INTERNATIONAL STANDARD

ISO/IEC 9529-2

First edition
1989-09-15

Information processing systems — Data interchange on 90 mm (3,5 in) flexible disk cartridges using modified frequency modulation recording at 15 916 ftprad, on 80 tracks on each side —

Part 2: Track format

Systèmes de 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 à* 15 916 ftprad *sur 80 pistes sur chaque face —*

Partie 2: Schéma de piste

Reference number
ISO/IEC 9529-2 : 1989 (E)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) together form a system for worldwide standardization as a whole. 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 approval before their acceptance as International Standards. They are approved in accordance with procedures requiring at least 75 % approval by the national bodies voting.

International Standard ISO/IEC 9529-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

Introduction

ISO/IEC 9529 specifies the characteristics of 90 mm (3,5 in) flexible disk cartridges recorded at 15 916 ftprad using modified frequency modulation recording, on 80 tracks on each side. ISO/IEC 9529-1 specifies the dimensional, physical and magnetic characteristics of the cartridge, so as to provide physical interchangeability between data processing systems.

ISO/IEC 9529-1 and ISO/IEC 9529-2, together with the labelling scheme specified in ISO 9293, provide for full data interchange between data processing systems.

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Information processing systems — Data interchange on 90 mm (3,5 in) flexible disk cartridges using modified frequency modulation recording at 15 916 ftprad, on 80 tracks on each side —

Part 2:
Track format

1 Scope

This part of ISO/IEC 9529 specifies the track layout, the track format and the characteristics of the recorded signals.

NOTE - Numeric values in the SI and/or Imperial measurement system in this part of ISO/IEC 9529 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 is in conformance with this Part of ISO/IEC 9529 if it meets all mandatory requirements specified herein.

A prerequisite for conformance with this part of ISO/IEC 9529 is conformance with ISO/IEC 9529-1.

3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9529. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 9529 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 646:1983, *Information processing - ISO 7-bit coded character set for information interchange.*
ISO 2022:1986, *Information processing - ISO 7-bit and 8-bit coded character sets - Code extension techniques.*
ISO 4873:1986, *Information processing - ISO 8-bit code for information interchange - Structure and rules for implementation.*
ISO 6429:1988, *Additional control functions for (7-bit and 8-bit coded) character-sets.*
ISO 8859:1987 *Information processing - 8-bit single-byte coded graphic character sets.*
ISO 9293:1987 *Information processing - Volume and file structure of flexible disk cartridges for information interchange.*

4 General requirements

4.1 Mode of recording

The mode of recording shall be Modified Frequency Modulation (MFM) for which the conditions are:

— a flux transition shall be written at the centre of each bit cell containing a ONE;
— a flux transition shall be written at each cell boundary between consecutive bit cells containing ZEROs.

An exception to this is defined in 4.12.

4.2 Track location tolerance of the recorded flexible disk cartridge

For the purposes of this part of ISO/IEC 9529 the nominal track locations specified in sub clause 9.2.3.1 of ISO/IEC 9529-1 require compensation for the actual temperature using the nominal value of the thermal coefficient of expansion specified in sub clause 8.2 of ISO/IEC 9529-1. Over the range of operating environment specified in sub clause 6.1.2 of ISO/IEC 9529-1, the centrelines of the recorded tracks shall be within ± 0,028 mm (± 0,001 1 in) of these compensated nominal track locations.

4.3 Recording offset angle

At the instant of writing or reading a magnetic transition, the transition shall have an angle of

$$\theta = \text{arc sin} \left(\frac{d}{Rn} \right) \pm 0°18'$$

where Rn is the radius through that transition (see ISO/IEC 9529-1, 9.2.3.1).

