelles, physiques et magnétiques*

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## Foreword

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## Contents

	Page
0 Introduction .....	1
1 Scope and field of application .....	1
2 References .....	1
3 Definitions .....	1
4 General description .....	2
4.1 General figures .....	2
4.2 Main elements .....	2
4.3 Description .....	2
4.4 Optional features .....	2
5 General requirements .....	2
5.1 Environment and transportation .....	2
5.2 Materials .....	3
5.3 Direction of rotation .....	3
6 Dimensional characteristics .....	3
6.1 Jacket .....	3
6.2 Liner .....	4
6.3 Disk .....	4
7 Physical characteristics .....	5
7.1 Inflammability .....	5
7.2 Coefficient of linear thermal expansion of the disk .....	5
7.3 Coefficient of linear hygroscopic expansion of the disk .....	5
7.4 Opacity .....	5
7.5 Torque .....	5

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<b>8</b> Magnetic characteristics .....	5
<b>8.1</b> Track geometry .....	5
<b>8.2</b> Functional testing .....	6

**Annexes**

<b>A</b> Measurement of light transmittance .....	11
<b>B</b> Measurement of the cartridge thickness .....	14
<b>C</b> Method for measuring the effective track width .....	16
<b>D</b> Write-inhibit notch .....	17

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# Information processing — Data interchange on 200 mm (8 in) flexible disk cartridges using two-frequency recording at 13 262 ftprad on one side — Part 1 : Dimensional, physical and magnetic characteristics

## 0 Introduction

ISO 5654 specifies the characteristics of 200 mm (8 in) flexible disk cartridges recorded at 13 262 ftprad on one side using two-frequency recording.

ISO 5654/2 specifies the quality of recorded signals, track layout, and the track format.

Together with the labelling scheme specified in ISO 7665, ISO 5654/1 and ISO 5654/2 provide for full data interchange between data processing systems.

## 1 Scope and field of application

This part of ISO 5654 specifies the dimensional, physical and magnetic characteristics of the cartridge, so as to provide physical interchangeability between data processing systems.

NOTE — Numeric values in the SI and/or Imperial measurements system in this International Standard may have been rounded and therefore are consistent with, but not exactly equal to, each other. Either system may be used, but the two should be neither intermixed nor reconverted. The original design was made using the Imperial measurement system.

## 2 References

ISO 646, *Information processing — 7-bit coded character set for information interchange.*<sup>1)</sup>

ISO 2022, *Information processing — ISO 7-bit and 8-bit coded character sets — Code extension techniques.*<sup>2)</sup>

ISO 4873, *Information processing — 8-bit coded character set for information interchange.*

ISO 7665, *Information processing — File structure and labelling of flexible disk cartridges for information interchange.*<sup>3)</sup>

1) At present at the stage of draft. (Revision of ISO 646-1973.)

2) At present at the stage of draft. (Revision of ISO 2022-1973.)

3) At present at the stage of draft.

## 3 Definitions

For the purpose of this International Standard, the following definitions apply :

**3.1 flexible disk** : 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 associates systems.

**3.2 reference flexible disk cartridge** : Flexible disk cartridge arbitrarily selected for a given property for calibrating purposes.

**3.3 secondary reference flexible disk cartridge** : 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.

**3.4 signal amplitude reference flexible disk cartridge** : Reference flexible disk cartridge selected as a standard for recording field and signal amplitude.

NOTE — A master standard for signal amplitudes, reference fields, overwrite and resolution characteristics has been established by the Physikalisch-Technische Bundesanstalt (PTB), Bundesallee 100, in Braunschweig, Germany. Secondary reference flexible disk cartridges can be ordered from PTB under part number RM 5654 as long as available.

**3.5 typical field** : The minimum recording field which, when applied to a flexible disk cartridge, causes a signal output equal to 95 % of the maximum average signal amplitude when taken as a function of the recording field at the specified track and flux transition frequency of that flexible disk cartridge.

**3.6 reference field** : The typical field of the signal amplitude reference flexible disk cartridge.

**3.7 test recording currents :** The two recording currents between 145 % and 155 % of the currents which produce the reference field at 250 000 flux transitions per second (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 8.2).

**3.8 standard reference amplitudes :** 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 8.2).

**3.9 average signal amplitude :** The arithmetically-averaged value for a track of the output voltage measured peak-to-peak over the whole track.

