International Standard 5652

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

Information processing — 9-Track, 12,7 mm (0.5 in) wide magnetic tape for information interchange — Format and recording, using group coding at 246 cpmm (6 250 cpi)

Traitement de l'information — Bande magnétique à 9 pistes de 12,7 mm (0,5 in) *de large pour l'échange d'information — Format et enregistrement utilisant des codages de groupe à* 246 cpmm (6 250 cpi)

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Descriptors : data processing, information interchange, magnetic tapes, 9-tracks, definitions, operating requirements, magnetic recording, data representation, block format, transportation.

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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 5652 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

ISO 5652 was first published in 1983. This second edition cancels and replaces the first edition, of which sub-clause B.3.2 of annex B has been technically revised.

Contents

Information processing — File structure and labelling of magnetic tapes for information interchange

1 Scope and field of application

This International Standard specifies the file structure and the labelling of magnetic tapes for the interchange of information between users of information processing systems.

This International Standard also specifies

— volume and file structure;

— basic characteristics of the blocks containing the records constituting the file;

— recorded labels for identifying files, file sections and volumes of magnetic tapes;

— four nested levels of interchange.

Furthermore, this International Standard specifies requirements for the processes which are provided within information processing systems, to enable information to be interchanged between different systems, utilizing recorded magnetic tape as the medium of interchange. For this purpose it specifies the functions to be provided within systems which are intended to originate or receive magnetic tape volumes which conform to this International Standard.

2 Conformance

2.1 Conformance of a magnetic tape volume set

A magnetic tape volume set conforms to this International Standard when all information recorded on it conforms to the specifications of this International Standard. A statement of conformance shall identify the lowest level of interchange to which the contents of the magnetic tapes conform.

A prerequisite to such conformance is conformance of each volume of the volume set to the same International Standard for information interchange on magnetic tapes.

2.2 Conformance of an information processing system

An information processing system conforms to this International Standard if it meets all the requirements specified in this International Standard either for an originating system, or for a receiving system, or for both types of system. A statement of conformance shall identify which of these sets of requirements can be met by the system.

3 References

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

ISO 962, *Information processing — Implementation of the 7-bit coded character set and its 7-bit and 8-bit extensions on 9-track,* 12,7 mm (0.5 in) *magnetic tape.*

ISO 1862, *Information processing — 9-track,* 12,7 mm (0.5 in) *wide magnetic tape for information interchange recorded at* 8 rpmm (200 rpi).

ISO 1863, *Information processing — 9-track,* 12,7 mm (0.5 in) *wide magnetic tape for information interchange recorded at* 32 rpmm (800 rpi).

ISO 1864, *Information processing — Unrecorded* 12,7 mm (0.5 in) *wide magnetic tape for information interchange —* 35 ftpmm (800 ftpi) *NRZ1,* 126 ftpmm (3 200 ftpi) *phase encoded and* 356 ftpmm (9 042 ftpi), *NRZ1.*

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

ISO 3788, *Information processing — 9-track,* 12,7 mm (0.5 in) *wide magnetic tape for information interchange recorded at* 63 rpmm (1 600 rpi), *phase-encoded.*

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

ISO 5652, *Information processing — 9-track,* 12,7 mm (0.5 in) *wide magnetic tape for information interchange — Format and recording, using group coding at* 246 cpmm (6 250 rpi).

4 Definitions

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

4.1 application program : A program that processes the contents of records belonging to a file, and may also process selected attribute data relating to the file or to the volume(s) on which it is recorded.

NOTE — An application program is a specific class of user as defined in this International Standard.

3.7 standard reference amplitude : The average peak-to-peak signal amplitude derived from the signal amplitude reference tape on the NBS measurement system, or equivalent, under the recording conditions specified in ISO 1864.

3.8 reference edge : The edge furthest from an observer when a tape is lying flat with the magnetic surface uppermost and the direction of movement for recording is from left to right.

3.9 in contact : An operation condition in which the magnetic surface of a tape is in contact with a magnetic head.

3.10 track : A longitudinal area on a tape along which a series of magnetic signals may be recorded.

3.11 row : Nine transversely related locations (one in each track) in which bits are recorded.

3.12 position of flux transition : The point which exhibits the maximum free-space flux density normal to the tape surface.

3.13 physical recording density : The number of recorded flux transitions per unit length of track (ftpmm or ftpi).

3.14 data density : The number of data characters stored per unit length of tape (cpmm or cpi).

3.15 skew : The maximum longitudinal deviation in the placement of bits within a row.

3.16 ECC character : A character used for error detection and correction within a data group.

3.17 auxiliary CRC character : A character used for error detection within the data part of a block.

3.18 CRC character : A character used for error detection within a complete block.

3.19 preamble : A pattern of signals marking the beginning of each storage block, used primarily for electronic synchronization.

3.20 postamble : A pattern of signals marking the end of each storage block.

3.21 density identification area (ID burst) : A burst of recording at the beginning of a tape identifying the use of the group-coded-recording method.

3.22 Automatic Read Amplification (ARA) burst : A burst of recording at the beginning of a tape which may be used for setting the gain of the read amplifiers.

3.23 error: The detection of a missing pulse or an extra pulse in a track. Missing pulse and extra pulse are as defined in ISO 1864 sub-clauses 5.16.1 c) and 5.16.2 respectively.

4 Operating and transportation conditions

4.1 Operating environment

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

— temperature : 16 to 32 °C (60 to 90 °F);

— relative humidity: 20 to 80 %;

— wet bulb temperature : not greater than 26 °C (78 °F).