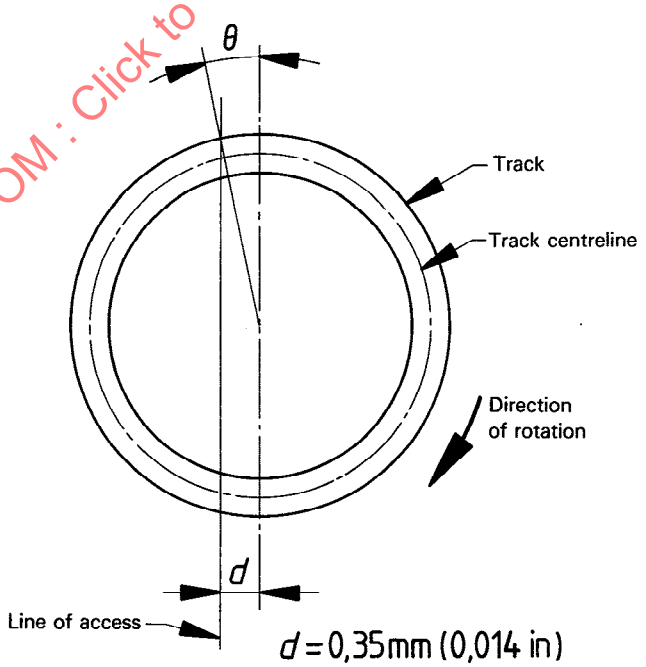

Figure 1

NOTE - As tracks may be written and overwritten at extremes of the tolerances given in 4.2 and 4.3, a band of old information may be left at one edge of the newly written data and would constitute unwanted noise when reading. It is therefore necessary to trim the edges of the tracks by erasure after writing.

4.4 Density of recording

4.4.1 The nominal density of recording shall be 15 916 ftprad. The resulting nominal bit cell length is 62,8 µrad.

4.4.2 The long term average bit cell length shall be the average bit cell length measured over a sector. It shall be within ± 2,5% of the nominal bit cell length.

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

4.5 Flux transition spacing

The instantaneous spacings between flux transitions are influenced by the reading and writing process, the bit sequence (pulse crowding effects) and other factors. The locations of the transitions are defined as the locations of the peaks in the signal when reading (see annexes A and B).

4.5.1 The spacing between the flux transitions of a sequence of ONEs shall be between 80% and 120% of the short-term average bit cell length.

4.5.2 The spacing between the flux transition for a ONE and that between two ZEROs preceding or following it shall be between 130% and 165% of the short-term average bit cell length.

4.5.3 The spacing between the flux transitions of two ONEs surrounding a ZERO shall be between 185% and 225% of the short-term average bit cell length.

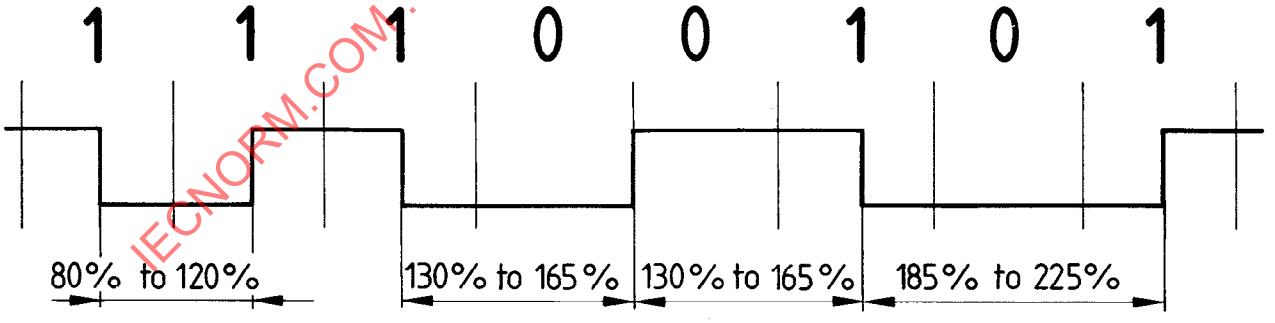

Figure 2

4.6 Average Signal Amplitude

For each side the Average Signal Amplitude on any track of the interchanged flexible disk cartridge shall be less than 160% of SRA_{1f} and more than 40% of SRA_{2f} (see 4.12 in ISO/IEC 9529-1).

4.7 Byte

A byte is a group of eight bit-positions, identified B1 to B8.

The bit in each position is a ZERO or a ONE.

4.8 Sector

All tracks shall be divided into 18 sectors of 512 bytes.

4.9 Cylinder

A pair of tracks, one on each side of the disk, having the same track number.

4.10 Cylinder number

The cylinder number shall be a two-digit number identical with the track number of the tracks of the cylinder.

4.11 Data capacity of a track

The data capacity of a track shall be 9 216 bytes.

4.12 Hexadecimal notation

Hexadecimal notation shall be used hereafter to denote the following bytes:

(00) for (B8 to B1) = 00000000
(01) for (B8 to B1) = 00000001
(02) for (B8 to B1) = 00000010
(4E) for (B8 to B1) = 01001110
(FE) for (B8 to B1) = 11111110
(FB) for (B8 to B1) = 11111011
(A1)* for (B8 to B1) = 10100001

In byte (A1)* the boundary transition between B3 and B4 is missing.

