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Information technology — Data interchange on 90 mm Flexible Disk Cartridges 10 MByte capacity using sector servo tracking — ISO Type 304

*Technologies de l'information — Échange de données sur cartouches
pour disque souple de 90 mm de diamètre, de 10 Mbyte de capacité,
utilisant le servo-pistage sur secteur — Type ISO 304*



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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 13422 was prepared by the Japanese Industrial Standards Committee (as JIS X 6227-1992) and was adopted, under a special "fast-track procedure" by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annexes A to D, G and H form an integral part of this International Standard. Annexes E, F, J, K and L are for information only.

Introduction

This International Standard specifies the characteristics of 90 mm Flexible Disk Cartridges recorded at 33 157 ftprad using modified frequency modulation recording, on 255 tracks at 16,9 tpmm on each side using sector servo tracking.

This International Standard specifies the physical interchangeability of the unrecorded disk and the format interchangeability of recorded data tracks and servo tracks.

In reference to ISO/IEC 9983, Flexible Disk Cartridges conforming to this International Standard are designated as ISO Type 304.

Information technology - Data interchange on 90 mm Flexible Disk Cartridges 10 MByte capacity using sector servo tracking - ISO Type 304

1 Scope

This International Standard specifies the characteristics of 90 mm Flexible Disk Cartridges of 10 MByte formatted capacity, recorded at 33 157 ftprad using modified frequency modulation recording and sector servo tracking on 255 data tracks on each side. Such Flexible Disk Cartridges are identified as ISO Type 304.

It specifies the mechanical, physical and magnetic characteristics of the cartridge, so as to provide physical interchangeability between data processing systems.

It also specifies the method of recording, the quality of the recorded signals, the track layout and the track format of data tracks and servo tracks.

Together with a standard for volume and file structure, for example International Standard ISO 9293, this International Standard provides for full data interchange between data processing systems.

2 Conformance

2.1 Flexible Disk Cartridge

A 90 mm Flexible Disk Cartridge is in conformance with this International Standard if it meets all mandatory requirements specified herein.

2.2 Generating systems

A system generating a Flexible Disk Cartridge for interchange shall be entitled to claim conformance with this International Standard if all recordings on the flexible disk meet the mandatory requirements of this International Standard.

2.3 Receiving systems

A system receiving a Flexible Disk Cartridge for interchange shall be entitled to claim full conformance with this International Standard if it is able to handle any recording made on the flexible disk according to this International Standard.

3 Normative references

The following International Standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the International Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 683-13:1986, *Heat treatable steels, alloy steels and free-cutting steels - Part 13: Wrought stainless steels.*

ISO 8860-1:1987, *Information Processing - Data interchange on 90 mm(3,5 in) flexible disk cartridges using modified frequency modulation recording at 7 958 fiprad on 80 tracks on each side - Part 1: Dimensional, physical and magnetic characteristics.*

ISO 9293:1987, *Information processing - Volume and file structure of flexible disk cartridges for information interchange.*

ISO/IEC 9529-1:1989, *Information processing systems - Data interchange on 90 mm(3,5 in) flexible disk cartridges using modified frequency modulation recording at 15 916 fiprad, on 80 tracks on each side - Part 1: Dimensional, physical and magnetic characteristics.*

ISO/IEC 9983:1989, *Information processing systems - Designation of unrecorded flexible disk cartridges.*

ISO/IEC 10994:1992, *Information technology - Data interchange on 90 mm flexible disk cartridges using modified frequency modulation recording at 31 831 fiprad on 80 tracks on each side - ISO Type 303.*

4 Definitions

For the purposes of this International Standard, the following definitions apply.

4.1 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.

4.2 case: A protective enclosure including a shutter mechanism, identification holes and a write-inhibit hole.

4.3 data track: A discrete concentric track on which data are recorded in the data sector areas.

4.4 Error Detecting Code: A mathematical computation yielding check bytes used for the detection of errors.

4.5 Flexible Disk Cartridge: A flexible information recording medium consisting of a case and a disk, which accepts and retains information for data processing and associated systems, on both recording surfaces.

4.6 flux transition frequency: The number of flux transitions per second (ftps) used for testing on the rotating disk at a certain speed.

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

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

4.9 MFM recording mode: A recording mode in which a flux transition shall be written at the centre of each bit cell containing a ONE, and at each cell boundary between consecutive bit cells containing ZEROs.

4.10 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 000 and track 254 on both sides are declared as reference tracks.

The reference tracks are calibrated at 360 rpm.

NOTE 1 - The Master Standard Reference Flexible Disk Cartridge has been established at the Reliability Centre for Electronic Components of Japan (RCJ), 1-1-12 Hachiman-cho, Higashikurume, Tokyo 203, Japan.

4.11 peak value: The crest value of read back output voltage, with 0 V as the reference voltage.