Conditioning before operating : If a tape has been exposed during storage and/or transportation to conditions outside the above values, it should be conditioned for a period of 2 to 12 h. depending on the extent of exposure.

4.2 Transportation

Responsibility for ensuring that adequate precautions against damage are taken during shipment shall lie with the sender (see annex A).

4.3 Wind tension

For interchange, the tape winding tension shall be between 2 N and 3,6 N (7 to 13 ozf).

5 Recording

5.1 Method of recording

The "non return to zero mark" (NRZ1) method of recording shall be used where a ONE is represented by a change of direction of longitudinal magnetization.

5.2 Density of recording

The nominal density shall be 356 ftpmm (9 042 ftpi). Other nominal densities used hereafter for specific measurements shall be

178 ftpmm (4 521 ftpi)

119 ftpmm (3 014 ftpi).

5.3 Average flux transition spacings

The following measurements shall be made after interchange using a tape recorded at a density of 178 ftpmm (4 521 ftpi). The nominal flux transition spacing at this density shall be 5,618 µm (221.2 µin) subject to the following variations.

5.3.1 The long term average (static) flux transition spacing shall be within ± 4 % of the nominal spacing. This average shall be measured over a minimum of 5×10^5 successive flux transitions.

5.3.2 The short term average (dynamic) flux transition spacing, when referred to a particular flux transition spacing, is the average of that flux transition spacing and the preceding flux transition spacing.

The short term average flux transition spacing shall be within the limits of ± 6 % of the long term average flux transition spacing.

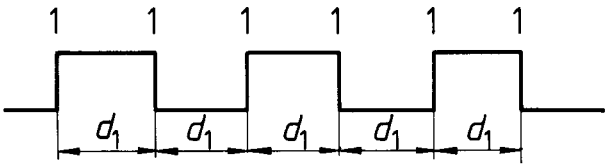
In addition, the rate of change of the short term average flux transition spacing shall not exceed 0,2 % per flux transition spacing.

5.4 Instantaneous flux transition spacings

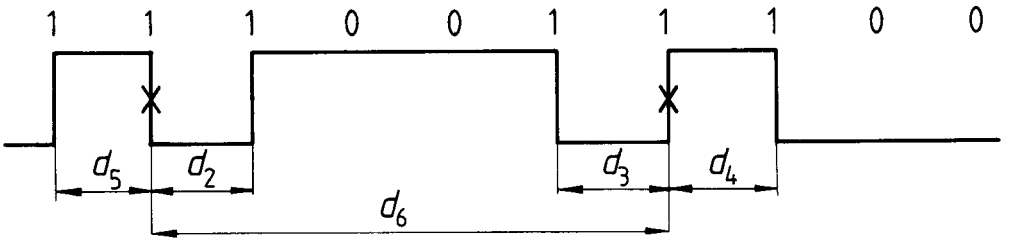
The instantaneous spacing between flux transitions may be influenced by the reading and writing processes, the pattern recorded (pulse crowding effects) and other factors.

Instantaneous spacings between flux transitions shall meet the following conditions, when tested on the reference read chain (see annex B).

5.4.1 At the nominal maximum density of 356 ftpmm (9 042 ftpi) the spacing d_1 between successive flux transitions shall be between 48 % and 52 % of the corresponding short term average flux transition spacing determined at 178 ftpmm (4 521 ftpi).



5.4.2 In a sequence of flux transitions defined by the bit pattern 1110011100..., the average displacement of the spacing of the flux transitions on either side of a reference transition, from that reference transition, shall be not more than ± 28 % from the average spacing of flux transitions at 356 ftpmm (9 042 ftpi).



Crosses denote reference transitions.

1,28 d_1 > average d_5 > 0,72 d_1

1,28 d_1 > average d_2 > 0,72 d_1

1,28 d_1 > average d_3 > 0,72 d_1

1,28 d_1 > average d_4 > 0,72 d_1

The tolerances of long term average spacing and short term average spacing (see 5.3.1 and 5.3.2) are included in this deviation.

The average distance d_6 between actual consecutive reference flux transitions in a sequence defined by the bit pattern 1110011100... and the calculated distance $5d_1$, of six flux transitions at nominal maximum density of 356 ftpmm (9 042 ftpi) shall not differ by more than 6 % of d_1.

5,06 d_1 > average d_6 > 4,94 d_1

5.5 Skew

No flux transition shall be displaced by more than 16,86 µm (664 µin) from any other flux transition in the same row. This displacement shall be measured as the distance between perpendiculars to the reference edge through the said flux transitions.

5.6 Signal amplitude

5.6.1 Standard reference amplitude

The standard reference amplitude is the average peak-to-peak signal amplitude derived from the signal amplitude reference tape on the qualified measurement system at the density of 356 ftpmm (9 042 ftpi) and the recording current $I_R = k \times I_f$ (see ISO 1864).

The signal amplitude shall be averaged over a minimum of 4 000 flux transitions and shall be measured on the read-while-write pass.

The reference current I_f is the current which produces the reference field (see 3.6).

5.6.2 Average signal amplitude

5.6.2.1 The average peak-to-peak signal amplitude of the interchanged tape at 356 ftpmm (9 042 ftpi) shall not deviate by more than ± 50 % from the standard reference amplitude.

5.6.2.2 The average peak-to-peak signal amplitude at 119 ftpmm (3 014 ftpi) shall be less than five times the standard reference amplitude.

