

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1864

UNRECORDED MAGNETIC TAPE FOR INFORMATION INTERCHANGE

8 AND 32 RPmm (200 AND 800 RPI), NRZI,
AND 63 RPmm (1600 RPI), PHASE-ENCODED

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 1864, *Unrecorded magnetic tape for information interchange – 8 and 32 RPmm (200 and 800 RPI), NRZI, and 63 RPmm (1600 RPI), phase-encoded*, was drawn up by Technical Committee ISO/TC 97, *Computers and information processing*, the Secretariat of which is held by the American National Standards Institute (ANSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1864, which was circulated to all the ISO Member Bodies for enquiry in December 1969. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	Israel	Sweden
Belgium	Italy	Switzerland
Brazil	Japan	Turkey
Canada	Netherlands	U.A.R.
Czechoslovakia	New Zealand	United Kingdom
France	Romania	U.S.A.
Greece	Spain	U.S.S.R.

The following Member Body opposed the approval of the Draft :

Germany

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

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UNRECORDED MAGNETIC TAPE FOR INFORMATION INTERCHANGE**8 AND 32 RPmm (200 AND 800 RPI), NRZI,
AND 63 RPmm (1600 RPI), PHASE-ENCODED****1. SCOPE**

This ISO Recommendation specifies a 12.7 mm (1/2 in) wide magnetic tape with reel and is designed to enable magnetic and mechanical interchangeability of such tape between information processing systems utilizing a recommended ISO code.

This ISO Recommendation refers solely to magnetic tape for digital recording using the NRZI method of recording at 8 and 32 RPmm (200 and 800 RPI) or the phase-encoded method of recording at 63 RPmm (1600 RPI) in which the direction of magnetization is nominally longitudinal.

2. DEFINITIONS OF TERMS

For the purpose of this ISO Recommendation the following definitions apply :

- 2.1 *Magnetic tape.* Tape which will accept and retain the magnetic signals intended for input, output and storage purposes on computers and associated equipment.
- 2.2 *Reference tape.* A tape which has been selected for given properties for use in calibration.
- 2.3 *Secondary reference tape.* A tape intended for routine calibrating purposes, whose performance is known and stated in relation to that of a reference tape.
- 2.4 *Signal amplitude reference tape.* A reference tape selected as a standard for signal amplitude.

NOTE. - A reference tape is maintained at the U.S. National Bureau of Standards (NBS) as the Master Standard Magnetic Tape (Computer Amplitude Reference).

Secondary signal amplitude reference tapes are available from the NBS under the part number SRM 3200.

- 2.5 *Reference field.* For any specified packing density, the minimum field applied to the reference tape which causes an output signal equal to 95 % of the maximum output.
- 2.6 *Reference signal level.* The signal level which is obtained from a reference tape under the recording conditions stated in clause 4.13.
- 2.7 *In contact.* An operating condition in which the oxide side of a tape is in contact with a magnetic head.
- 2.8 *Track.* A longitudinal area on the tape along which a series of magnetic signals may be recorded.
- 2.9 *Packing density.* The number of bits of recorded information per unit length of track.
- 2.10 *Reference edge.* The edge farthest from an observer, or nearest the top of a page, when a tape is lying flat with the oxide side uppermost and the direction of movement for recording from left to right. (See Figure 1.)
- 2.11 *Row.* A row consists of 7 or 9 transversely related locations (one on each track) in which bits are recorded.
- 2.12 *Position of flux transition.* That point which exhibits the maximum free-space flux density normal to the tape surface.

3. TESTING ENVIRONMENT

Unless otherwise stated, all measurements made on a tape to check compliance with the requirements of this ISO Recommendation and all tests prescribed for a tape in the document shall be carried out at a temperature of 23 ± 2 °C (73 ± 5 °F) and relative humidity of 50 ± 10 %, after at least 24 hours conditioning in the same environment.

(See Appendix.)

4. CHARACTERISTICS OF TAPE

4.1 Materials

The tape shall consist of a base material (oriented polyethylene terephthalate film or its equivalent) coated on one side with a strong yet flexible layer of ferromagnetic material dispersed in a suitable binder.

4.2 Width

The width of the tape shall be $12.7 \begin{smallmatrix} 0 \\ -0.1 \end{smallmatrix}$ mm ($0.500 \begin{smallmatrix} 0 \\ -0.004 \end{smallmatrix}$ in).

