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**Information processing — Data interchange on 90 mm
(3.5 in) flexible disk cartridges using modified
frequency modulation recording at 7 958 ftprad on
80 tracks on each side —**

Part 1 :

Dimensional, physical and magnetic characteristics

*Traitement de l'information — Échange de données sur cartouches à disquette de 90 mm
(3,5 in) utilisant un enregistrement à modulation de fréquence modifiée (MFM) à 7 958 ftprad
sur 80 pistes sur chaque face —*

Partie 1 : Caractéristiques dimensionnelles, physiques et magnétiques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8860-1 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Information processing — Data interchange on 90 mm (3.5 in) flexible disk cartridges using modified frequency modulation recording at 7 958 ftprad on 80 tracks on each side —

Part 1 : Dimensional, physical and magnetic characteristics

0 Introduction

ISO 8860 specifies the characteristics of 90 mm (3.5 in) flexible disk cartridges recorded at 7 958 ftprad using modified frequency modulation (MFM) recording on 80 tracks on each side.

ISO 8860-2 specifies the track layout, the track format and the characteristics of the recorded signals.

ISO 8860-1 and ISO 8860-2, together with the labelling scheme specified in ISO 9293, provide for full data interchange between data processing systems.

1 Scope and field of application

This part of ISO 8860 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 part of ISO 8860 may have been rounded off 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 SI units.

2 Conformance

A 90 mm (3.5 in) flexible disk cartridge shall be in conformance with this part of ISO 8860 if it meets all mandatory requirements contained herein.

3 References

ISO 683-13, *Heat-treated steels, alloy steels and free-cutting steels — Part 13 : Wrought stainless steels.*

ISO 8860-2, *Information processing — Data interchange on 90 mm (3.5 in) flexible disk cartridges using modified frequency modulation recording at 7 958 ftprad on 80 tracks on each side — Part 2 : Track format.*

ISO 9293, *Information processing — Volume and file structure of flexible disk cartridges for information interchange.*

4 Definitions

For the purpose of this International Standard the following definitions apply.

4.1 recording disk : A flexible disk which accepts and retains, on the specified side or sides, magnetic signals intended for input/output and storage purposes.

4.2 hub : A centring and referencing device attached to the centre of the disk which allows torque to be transmitted to the disk. It ensures centring of the disk on the drive shaft in a unique angular position.

4.3 shutter : A device which uncovers the head windows upon insertion, and automatically covers them upon removal from the drive.

4.4 liner : Suitable material positioned between the case and the disk to provide cleaning action and protection from abrasion.

4.5 case : A protective enclosure including a shutter mechanism and a write-inhibit hole.

4.6 Master Standard Reference Flexible Disk Cartridge : A reference flexible disk cartridge selected as the standard for reference fields, signal amplitudes, resolution, peak shift and overwrite. Track 00 and track 79 on both sides are declared as reference tracks.

The reference tracks are calibrated at 600 r/min. The calibration is also valid at 300 r/min.

NOTE — This master standard has been established by the Physikalisch-Technische Bundesanstalt (PTB), Bundesallee 100, D-3300 Braunschweig, Germany, F.R.

4.7 Secondary Standard Reference Flexible Disk Cartridge : A flexible disk cartridge the performance of which is known and stated in relation to that of the Master Standard Reference Flexible Disk Cartridge.

NOTE — Secondary Standard Reference Flexible Disk Cartridges can be ordered from PTB Lab. 1.41 under Part Number RM 8860 as long as available. It is intended that these be used for calibrating further cartridges for use in routine calibration.

4.8 Typical Field : In the plot of average signal amplitude against recording field at the specified track and flux transition density, the Typical Field is the minimum field which causes a signal output equal to 95 % of the maximum Average Signal Amplitude.

4.9 Reference Field : The typical field of the Master Standard Reference Flexible Disk Cartridge.

There are two Reference Fields, one for each side.

4.10 Test Recording Current : The current between 148 % and 152 % of the current which produces the Reference Field at test frequency $1f$ on track 00.

There are two Test Recording Currents, one for each side.

4.11 Standard Reference Amplitudes (SRAs) : The Average Signal Amplitudes derived from the reference tracks of the Master Standard Reference Flexible Disk Cartridge using the Test Recording Current.

There are four SRAs, two for each side.

SRA_{1f} is the Average Signal Amplitude from a recording written using Test Frequency $1f$ at Track 00.

SRA_{2f} is the Average Signal Amplitude from a recording written using Test Frequency $2f$ at Track 79.

4.12 Average Signal Amplitude : For a track : the arithmetically averaged value of the output voltages measured peak-to-peak over the whole track.