5.6.2.3 Averaging shall be done over a minimum of 4 000 flux transitions, which for the interchange tape may be segmented into blocks. Averaging shall be done on the first-read pass after interchange.

5.6.3 Minimum signal amplitude

A tape to be interchanged shall contain no flux transition in more than one track since the last MARK 1 control sub-group, the base-to-peak amplitude of which is less than 15 % of half the standard reference amplitude.

5.7 Erasure

5.7.1 When erased, the rim end of the erased area of the tape shall be magnetized so that it is a North-seeking pole.

5.7.2 The full width of the tape shall be DC erased in the direction specified in 5.7.1.

5.7.3 The tape shall be erased so that the residual signal shall not exceed 4 % of the standard reference amplitude.

6 Tracks

6.1 Number of tracks

There shall be nine tracks.

6.2 Track identification

Tracks shall be numbered consecutively beginning at the reference edge with track 1.

6.3 Track positions

The distance from the centrelines of the tracks to the reference edge shall be :

Track 1 : 0,74 ± 0,08 mm (0.029 ± 0.003 in)
Track 2 : 2,13 ± 0,08 mm (0.084 ± 0.003 in)
Track 3 : 3,53 ± 0,08 mm (0.139 ± 0.003 in)
Track 4 : 4,93 ± 0,08 mm (0.194 ± 0.003 in)
Track 5 : 6,32 ± 0,08 mm (0.249 ± 0.003 in)
Track 6 : 7,72 ± 0,08 mm (0.304 ± 0.003 in)
Track 7 : 9,12 ± 0,08 mm (0.359 ± 0.003 in)
Track 8 : 10,52 ± 0,08 mm (0.414 ± 0.003 in)
Track 9 : 11,91 ± 0,08 mm (0.469 ± 0.003 in)

6.4 Track width

The width of a written track shall be :

1,09 mm min. (0.043 in min.)

7 Data representation

The characters shall be represented by means of the 7-bit coded character set (see ISO 646) or the 8-bit coded character set (see ISO 4873) or, where required, of an extension of the 7-bit coded character set (see ISO 2022).

The bit-to-track allocation shall be as follows :

7.1 7-bit coded characters

Binary weight	2^0	2^1	2^2	2^3	2^4	2^5	2^6	—	—
Bit designation	b_1	b_2	b_3	b_4	b_5	b_6	b_7	—	P
Track	2	8	1	9	3	5	6	7	4

Track 7 shall always be recorded with bit ZERO.

7.2 8-bit coded characters

Binary weight	2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	—
Bit designation	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	P
Track	2	8	1	9	3	5	6	7	4

Bit P in track 4 shall be the parity bit. The parity shall be odd.

8 Data formatting

Prior to recording, the data shall be arranged in groups completed with computed check characters (see 8.4). These data groups shall be in turn arranged in a given sequence together with groups of control characters. The data and control character groups so arranged are then recorded on the tape according to a specific coding scheme (see clause 9).

8.1 Data groups

A data group shall comprise 8 bytes as follows :

— in positions 1 to 7, seven data bytes;

— in position 8, an ECC character.

8.2 Residual group

A residual group shall be a group comprising

— in positions 1 to 6, the remaining data bytes, if any;

— in positions 1 to 6, not occupied by a data byte, a padding character [byte (00) with odd parity];

— in position 7, an auxiliary CRC character;

— in position 8, an ECC character.

8.3 CRC group (see figure below)

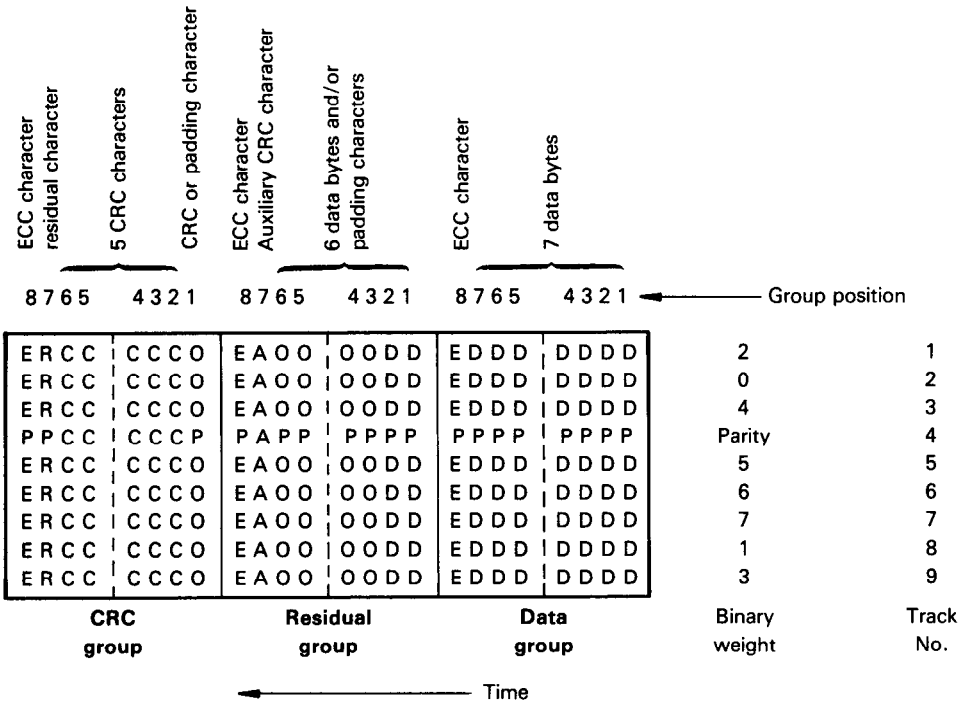
After the residual group, a CRC group shall be formed comprising

— in position 1 : byte (00) with odd parity if the number of preceding data groups is even, or the CRC character if the number of preceding data groups is odd;

— in positions 2 to 6, the CRC character;

— in position 7, the residual character;

— in position 8, an ECC character.



