International Standard 8378/2

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Information processing — Data interchange on 130 mm (5.25 in) flexible disk cartridges using modified frequency modulation recording at 7 958 ftprad, 3,8 tpmm (96 tpi), on both sides — Part 2: Track format A

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Traitement de l'information — Échange de données sur cartouches à disquette de 130 mm (5,25 in) *utilisant un enregistrement à modulation de fréquence modifiée à* 7 958 ftprad, 3,8 tpmm (96 tpi), *sur les deux faces — Partie 2: Schéma de piste A*

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First edition — 1986-04-15

UDC 681.327.63 **Ref. No. ISO 8378/2-1986 (E)**

Descriptors: data processing, information interchange, data recording devices, magnetic disks, flexible disks, track formats, specifications.

Price based on 13 pages

Foreword

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International Standard ISO 8378/2 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

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Printed in Switzerland

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Information processing — Data interchange on 130 mm (5.25 in) flexible disk cartridges using modified frequency modulation recording at 7 958 ftprad, 3,8 tpmm (96 tpi), on both sides — Part 2: Track format A

0 Introduction

ISO 8378 specifies the characteristics of 130 mm (5.25 in) flexible disk cartridges recorded at 7 958 ftprad, 3,8 tpmm (96 tpi), on both sides using modified frequency modulation (MFM) recording.

ISO 8378/1 specifies the dimensional, physical and magnetic characteristics of the cartridge so as to provide physical interchangeability between data processing systems.

ISO 8378/3 specifies an alternative track format for data interchange.

Together with the labelling scheme specified in ISO 7665, ISO 8378/1 and ISO 8378/2 provide for full data interchange between data processing systems.

1 Scope and field of application

This part of ISO 8378 specifies the quality of recorded signals, the track layout, and a track format to be used on 130 mm (5.25 in) flexible disk cartridges intended for data interchange between data processing systems.

NOTE — Numeric values in the SI and/or Imperial measurement system in this part of ISO 8378 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 of this part of ISO 8378 was made using SI units.

2 Conformance

A flexible disk cartridge shall be in conformance with ISO 8378 when it meets all the requirements either of parts 1 and 2 or of parts 1 and 3 of ISO 8378.

3 References

ISO 646, *Information processing — ISO 7-bit coded character set for information interchange.*

ISO 2022, *Information processing — ISO 7-bit and 8-bit coded character sets — Code extension techniques.*

ISO 4873, *Information processing — ISO 8-bit code for information interchange — Structure and rules for implementation.*

ISO 7665, *Information processing — File structure and labelling of flexible disk cartridges for information interchange.*

ISO 8378, *Information processing — Data interchange on 130 mm (5.25 in) flexible disk cartridges using modified frequency modulation recording at 7 958 ftprad, 3,8 tpmm (96 tpi), on both sides —*

Part 1: Dimensional, physical and magnetic characteristics.

Part 3: Track format B.

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4 Track format

4.1 General requirements

4.1.1 Mode of recording

4.1.1.1 Track 00, side 0

The mode of recording shall be two-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. Exceptions to this are defined in 4.1.12.

4.1.1.2 All tracks other than track 00, side 0

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

a) a flux transition shall be written at the centre of each bit cell containing a ONE;

b) a flux transition shall be written at each cell boundary between consecutive bit cells containing ZEROs.

Exceptions to this are defined in 4.1.12.

4.1.2 Track location tolerance of the recorded flexible disk cartridge

The centrelines of the recorded tracks shall be within ±0,042 5 mm (0.001 7 in) of the nominal positions, over the range of operating environment specified in ISO 8378/1.

4.1.3 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.

NOTE — As tracks may be written and overwritten at extremes of the tolerances given in 4.1.2 and 4.1.3, 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.

4.1.4 Density of recording

4.1.4.1 The nominal density of recording shall be 7 958 ftprad. The nominal bit cell length for track 00, side 0 is 251 µrad, and for all the other tracks it is 125,7 µrad.

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4.1.4.2 The long-term average bit cell length shall be the average bit cell length measured over a sector. It shall be within ±3,5 % of the nominal bit cell length.

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4.1.4.3 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.