4.13 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 annex C).

5 Track layout

Formatting of a track shall commence with the occurrence of Index. Index shall occur within ± 440 µs of the instant at which reference line B (see 7.4.2.2 of ISO/IEC 9529-1) is parallel to the line of access.

During formatting the rotational speed of the disk shall be

— averaged Index to Index : 300 r/min ± 2%

— averaged over a sector : 300 r/min ± 2,5%

After formatting, there shall be 18 sectors on each track. The layout of each track shall be as shown in figure 3.

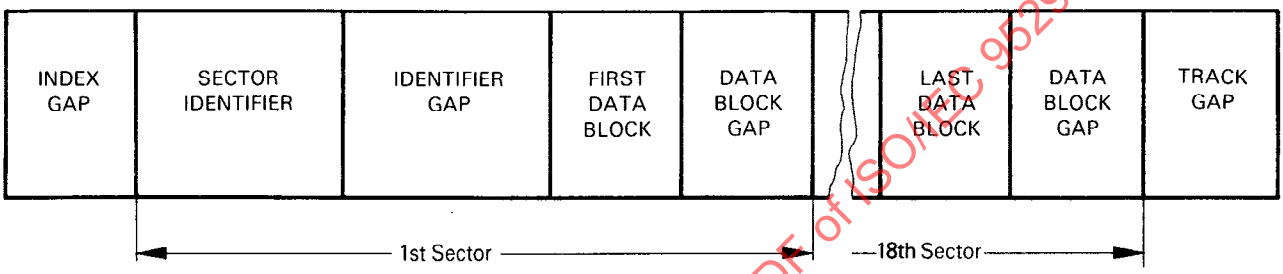

Figure 3

5.1 Index Gap

At nominal density, this field shall comprise 146 bytes of unspecified content except that it shall not contain any (A1)*-bytes. Some of the first bytes may have become ill-defined due to overwriting.

5.2 Sector Identifier

The layout of this field shall be as shown in figure 4.

Sector identifier							
Identifier mark			Address identifier				
			Track address		S		EDC
12 bytes (00)	3 bytes (A1)*	1 byte (FE)	C 1 byte	Side 1 byte (00) or (01)	1 byte	1 byte (02)	2 bytes

Figure 4

5.2.1 Identifier Mark

This field shall comprise 16 bytes:

12 (00) -bytes

3 (A1)* -bytes

1 (FE) -byte

5.2.2 Address Identifier

This field shall comprise 6 bytes.

5.2.2.1 Track Address

This field shall comprise 2 bytes:

a) Cylinder Number (C)

This field shall specify in binary notation the cylinder number from 00 for the outermost cylinder to 79 for the innermost cylinder.

b) Side Number (Side)

This field shall specify the side of the disk. On Side 0, it shall be (00) on all tracks. On Side 1 it shall be (01) on all tracks.

5.2.2.2 Sector Number (S)

The 3rd byte shall specify in binary notation the sector number from 01 for the 1st sector to 18 for the last sector.

The sectors may be recorded in any order of their sector numbers.

5.2.2.3 4th Byte

The 4th byte shall always be a (02)-byte.

5.2.2.4 EDC

These two bytes shall be generated as defined in 4.13 using the bytes of the Sector Identifier starting with the first (A1)*-byte (see 5.2.1) of the Identifier Mark and ending with the 4th byte (see 5.2.2.3) of the Address Identifier.

If the EDC is incorrect the sector is defective. ISO 9293 specifies the handling of defective sectors.

5.3 Identifier Gap

This field shall comprise initially 22 (4E)-bytes. These bytes may have become ill-defined due to overwriting.

5.4 Data Block

The layout of this field shall be as shown in figure 5.

Data block				
Data mark			Data field	EDC
12 bytes (00)	3 bytes (A1)*	1 byte (FB)	512 bytes	2 bytes

Figure 5

5.4.1 Data Mark

This field shall comprise:

12 (00) -bytes
3 (A1)* -bytes
1 (FB) -byte

5.4.2 Data Field

This field shall comprise 512 bytes.

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

5.4.3 EDC

These two bytes shall be generated as defined in 4.13 using the bytes of the Data Block starting with the first (A1)*-byte of the Data Mark and ending with the last byte of the Data Field.