**3.10 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.

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

**3.12 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.

**3.13 recording area :** That area of the disk surface with which the head may come into contact.

## 4 General description

### 4.1 General figures

A typical flexible disk cartridge is represented in figures 1 to 3 as follows :

- figure 1 shows the cartridge seen from above, side 0 up;
- figure 2 shows section A-A which is a cross-section along the line A-A in figure 1;
- figure 3 shows a protective envelope with cartridge, side 1 up.

### 4.2 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.

### 4.3 Description

The jacket is of 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.

### 4.4 Optional features

The interchange characteristics of the jacket allow for variations of its construction. It may include flaps, (for example, three flaps as shown in the drawings, or none), and notches along the reference edge. For conditions under which a write-inhibit notch may be used, see annex D.

## 5 General requirements

### 5.1 Environment and transport

#### 5.1.1 Testing environment

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

- temperature :  $23 \pm 2$  °C ( $73 \pm 4$  °F);
- relative humidity : 40 to 60 %;
- conditioning before testing : 24 h minimum.

The temperature and the relative humidity 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 4 000 A/m (50 Oe).

#### 5.1.2 Operating environment

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

- temperature : 10 to 50 °C (50 to 122 °F);
- relative humidity : 20 to 60 %;
- wet bulb temperature : < 29 °C (84 °F).

The temperature and the relative humidity 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 (36 °F) per hour.

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

*within*

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 4 000 A/m (50 Oe).

### 5.1.3 Storage environment

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

- temperature : 4 to 53 °C (40 to 127 °F);
- relative humidity : 8 to 80 %.

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

The ambient stray magnetic field shall not exceed 4 000 A/m (50 Oe).

NOTE — Cartridges which have been exposed to temperatures and humidities outside the operating condition may exhibit degraded performance characteristics. Such cartridges should be subjected to a conditioning period of not less than 24 h within the operating environment prior to use.

### 5.1.4 Transportation

Responsibility for ensuring that adequate precautions are taken during transportation shall be with the sender. During transportation, the cartridge shall be in its envelope, and in a protective package. The latter must be free from dust or extraneous matter. It must have a clean interior and a construction that prevents 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 to 53 °C (-40 to 127 °F);
- maximum rate of temperature change : 20 °C (36 °F) per hour;
- relative humidity : 8 to 90 %.

No moisture shall condense in or on the cartridge.

### 5.1.5 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.

## 5.2 Materials

### 5.2.1 Jacket

The jacket may be constructed from any suitable material.

### 5.2.2 Liner

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

### 5.2.3 Disk

The disk may be constructed from any suitable material (for example, bi-axially oriented polyethylene terephthalate) coated at least on one side with a strong and flexible layer of magnetic material (for example,  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>).

### 5.2.4 Envelope

The envelope may be manufactured from any suitable material (for example, paper).

## 5.3 Direction of rotation

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

## 6 Dimensional characteristics

The dimensional characteristics listed in sub-clauses below are indicated in figures 4 to 7 as follows :

- figure 4 shows the jacket;
- figure 5 shows a partial cross-section of the jacket;
- figure 6 shows the disk;
- figure 7 shows a cross-section of the disk.

All dimensions are referred to the reference edge of the cartridge (see figure 4).

### 6.1 Jacket

#### 6.1.1 Form

The jacket is of a square form with angles of  $90^\circ \pm 30'$  and a side length :

$$l_1 = 203,2 \pm 0,4 \text{ mm (8.000} \pm 0.015 \text{ in)}$$

#### 6.1.2 Thickness

##### 6.1.2.1 Jacket wall and liner

In an area defined by :

$$r_1 = 60 \text{ mm (2.36 in)}$$

$$r_2 = 85 \text{ mm (3.35 in)}$$

and with a probe having a diameter of 15 mm (0.59 in) applied against the cartridge with a force of 1 N, the thickness of the jacket wall and liner shall be :

$$e_1 = 0,45 \pm 0,15 \text{ mm (0.018} \pm 0.005 \text{ in)}$$

### 6.1.2.2 Cartridge

The overall thickness of the cartridge shall be (see also 6.1.7) :

$$1,2 \text{ mm (0.047 in)} < e_2 < 2,1 \text{ mm (0.083 in)}$$

measured in accordance with annex B

The cartridge shall fall freely through a gauge with a 2,6 mm (0.10 in) wide opening having flat and vertical walls and having a depth of 150 mm (5.9 in).