4.3 Total thickness

The total thickness of the tape, at any point, shall be 0.048 ± 0.008 mm (0.0019 ± 0.0003 in).

4.4 Base material thickness

The thickness of the base material shall be 0.038 mm (0.0015 in) nominal.

4.5 Coating thickness

The coating thickness shall not exceed 0.015 mm (0.0006 in).

4.6 Length

The normal minimum length of tape is 732 m (2400 ft), splice-free. If the length of tape is less than 732 m (2400 ft), the length must be stated. Maximum tape length is limited by thickness, E value (see clause 4.7), moment of inertia and reel dimensions.

4.7 E value

The E value is defined as the radial distance by which the reel flanges extend beyond the outermost layer of a tape which has been wound at a tension of 2 to 3 N (7 to 10 ozf) on the specified reel. The minimum E value shall be 3.2 mm (1/8 in).

4.8 Elastoplastic properties

The elastoplastic properties of the tape shall be such that when the tape is subjected to a tension of 30 N (6.75 lbf) for a period of 3 minutes under any combination of temperature and relative humidity within the ranges of 10 to 50 °C (50 to 122 °F) and 20 to 80 % relative humidity, the permanent elongation measured with negligible tension after a second 3 minutes interval is less than 1.0 %.

4.9 Longitudinal curvature

There shall be a minimum radius of curvature for the edge of the tape, defined and tested by allowing a 1 m length or a 36 in length of tape to unroll and assume its natural curvature on a flat surface. The minimum radius shall be 33 m (108 ft); if measured over an arc of a circle, this corresponds to a deviation of 3.8 mm from a 1 m chord (or a deviation of 1/8 in from a 36 in chord).

4.10 Tape wind

Tape shall be wound, with its oxide surface toward the reel hub, in a clockwise direction; i.e. when the reel is viewed from the front, the loose end of the tape hangs from the right side of the reel. Tape shall be wound with a tension of 2 to 3 N (7 to 10 ozf). (See Figure 2.)

4.11 Magnetic properties

The magnetic properties of the tape are not defined here by *B-H* loops or similar parameters, but are defined by the testing procedures given in clauses 4.13 to 4.16.

4.12 Test density

For the purpose of testing tape in accordance with this ISO Recommendation, the packing density of flux transitions shall not be less than that of the nominal value for an all "ones" pattern for the system with which the tape is to be used. In addition, for this test the flux reversals shall be uniformly spaced.

4.13 Recording current

The relationship between the recording current (I_r) and the current required to produce the reference field (I_f) at various packing densities in flux reversals per millimetre (frpmm) or per inch (frpi) is as follows :

Packing density	Ratio $\frac{I_r}{I_f}$
For 8 frpmm (200 frpi)	2.0 to 2.2
For 32 frpmm (800 frpi)	2.0 to 2.2
For 126 frpmm (3200 frpi)	1.75 to 1.85

4.14 Average peak output

The average peak output is defined as the average value of the peaks of the output voltage over at least 75 mm (3 in) of a tape that has been recorded under the conditions of clause 4.13 on all tracks.

When played back on a system each channel of which has been calibrated by means of a reference tape, the average peak output shall be within $\pm 10\%$ of the output of the reference tape at 8 frpmm (200 frpi), within $\pm 10\%$ at 32 frpmm (800 frpi), and within $^{+25}_{-15}\%$ at 126 frpmm (3200 frpi).

NOTE. - This test shall be conducted in accordance with instructions issued with the reference tape.

4.15 Ease of erasure

When a tape has been recorded at 8 frpmm (200 frpi) or 32 frpmm (800 frpi) according to this ISO Recommendation and then passed through a longitudinal unidirectional steady field of 79 500 ampere-turns per metre (1000 oersteds), the average peak output level, over a distance of at least 75 mm (3 in), of the remaining unwanted signal plus tape noise shall not exceed 4 % of the output of the Signal Amplitude Reference Tape at 126 frpmm (3200 frpi). The field for erasure shall be reasonably uniform, such as that in the middle of a solenoid.

4.16 Tests for drop-outs and drop-ins

These tests shall be carried out in the "in contact" condition and over the entire tested area, which shall extend from 0.2 m (8 in) before the beginning-of-tape reflective marker (BOT) to 3.0 m (10 ft) beyond the end-of-tape reflective marker (EOT). (See Figure 1.)

