INTERNATIONAL STANDARD

ISO/IEC 8441-1

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Information technology — High density digital recording (HDDR) —

Part 1: Unrecorded magnetic tape for (HDDR) applications

Technologies de l'information — Enregistrement numérique à haute densité (HDDR) —
Partie 1: Bande magnétique vierge pour les applications HDDR

Reference number
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Contents

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 8441-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

ISO/IEC 8441 consists of the following parts, under the general title *Information technology — High density digital recording (HDDR)*:

— *Part 1: Unrecorded magnetic tape for (HDDR) applications*

— *Part 2: Guide for interchange practice*

Annexes A, B, C, D, E, F and G of this part of ISO/IEC 8441 are for information only.

Introduction

This part of ISO/IEC 8441 gives guidance on the performance levels of unrecorded tape suitable for high density digital recording for interchange purposes. It should be noted that the performance levels specified may differ from those attained at the time of purchase of the tape.

Information technology — High density digital recording (HDDR) —

Part 1:
Unrecorded magnetic tape for (HDDR) applications

1 Scope

This part of ISO/IEC 8441 specifies requirements for unrecorded magnetic tape designed for high density digital recording (HDDR) having the following characteristics:

a) nominal thickness 25,4 µm (0,001 in);

b) longitudinal magnetic orientation;

c) coercivity 72 kA/m (900 Oe) max.

These tapes are suitable for interchange in accordance with ISO/IEC 8441-2.

Requirements for packaging are also included.

NOTE 1 Tapes of coercivity above 32 kA/m (400 Oe) are usually classified as high energy tapes and users should establish compatibility with equipment used for driving them.

Annex A gives guidance on glass and metal-flanged reels. Annex B gives information on the wear of recording heads. Different categories of environmental conditions and their effects on tape are dealt with in annex C. Severe operating conditions are considered in annex D. Surface electrical resistance testing is dealt with in annex E. A tape abrasivity testing technique is described in annex F. A list of bibliographical references is given in annex G.

NOTES

2 It is recognized that archival interchange tapes, or those produced by systems in use prior to the publication of this part of ISO/IEC 8441, may not comply with the requirements and/or recommendations herein.

3 Various tests and procedures herein refer to recording with a.c. HF bias. In practice, certain HDDR systems do not use bias. The use of bias in this part of ISO/IEC 8441 does not imply that the tape so tested is in any way unsuitable for a biasless system.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 8441. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 8441 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1184:1983, *Plastics — Determination of tensile properties of films.*

ISO 1860:1986, *Information processing — Precision reels for magnetic tape used in interchange instrumentation applications.*

3 Definitions

For the purpose of this part of ISO/IEC 8441, the following definitions apply.

NOTE 4 Tape speed is taken to be 3 048 m/s (120 in/s), unless otherwise stated.

3.1 abrasivity: The propensity of a magnetic tape to cause wear of a recording head, by the passage of the tape over the head.

NOTES

5 It may be expressed as micrometres of head wear per metre of tape passed (microinches per inch), or as a value relative to a given reference tape.

6 The actual wear produced in the recording head will also depend on the tape speed and tension (see annex B).

3.2 durability: The ability of a tape to maintain its output uniformity and dropout characteristics after a given number of passes on the reference test recorder.

3.3 ease of erasure: The ability of a specified erasing field to effect a specified reduction in the level of a signal recorded on a tape.

3.4 electrical surface resistance: The surface resistance, in ohms per square, of the magnetic coating or the back surface of a tape, as appropriate.

NOTE 7 The SI unit of surface resistivity is the ohm, although ohms per square is used in practice.

3.5 elongation under stress: The increase in the distance between reference lines on the test piece due to a tensile load, expressed as a percentage of the initial distance between the reference lines.

3.6 E value: The radial distance by which the reel flanges extend beyond the outermost layer of tape wound on a reel under a tensile force of 0,109 N/mm ± 0,033 N/mm of tape width (10 ozf/in ± 3 ozf/in of tape width).

NOTE 8 0,109 N/mm ± 0,033 N/mm is equivalent to 282 gf/in ± 85 gf/in.

3.7 instantaneous nonuniformities (dropouts): A tape defect which causes a reduction in the reproduced signal amplitude sufficient to jeopardize or impair data recovery.

For the purpose of this part of ISO/IEC 8441, the onset of a dropout event is denoted by a 12 dB reduction in the output level from a 0,635 mm (0,025 in) wide track of a 1,524 µm (60 µin) wavelength test signal recorded as a square wave slightly above saturation level (see 8.5.1). The end of a dropout event is denoted by recovery of the signal to within 9 dB of the average level.

NOTES

9 The dropout count associated with each dropout event is the duration of the event expressed as one-half of the number of test signal periods occurring during the dropout event.