4.13 In-contact : An operating condition in which the magnetic surface of the disk is in physical contact with the magnetic heads.

4.14 side : Side 0 is the side engaged by the spindle. Side 1 is the opposite side.

4.15 direction of rotation : The direction of rotation shall be counter-clockwise when looking at Side 0.

4.16 index : The point on a track which determines the beginning and the end of the track.

4.17 formatting : Writing the proper control information, establishing the physical cylinders and the addresses of physical records on the surfaces of the flexible disk.

4.18 Initialization : Writing any information initially required to be on the flexible disk cartridge, for example the Volume Label, prior to the commencement of general processing use.

5 General description

5.1 Figures

In figures 1 to 5 :

- Figure 1 shows Side 0 and enlarged cross-sections through the location holes;
- Figure 2 shows Side 1;
- Figure 3 shows at a larger scale the upper part of Side 0 without shutter;
- Figure 4 shows the disk with hub;
- Figure 5 shows the interface between the cartridge and the drive.

5.2 Main elements

The main elements of the flexible disk cartridge are

- the recording disk;
- the liner,
- the case.

5.3 Description

The cartridge is of a substantially square form. It includes a central hole on one side, a heat window on both sides and a write-inhibit hole.

The liner is provided between the case and the disk. It comprises two layers of material between which the disk lies.

The disk has a central hole with a metal hub attached.

6 General requirements

6.1 Environment and transportation

6.1.1 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 ± 2 °C (73 ± 4 °F)

relative humidity : 40 to 60 %

conditioning before testing : 24 h minimum

For the tests specified in 9.3 the temperature and relative humidity shall be measured in the air immediately surrounding the cartridge drive. For all other tests the temperature and 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).

6.1.2 Operating environment

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

temperature : 10 to 60 °C (50 to 140 °F)

relative humidity : 8 to 80 %

wet bulb temperature : less than 29 °C (85 °F)

The temperature and 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.

NOTE — For reliable interchange, it is recommended that the temperature and relative humidity conditions when reading are not the opposite extreme to the conditions when writing.

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 4 000 A/m (50 Oe).

6.1.3 Storage environment

During storage the cartridges shall be kept under the following conditions :

temperature : 4 to 53 °C (39 to 127 °F)

relative humidity : 8 to 90 %

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

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

NOTE — Cartridges which have been stored at 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 h within the operating environment prior to use.

6.1.4 Transportation

Responsibility for ensuring that adequate precautions are taken during transportation shall be with the sender. The cartridge shall be in a protective package free from dust or extraneous matter. It is recommended that a sufficient space exists between cartridge and outer surface of the final container, so that risk of erasure due to stray magnetic fields will be negligible.

It is recommended that the following conditions should not be exceeded :

temperature : -40 to 60 °C (-40 to 140 °F)

maximum rate of temperature change : 20 °C (36 °F) per hour

relative humidity : 8 to 90 %

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

6.2 Materials

6.2.1 Case

The case, which may be constructed from any suitable material, shall comply with the requirements of annex A.

6.2.2 Liner

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

6.2.3 Disk

The disk shall be constructed from any suitable material (for example bi-axially oriented polyethylene terephthalate) coated with a flexible layer of magnetic material.

6.2.4 Hub

The hub shall be made from any suitable material (for example stainless steel alloy in compliance with ISO 683-13, type 8).

7 Dimensional characteristics

The dimensions of the cartridge are referred to two reference axes X and Y, i.e. two lines in space intersecting at right angles. The plane they define is the Reference Plane XY of the cartridge.

7.1 Case

7.1.1 Shape (see figure 1)

The case shall be of rectangular form, its sides shall be

$$l_1 = 94,0 \pm 0,3 \text{ mm } (3.700 \pm 0.012 \text{ in})$$

$$l_2 = 90,0 \begin{smallmatrix} +0,4 \\ -0,1 \end{smallmatrix} \text{ mm } \left(3.540 \begin{smallmatrix} +0.016 \\ -0.004 \end{smallmatrix} \text{ in} \right)$$

The radius of three of its corners shall be

$$r_1 = 2,0 \pm 1,0 \text{ mm } (0.079 \pm 0.040 \text{ in})$$

The angle of its fourth corner shall be

$$\omega = 45^\circ \pm 2^\circ$$

7.1.2 Thickness (see figure 2)

In the area extending 8,5 mm (0.335 in) from each of the two edges as shown in figure 2, the thickness of the case shall be

$$e_1 = 3,3 \pm 0,2 \text{ mm } (0.130 \pm 0.008 \text{ in})$$

When the cartridge is inserted in the test gauge specified in annex D, a force not exceeding 0,2 N (0.69 ozf), applied to the centre of the back edge shall cause the cartridge to pass through the gauge.