4.1.5 Flux transition spacing

The instantaneous spacing between flux transitions may be influenced by the reading and writing process, the bit sequence recorded (pulse crowding effects), and other factors. The locations of the transitions are defined as the locations of the peaks in the signal when reading. Tests should be carried out using a peak-sensing amplifier.

4.1.5.1 Flux transition spacing for track 00, side 0 (see figure 1).

4.1.5.1.1 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.

4.1.5.1.2 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.

4.1.5.1.3 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.

4.1.5.2 Flux transition spacing for all tracks other than track 00, side 0 (see figure 2).

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

4.1.5.2.2 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.

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

4.1.6 Average signal amplitude

For each side the average signal amplitude on any non-defective track (see ISO 8378/1) of the interchanged flexible disk cartridge shall be less than 160 % of SRA_{1f} and more than 40 % of SRA_{2f}.

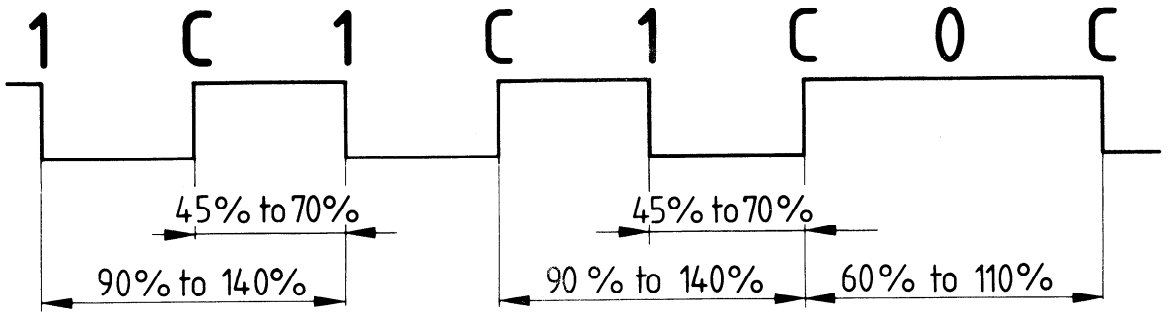

Figure 1

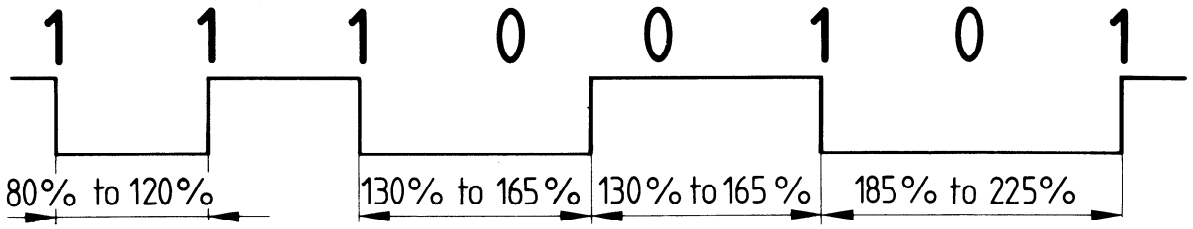

Figure 2

4.1.7 Byte

A byte is a group of eight bit-positions, identified B1 to B8, with B8 the most significant and recorded first.

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

4.1.8 Sector

All tracks are divided into 16 sectors.

4.1.9 Cylinder

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

4.1.10 Cylinder number

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

4.1.11 Data capacity of a track

The data capacity of track 00, side 0 shall be 2 048 bytes. The data capacity of all tracks other than track 00, side 0 shall be 4 096 bytes.

4.1.12 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

(FF) for (B8 to B1) = 11111111

(FE)* for (B8 to B1) = 11111110

where the clock transitions of B6, B5 and B4 are missing

(FB)* for (B8 to B1) = 11111011

where the clock transitions of B6, B5 and B4 are missing

(F8)* for (B8 to B1) = 11111000

where the clock transitions of B6, B5 and B4 are missing

(4E) for (B8 to B1) = 01001110

(FE) for (B8 to B1) = 11111110

(FB) for (B8 to B1) = 11111011

(F8) for (B8 to B1) = 11111000

(A1)* for (B8 to B1) = 10100001

where the boundary transition between B3 and B4 is missing.

4.1.13 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

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

(See also annex A.)