### 6.1.3 Central windows

The central windows shall have a diameter :

$$d_1 = 58,40 \pm 0,15 \text{ mm (2.300} \pm 0.005 \text{ in)}$$

The position of their centre is defined by :

$$l_2 = 101,6 \pm 0,3 \text{ mm (4.000} \pm 0.010 \text{ in)}$$

### 6.1.4 Index windows

#### Location

The centre of the index windows shall be :

$$l_3 = 96,50 \pm 0,25 \text{ mm (3.803} \pm 0.010 \text{ in)}$$

$$l_4 = 139,40 \pm 0,25 \text{ mm (5.487} \pm 0.010 \text{ in)}$$

#### Diameter

The centre of the index windows shall be :

$$d_2 = 7,7 \pm 0,1 \text{ mm (0.302} \pm 0.005 \text{ in)}$$

### 6.1.5 Head windows

#### Location

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

$$l_5 = 3,70 \pm 0,25 \text{ mm (0.145} \pm 0.010 \text{ in)}$$

#### Dimensions

The width of the head windows shall be :

$$l_6 = 12,7 \pm 0,1 \text{ mm (0.500} \pm 0.005 \text{ in)}$$

The nominal radius of their ends shall be :

$$r_3 = 6,35 \text{ mm (0.250 in)}$$

Their length shall be :

$$l_7 = 52,60 \pm 0,25 \text{ mm (2.071} \pm 0.010 \text{ in)}$$

### 6.1.6 Reference edge profile

Within an area defined by :

$$l_8 = 25 \text{ mm (1 in)}$$

the reference edge shall have a convex profile, for example, be rounded off with one or more radii of 0,5 mm (0.020 in) minimum.

### 6.1.7 Construction of the jacket

If the jacket utilises flaps, their width shall be :

$$l_9 = 14 \text{ mm max. (0.550 in max.)}$$

The total thickness  $e_2$  of the cartridge with flaps shall satisfy the conditions of 6.1.2. The thickness of the flaps shall be at most 0,9 mm (0.035 in). (See also annex B.)

### 6.1.8 Notches

Two notches may be provided along the reference edge. If provided, they shall be entirely contained within areas defined by :

$$l_{10} = 81,6 \text{ mm max. (3.22 in max.)}$$

$$l_{11} = 94,6 \text{ mm max. (3.72 in max.)}$$

$$l_{12} = 108,6 \text{ mm max. (4.28 in max.)}$$

$$l_{13} = 121,6 \text{ mm max. (4.78 in max.)}$$

$$l_{14} = 2,0 \text{ mm max. (0.08 in max.)}$$

### 6.2 Liner

The liner shall always cover the recording area (see 6.3.4). However, no part of the liner shall protrude by more than 0,2 mm (0.008 in) into the openings of the jacket.

### 6.3 Disk

#### 6.3.1 Diameters

The external diameter of the disk shall be :

$$d_3 = 200,2 \pm 0,2 \text{ mm (7.882} \pm 0.008 \text{ in)}$$

The inner diameter of the disk shall be :

$$d_4 = 38,100 \pm 0,025 \text{ mm (1.500} \pm 0.001 \text{ in)}$$

#### 6.3.2 Thickness

The thickness of the disk shall be :

$$e_3 = 0,080 \pm 0,010 \text{ mm (0.003 0} \pm 0.000 5 \text{ in)}$$



### 6.3.3 Index hole

#### Location

The location of the index hole shall be defined by :

$$r_4 = 38,1 \pm 0,1 \text{ mm (1.500} \pm 0.004 \text{ in)}$$

#### Diameter

The diameter of the index hole shall be :

$$d_5 = 2,54 \pm 0,10 \text{ mm (0.100} \pm 0.005 \text{ in)}$$

### 6.3.4 Recording area

The recording area shall be defined by :

$$r_5 = 46,2 \text{ mm max. (1.82 in max.)}$$

$$r_6 = 96,6 \text{ mm min. (3.80 in min.)}$$

### 6.3.5 Sides

For convenience of description two sides are defined :

- side 0 is the side on which the disk is recorded and is accessed through side 0 of the jacket;
- side 1 is the other side.

## 7 Physical characteristics

### 7.1 Inflammability

The cartridge shall be made from materials that, if ignited from a match flame do not continue to burn in a still carbon dioxide atmosphere.

