INTERNATIONAL STANDARD 1863

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

Traitement de l'information — Bande magnétique à 9 pistes, de 12,7 mm (0,5 in) de large, pour l'échange d'information, enregistrée à 32 rangées par millimètre (800 rpi)

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

International Standard ISO 1863 was drawn up by Technical Committee ISO/TC 97, *Computers and information processing*, and circulated to the Member Bodies in February 1975.

It has been approved by the Member Bodies of the following countries :

Australia	Japan	Switzerland
Canada	Mexico	Turkey
Czechoslovakia	Netherlands	United Kingdom
France	New Zealand	U.S.A.
Germany	Poland	Yugoslavia
Hungary	Romania	
Italy	South Africa, Rep. of	

The Member Body of the following country expressed disapproval of the document on technical grounds :

Belgium

This International Standard cancels and replaces ISO Recommendation R 1863-1971, of which it constitutes a technical revision.

Printed in Switzerland

This International Standard presents the standard technique for recording the ISO 7-bit coded character set for information processing interchange on 9-track magnetic tape at 32 rows per millimetre (rpmm) [800 rows per inch (rpi)] using the "non-return to zero mark" (NRZI) recording technique. It is one of a series of International Standards concerning implementation of 6- and 7-bit codes in media.

In the development of this International Standard, careful consideration was given to current practices, existing equipment and supplies, and the broadest possible acceptance while providing a basis for future improvement in the use of the medium.

In previous standards for the interchange of data on magnetic tape, the problems encountered due to packing density of 8 rows per millimetre (rpmm) [200 rows per inch (rpi)] have not created any serious difficulty with respect to the definitions or the quantitative values assigned to the various parameters.

Some of the difficulties and technical shortcomings which had to be faced in the preparation of this International Standard are listed below :

a) the positioning of the data on the tape is very dependent on the particular guidance geometry of the tape transport;

b) the coating thickness of the tape has an appreciable effect on the position of bits due to the pulse crowding factor on the tape as specified;

c) the characteristics of the head and in particular the crosstalk factor;

d) the initial transient conditions as the tape is started from rest;

e) the problem of defining and utilizing the reference edge;

f) speed variations at the time of writing and reading which could also include different nominal speeds;

g) timing constraints due to coding and pattern sensitivity.

It is important to recognize, in the light of these difficulties, that the write-check by the control device is the most practical method of measuring the quality of the written tape. This International Standard therefore includes certain definitions and quantitative values which represent the most meaningful checks that can be provided at the present time.

When magnetic tape is read by the recipient, certain additional factors of tape dynamics will have to be considered.

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

1 SCOPE AND FIELD OF APPLICATION

This International Standard provides a format and recording standard for 9-track, 12,7 mm (0.5 in) wide magnetic tape and reels to be used for information interchange among information processing systems, communication systems, and associated equipment utilizing the 7-bit coded character set specified in ISO 646 or its 7-bit or 8-bit extensions specified in ISO 2022.

NOTES

1 Certain other aspects of coding requirements, such as significance of binary digits, sequence of characters, filling of unused positions and magnetic labelling for use on magnetic tape, are the subject of ISO 962 and ISO 1001.

2 Details of unrecorded tape and reels are specified in the complementary publication, ISO 1864.

2 REFERENCES

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 1001, *Information processing — Magnetic tape labelling and file structure for information interchange.*[1)]

ISO 1864, *Information processing — Unrecorded 12,7 mm (0.5 in) wide magnetic tape for information interchange — 8 and 32 rpmm (200 and 800 rpi), NRZI, and 63 rpmm (1 600 rpi), phase-encoded.*

3 DEFINITIONS

NOTE — The material contained in clauses 3 and 4 and in 17.3 of this International Standard is duplicated from ISO 1864 for unrecorded magnetic tape. The latter document shall be considered to be correct, that is, the primary document, so far as any differences between the comparable clauses of the two documents are concerned.

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

3.1 magnetic tape : Tape which will accept and retain the magnetic signals intended for input, output and storage purposes on computers and associated equipment.

3.2 reference tape : A tape which has been selected for given properties for use in calibration.