NOTE — The line of bits corresponding to each track number shown will then be group coded (see clause 9), and the resulting bit stream will then be recorded on the tape in the corresponding track.

8.4 Check characters

8.4.1 ECC character

The ECC character shall be calculated separately for each group (data group, residual group and CRC group). In each case, 7 polynomials D_1 to D_7 shall be formed, the coefficients of which shall be the 8 bits of each byte in positions 1 to 7. The coefficients of polynomial D_1 shall be the bits in position 1, those of polynomial D_2 shall be the bits in position 2, etc. The parity bit in track 4 shall not be part of the ECC character generation.

These bits shall be allocated to the polynomials as follows :

Bit from track	is coefficient of
7	x^0
1	x^1
8	x^2
5	x^3
2	x^4
9	x^5
6	x^6
3	x^7
–	–

The ECC character shall be obtained from the coefficients of polynomial E computed as follows :

$$E = \Sigma (x^i D_j) \pmod{G}$$

where

$i = 7$ to 1

$j = 1$ to 7

$G = x^0 + x^3 + x^4 + x^5 + x^8$

All arithmetic operations shall be (mod 2).

The bits of the ECC character shall be the coefficients of the resulting polynomial :

In track	the coefficient of
1	x^1
2	x^4
3	x^7
4	P
5	x^3
6	x^6
7	x^0
8	x^2
9	x^5

In track 4, an odd parity bit P shall be inserted.

8.4.2 Auxiliary CRC character

The auxiliary CRC character shall be calculated from all the data bytes within the storage block considered as 9-bit bytes by inclusion of their parity bit P. Polynomials M_j shall be formed.

The coefficients shall be the bits in each data byte.

The coefficients of polynomial M_1 shall be the bits of the byte in position 1 of the first data group, those of polynomial M_2 shall be the bits of the byte in position 2, etc., up to M_n where n is the number of data bytes within the block.

These bits shall be allocated to the polynomials as follows :

Bit from track	is coefficient of
1	x^0
5	x^1
8	x^2
4	x^3
2	x^4
6	x^5
3	x^6
7	x^7
9	x^8

The auxiliary CRC character shall be obtained as follows. An asymmetrical polynomial N shall be computed

$$N = \Sigma (x^i M_j) \pmod{H}$$

where

$i = n$ to 1

$j = 1$ to n

$H = x^0 + x^2 + x^6 + x^9$

All arithmetic operations shall be (mod 2).

A polynomial $(x^0 + x^1 + x^6 + x^7 + x^8)$ shall be combined by means of an exclusive OR operation with N in the corresponding bit positions.

The coefficients of the resulting polynomial shall be the bits of the auxiliary CRC character according to the following allocation :

In track	the coefficient of
1	x^0
2	x^4
3	x^6
4	x^3
5	x^1
6	x^5
7	x^7
8	x^2
9	x^8

The auxiliary CRC character shall have odd parity. If the auxiliary CRC character obtained has even parity, the bit in track 4 shall be inverted to obtain odd parity.

8.4.3 CRC character

The CRC character shall be calculated from all the previous characters within the block (data, padding characters, auxiliary CRC, and the padding character, if any, in position 1 of the CRC group) considered as 9-bit bytes by inclusion of their parity bit, but excluding all the ECC characters in position 8 of the data groups and of the residual group. Polynomials M_j shall be formed, the coefficients of which are the bits in each byte. The coefficients of polynomial M_1 shall be the bits of the byte in position 1 of the first data group, those of polynomial M_2 shall be the bits of the byte in position 2, etc., up to M_n for the n characters to be considered.

These bits shall be allocated to the polynomials as follows :

Bit from track	is coefficient of
4	x^0
7	x^1
6	x^2
5	x^3
3	x^4
9	x^5
1	x^6
8	x^7
2	x^8

The CRC character shall be obtained as follows. A polynomial C shall be computed

$$C = \Sigma\ (xiM_j) \text{ (mod } K)$$

where

$i = n$ to 1

$j = 1$ to n

$$K = x^0 + x^3 + x^4 + x^5 + x^6 + x^9$$

All arithmetic operations shall be (mod 2).

A polynomial $(x^0 + x^1 + x^2 + x^4 + x^6 + x^7 + x^8)$ shall be combined by means of an exclusive OR operation with C in the corresponding bit positions. The coefficients of the resulting polynomial shall be the bits of the CRC character according to the following allocation :

In track	the coefficient of
1	x^6
2	x^8
3	x^4
4	x^0
5	x^3
6	x^2
7	x^1
8	x^7
9	x^5

NOTE — The CRC character will always have an odd parity.

8.4.4 Residual character

The residual character shall be obtained from the number n of data bytes within the block.

$$R_1 = n \text{ (mod 7)}$$

$$R_2 = n - 1 \text{ (mod 32)}$$

With R_1 and R_2 expressed in binary notation, the bits of the residual character shall be :

R_1 = bits 0 1 2

R_2 = bits 3 4 5 6 7

These bits shall be allocated to tracks as follows :

	Bit	In track
R_1 0	0	5
1	1	6
2	2	7
R_2 0	3	2
1	4	8
2	5	1
3	6	9
4	7	3

In track 4, an odd parity bit P shall be inserted.