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4.2 Track layout after the first formatting for track 00, side 0

After the first formatting, there shall be 16 usable sectors on the track. The layout of the track shall be as shown in figure 3.

During formatting the rotational speed of the disk, averaged index to index, shall be 300 ± 6 r/min.

4.2.1 Index gap

At nominal density, this field shall comprise 16 (FF)-bytes. Writing the index gap is started when the index hole is detected. Any of the first 8 bytes may be ill-defined due to subsequent overwriting.

4.2.2 Sector identifier

This field shall be as given in table 1.

Table 1

Sector identifier						
Identifier mark		Address identifier				
		Track address		S		EDC
6 bytes (00)	1 byte (FE)	C 1 byte (00)	Side 1 byte (00)	1 byte	1 byte (00)	2 bytes

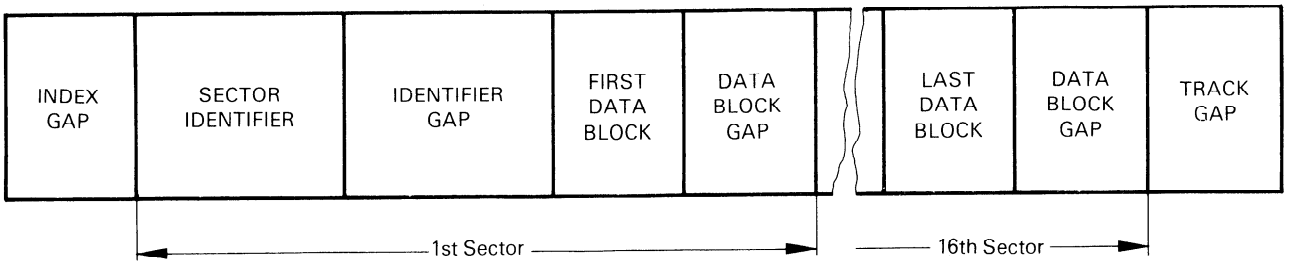

Figure 3

4.2.2.1 Identifier mark

This field shall comprise 7 bytes:

6 (00)-bytes

1 (FE)*-byte

4.2.2.2 Address identifier

This field shall comprise 6 bytes.

4.2.2.2.1 Track address

This field shall comprise two bytes:

a) Cylinder address (C)

This field shall specify in binary notation the cylinder address. It shall be (00) for all sectors.

b) Side number (Side)

This field shall specify the side of the disk. It shall be (00) for all sectors.

4.2.2.2.2 Sector number (S)

The 3rd byte shall specify in binary notation the sector number from 01 for the 1st sector to 16 for the last sector.

The 16 sectors shall be recorded in the natural order:

1, 2, 3 ... 15, 16

4.2.2.2.3 4th byte of the sector address

The 4th byte shall always be a (00)-byte.

4.2.2.2.4 EDC

These two bytes shall be generated as defined in 4.1.13 using the bytes of the sector identifier starting with the (FE)*-byte (see 4.2.2.1) of the identifier mark and ending with the 4th byte (see 4.2.2.2.3) of the address identifier.

4.2.3 Identifier gap

This field shall comprise 11 initially recorded (FF)-bytes.

4.2.4 Data block

This field shall be as given in table 2.

Table 2

Data block			
Data mark		Data field	EDC
6 bytes (00)	1 byte (FB)*	128 bytes	2 bytes

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4.2.4.1 Data mark

This field shall comprise

6 (00)-bytes

1 (FB)*-byte

4.2.4.2 Data field

This field shall comprise 128 bytes. No requirements are implied beyond the correct EDC for the content of this field (see also 4.4.4.2.4.2).

4.2.4.3 EDC

These two bytes shall be generated as defined in 4.1.13 using the bytes of the data block starting with the 7th byte of the data mark (see 4.2.4.1) and ending with the last byte of the data field (see 4.2.4.2).

4.2.5 Data block gap

This field shall comprise 27 initially recorded (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.

4.2.6 Track gap

This field shall follow the data block gap of the 16th sector. (FF)-bytes are written until the index hole is detected, unless it has been detected during writing of the last data block gap, in which case there shall be no track gap.

4.3 Track layout after the first formatting for all tracks other than track 00, side 0

After the first formatting, there shall be 16 usable sectors on each track. The layout of each track shall be as shown in figure 4.