3.3 secondary reference tape : A tape intended for routine calibrating purposes, whose performance is known and stated in relation to that of a reference tape.

3.4 signal amplitude reference tape : A reference tape selected as a standard for signal amplitude.

NOTE — A master standard (computer amplitude reference) has been established at the U.S. National Bureau of Standards (NBS), based on reference tapes and heads. Secondary signal amplitude reference tapes are available from NBS under the part number SRM 3200.

3.5 reference field : For any specified packing density, the minimum field applied to a signal amplitude reference tape which causes an output signal equal to 95 % of the maximum output.

3.6 reference edge : The edge further from an observer, when a tape is lying flat with the magnetic surface uppermost and the direction of movement for recording from left to right. (See figures 1, 2 and 3.)

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

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

3.9 packing density : The number of bits of recorded information per unit length of track.

3.10 inter-block gap : A DC-erased section of tape separating blocks of information.

1) At present at the stage of draft. (Revision of ISO/R 1001-1969.)

4 REFLECTIVE MARKERS (See note introducing clause 3, and figure 3)

Each reel of tape shall be furnished with two photo-reflective markers, each consisting of, or equivalent to, a transparent plastic base with a metallic (for example vaporized aluminium) coating sandwiched between the base and a thin layer of low cold flow thermal setting adhesive.

Reflective markers shall be placed on the side of the tape which does not carry the magnetic surface, and they shall be on opposite edges of the tape with the beginning-of-tape reflective marker (BOT) on the reference edge.

The width of the markers shall be 4,8 ± 0,5 mm (0.19 ± 0.02 in).

The length of the markers shall be 28 ± 5 mm (1.1 ± 0.2 in).

The thickness of the markers, measured after their application to the tape, shall be not greater than 0,020 mm (0.000 8 in).

The beginning-of-tape reflective marker (BOT) shall be placed 4,9 ± 0,6 m (16 ± 2 ft) from the beginning of the tape and the end-of-tape marker (EOT) shall be placed $7{,}6\,^{+1{,}5}_{\;\;0}$ m ($25\,^{+5}_{\;\;0}$ ft) from the end of the tape.

The distance from the outer edge of a marker to the adjacent edge of the tape shall be 0,8 mm (0.03 in) maximum and the marker shall not protrude beyond the edge of the tape.

The markers shall be free of wrinkles and excessive adhesive. The surface of the reflective markers shall be non-conductive.

NOTE — It is desirable to employ the thinnest markers which perform satisfactorily to minimize the distortion of layers of tape adjacent to them.

5 DIRECTION OF TAPE WIND (See figure 4)

On a reel of tape used for data interchange, the tape shall be wound with the magnetic surface innermost and the reference edge towards the front, i.e. away from the write-enable ring groove.

NOTE — This means that the tape will be wound in a clockwise direction from the end (nearest the hub) to the start (outer end) if the reel is viewed from the front.

6 WIND TENSION

For interchange purposes, a tape shall be wound at a tension not less than 1,5 N and not greater than 3 N (5 to 10 ozf approximately).

7 REFERENCE EDGE

The reference edge shall be used for determining the position of the tracks and rows on tape, within the requirements of this International Standard.

8 TRACK IDENTIFICATION

Tracks shall be numbered consecutively, beginning at the reference edge with track No. 1, and shall be assigned as follows :

Magnetic tape track	1	2	3	4	5	6	7	8	9
Environment bit	E_3	E_1	E_5	P	E_6	E_7	E_8	E_2	E_4
Binary value	2^2	2^0	2^4	P	2^5	2^6	2^7	2^1	2^3

Bit "P" is the parity bit. Row parity is odd.

9 TRACK CONFIGURATION

The written track width shall be 1,09 mm (0.043 in) minimum.

The distance from the centre line of any track to the reference edge shall be

$$[0{,}737 + (n - 1)\ 1{,}397] \pm 0{,}08 \text{ mm}$$
$$[0.029 + (n - 1)\ 0.055] \pm 0.003 \text{ in}$$

where n is the track number. (See figures, 1 and 2.)