4.12 primary identification hole: A through-hole provided on the case to identify the Flexible Disk Cartridge specified by this International Standard.

4.13 Reference Field: The Typical Field of the Master Standard Reference Flexible Disk Cartridge. There are two Reference Field, one for each side.

4.14 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 2 - Secondary Standard Reference Flexible Disk Cartridges can be ordered under Part Number JRM 6227 from the Reliability Centre for Electronic Components of Japan (RCJ), 1-1-12 Hachiman-cho, Higashikurume, Tokyo 203, Japan, until the year 2004 (see annex L). It is intended that these be used for calibrating tertiary reference disks for use in routine calibration.

4.15 secondary identification hole: An identification hole provided on the case to identify the Flexible Disk Cartridge specified by this International Standard.

4.16 sector servo: A method of position control, where head positioning information is recorded between sectors, in which data are written and read.

4.17 servo track: A discrete concentric track on which servo data are recorded permanently in the servo sector areas.

4.18 shutter: A device which uncovers the head windows upon insertion of the cartridge into a drive, and automatically covers them upon removal from the drive.

4.19 Standard Reference Amplitude: The Standard Reference Amplitudes (SRAs) are 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- f_1 is the Average Signal Amplitude from a recording written using f_1 at track 000.

SRA- f_2 is the Average Signal Amplitude from a recording written using f_2 at track 254.

4.20 Typical Field: The minimum recording field which, when applied to a Flexible Disk Cartridge, causes an Average Signal Amplitude 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 density.

4.21 write-inhibit hole: A through-hole with a sliding cover, provided on the case to inhibit writing on the disk when the hole is uncovered.

5 Conventions and Notations

5.1 Representation of numbers

- A measured value is rounded off to the least significant digit of the corresponding specified value. It implies that a specified value of 40,00 with a positive tolerance of +0,15, and a negative tolerance -0,15 allows a range of measured values from 39,845 to 40,155.
- Letters A to F and digits in parentheses represent numbers in hexadecimal notation.
- The setting of a bit is denoted by ZERO or ONE.
- Numbers in binary notation and bit combinations are represented by strings of ZEROs and ONES.
- Numbers in binary notation and bit combinations are shown with the most significant bit to the left.
- Negative value of numbers in binary notation are given in TWO's complement.
- In each field the data is recorded so that the most significant byte (byte 0) is recorded first. Within each byte the least significant bit is numbered 1 and is recorded last, the most significant bit (numbered 8 in an 8-bit byte) is recorded first.
This order of recording applies also to the data input of the Error Detection circuits and to their output.

5.2 Acronyms

ASA	Average Signal Amplitude
EDC	Error Detecting Code
FDC	Flexible Disk Cartridge
FFT	Fast Fourier Transform
ftprad	flux transition per radian
ftps	flux transition per second
MFM	Modified Frequency Modulation
SRA	Standard Reference Amplitude
SVDT	Servo Data
SVID	Servo Identifier

6 General description

6.1 Drawings

In the enclosed drawings:

- Figure 13 shows Side 0 and enlarged cross-sections through the location and secondary identification holes;
- Figure 14 shows Side 1;
- Figure 15 shows at a larger scale the top part of Side 0 without shutter;
- Figure 16 shows the disk with hub;
- Figure 17 shows the interface between the cartridge and the drive.

6.2 Main elements

The main elements of the Flexible Disk Cartridge are

- the disk,
- the liner,
- the case.

6.3 Description

The case includes a central hole on one side, head windows covered with a shutter on both sides, identification holes 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.

6.4 Marking of the Flexible Disk Cartridge

The case of the flexible disk shall be clearly marked with the following information:

- Type of flexible disk, type (both sides), mode of recording and number of tracks, ISO Type number
- Year and month of manufacture or mark thereof
- Manufacturer's name or mark

7 General requirements

7.1 Environment and transportation

7.1.1 Testing environment

Tests and measurements made on the cartridge to check the requirements of this International Standard shall be operated under the following conditions,

temperature:	$23^{\circ}\text{C} \pm 2^{\circ}\text{C}$
relative humidity:	40 % to 60 %
conditioning before testing:	24 h min.

For the tests specified in 10.3 the temperature and relative humidity shall be measured in the air immediately surrounding the cartridge drive. For all other tests 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 magnetic head, shall not exceed 4 000 A/m.

7.1.2 Operating environment

Cartridges used for data interchange shall be capable of operating under the following conditions

temperature:	10°C to $51,5^{\circ}\text{C}$
relative humidity:	20 % to 80 %
wet bulb temperature:	less than 29°C

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 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 magnetic head, shall not exceed 4 000 A/m.

7.1.3 Storage environment

During storage the cartridges shall be kept within the following conditions

temperature:	4°C to 53°C
relative humidity:	8 % to 90 %

The ambient stray magnetic field shall not exceed 4 000 A/m. There shall be no deposit of moisture on or in the cartridge.

