INTERNATIONAL STANDARD ISO 3788

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 recorded at 63 rpmm (1 600 rpi), phase encoded

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 63 rangées par millimètre (1 600 rpi) par codage de phase

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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 3788 was drawn up by Technical Committee ISO/TC 97, *Computers and information processing*, and was circulated to the Member Bodies in June 1975.

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

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

* with the exception of sub-clause 16.2.

No Member Body expressed disapproval of the document.

Printed in Switzerland

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

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 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 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 : The minimum field applied to the signal amplitude reference tape which causes an output signal equal to 95 % of the maximum output at 126 flux transitions per millimetre (3 200 ftpi).

3.6 reference edge : The edge further from an observer, or nearer the top of a page, 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.

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

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.

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

NOTE — The contents of this clause are in accordance with ISO 962.

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 RECORDING METHOD

The recording method shall be phase encoding, described as follows :

10.1 A "1" bit is defined as a flux transition to the polarity of the interblock gap, when reading in the forward direction.

10.2 A "0" is defined as a flux transition to the polarity opposite to that of the interblock gap, when reading in the forward direction.

10.3 Additional flux transitions shall be written at the nominal midpoint between bit flux transitions, as defined in 10.1 and 10.2, if required to establish the proper polarity for the succeeding bits. These flux transitions shall be called phase transitions.

10.4 Interblock gaps shall be of the same polarity as erase. (See clause 15.)

11 DENSITY OF RECORDING

The recording density shall be 63 rows per millimetre (rpmm) [1 600 rows per inch (rpi)] nominal. The nominal row spacing, exclusive of phase flux transitions, shall be 15,87 μm (625 μin) subject to the following variations.

NOTE – Density statements in rpmm and rpi are always exclusive of phase flux transitions.

11.1 Long-term average (static) row spacing shall be within ± 4 % of the nominal spacing. This average shall be measured over a minimum of 240 000 successive rows.

11.2 Short-term average (dynamic) row spacing, when referred to a particular row spacing, is defined as the average of that row spacing and the preceding three row spacings.

The short-term average row spacing shall be within the limits of ± 10 % of the long-term average row spacing.

In addition, the short-term average row spacing shall change at a rate not greater than 0,5 % per row.

12 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.

To determine the instantaneous spacing between any two flux transitions, the following five sub-clauses must be taken together :

12.1 The spacing between successive data bits without an intervening phase flux transition shall be between 85 and 108 % of the corresponding short-term average row spacing.

12.2 The spacing between successive data bits with an intervening phase flux transition shall be between 93 and 112 % of the corresponding short-term average row spacing.

12.3 The spacing between a data bit and any adjacent phase flux transition shall be between 44 and 62 % of the corresponding short-term average row spacing.

12.4 The average distance between actual data bits in a sequence of flux transitions of 63 per millimetre (1 600 per inch) and the predicted position of those data bits relative to flux transitions of 126 per millimetre (3 200 per inch) preceding or succeeding the sequence shall not exceed ± 6 % of the corresponding short-term average spacing.

12.5 Procedure : The equipment used for recording tapes at 63 rows per millimetre (1 600 rows per inch) and the magnetic tape to be used for interchange shall fulfil the requirements of sub-clauses 12.1, 12.2, 12.3 and 12.4 when tested under the conditions specified in the reference read chain (see annex A).

13 SKEW

The position of the flux transition is defined as that point which exhibits the maximum free space surface flux density normal to the tape surface. No data flux transition shall be displaced more than 15,87 μm (625 μin) from any other data flux transition in the same row. This is measured as the distance parallel to the reference edge between the lines drawn perpendicular to the reference edge and passing through the said flux transitions.

14 SIGNAL AMPLITUDE

14.1 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 density of 126 ftpmm (3 200 ftpi) and the recording current I_r of 1,8 $\times I_f$. 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.

14.2 Average signal amplitude

The average peak-to-peak signal amplitude of the interchanged tape at 126 ftpmm (3 200 ftpi) shall deviate not more than + 50 %, − 35 % from the standard reference amplitude.

The average peak-to-peak signal amplitude at 63 ftpmm (1 600 ftpi) shall be less than 3 times 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.