The edge radius shall be

$$r_2 = 0,40 \pm 0,25 \text{ mm (0.150} \pm 0,010 \text{ in)}$$

7.1.3 Hub access hole (see figure 1)

On Side 0 there shall be a hub access hole the diameter of which shall be

$$d_1 = 26,50 \text{ mm min. (1.043 in min.)}$$

The position of the centre of this hole shall be defined by

$$l_3 = 40,00 \pm 0,15 \text{ mm (1.575} \pm 0.006 \text{ in)}$$

$$l_4 = 31,00 \pm 0,15 \text{ mm (1.220} \pm 0.006 \text{ in)}$$

7.1.4 Locating holes (see figures 1 and 3)

7.1.4.1 Primary locating hole

The centre of the primary locating hole shall be at the intersection of Reference Axes X and Y.

Its diameter shall be

$$d_2 = 3,6 \pm 0,1 \text{ mm (0.142} \pm 0.004 \text{ in)}$$

The dimensions of its section (see cross-section A-A in figure 1) shall be

$$d_3 = 1,5 \text{ mm min. (0.059 in min.)}$$

$$l_8 = 0,2 \pm 0,1 \text{ mm (0.010} \pm 0.004 \text{ in)}$$

$$l_9 = 1,0 \text{ mm min. (0.039 in min.)}$$

$$l_{10} = 2,5 \text{ mm min. (0.098 in min.)}$$

7.1.4.2 Secondary locating hole

The centre of the secondary locating hole shall be on Reference Axis X, its distance from Reference Axis Y shall be

$$l_5 = 80,0 \pm 0,2 \text{ mm (3.150} \pm 0.008 \text{ in)}$$

It shall have a substantially rectangular shape. Its short axis shall be (cross-section B-B in figure 1)

$$l_6 = 3,6 \pm 0,1 \text{ mm (0.142} \pm 0.004 \text{ in)}$$

Its long axis shall be

$$l_7 = 4,4 \pm 0,2 \text{ mm (0.173} \pm 0.008 \text{ in)}$$

The dimensions d_3 , l_8 , l_9 and l_{10} of the cross-section of the secondary locating hole are as specified in 7.1.4.1.

7.1.5 Label area

7.1.5.1 Side 0 (see figure 1)

The locations and dimensions of the label area of Side 0 shall be

$$l_{11} = 3,5 \text{ mm min. (0.138 in min.)}$$

$$l_{12} = 76,5 \text{ mm max. (3.012 in max.)}$$

$$l_{14} = 60,0 \text{ mm min. (2.362 in min.)}$$

7.1.5.2 Side 1 (see figure 2)

The locations and dimensions of the label area of Side 1 shall be

$$l_{11} = 3,5 \text{ mm min. (0.138 in min.)}$$

$$l_{12} = 76,5 \text{ mm max. (3.012 in max.)}$$

$$l_{13} = 20,0 \text{ mm min. (0.787 in min.)}$$

7.1.6 Head windows (see figure 3)

The locations and the dimensions of the two head windows are specified by the same set of dimensions.

7.1.6.1 Location

The location of the head windows shall be defined by

$$l_{15} = 12,3 \text{ mm min. (0.485 in min.)}$$

$$l_{16} = 11,5 \text{ mm min. (0.45 in min.)}$$

$$l_{17} = 35,5 \pm 0,2 \text{ mm (1.400} \pm 0.008 \text{ in)}$$

7.1.6.2 Dimensions

The width of the head windows shall be

$$l_{18} = 9,00 \pm 0,20 \text{ mm (0.354} \pm 0.008 \text{ in)}$$

The radius of their corners shall be

$$r_3 = 0,5 \pm 0,1 \text{ mm (0.020} \pm 0.004 \text{ in)}$$

The radius of their upper edge shall be

$$r_4 = 8,85 \text{ mm min. (0.348 in min.)}$$

7.1.7 Write-inhibit hole (see figure 2)

7.1.7.1 Location

The centre of the write-inhibit hole shall be on Reference Axis Y. Its distance from Reference Axis X shall be

$$l_{19} = 67,75 \pm 0,25 \text{ mm (2.667} \pm 0.010 \text{ in)}$$

7.1.7.2 Dimensions

The dimensions of the write-inhibit hole shall be

$$l_{20} = 3,5 \text{ mm min. (0.138 in min.)}$$

$$l_{21} = 4,0 \text{ mm min. (0.157 in min.)}$$

7.1.7.3 Use

The write-inhibit hole is intended for use either with a mechanical switch or with an optical detector so that only when the hole is covered is writing on the disk possible. When covered, the closure device shall not extend outside the Reference Plane nor shall it deflect by more than 0,3 mm (0.012 in) from the Reference Plane inside the case under the action of a force of 3 N (0.67 lbf).