NOTE 3 - 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.

7.1.4 Transportation

Responsibility for ensuring that adequate precautions are taken during the 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 are not exceeded

temperature:	-40°C to 60°C
maximum rate of temperature change:	20°C per hour
relative humidity:	8 % to 90 %

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

7.2 Materials

7.2.1 Case

The case may be constructed from any suitable material such that it meets the requirements of 8.7.

7.2.2 Liner

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

7.2.3 Disk

The disk may be constructed from any suitable material (e.g. bi-axially oriented polyethylene terephthalate) coated on both sides with a flexible layer of magnetic material (e.g. metal iron particles).

7.2.4 Hub

The hub shall be made of any suitable material (e.g. stainless steel alloy in accordance with ISO 683-13, type 8).

8 Dimensional characteristics

The dimensions of the cartridge are referred to two Reference Axes X and Y. They are two lines in space intersecting at right angles. The plane they define is the Reference Plane XY of the cartridge.

8.1 Case

8.1.1 Shape (figure 13)

The case has a rectangular form, its sides shall be

$$L_1 = 94,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_2 = 90,0 \text{ mm} \begin{array}{l} +0,4 \\ - 0,1 \end{array} \text{ mm}$$

The radius of three of its corners shall be

$$R_1 = 2,0 \text{ mm} \pm 1,0 \text{ mm}$$

The angle of its fourth corner shall be

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

8.1.2 Thickness (figure 14)

In the area extending 8,5 mm from each of the two edges as shown in figure 14, the thickness of the case shall be

$$E_1 = 3,3 \text{ mm} \pm 0,2 \text{ mm}$$

When the cartridge is inserted in the test gauge specified in annex G, a force of 0,2 N maximum, applied to the centre of the back edge shall cause the cartridge to pass through the gauge.

The edge radius shall be

$$R_2 = 0,40 \text{ mm} \pm 0,25 \text{ mm}$$

8.1.3 Hub access hole (figure 13)

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

$$D_1 = 26,50 \text{ mm min.}$$

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

$$L_3 = 40,00 \text{ mm} \pm 0,15 \text{ mm}$$

$$L_4 = 31,00 \text{ mm} \pm 0,15 \text{ mm}$$

8.1.4 Locating holes (figures 13 and 15)**8.1.4.1 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

$$D_2 = 3,6 \text{ mm} \pm 0,1 \text{ mm}$$

The dimensions of its section (see cross-section A-A in figure 13) shall be

$$D_3 = 1,5 \text{ mm min.}$$

$$L_8 = 0,2 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_9 = 1,0 \text{ mm min.}$$

$$L_{10} = 2,5 \text{ mm min.}$$

8.1.4.2 Secondary locating hole

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

$$L_5 = 80,0 \text{ mm} \pm 0,2 \text{ mm}$$

It shall have a substantially rectangular shape. Its short axis shall be (see cross-section B-B in figure 13)

$$L_6 = 3,6 \text{ mm} \pm 0,1 \text{ mm}$$

Its long axis shall be

$$L_7 = 4,4 \text{ mm} \pm 0,2 \text{ mm}$$

The dimensions D_3 , L_8 , L_9 and L_{10} of the cross-section of the secondary locating hole are as specified in 8.1.4.1.

8.1.5 Label area**8.1.5.1 Side 0 (figure 13)**

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

$$L_{11} = 3,5 \text{ mm min.}$$

$$L_{12} = 76,5 \text{ mm max.}$$

$$L_{14} = 60,0 \text{ mm min.}$$

8.1.5.2 Side 1 (figure 14)

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

$$L_{11} = 3,5 \text{ mm min.}$$

$$L_{12} = 76,5 \text{ mm max.}$$

$$L_{13} = 20,0 \text{ mm min.}$$

8.1.6 Head windows (figure 15)

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

8.1.6.1 Location

The location of the head windows shall be defined by

$$L_{15} = 12,3 \text{ mm min.}$$

$$L_{16} = 11,5 \text{ mm min.}$$

$$L_{17} = 35,5 \text{ mm} \pm 0,2 \text{ mm}$$

8.1.6.2 Dimensions

The width of the head windows shall be

$$L_{18} = 9,00 \text{ mm} \pm 0,20 \text{ mm}$$

The radius of their corners shall be

$$R_3 = 0,5 \text{ mm} \pm 0,1 \text{ mm}$$

$$R_4 = 0,5 \text{ mm} \pm 0,1 \text{ mm}$$

8.1.7 Write-inhibit hole (figures 13 and 14)**8.1.7.1 Location**

The centre of the write-inhibit hole shall be specified by L_5 and

$$L_{19} = 67,75 \text{ mm} \pm 0,25 \text{ mm}$$

8.1.7.2 Dimensions

The dimensions of the write-inhibit hole shall be

$$L_{49} = 3,5 \text{ mm min.}$$

$$L_{50} = 4,0 \text{ mm min.}$$

8.1.7.3 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 XY nor shall it deflect by more than 0,3 mm from the Reference Plane XY inside the case under the action of a force of 3 N.