14.3 Minimum signal amplitude

No tapes when interchanged shall contain any adjacent flux transitions whose peak-to-peak signal amplitude is less than 20 % of the standard reference amplitude.

15 ERASE

15.1 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.)

15.2 The full width of the tape is DC-erased in the direction specified in 15.1.

15.3 The erase head should erase all signals, including NZRI, to a level less than 4 % of the standard reference amplitude at 126 ftpmm (3 200 ftpi).

15.4 The write head should erase all phase-encoded signals, written by itself only, to a level less than 4 % of the standard reference amplitude at 126 ftpmm (3 200 ftpi).

16 BLOCKS (See figures 1 and 2)

16.1 The data portion of a block shall contain a minimum of 18 rows containing characters of the ISO 7-bit code or its 7-bit or 8-bit extensions as prescribed in ISO 962.

16.2 The data portion of a block shall contain a maximum of 2 048 rows containing characters of the ISO 7-bit code, as prescribed in ISO 962.

16.3 Preamble : Preceding data in each block, a preamble shall be written consisting of 41 rows, of which 40 rows contain "0" bits in all tracks followed by a single row containing "1" bits in all tracks.

16.4 Postamble : Following the data in each block, a postamble shall be written consisting of 41 rows, of which the first row contains "1" bits in all tracks followed by 40 rows containing "0" bits in all tracks.

17 IDENTIFICATION BURST

The phase-encoding recording method shall be identified by a burst of recording at the BOT marker (see figures 1 and 2). This burst shall consist of 63 ftpmm (1 600 ftpi) on track 4 and erasure on all other tracks. The identification burst shall begin at least 43,2 mm (1.7 in) before the hub end of the BOT marker, and continue part the hub end of the BOT marker, but shall end at least 12,7 mm (0.5 in) before the first block.

18 GAPS

18.1 Inter-block gap

The length of inter-block gaps, in addition to preambles and postambles (16.3 and 16.4), shall be :

- Nominal : 15 mm (0.6 in)
- Minimum : 12,7 mm (0.50 in)
- Maximum : 7,6 m (25 ft)