9 Recording of groups on tape

The groups prepared as specified in clause 8 shall be recorded on the tape as follows :

Each 4 consecutive positions on each track shall be translated according to the following table and recorded on the tape as five consecutive bits.

0000 → 11001
0001 → 11011
0010 → 10010
0011 → 10011
0100 → 11101
0101 → 10101
0110 → 10110
0111 → 10111
1000 → 11010
1001 → 01001
1010 → 01010
1011 → 01011
1100 → 11110
1101 → 01101
1110 → 01110
1111 → 01111

After recording, the different fields on the tape are called

— data storage group

— residual storage group

— CRC storage group

— a row of nine bits across the tape is called a storage row

— a block of data is called a storage block

10 Control sub-groups

A control sub-group shall comprise five consecutive storage rows having, with the exception of TERM 2, the same bit pattern in each track.

10.1 Terminator control sub-groups (TERM)

A TERM 1 shall be a (10101) control sub-group. It shall be placed at the BOT end of each storage block (see 11.2.1).

A TERM 2 shall be a (1010X) control sub-group, where X represents a bit which restores for each track the magnetic remanence to the erase state (see 5.7). It shall be placed at the EOT end of each storage block (see 11.2.7).

10.2 Second control sub-groups (SEC)

A SEC 1 shall be a (01111) control sub-group. It shall follow TERM 1 (see 11.2.1) at the BOT end of each block.

A SEC 2 shall be a (11110) control sub-group. It shall precede TERM 2 (see 11.2.7) at the EOT end of each block.

10.3 Synchronization control sub-group (SYNC)

A SYNC shall be a (11111) control sub-group.

10.4 MARK 1 control sub-group

A MARK 1 shall be a (00111) control sub-group.

10.5 MARK 2 control sub-group

A MARK 2 shall be a (11100) control sub-group.

10.6 END MARK sub-group

An END MARK shall be a (11111) control sub-group. It has the same pattern as a SYNC sub-group, but not the same function.

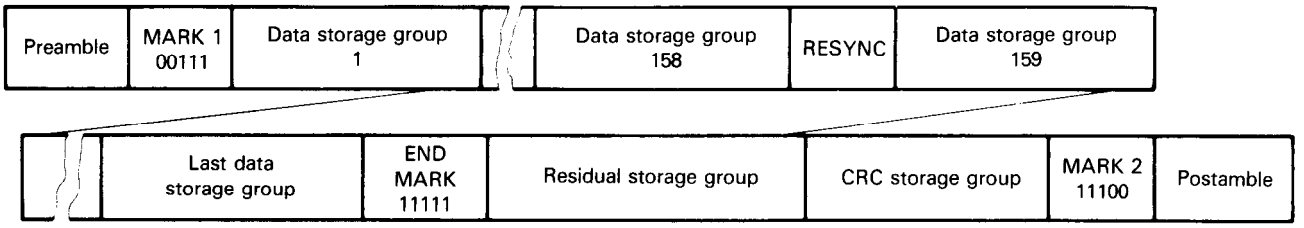
11 Storage block

11.1 Data portion

The data portion of a storage block shall accommodate, in group-coded form, a minimum of 18 data bytes and a maximum of 8 192 data bytes. However, larger blocks may be used by agreement between the interchanging parties.

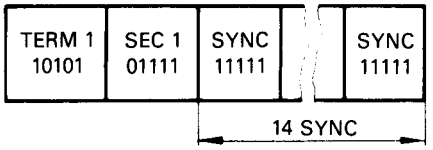
11.2 Structure of a block

The structure of a block shall depend on the number of data storage groups. The general structure shall be :



11.2.1 Preamble

The structure of the preamble shall be



11.2.2 MARK 1

A MARK 1 control sub-group shall follow the preamble.

11.2.3 Re-sychronization burst (RESYNC)

The structure of a RESYNC burst shall be :

MARK 2 11100	SYNC 11111	SYNC 11111	MARK 1 00111

11.2.4 Number N of data storage groups

$N < 158$

In this case, the last data storage group shall be followed by an END MARK control sub-group preceding the residual group and there shall be no RESYNC burst.

$N > 158$

In this case, a RESYNC burst shall be inserted after every 158 data storage groups and an END MARK control sub-group shall be inserted after the last data storage group. However, if N is a multiple of 158, there shall be no RESYNC burst after the last data storage group but only an END MARK control sub-group.

NOTE — When a RESYNC burst is present, a MARK 1 and a MARK 2 control sub-group bracket all sequences of 158 data storage groups.

11.2.5 Residual storage group and CRC storage group

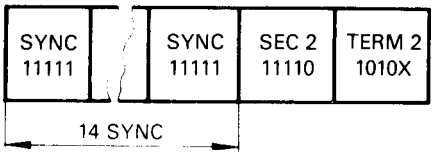
The residual storage group and the CRC storage group shall follow the END MARK inserted after the last data storage group.

11.2.6 MARK 2

A MARK 2 control sub-group shall follow the CRC storage group and precede the postamble.

11.2.7 Postamble

The structure of the postamble shall be :



11.3 Interblock gap

Between storage blocks there shall be an interblock gap :

Nominal length : 7,6 mm (0.3 in)

Minimum length : 7,1 mm (0.28 in)

Maximum length : 4,6 m (15 ft)

The tape shall be erased in these gaps as defined in 5.7.