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

8.1.8 Identification holes (figures 13, 14 and 15)

The identification holes are provided to distinguish between the Flexible Disk Cartridge by this International Standard from those specified by ISO 8860-1, ISO/IEC 9529-1, and ISO/IEC 10994.

NOTE 4 - As the secondary identification hole is not a through-hole, it is recommended that the identification holes are detected by mechanical means.

8.1.8.1 Primary identification hole

The position of the centre of the primary identification hole shall be on Reference Axis Y. Its distance from Reference Axis X shall be specified by L_{19} .

The dimensions of the primary identification hole shall be

$$L_{20} = 3,5 \text{ mm min.}$$

$$L_{21} = 4,0 \text{ mm min.}$$

8.1.8.2 Secondary identification hole

The position of the centre of the secondary identification hole shall be

$$L_{60} = 7,50 \text{ mm} \pm 0,15 \text{ mm}$$

$$L_{61} = 74,0 \text{ mm} \pm 0,2 \text{ mm}$$

Its diameter shall be

$$D_{10} = 3,5 \text{ mm min.}$$

The dimensions of its section (see cross-section C-C in figure 13) shall be specified by L_8 and

$$L_{62} = 2,5 \text{ mm min.}$$

8.1.9 Profile of the shutter edge of the case (figure 15)

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

$$L_{22} = 80,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{23} = 76,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{24} = 68,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{25} = 64,50 \text{ mm} \pm 0,35 \text{ mm}$$

$$L_{26} = 57,00 \text{ mm} \pm 0,35 \text{ mm}$$

$$L_{27} = 55,5 \text{ mm} \pm 0,6 \text{ mm}$$

$$L_{28} = 3,5 \text{ mm min.}$$

$$L_{29} = 17,5 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{30} = 17,00 \text{ mm} \pm 0,15 \text{ mm}$$

$$L_{31} = 15,50 \text{ mm} \pm 0,25 \text{ mm}$$

$$L_{45} = 12,50 \text{ mm} \pm 0,25 \text{ mm}$$

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

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

8.1.10 Shutter (figures 14 and 15)

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 the Reference Axis Y shall be

$$L_{32} = 53,75 \text{ mm} \pm 1,25 \text{ mm}$$

The width of the windows of the shutter shall be

$$L_{33} = 12,0 \text{ mm} \pm 0,2 \text{ mm}$$

NOTE 5 - 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.

8.2 Liner

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

8.3 Disk (figure 16)**8.3.1 Diameter**

The diameter of the disk shall be

$$D_4 = 85,8 \text{ mm} \pm 0,2 \text{ mm}$$

8.3.2 Thickness

The thickness of the disk shall be

$$E_2 = 0,067 \text{ mm} \pm 0,008 \text{ mm}$$

8.4 Hub (figure 16)

The hub shall have a central part and a flange.

8.4.1 Dimensions

The diameter of the central part shall be

$$D_5 = 25,00 \text{ mm} \begin{matrix} 0,00 \\ -0,15 \end{matrix} \text{ mm}$$

The diameter of the flange shall be

$$D_6 = 29,50 \text{ mm max.}$$

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

$$L_{34} = 1,36 \text{ mm} \pm 0,10 \text{ mm}$$

when measured at a radius R_7

$$R_7 = 14 \text{ mm nominal}$$

8.4.2 Hub orientation holes (figure 16)

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

8.4.2.1 First orientation hole

The first orientation hole shall have a square form defined by

$$L_{35} = 4,0 \text{ mm min.}$$

The position of the centre of rotation of the disk is defined by

$$L_{36} = 1,995 \text{ mm}$$

measured from two sides of the hole. The centre of rotation shall be within 0,5 mm of the geometric centre of the disk.

The radius of the four corners of this hole shall be

$$R_5 = 1,0 \text{ mm} \pm 0,3 \text{ mm}$$

The angles of two sides of the hole which is in contact with the spindle shaft (see cross-sections D-D and E-E in figure 16) shall be

$$\delta = 90^\circ \begin{matrix} +1^\circ \\ 0^\circ \end{matrix}$$

8.4.2.2 Second orientation hole

The position and dimensions of the sides of the rectangular second orientation hole are referred to two radial Reference Lines A and B that are perpendicular to each other. Their positions shall be specified by

$$\gamma = 15^\circ \pm 3^\circ$$

The length of the sides of this hole shall be

$$L_{37} = 8,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{38} = 4,5 \text{ mm min.}$$