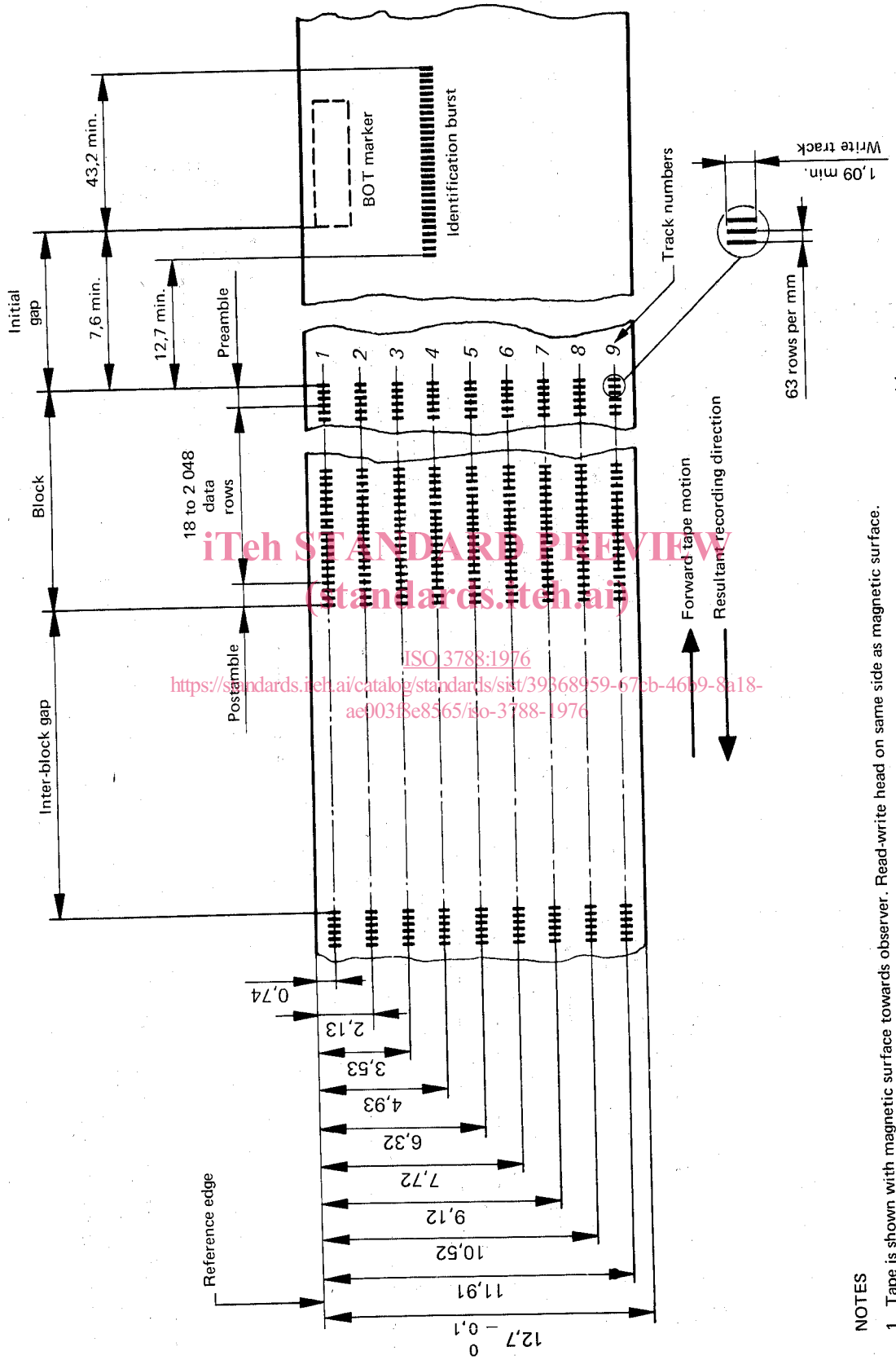
The actual gap length depends upon the number of consecutive erase instructions.

18.2 Initial gap

The gap between the hub end of the BOT marker and the first block shall be 76 mm (3 in) minimum and 7,6 m (25 ft) maximum.

19 TAPE MARK

The tape mark is a special control block consisting of 64 to 256 flux transitions at 126 ftpmm (3 200 ftpi) in tracks 2, 5 and 8. Tracks 3, 6 and 9 are DC-erased. Tracks 1, 4 and 7 in any combination may be DC-erased, or recorded in the manner stated for tracks 2, 5 and 8. All eight possible combinations shall be treated as a tape mark.