During formatting the rotational speed of the disk, averaged index to index, shall be 300 ± 6 r/min.

4.3.1 Index gap

At nominal density, this field shall comprise 32 (4E)-bytes. Writing the index gap is started when the index hole is detected. Any of the first 16 bytes may be ill-defined due to subsequent overwriting.

4.3.2 Sector identifier

This field shall be as given in table 3.

4.3.2.1 Identifier mark

This field shall comprise 16 bytes:

12 (00)-bytes

3 (A1)*-bytes

1 (FE)-byte

4.3.2.2 Address identifier

This field shall comprise 6 bytes.

4.3.2.2.1 Track address

This field shall comprise 2 bytes:

a) Cylinder address (C)

This field shall specify in binary notation the cylinder address from 00 for the outermost cylinder to 77 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.

4.3.2.2.2 Sector number (S)

The 3rd byte shall specify in binary notation the sector number from 01 for the 1st sector to 16 for the last sector.

The sectors shall be recorded in the natural order:

1, 2, 3 . . . 15, 16

4.3.2.2.3 4th byte

The 4th byte shall always be a (01)-byte.

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4.3.2.2.4 EDC

These two bytes shall be generated as defined in 4.1.13 using the bytes of the sector identifier starting with the first (A1)*-byte (see 4.3.2.1) of the identifier mark and ending with the 4th byte (see 4.3.2.2.3) of the address identifier.

4.3.3 Identifier gap

This field shall comprise 22 initially recorded (4E)-bytes.

Table 3

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

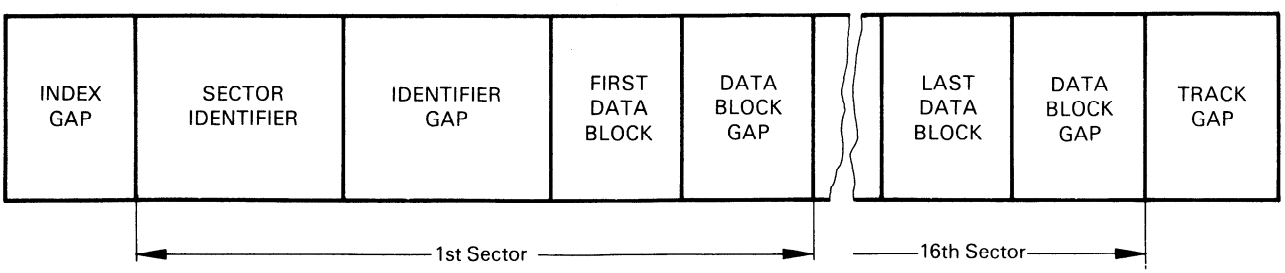

Figure 4

4.3.4 Data block

This field shall be as given in table 4.

Table 4

Data block				
Data mark			Data field	EDC
12 bytes (00)	3 bytes (A1)*	1 byte (FB)	256 bytes	2 bytes

4.3.4.1 Data mark

This field shall comprise

12 (00)-bytes

3 (A1)*-bytes

1 (FB)-byte

4.3.4.2 Data field

This field shall comprise 256 bytes. No requirements are implied beyond the correct EDC for the content of this field (see also 4.4.4.2.4.2).

4.3.4.3 EDC

These two bytes shall be generated as defined in 4.1.13 using the bytes of the data block starting with the 1st (A1)*-byte of the data mark (see 4.3.4.1) and ending with the last byte of the data field (see 4.3.4.2).

4.3.5 Data block gap

This field shall comprise 54 initially recorded (4E)-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.

4.3.6 Track gap

This field shall follow the data block gap of the last sector. (4E)-bytes are written until the index hole is detected, unless it has been detected during writing of the last data block gap, in which case there shall be no track gap.

4.4 Track layout of a recorded flexible disk for data interchange

4.4.1 Representation of characters

Characters shall be represented by means of the 7-bit coded character set (ISO 646) and, where required, by its 7-bit or 8-bit extensions (ISO 2022) or by means of the 8-bit coded character set (ISO 4873).

Each 7-bit coded character shall be recorded in bit-positions B7 to B1 of a byte; bit position B8 shall be recorded with bit ZERO.