11.4 Maximum data density

Due to the insertion of an ECC character after each seventh data byte, to the 4-bit to 5-bit conversion and to the RESYNC burst after each 158th data storage group, the maximum density of recorded data is less than the maximum physical recording density of 356 ftpmm (9 042 ftpi) by a factor of

$$\frac{7}{8} \times \frac{4}{5} \times \frac{158}{160}$$ giving 246 data bytes per millimetre (6 250 bytes per inch).

12 Tape format

The beginning of the tape before the first preamble shall present typical areas defined in 12.1 to 12.5 inclusive.

12.1 Density identification area (ID burst)

The ID burst shall be an area characterized by bit pattern (100100100...) in track 6, i.e. by a density of 119 ± 12 ftpmm (3 014 ± 300 ftpi) and by erasure in all other tracks. It shall begin at least 43 mm (1.7 in) before the trailing edge of the BOT marker and continue past this edge.

12.2 Gap G1

The ID burst shall be followed by a gap G1 of at most 86,36 mm (3.4 in).

12.3 Automatic Read Amplification (ARA) Area

The ARA Area shall comprise an ARA level burst followed by an ARA identification burst.

12.3.1 ARA level burst

The ARA level burst, which follows gap G1 shall be characterized by bit pattern (1111...) recorded in all tracks, i.e. by a density of 356 ftpmm (9 042 ftpi). It shall begin at least 38 mm (1.5 in) and at most 109 mm (4.3 in) after the leading edge of the BOT marker. It shall end at least 241 mm (9.5 in) and at most 292 mm (11.5 in) after this edge. Accordingly its minimum length is 132 mm (5.20 in) and its maximum length is 254 mm (10 in).

12.3.2 Automatic Read Amplification identification (ARA ID burst)

The last part of the ARA Area shall be the ARA ID burst of 50 ± 10 mm (2.0 ± 0.4 in). It shall be characterized by

- erasure in tracks 1, 4 and 7;
- recording of bit pattern (1111...) in all other tracks.

A length of at least 6,35 mm (0.250 in) shall be error-free in all tracks. (See 13.2.)

12.4 Gap G2

Between the end of the ARA ID burst and the first storage block there shall be a gap G2 of the same length as an interblock gap.

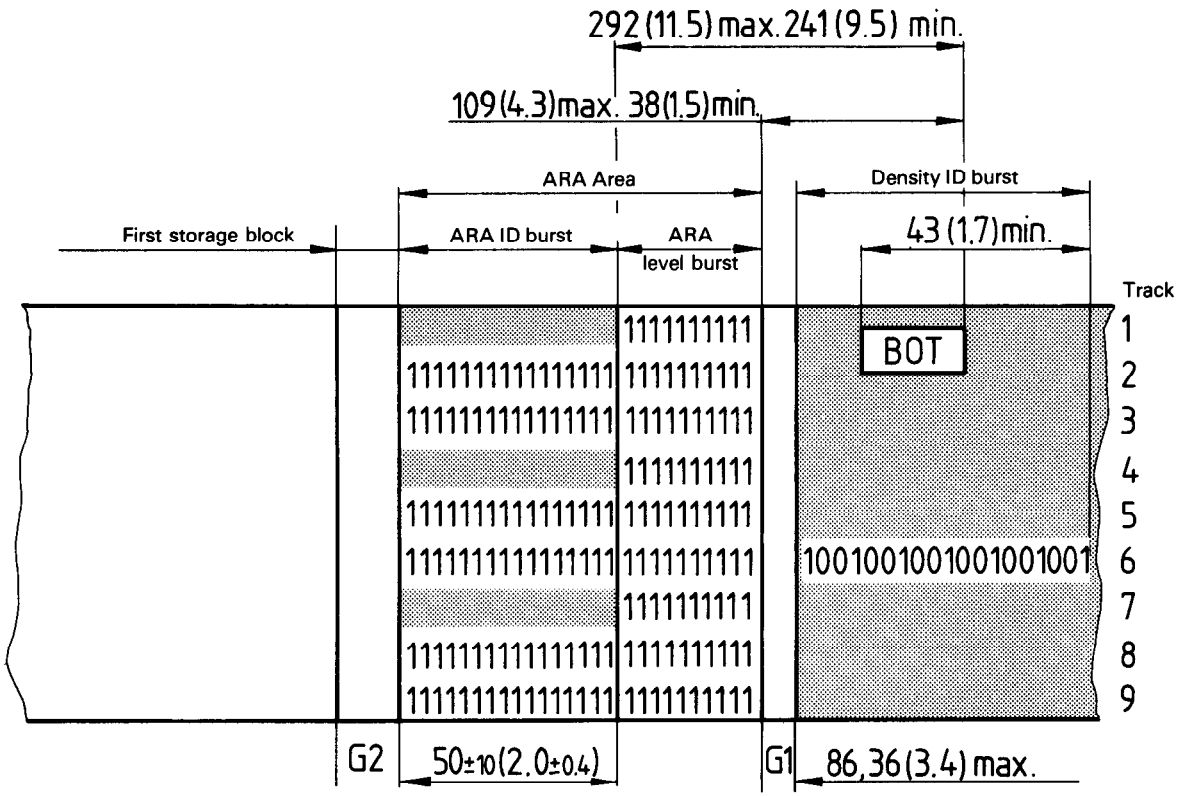
12.5 Tape mark

The tape mark (see ISO 1001) shall be a control block characterized by

- erasure in tracks 3, 6 and 9;
- bit pattern (1111...) over 250 to 400 transitions in all other tracks.