If the EDC is incorrect the sector is defective. ISO 9293 specifies the handling of defective sectors.

5.5 Data Block Gap

This field shall comprise initially 101 (4E)-bytes. These bytes may have become ill-defined due to overwriting. The Data Block Gap is recorded after each Data Block and it precedes the following Sector Identifier. After the last Data Block, it precedes the Track Gap.

5.6 Track Gap

This field shall follow the Data Block Gap of the last sector. (4E)-bytes are written until the Index 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 Coded representation of data

6.1 Standards

The contents of the data field shall be recorded and interpreted according to the relevant International Standards for the coding of information, for example ISO 646, ISO 2022 or ISO 4873.

6.2 Coding methods

6.2.1 When the coding method requires it, the Data Field shall be regarded as an ordered sequence of 8-bit bytes.

Within each byte the bit positions shall be identified by B8 to B1. The high-order bit shall be recorded in position B8 and the low-order bit in position B1. The sequence of recording shall be high-order bit first.

When the data is encoded according to an 8-bit code, the binary weights of the bit positions shall be as shown in figure 6.

Bit Position	B8	B7	B6	B5	B4	B3	B2	B1
Binary Weight	128	64	32	16	8	4	2	1

Figure 6

When the data is encoded according to a 7-bit code, bit position B8 shall contain bit ZERO, and the data shall be encoded in bit positions B7 to B1, using the same binary weights as shown above.

6.2.2. When the coding method requires it, the Data Field shall be regarded as an ordered sequence of bit positions, each containing a bit.

Annex A

(informative)

Procedure and equipment for measuring flux transition spacing

A.1 General

This annex specifies equipment and procedure for measuring flux transition spacing on 90 mm flexible disk cartridges using MFM recording at 15 916 flux transitions per radian on both sides.

The testing rotational speed is 300 r/min nominal.

A.2 Format

The disk to be measured shall be written by the disk drive for data interchange use.

A.3 Test Equipment

A.3.1 Disk Drive

The disk drive shall have a rotational speed of 300 r/min ± 3 r/min averaged over one revolution. The average angular speed taken over 32 µs shall not deviate by more than 0,5% from the speed averaged over one revolution.

A.3.2 Head

A.3.2.1 Resolution

The head shall have an absolute resolution of 70% to 75% at Track 79 on each side, using the Reference Material RM 9529, applying the calibration factor of the Reference Material appropriate to the side, and recording with the appropriate Test Recording Current.

The resonant frequency of the head shall be at least 500 000 Hz.

The resolution shall not be adjusted by varying the load impedance of the head.

The resolution shall be measured at the output of the amplifier defined in A.3.3.1.

A.3.2.2 Offset angle

The offset angle of the head shall be $\theta = \arcsin\left(\frac{d}{R\,n}\right) \pm 0° 6'$,

where d = 0,35 mm (0,014 in).

A.3.2.3 Contact

Care shall be taken that the heads are in good contact with the disk during tests.

A.3.3 Read Channel

A.3.3.1 Read amplifier

The read amplifier shall have a flat response from 1 000 Hz to 375 000 Hz within ± 1 dB, and amplitude saturation shall not occur.

A.3.3.2 Peak sensing amplifier

Peak sensing shall be carried out by a differentiating and limiting amplifier, or equivalent good peak sensing circuit.

A.3.4 Time interval measuring resolution

The time interval counter shall be able to measure 5 µs to at least 5 ns resolution.

A.4 Procedure for measurement

A.4.1 Flux transition spacing measurement

The flux transition spacings shall be measured by measuring the time intervals between successive peaks in the read signal for 10^5 intervals of random sampling on a track, and plotting logarithmically the distribution of time intervals as shown below.
The measurements should be made at the output of the read amplifier defined in A.3.3.

A.4.2 Flux transition spacing for all tracks

Measurement time intervals t_1 to t_6 shall be as shown below.

t_2/t_0 and t_1/t_0 (× 100%) correspond to sub clause 4.5.1.
t_4/t_0 and t_3/t_0 (× 100%) correspond to sub clause 4.5.2.
t_6/t_0 and t_5/t_0 (× 100%) correspond to sub clause 4.5.3.

t_0 is the short-term average bit cell length = 2 µs normal. Intervals which are out of specification due to data block splicing or index splicing shall be neglected.