### 7.2 Coefficient of linear thermal expansion of the disk

The coefficient of thermal expansion of the disk shall be :

$$(17 \pm 8) \times 10^{-6} \text{ per degree Celsius}$$

### 7.3 Coefficient of linear hygroscopic expansion of the disk

The coefficient of hygroscopic expansion of the disk shall be in the range :

$$(0 \text{ to } 15) \times 10^{-6} \text{ per percent of relative humidity.}$$

## 7.4 Opacity

### 7.4.1 Opacity of the jacket

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

### 7.4.2 Opacity of the disk

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

## 7.5 Torque

### 7.5.1 Starting torque

The starting torque, without head and pads loaded to the cartridge, shall not exceed 0,042 N.m (6.0 ozf.in).

### 7.5.2 Running torque

When the disk cartridge is tested at a rotational speed of  $360 \pm 7$  rev/min, with a pressure pad of  $690 \pm 10$  mm<sup>2</sup> ( $1.000 \pm 0.015$  in<sup>2</sup>) applied with a force of  $1,50 \pm 0,05$  N ( $5.4 \pm 1.8$  ozf) and located parallel to the head window as defined in figure 8 by :

$$l_{15} = 62,0 \text{ mm (2.44 in)}$$

$$l_{16} = 75,0 \text{ mm (2.95 in)}$$

$$l_{17} = 10,0 \text{ mm (0.39 in)}$$

$$l_{18} = 64,0 \text{ mm (2.52 in)}$$

the torque necessary to rotate the disk shall be between 0,028 N.m (4 ozf.in) and 0,088 N.m (12.46 ozf.in).

## 8 Magnetic characteristics

### 8.1 Track geometry

#### 8.1.1 Number of tracks

There shall be 77 discrete concentric tracks in the recording area (see 6.3.4).

#### 8.1.2 Width of tracks

The recorded track width on the disk surface shall be :

$$0,300 \pm 0,025 \text{ mm (0.011 8} \pm 0.001 0 \text{ in)}$$

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

#### 8.1.3 Tracks locations

##### 8.1.3.1 Nominal locations

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

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

$$\left( R_n = 2.029 + \frac{76 - n}{48} \text{ in} \right)$$

$n$  being the numeric value corresponding to track number :  
 $n = 0$  to 76.

**8.1.3.2 Track location tolerance**

For testing purposes, the centrelines of tracks recorded shall be within  $\pm 0,025$  mm ( $\pm 0,001$  in) of the nominal positions, when measured in the testing environment (see 5.1.1).

**8.1.4 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 (00).

**8.1.5 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.

**8.2 Functional testing**

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

**8.2.1 Surface tests**

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

**8.2.1.1 Test conditions**

The disk shall be tested at  $360 \pm 7$  rev/min. The test frequencies used shall be :

$$1f = 250\,000 \pm 250 \text{ ftps}$$

$$2f = 500\,000 \pm 500 \text{ ftps}$$

and shall be used as specified for each test.

**8.2.1.2 Typical field**

The typical field of the disk under test shall be within  $\pm 20$  % of the reference field. It shall be measured using  $1f$  on tracks 00 and 76.

**8.2.1.3 Average signal amplitude**

When a disk has been recorded with the test recording currents, then read back on a system which has been calibrated by means of a signal amplitude reference flexible disk cartridge, recorded under the same conditions, the average signal amplitude of the disk under test shall be :

- not more than 130 % on track 00 using  $1f$ ;

- not less than 80 % on track 76 using  $2f$ ;

of the appropriate standard reference amplitude.

**8.2.1.4 Resolution**

On track 76, after recording with the appropriate test recording current, the ratio

$$\frac{\text{average signal amplitude using } 2f}{\text{average signal amplitude using } 1f}$$

shall be greater than 80 % of the value of the same ratio for the signal amplitude reference flexible disk cartridge.

**8.2.1.5 Overwrite**

On track 00, after recording with the appropriate test recording current, first using  $1f$  and then overwriting using  $2f$  for one revolution, the ratio

$$\frac{\text{residual average signal amplitude at } 1f \text{ after overwrite using } 2f}{\text{average signal amplitude after the first recording using } 1f}$$

shall be less than 100 % of the value of the same ratio for the signal amplitude reference flexible disk cartridge.