A tape mark shall be separated from the storage blocks by interblock gaps.

Dimensions in millimetres
(Dimensions in inches in parentheses)



13 Interchange criteria

13.1 Correctable errors

In a tape offered for interchange there shall not be, between a MARK 1 Sub-group and MARK 2 Sub-group, more than two tracks in which errors occur.

13.2 Acceptable criteria

Tapes with errors in excess of the requirement of 13.1 do not conform with this International Standard. However, they may be acceptable for interchange between parties after agreement between those parties.

13.3 Elongated interblock gap

An elongated interblock gap shall be a gap which has been elongated due to an erase instruction.

Interchange parties shall agree on

- the error criteria which generate the erase instruction;
- an acceptable number of elongated interblock gaps.

Annex A

Transportation

(This annex does not form part of the standard.)

A.1 Environment

It is recommended that during transportation the tapes are kept within the following conditions :

temperature : 4 to 32 °C (40 to 90 °F)

relative humidity: 20 to 80 %

A.2 Hazards

Transportation of data-bearing magnetic tape involves three basic potential hazards :

A.2.1 Impact loads and vibrations

Those forces which could cause damage to the reel, or movement within the tape pack, with consequential loss of wind tension.

Recommendations

a) The free end of the tape should be secured to prevent any tendency to unwind.

b) A rigid plastic container free from dust or other extraneous matter should be used.

c) The plastic container(s) should be fitted into a rigid box containing adequate shock absorbent material.

d) The final box should have a clean interior and a lid construction that provides sufficient sealing to prevent the ingress of dirt and water.

e) The orientation of the reels within the final box should be such that their axes are horizontal.

f) The final box should be clearly marked to indicate its correct orientation.

A.2.2 Extremes of temperature and humidity

Those extremes which could set up stresses within the body of the tape.

Recommendations

a) Extreme changes in temperature and humidity should be avoided wherever possible.

b) Whenever a tape is received, it should be conditioned in the operating environment (see 4.1) for a period of 2 to 12 h, depending upon the type of transportation used and the likely extent of exposure to conditions outside the operating environment.

A.2.3 Effects of stray magnetic fields

Those effects which would possibly cause corruption of data.

Recommendation

A nominal spacing of not less than 80 mm (3.15 in) should exist between the magnetic tape reel and the outer surface of the final container in which case it is considered that the risk of corruption will be negligible.

Annex B

Procedure and equipment for measuring flux transition spacing

(This annex forms part of the standard.)

B.1 General

The equipment normally used for recording interchange tapes (tape transport) at 246 cpmm (6 250 cpi) shall be used for recording the tape under test.

The tape shall be written in any start-stop mode of operation compatible with system operation.

The full length of tape of 732 m (2 400 ft) shall be recorded with the following test patterns.

Track No	Test pattern
9	1 0 0 1 1 1 0 0 1 1
8	1 1 0 0 1 1 1 0 0 1
7	1 0 0 1 1 1 0 0 1 1
6	1 1 0 0 1 1 1 0 0 1
5	1 0 1 0 1 0 1 0 1 0
4	1 1 0 0 1 1 1 0 0 1
3	1 0 0 1 1 1 0 0 1 1
2	1 1 0 0 1 1 1 0 0 1
1	0 1 0 0 1 1 0 1 1 0

The tape under test shall be read through the instrumentation chain.

Measurement samples shall be made once on each block for a minimum of 100 blocks.

Average measurements associated with 5.4.1 of this International Standard shall be made in the stable part of the preamble, that is, closest to the data. At this point the density is 356 ftpmm (9 042 ftpi).

B.2 Read equipment

B.2.1 Tape transport

The tape speed shall be 1,52 m/s (60 in/s) ± 1 %. As the start/stop mode is not used, start/stop requirements are irrelevant.

B.2.2 Head

There are no absolute output voltage requirements. However, the output voltage shall be sufficient to avoid problems due to a low signal-to-noise ratio.

The gap shall be less than 1,143 µm.

The transfer function of the head shall be such that :

— The amplitude and phase response relative to the magnetic field induced can be tested by means of a wire placed parallel and adjacent to the gap. The position of the wire shall be such as to maximize the head output.

— In the frequency range of 27 to 540 kHz, the magnitude characteristic shall be within 1 dB from a + 6 dB/octave line.

The loading effect of the input impedance of the amplifier-differentiator shall not cause the head output to change by more than $^{0}_{-0,1}$ dB in the frequency range from 0 to 540 kHz.

B.2.3 Amplifier-differentiator

The frequency response of the amplifier without the frequency-limiting lumped components shall be flat within $^{0}_{-1}$ dB in the frequency range from 13,5 kHz to 1,08 MHz.

The frequency-limiting lumped components within the amplifier-differentiator shall be designed to produce the following transfer function :

$$H(S) = \frac{A \times S}{\left(\frac{S}{\omega_0}\right)^3 + 6\left(\frac{S}{\omega_0}\right)^2 + 15\frac{S}{\omega_0} + 15}$$

A is the gain to be adjusted to produce at the output of the amplifier-limiter the specified rise and fall times. In the numerator, S produces differentiation, in the denominator, the poles are designed for a 3-pole Bessel filter. At 1,52 m/s, $\omega_0 = 2\,\pi\,540 \times 10^3$ rad/s.

B.2.4 Amplifier-limiter

The gain of the amplifier-limiter together with the head and amplifier-differentiator shall be such as to produce the waveform shown in figure 1.