10 For a tape speed of 3 048 m/s (120 in/s) the test signal period is 0,5 µs. Hence, the dropout count is equal to the duration, in microseconds, for a tape speed of 3 048 m/s (120 in/s) (for a general definition, see ISO/IEC 8441-2).

3.8 operating bias current: That bias current through the recording head which gives a 2 dB fall-off (overbias peak) of the peak output from the reference tape when a 2,0 MHz signal is recorded at reference level (see 3.13), at a tape speed of 3 048 m/s (120 in/s).

3.9 output level uniformity (long term): The difference between the maximum and minimum peak output levels, the peak value in either case being the value that contains 95 % of the peaks (see figure 1 and 8.4).

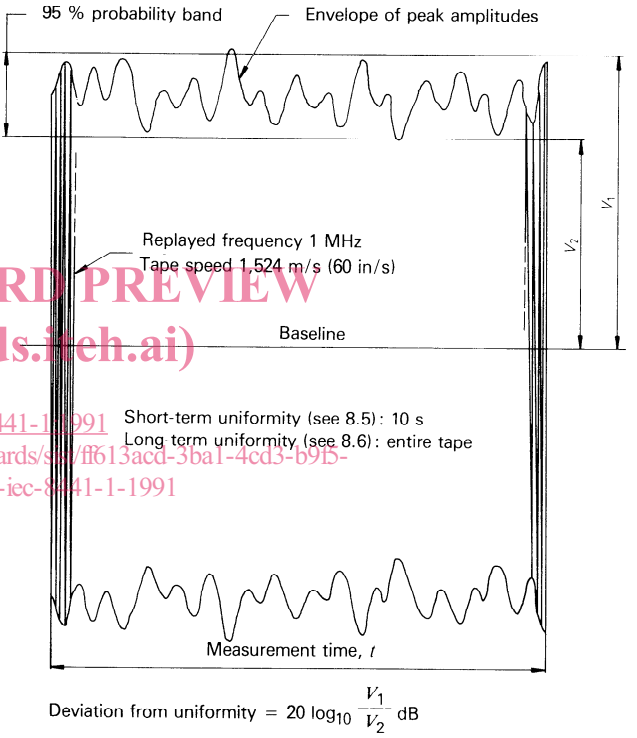

Figure 1 — Replayed waveform for output uniformity test

3.10 reference tape: An unrecorded length of tape used as a reference.

NOTE 11 The reference tape should be one adopted by agreement between the interchange parties. When absolute quantitative performance levels and an international source of standard reference tapes have been established, such agreements may be replaced by reference to standard reference tapes.

3.11 reference head: A head used in conjunction with the reference tape.

NOTE 12 The reference head should be agreed on between the interchange parties.

3.12 reference output level: The reproduce level of a 200 kHz signal recorded on the reference tape at 6 dB below standard record level 3 048 m/s (120 in/s) and with operating bias current.

3.13 reference record level

3.13.1 with a.c. bias: The input level of a 200 kHz signal recorded on the reference tape at 3 048 m/s (120 in/s), with operating bias current such that on play back, the output signal has 1 % third-harmonic distortion as measured with a wave analyser.

3.13.2 without a.c. bias: The record head reference current level without a.c. bias (generally expressed in milliamperes peak-to-peak) is established in accordance with ISO/IEC 8441-2. The same current level (in milliamperes) established at the record head to 200 kHz and for tape speed 3 084 m/s (120 in/s) is defined as the reference record level.

3.14 secondary reference tape: An unrecorded length of tape, the magnetic characteristics (i.e. sensitivity, wavelength response, bias characteristic, distortion characteristics), of which have been calibrated against the reference tape.

3.15 sensitivity: The output of the tape sample under test compared to that from the reference tape expressed as a ratio, normally quoted in decibels, the frequency being 200 kHz in both cases.

3.16 signal-to-noise ratio: The ratio of the reproduced signal power from a tape and the wideband noise power (tape and equipment) measured over the system bandwidth.

3.17 wavelength response: The output voltage frequency characteristic of the tape when normalized to a specific wavelength compared to the response of the reference tape.

4 General

4.1 Materials

The tape shall consist of a uniform layer of ferromagnetic material held in a flexible binder medium on a suitable continuous and splice-free, flexible base material with a conductive back coating.

4.2 Tape reels

The tape shall be wound on reels in accordance with ISO 1860.

NOTE 13 Glass-flanged reels are preferable to reels with metal flanges, with or without window slots (see annex A), particularly for recorders in performance categories B and C (see ISO 8441-2, annex A) because they are known to give improved performance and greater protection against dropouts, especially if combined with protecting collars.