4.16.1 Drop-outs. When a tape has been recorded on all tracks, with an 8 or 32 frpmm (200 or 800 frpi) signal, as defined in clauses 4.12 and 4.13, and is played back on a system of which each channel has been calibrated as in clause 4.14, any signal from any track which is less in amplitude than 50 % of the output of a reference tape is considered a drop-out. At 126 frpmm (3200 frpi) a drop-out is defined as any pair of consecutive output pulses from any track which is less in amplitude than 35 % of the output of the reference tape.

4.16.2 Drop-ins. Following DC erasure of the tape on the machine used for conducting the drop-out test as described above, any signal from any track which exceeds in amplitude 10 % of the output of the reference tape is considered a drop-in.

NOTE. - When performing these tests, the output or resultant signal must be measured on the same relative pass for both the reference tape (or secondary reference tape) and the tape under test, i.e. read-while-write or read on first pass after write.

4.16.3 Rejected region. A rejected region is an area of tape extending across the full width of the tape and not more than 10 mm (0.4 in) length which contains areas of tape which on two consecutive tests exhibit drop-outs or drop-ins.

NOTE. - A limit on the frequency of occurrence of rejected regions on a tape is not an absolute requirement for interchange. It is considered impractical to specify limits for the following reasons :

- (a) the performance of test equipment for magnetic tape is not uniform but depends on such things as tape tension, head design and the method of guiding employed;
- (b) different machines and systems of programming vary in their tolerance limits for rejected regions on tapes.

4.17 Reflective markers

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 (e.g. 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 oxide coating, 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 (0.0008 in).

The beginning-of-tape reflective marker (BOT) shall be placed 4.6 ± 0.3 m (15 ± 1 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. REEL (SPOOL)

- 5.1 Reels shall be so constructed that any profile section taken through the centre axis of the reel conforms to Figure 3 except where taken so as to pass through the relieved portion of the write-enable ring groove. The section shall, in this case, conform to the profile of Figure 3, with appropriate deviations permitted at the ring groove relief as illustrated in detail Z of Figure 3.
- 5.2 Dimension L (Figure 3) defines the mounting surface of reels. The ring groove relief (Figure 3) is not required so long as the ring type designated for that reel does not protrude beyond the reel mounting surface.
- 5.3 All dimensions shown in Figure 3, including those in detail sections, shall be held to the tolerances specified in the Table below that Figure.
- 5.4 Thickness of the flange portion of reels may be varied, but must fall entirely within the cross-hatched envelopes defined by dimensions J , K_f , K_r and M .
- 5.5 Hub and flanges need not be integral, but may be separate parts at the manufacturer's option as long as all other requirements of this ISO Recommendation are met.
- 5.6 Bosses, ribs, or raised designs are permitted on the outside surfaces of the flanges, provided that they do not extend beyond the cross-hatched envelope of Figure 3.

- 5.7 Flanges may have holes to permit threading tape onto the hub. Size and shape of flange holes shall be optional, having such a minimum dimension as not to inhibit the usual technique of manual threading.
- 5.8 Reels may be constructed from any suitable material or materials so long as the dimensional and inertial requirements of this ISO Recommendation are maintained.
- 5.9 Reels are not symmetrical. The flanges differ primarily in the presence or absence of a groove for the write-enable ring, which must be adjacent to the mounting pedestal for correct machine operation.
- 5.10 The outside cylindrical surface of the hub shall be concentric with the centre bore (dimensions C and A respectively of Figure 3) within 0.254 mm (0.01 in).
- 5.11 Dimension A shall be not less than 93.5 mm (3.680 in) when the reel is fully loaded with tape wound at 3.4 N (12 ozf) constant tension.
- 5.12 The moment of inertia of the tape and reel combined shall not exceed 105 000 g·cm² (574 oz·in²). In general this will require a reel whose moment of inertia does not exceed 27 500 g·cm² (150 oz·in²).
- 5.13 **Identification of reel of tape**
- 5.13.1 *Owner identification.* A labelling area shall be provided on the front flange of the reel to provide ownership identification.
- 5.13.2 *Manufacturer's reel identification.* The manufacturer's identification may be placed on the reel.
- 5.13.3 *Interchange identification.* A labelling area shall be provided on the front flange. Suitable labels shall be used for marking the contents of the reel of the tape. Adhesive labels, if employed, shall leave no residue when removed. The use of pencil or similar erasable marking is not allowed.
- 5.13.4 *Manufacturer's tape identification.* The tape manufacturer's identification may be placed on one or both ends of the tape.

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