Measurements shall be made using a frequency-selective voltmeter.

**8.2.1.6 Modulation**

Modulation shall be :

$$\frac{\text{maximum mean} - \text{minimum mean}}{\text{maximum mean} + \text{minimum mean}} \times 100 \%$$

The maximum mean shall be the average value of the amplitude-modulated output voltage in that part of the track with the maximum amplitudes, and the minimum mean shall be that in the respective part with the minimum amplitudes. Output voltage shall be measured peak-to-peak; averaging shall be done over about 2 000 consecutive flux transitions.

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

**8.2.2 Track quality test**

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.

**8.2.2.1 Missing pulse**

Write a track at  $2f$  with the appropriate test recording current.

Any playback signal, when measured base-to-peak which is less than 40 % of half the arithmetically averaged values of the output voltages measured peak-to-peak over the preceding 2 000 consecutive flux transitions, shall be a missing pulse.

**8.2.2.2 Extra pulse**

Write a track at  $2f$  with the appropriate test recording current. Erase for one revolution with a constant direct current equivalent to the quiescent value of the test recording current.

Any playback signal, which when measured base-to-peak, including the statistical noise and the residual signal of the disk exceeds 30 % of half the average signal amplitude of the track under test, shall be an extra pulse.

**8.2.3 Rejection criteria**

**8.2.3.1 Defective track**

A track on which one or more missing 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 of agreement between interested parties.

**8.2.3.2 Requirements for tracks**

As initially received from the media supplier, cartridges shall have no defective tracks.

**8.2.3.3 Rejected cartridge**

A cartridge which does not meet the requirements of 8.2.3.2 shall be rejected.

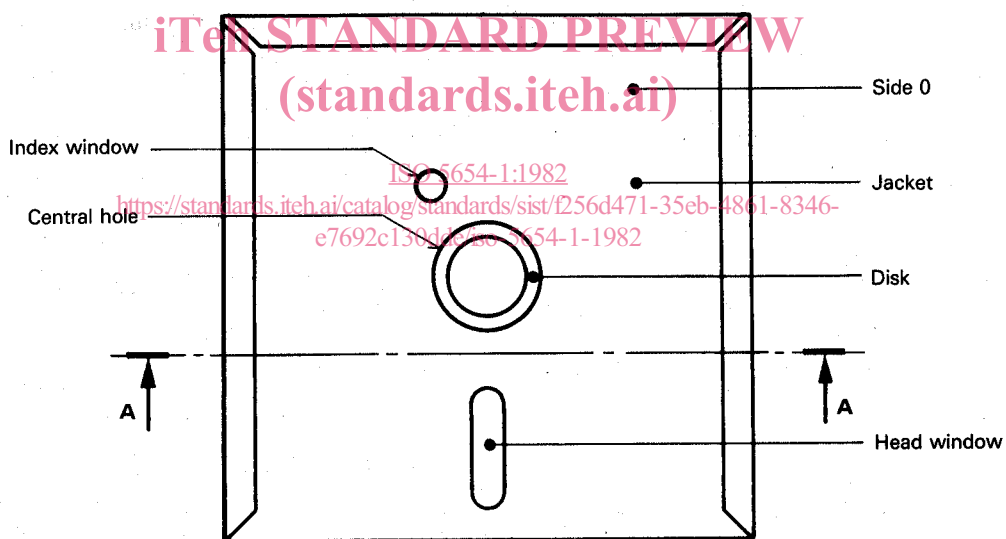


Figure 1 — Flexible disk cartridge

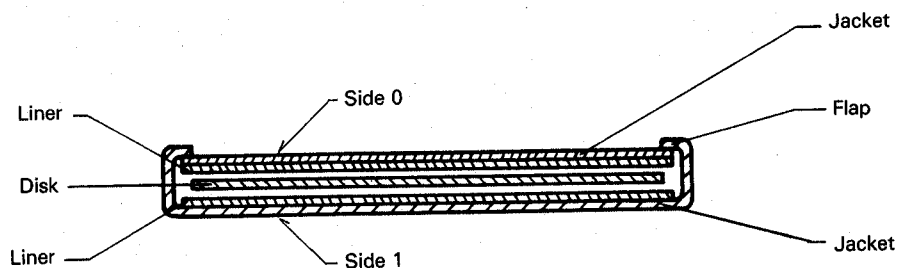


Figure 2 — Section A-A