10 DENSITY OF RECORDING

The nominal density shall be 32 rows per millimetre (800 rows per inch), i.e. 32 bits per millimetre of track.

11 SINGAL AMPLITUDE

11.1 Standard reference amplitude

The standard reference amplitude is the average peak-to-peak signal amplitude derived from the signal amplitude reference tape (SRM 3200) on the NBS measurement system or equivalent at the recording current I_r of $2{,}1 \times I_f$ and the recording density of 8 ftpmm (200 ftpi). On equipment capable of recording only at 32 ftpmm (800 ftpi), the recording density of 8 ftpmm (200 ftpi) can be achieved by using the recording pattern . . . 010001000100010 . . .

The signal amplitude shall be averaged over 4 000 flux transitions, and shall be measured on the read-while-write pass. The reference current I_f is the minimum current which produces the reference field.

11.2 Average signal amplitude

The average peak-to-peak output signal amplitude of an interchanged tape at 32 ftpmm (800 ftpi) shall not deviate more than + 15 %, − 30 % of the standard reference amplitude. 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.

11.3 Maximum signal amplitude

An interchanged tape shall contain no flux transition whose base-to-peak signal amplitude exceeds 1,2 times half the standard reference amplitude, in the first read pass after interchange.

11.4 Minimum signal amplitude

An interchanged tape shall contain no flux transition whose base-to-peak signal amplitude is less than 35 % of half the standard reference amplitude, in the first read pass after interchange.

12 SPACING OF ROWS

The average written row spacing variation allowed shall be ± 3 % of the nominal spacing of 31,75 μm (1 250 μin). The capability of a machine in this respect shall be measured over a distance of 3,8 m (150 in), at the extremes of operating conditions, by reading a continuously and evenly recorded tape with 31,5 in-phase flux transitions per millimetre (800 per inch) in all tracks.

13 SKEW

Skew is defined as the deviation of the bits within the recorded row during reading from time coincidence (converted to apparent length) when measured in the control device.

13.1 Static skew

The equipment used for recording tapes at 32 ftpmm (800 ftpi) must be capable of recording 3,81 μm (150 μin) or less absolute static skew. This capability shall be measured on a tape which has been recorded continuously with 32 in-phase flux transitions per millimetre (800 ftpi) in all tracks. This maximum static deviation within a row is the value of static recorded skew. Both row polarities must meet the criterion.

13.2 Write quality check

During the writing of a 32 ftpmm (800 ftpi) interchange tape, the write-check operation will determine bit timing (converted to apparent length) and signal amplitude.

NOTE – On equipment that is not capable of reading during the write pass, bit timing and signal amplitude may be checked on the first read pass.

1) Bit timing (converted to apparent length)

To determine bit timing, from leading edge to leading edge, the following conditions must be considered together :

a) the timing between the first detected bit of successive rows is measured greater than a design centre value which shall exceed 22,9 μm (900 μin);

b) the timing between the first detected bit and the last detected bit of a row is measured less than a design centre value which shall not exceed 10,8 μm (425 μin);

c) there shall be a minimum apparent space between any bits of successive rows of 11,2 μm (440 μin).

2) Signal amplitude

The signal amplitude shall be such that when the tape is interchanged the requirements of clause 11 are complied with.

14 BLOCK LENGTH

All blocks for data interchange shall consist of not less than 18 data rows and not more than 2 048 data rows and, in addition, a cyclic redundancy check row (see clause 15) and a longitudinal check row (see clause 16).

15 CYCLIC REDUNDANCY CHECK ROW

At the end of each tape block, a row shall be written on tape for the possible recovery of single track errors. This row shall be called the cyclic redundancy check (CRC) character. In tape mark blocks, zero bits are written in all tracks for the CRC character.