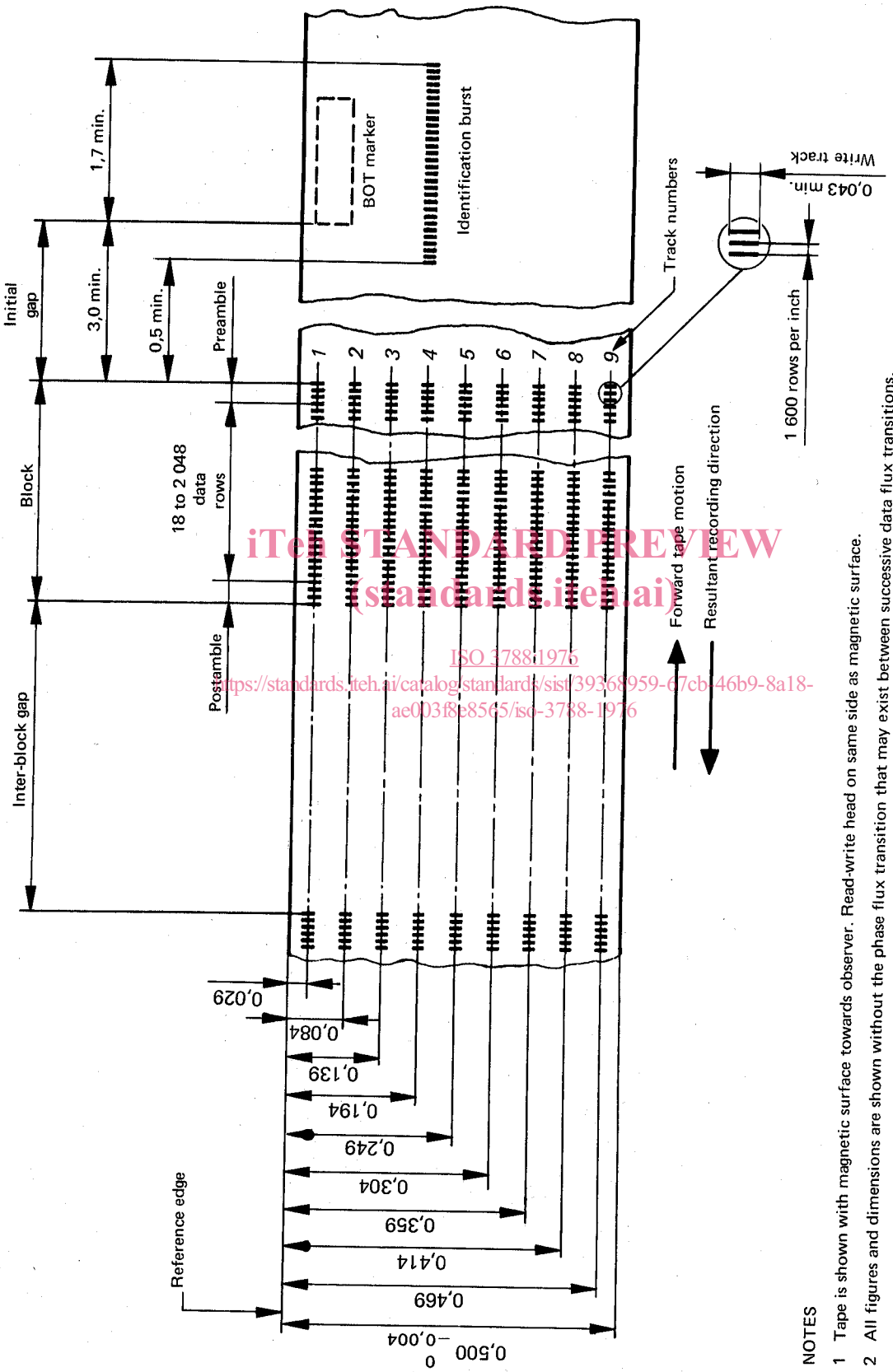
NOTES

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

2 All figures and dimensions are shown without the phase flux transition that may exist between successive data flux transitions.