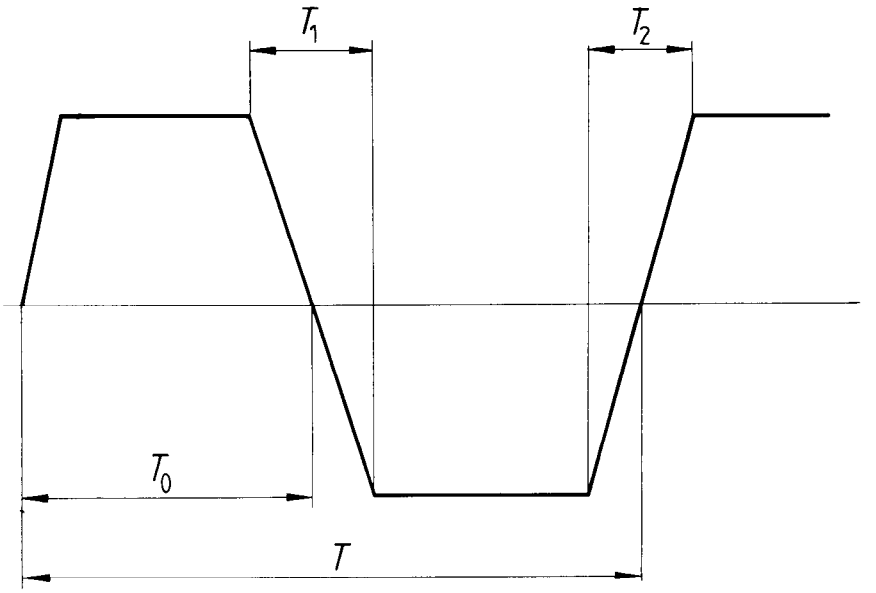


Figure 1 — Output signal waveform of amplifier-limiter-differentiator

where

T is the period equal to 3,686 5 µs (356 ftpmm at 1,52 m/s);

T_0 is the transition time and lies within the range of 0,497 5 to 0,5025 T;

T_1, T_2 are the rise/fall times and have a value of 18 ns max.

B.2.5 Sinewave generator

The sinewave generator shall be capable of generating frequencies in the range from 27 to 540 kHz. The harmonic distortion content of the generator's sinewave output shall be less than 1 % at the output of the amplifier-differentiator.

B.2.6 Time interval counter

The time-interval counter shall be able to measure 10 µs with at least 5 ns resolution.

B.3 Procedure and calibration

B.3.1 Procedure

The generator amplitude is set so as to produce a signal at the head equivalent to that observed when reading a tape recorded at 356 ftpmm (9 042 ftpi). With this amplitude setting, the frequency is varied from 27 to 540 kHz. At each test frequency, the time displacement between the positive zero crossover of the current sinewave flowing through the gap wire and the positive transition at the output of the amplifier-limiter is measured (see figure 1).

B.3.2 Calibration of the read chain

The time delay between the positive zero crossover of the current sinewave flowing through the gap wire and the positive transition at the output of the amplifier-limiter shall not differ from that at 27 kHz by more than

$$\pm \left(\frac{100 \times 27\,000}{f} \right) \text{ns} = \pm \frac{1}{f} \times 2{,}7 \text{ ms}$$

where f is the test frequency in hertz in the range 27 to 540 kHz.

The value $(1/f \times 2{,}7)$ ms is equivalent to ± 1°.

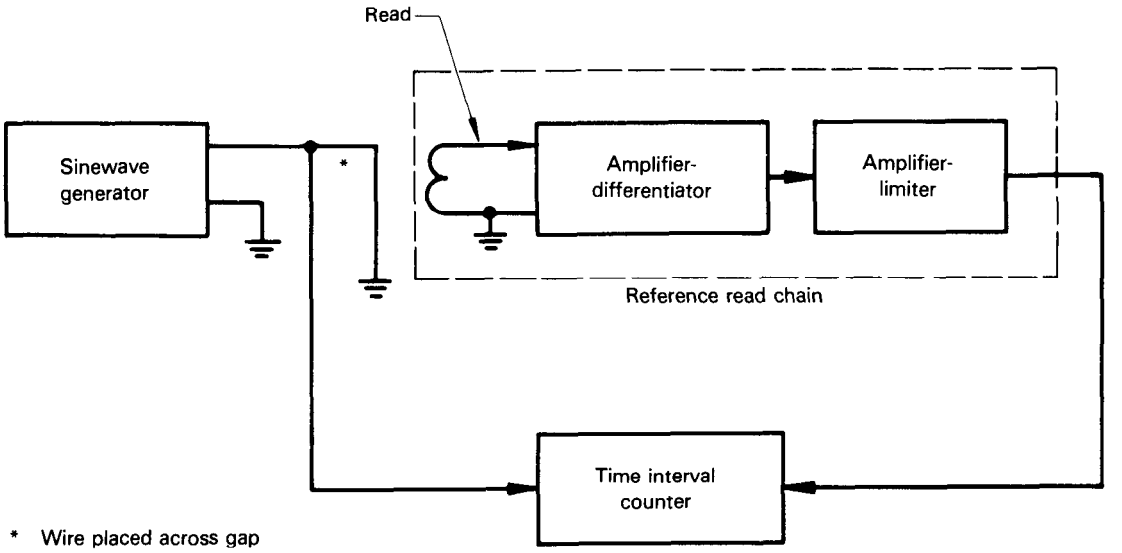


Figure 2 — Block diagram for calibration of read chain