The relationship shall be as shown in figure 5.

Each 8-bit coded character shall be recorded in bit-positions B8 to B1 of a byte.

The relationship shall be as shown in figure 6.

4.4.2 Good and bad cylinders

A good cylinder is a cylinder which has both tracks formatted according to 4.4.4.

A bad cylinder is a cylinder which has both tracks formatted according to 4.4.5.

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4.4.3 Requirements for cylinders

Cylinder 00 shall be a good cylinder and shall have no defective sectors on side 0. There shall be at least 77 good cylinders between cylinder 01 and cylinder 79.

4.4.4 Layout of the tracks of a good cylinder

References to 4.2 are for track 00, side 0. References to 4.3 are for all other tracks.

4.4.4.1 Index gap

Description: see 4.2.1 and 4.3.1.

4.4.4.2 Sector identifier

4.4.4.2.1 Identifier mark

Description: see 4.2.2.1 and 4.3.2.1.

Bits of the 7-bit combination	0	b7	b6	b5	b4	b3	b2	b1
Bit-positions in the byte	B8	B7	B6	B5	B4	B3	B2	B1

Figure 5

Bits of the 8-bit combination	b8	b7	b6	b5	b4	b3	b2	b1
Bit-positions in the byte	B8	B7	B6	B5	B4	B3	B2	B1

Figure 6

4.4.4.2.2 Address identifier

Description: see 4.2.2.2 and 4.3.2.2.

4.4.4.2.2.1 Track address

This field shall comprise 2 bytes:

a) Cylinder address (C)

This field shall specify in binary notation the cylinder address from 00 for the outermost cylinder to 77 for the innermost cylinder.

NOTE — A unique cylinder number is associated with each cylinder (see 4.1.10). Two of these cylinders are intended for use only when there are one or two defective cylinders. Each good cylinder possesses a unique cylinder address; a defective cylinder does not possess a cylinder address. Cylinder addresses are assigned consecutively to the good cylinders in the ascending sequence of cylinder numbers.

b) Side number (Side)

Description: see 4.2.2.2.1 and 4.3.2.2.1.

4.4.4.2.2.2 Sector number (S)

Description: see 4.2.2.2.2 and 4.3.2.2.2.

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4.4.4.2.2.3 4th byte

Description: see 4.2.2.2.3 and 4.3.2.2.3.

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4.4.4.2.2.4 EDC

Description: see 4.2.2.2.4 and 4.3.2.2.4.

4.4.4.2.3 Identifier gap

Description: see 4.2.3 and 4.3.3. These bytes may have become ill-defined due to the overwriting process.

4.4.4.2.4 Data block

4.4.4.2.4.1 Data mark

For track 00, side 0, this field shall comprise

6 (00)-bytes

1 byte

The 7th byte shall be

(FB)* indicating that the data are valid and that the whole data field can be read;

(F8)* indicating that the 1st byte of the data field shall be interpreted according to ISO 7665.

For all other tracks, this field shall comprise

12 (00)-bytes

3 (A1)*-bytes

1 byte

The 16th byte shall be

(FB) indicating that the data are valid and that the whole data field can be read;

(F8) indicating that the 1st byte of the data field shall be interpreted according to ISO 7665.

4.4.4.2.4.2 Data field

This field shall comprise 128 bytes or 256 bytes as specified in 4.2.4.2 and 4.3.4.2.

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

Data fields in cylinder 00 are reserved for operating system use, including labelling.

4.4.4.2.4.3 EDC

Description: see 4.2.4.3 and 4.3.4.3.

If the last byte of the data mark is (F8)* or (F8) and the 1st character of the data field is CAPITAL LETTER F, 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.

On cylinder 00, only CAPITAL LETTER D shall be allowed.

4.4.4.2.5 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 (FF)-bytes (see 4.2.5) or 54 (4E)-bytes (see 4.3.5). These bytes may have become ill-defined due to the overwriting process.

4.4.4.2.6 Track gap

Description: see 4.2.6 and 4.3.6.

4.4.5 Layout of the tracks of a bad cylinder

4.4.5.1 Contents of the fields

The fields of the tracks of a bad cylinder should have the following contents:

4.4.5.1.1 Index gap

Description: see 4.2.1 and 4.3.1.