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

FIGURE 1 – **Track layout – Dimensions in millimetres**



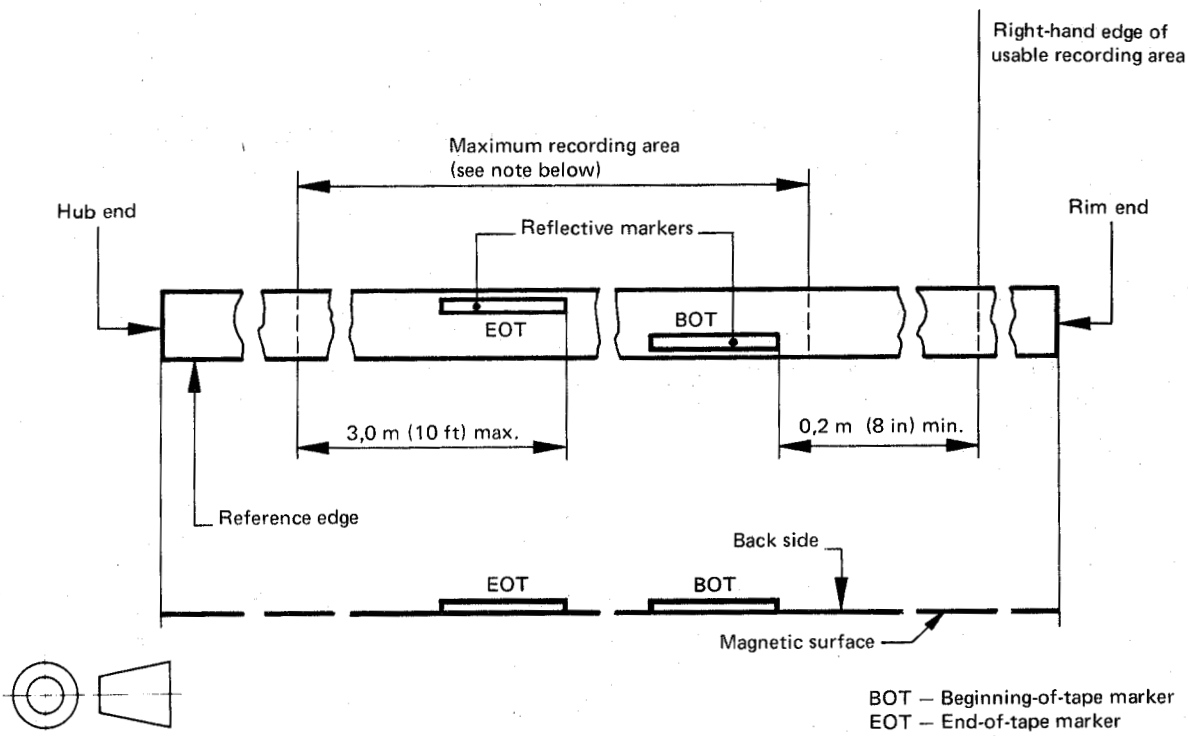
NOTES

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

2 All figures and dimensions are shown without the phase flux transition that may exist between successive data flux transitions.

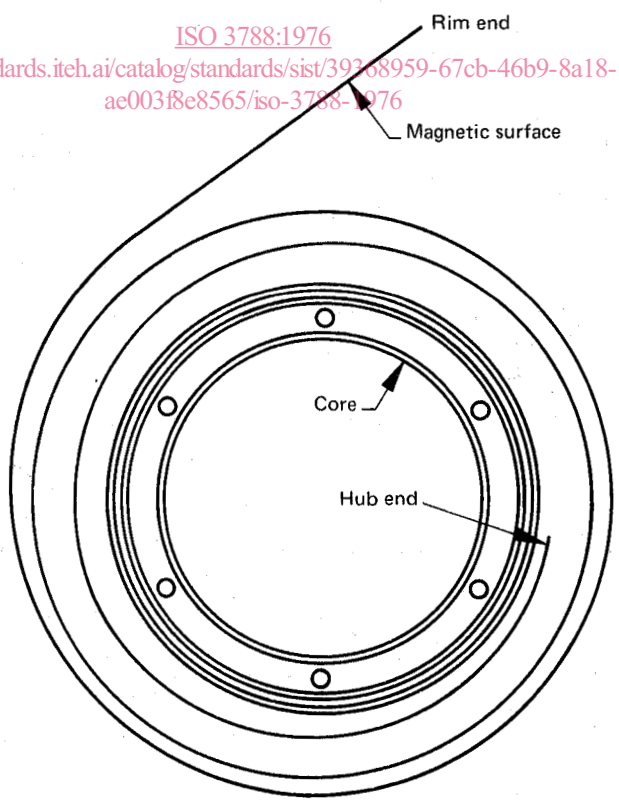
3 Exact track dimensions and tolerances are given in clause 9. Dimensions shown above are approximate.

FIGURE 2 – **Track layout – Dimensions in inches**



NOTE – The right-hand end of the "maximum recording area" is dependent upon the placement of the identification burst but should not extend beyond the right-hand edge of the usable recording area. (See clause 17 and figures 1 and 2.)

FIGURE 3 – **Reflective markers and recording area**



NOTES

1 Spool viewed from front. Write-enable ring groove at rear.

2 The tape shall not be attached to the hub.

FIGURE 4 – **Direction of tape wind**

ANNEX A

PROCEDURE AND INSTRUMENTATION FOR MEASURING FLUX TRANSITION SPACING

(This annex forms part of the standard.)

A.1 FORMAT

The equipment used for recording tapes (see tape transport, A.2.1) at 63 rpmm (1 600 rpi) shall record on the magnetic tape to be used for interchange using the format described in the following six sub-clauses.