Also when covered, the light transmittance of the write-inhibit hole area shall not exceed 1 %, when measured with an optical system as described in annex B.

7.1.8 Profile of the shutter edge of the case (see figures 1 and 3)

The edge on which the shutter is mounted shall have a profile defined by the following dimensions :

$$l_{22} = 80,0 \pm 0,2 \text{ mm (3.150} \pm 0.008 \text{ in)}$$

$$l_{23} = 76,0 \pm 0,3 \text{ mm (2.990} \pm 0.012 \text{ in)}$$

$$l_{24} = 68,0 \pm 0,3 \text{ mm (2.680} \pm 0.012 \text{ in)}$$

$$l_{25} = 64,50 \pm 0,35 \text{ mm (2.540} \pm 0.014 \text{ in)}$$

$$l_{26} = 57,00 \pm 0,35 \text{ mm (2.240} \pm 0.014 \text{ in)}$$

$$l_{27} = 55,5 \pm 0,6 \text{ mm (2.180} \pm 0.025 \text{ in)}$$

$$l_{28} = 3,5 \text{ mm min. (0.137 in min.)}$$

$$l_{29} = 17,5 \pm 0,2 \text{ mm (0.690} \pm 0.008 \text{ in)}$$

$$l_{30} = 17,00 \pm 0,15 \text{ mm (0.669} \pm 0.006 \text{ in)}$$

$$l_{31} = 15,50 \pm 0,25 \text{ mm (0.61} \pm 0.010 \text{ in)}$$

$$l_{45} = 12,50 \pm 0,25 \text{ mm (0.492} \pm 0.010 \text{ in)}$$

$$\alpha = 45^\circ \pm 2^\circ$$

$$\beta = 135^\circ \pm 2^\circ$$

$$\omega = 45^\circ \pm 2^\circ$$

7.1.9 Shutter (see figures 2 and 3)

The shutter shall slide upon insertion of the cartridge into the drive so as to uncover the head windows, and close automatically upon removal. The maximum resistance force at the fully open position shall be 1 N, and the minimum resistance force at the fully closed position shall be 0,2 N.

The path along which the shutter can slide is defined by l_{25} and l_{28} .

In the open position of the shutter, the distance from its leading edge to Reference Axis Y shall be

$$l_{32} = 53,75 \pm 1,25 \text{ mm (2.116} \pm 0.050 \text{ in)}$$

The width of the windows of the shutter shall be

$$l_{33} = 12,0 \pm 0,2 \text{ mm (0.472} \pm 0.008 \text{ in)}$$

NOTE — It is a requirement that the drive shall provide a mechanism whereby correct insertion of the cartridge into the drive causes the shutter to slide so as to uncover the head windows.

7.2 Liner

No part of the liner shall protrude by more than 0,2 mm (0.008 in) into the head access windows.

7.3 Disk (see figure 4)

7.3.1 Diameter

The diameter of the disk shall be

$$d_4 = 85,8 \pm 0,2 \text{ mm (3.378} \pm 0.008 \text{ in)}$$

7.3.2 Thickness

The thickness of the disk shall be

$$e_2 = 0,080 \pm 0,008 \text{ mm (0.003 1} \pm 0.000 3 \text{ in)}$$

7.4 Hub (see figure 4)

The hub shall have a central part and a flange.

7.4.1 Dimensions

The diameter of the central part shall be

$$d_5 = 25,00 \begin{matrix} +0,00 \\ -0,15 \end{matrix} \text{ mm} \left(0,984 \begin{matrix} +0,000 \\ -0,006 \end{matrix} \text{ in} \right)$$

The diameter of the flange shall be

$$d_6 = 31,15 \text{ mm max. (1.226 in max.)}$$

The distance from the surface of the central part of the hub to the surface of Side 0 of the disk shall be

$$l_{34} = 1,36 \pm 0,10 \text{ mm (0.053} \pm 0.004 \text{ in)}$$

when measured at a radius r_7

$$r_7 = 14 \text{ mm nom. (0.55 in nom.)}$$

7.4.2 Hub orientation holes (see figure 4)

The hub shall have two orientation holes. The first one at its centre, the second off-centre.