15.1 Consider the contents of a 9-position register to be C_1 to C_9 with the following track assignments :

Register position	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
Track	4	7	6	5	3	9	1	8	2

15.2 The CRC character shall be derived as follows :

1) all data rows in the tape block are added to the CRC register without carry (each bit position is exclusive OR'ed to C_n);

2) between additions, the CRC register is shifted one position : C_1 to C_2 etc., and C_9 to C_1;

3) if shifting will cause C_1 to become "1", then the bits being shifted into positions C_4, C_5, C_6 and C_7 are inverted;

4) after the last data row has been added, if shifting will cause C_1 to become "1", then the CRC register is shifted once more in accordance with paragraphs 2) and 3) above;

5) to write the CRC character on tape, the contents of all positions except C_4 and C_6 are inverted. The parity of the CRC character will be odd if the number of data rows within the block is even, and even if the number of data rows within the block is odd. The CRC character may contain all zero bits, in which case the number of data rows is odd.

16 LONGITUDINAL REDUNDANCY CHECK ROW

Following the row CRC character, an additional checking row shall be written for the further possible detection of read errors. This row shall be called the longitudinal redundancy check (LRC) character. A longitudinal check bit "ONE" is written in any track if the longitudinal count is otherwise odd.

17 ERASE

17.1 Erase direction

When erased, the rim end of the erased area of the tape shall be magnetized so that it is a North-seeking pole and the hub end of the erased area is a South-seeking pole (see figure 3 and annex B). This criterion shall also apply to the inter-block gaps.

17.2 Erase width

The full width of the tape is DC-erased in the direction specified in 17.1.

17.3 Ease of easure (see note introducing clause 3)

When a tape has been recorded at 8 ftpmm (200 ftpi) or 32 ftpmm (800 ftpi) according to this International Standard and then passed through a longitudinal unidirectional steady field of 79 500 A/m (1 000 Oe), the average peak to peak output level, over a distance of at least 76 mm (3 in), of the remaining unwanted signal plus tape noise shall not exceed 4 % of the standard reference amplitude at 126 ftpmm (3 200 ftpi). The field for erasure shall be reasonably uniform, such as that in the middle of a solenoid.

18 GAPS (see figures 1 and 2)

18.1 Inter-block gap

The length of inter-block gap shall be

- nominal : 15 mm (0.6 in)
- minimum : 12,7 mm (0.50 in)
- maximum : 7,6 m (25 ft)

The actual gap length depends upon the number of consecutive erase instructions.

18.2 Initial gap

The gap between the trailing edge of the BOT marker and the first recorded row shall be 76 mm (3 in) minimum and 7,6 m (25 ft) maximum.

18.3 Cyclic redundancy check row gap

There shall be a gap of 0,127 mm ± 10 % (0.005 in ± 10 %) between the last row of the recorded data and the cyclic redundancy check row (see clause 15).

18.4 Longitudinal redundancy check row gap

There shall be a gap of 0,127 mm ± 10 % (0.005 in ± 10 %) between the CRC row and the longitudinal check row.

19 METHOD OF RECORDING

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

20 QUALITY OF RECORDING FOR DATA INTERCHANGE

Tape shall not be employed for data interchange where the number of gaps which have been elongated due to erase instructions exceed two in number or 0,5 % of the total number of blocks written, whichever is the larger.

No permanent parity errors while writing are permissible in the data to be interchanged.