A.1.1 Worst case patterns

	Test pattern
1.	11111111
2.	00000000
3.	11110000
4.	00001111
5.	00010000
6.	11101111
7.	00010111
8.	11101000
9.	11001100
10.	10101010
11.	10101111
12.	11110101
13.	01010000
14.	00001010

These test patterns are to be used in the following sequence :

1, 1, 1, 3, 2, 2, 2, 4, 6, 3, 4, 4, 6, 6, 3, 5, 5, 5, 7, 8, 7, 8, 7, 8, 9, 9, 9, 10, 10, 10, 12, 11, 14, 13.

This sequence is to be repeated 3 times to constitute each tape block.

A.1.2 Writing. The tape shall be written in any start-stop mode of operation compatible with system operation.

A.1.3 Block format. Two block formats shall be generated. Each block format shall be repeated 800 times together with interblock gaps. All tracks shall be recorded simultaneously, each to meet the format specified as follows :

A.1.3.1 *Format A*

A.1.3.1.1 Each of tracks 1, 2, 4, 6, 8 and 9 shall contain preamble, the 102 eight-bit test patterns defined in A.1.1, and postamble.

A.1.3.1.2 Track 5 shall contain the preamble, 816 one-bits, and postamble. This track is written to provide a record of speed variations.

A.1.3.1.3 Each of tracks 3 and 7 shall contain preamble, the sequence of test pattern No. 1 followed by test pattern No. 2 to be recorded 51 times, and postamble. These tracks are written to provide a means for locating any test pattern in a block defined in A.1.3.1.1.

A.1.3.2 *Format B*

A.1.3.2.1 Each of tracks 1, 3, 5, 7, 8 and 9 shall contain preamble, the 102 eight-bit test patterns defined in A.1.1 and postamble.

A.1.3.2.2 Track 4 shall contain the preamble, 816 one-bits, and postamble. This track is written to provide a record of speed variations.

A.1.3.2.3 Each of tracks 2 and 6 shall contain preamble, the sequence of test pattern No. 1 followed by test pattern No. 2 to be recorded 51 times, and postamble. These tracks are written to provide a means for locating any test pattern in a block defined in A.1.3.2.1.

NOTE – On using the formats described in A.1.3.1 and A.1.3.2, odd parity is preserved in each row on recorded tape.

A.2 INSTRUMENTATION

A.2.1 Tape transport

A.2.1.1 Nominal tape speeds shall be between 380 and 480 mm/s (15.0 to 18.9 in/s), ± 1 %, constant speed.

A.2.1.2 The equipment shall accept 266,7 mm (10.5 in) reels.

A.2.1.3 The start-stop mode is not used; therefore, start-stop parameters are irrelevant.

A.2.2 Read chain

A.2.2.1 *Read head*

NOTE – The length of gap is defined as the dimension parallel to the tape movement.

A.2.2.1.1 Voltage output parameters are irrelevant.

A.2.2.1.2 The head mechanical dimensions should be such as to meet the specifications in clause 9. The length of the physical read gap shall be less than 2,8 μm (110 μin) but greater than 1,9 μm (75 μin).

A.2.2.1.3 Transfer function

A.2.2.1.3.1 TEST

Test the amplitude and phase response relative to the magnetic field induced by a wire placed at right angles to the length of the gap. The position of the wire shall be such as to maximize the head output. The current in the wire shall be constant at all frequencies of the test.

A.2.2.1.3.2 SPECIFICATION

In the frequency range of 6 to 45 kHz, the amplitude frequency characteristic shall be within 1 dB from a + 6 dB per octave line.

A.2.2.2 *Impedance match*

Head to amplifier : The loading effect of the input impedance of the amplifier shall not cause the head output to change by more than + 0 dB, − 0,1 dB in the range of frequencies from 0 to 200 kHz.

A.2.2.3 *Amplifier-differentiator*

A.2.2.3.1 The frequency response of the amplifier alone shall be flat within a total variation of 0,1 dB in the frequency range of 1 to 100 kHz, and not more than 3 dB down at 30 Hz and 1 MHz.