21 DATA CONTENT

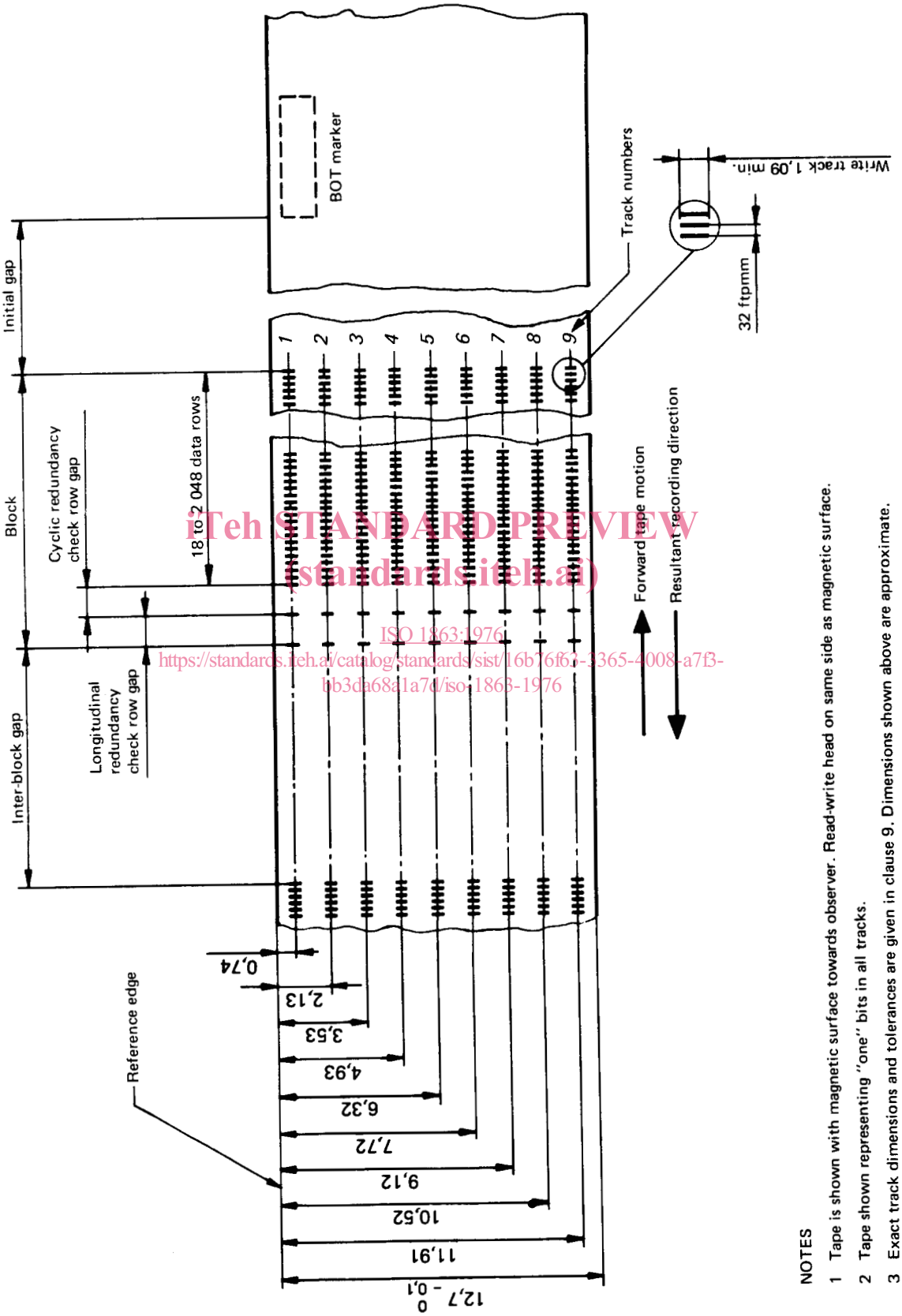
All 256 bit combinations are permissible in a row.

22 TAPE MARK

For the purpose of separating data, a single row control block (known as a tape mark) shall be allowed. This block shall be accompanied by a longitudinal check row. The tape mark shall be represented by "1" bits in tracks 2, 3 and 8 only. The CRC character for tape mark blocks shall contain all zero bits.

23 USE OF DUAL DENSITY SYSTEMS NRZI/PE

The use of tapes, previously recorded at 63 ftpmm (1 600 ftpi), for recording at 32 ftpmm (800 ftpi) presents a difficulty in an NRZI/PE system in that the 63 ftpmm (1 600 ftpi) PE identification burst extends from a minimum of 43,2 mm (1.7 in) before the trailing edge of the BOT marker. To ensure proper working of the 32 ftpmm (800 ftpi) system, it is necessary for the burst to be erased, either by the system itself or by bulk erasure.



NOTES

1 Tape is shown with magnetic surface towards observer. Read-write head on same side as magnetic surface.

2 Tape shown representing "one" bits in all tracks.

3 Exact track dimensions and tolerances are given in clause 9. Dimensions shown above are approximate.

FIGURE 1 – Track layout – Dimensions in millimetres