4.3 Tape wind

The tape shall be wound with the magnetic coated surface innermost.

NOTE 14 This is sometimes called "A" wind.

4.4 Packaging

Each reel shall be enclosed by an individual wrapper (e.g. polyethylene) packaged in an appropriate container which provides support of the enclosed reel at the hub. If windowless flanges with wraparound bands are used, the wrapper may not be necessary.

5 Test conditions

5.1 General

For all procedures described in this part of ISO/IEC 8441, conditioning shall be as specified in 5.2 and in the test environment as specified in 5.3.

5.2 Conditioning

Conditioning shall be carried out in the test environment (see 5.3). The tape may be tissue cleaned. It shall be wound and rewound with a tensile force of 0,109 N/mm ± 0,33 N/mm of tape width (10 ozf/in ± 3 ozf/in of tape width). The tape shall then be stored, unwrapped, for a minimum of 24 h to allow it to stabilize.

NOTE 15 0,109 N/mm ± 0,033 N/mm is equivalent to 282 gf/in ± 85 gf/in.

5.3 Test environment

The test environment shall be as follows:

a) Temperature: + 23 °C ± 3 °C (+ 73 °F ± 5 °F)

b) Relative humidity: 45 % to 55 %

6 Dimensions

6.1 Tape width

The tape width shall be one of those given in table 1.

NOTE 16 The metric and imperial dimensions are not exact conversions.

In case of doubt or dispute, the imperial values shall be used to determine compliance with this part of ISO/IEC 8441.

Table 1 — Tape widths

Millimetres	Inches
12,65 ± 0,025	0,498 ± 0,001
25,35 ± 0,025	0,998 ± 0,001
50,75 ± 0,025	1,998 ± 0,001

6.2 Tape length

The tape length shall be as given in table 2 for the appropriate reel diameter.

6.3 Tape thickness

The tape thickness is controlled by, and specified in terms of, the "E" value (see 3.6). The nominal thickness of the magnetic coating is 5 µm (200 µin), and the nominal tape thickness is 25 µm (0,001 in). The "E" value shall be at least 2,54 mm (0,1 in) for reels having a diameter up to and including 203 mm (8 in), and shall be at least 3,18 mm (0,125 in) for reels having a diameter greater than 203 mm (8 in).

Table 2 — Tape lengths

Nominal reel diameter		m	ft
203 mm (8 in)	Minimum length[1)]	670 674	2 210
267 mm (10,5 in)	Minimum length[1)]	1 400 1 410	4 625
318 mm (12,5 in)	Minimum length[1)]	2 200 2 204	7 230
356 mm (14 in)	Minimum length[1)]	2 800 2 815	9 235
381 mm (15 in)	Minimum length[1)]	3 290 3 303	10 795
406 mm (16 in)	Minimum length[1)]	3 800 3 822	12 440

1) The minimum lengths are specified on the basis of tapes with a nominal thickness of 25 µm (0,001 in), and the "E" values given in 6.3. "E" values less than those given in 6.3 will result in longer tapes.

7 Physical properties

7.1 Yield strength

7.1.1 Procedure

Test five samples in accordance with ISO 1184, except that

a) the minimum tape length is 200 mm (8 in);

b) the initial jaw separation is 100 mm (4 in);

c) the rate of jaw separation is 0,8 mm/s (2 in/min).

7.1.2 Requirement

The tensile load at the 1 % offset yield point (as defined in ISO 1184) shall not be less than 2,10 N/mm (12 lbf/in) of tape width, even if the tape breaks prior to reaching the 1 % offset yield point.

NOTE 17 2,10 N/mm is equivalent to 5,44 kgf/in.

7.2 Elongation under stress

7.2.1 Procedure

Test at least five sample lengths of each type of tape. Select sample lengths of 600 mm (24 in) minimum. Clamp each sample at one end and make a transverse length reference mark approximately 500 mm (20 in) from the point of clamping. Allow the samples to hang freely in the test environment (see 5.3) for at least 24 h.

Attach a 50 g (2 oz) weight to the free end of each sample. Measure the distance between the clamping point and the reference mark with an accuracy of ± 0,25 mm (0,010 in), taking care that the tape is tensioned only by the 50 g (2 oz) weight. Note this length for each sample. This is the pre-stress length measurement.

Remove the 50 g (2 oz) weight and attach a weight corresponding to a tension of 1,75 N/mm (10 lbf/in) of tape width to each sample below the reference mark. Note the time of attachment to each sample. Allow the stressed samples to hang undisturbed for 180 min ± 3 min. Attach a 50 g (2 oz) weight to each sample and measure the distance between the clamping point and the reference mark with an accuracy of ± 0,25 mm (0,010 in), noting the length for each sample as before. This is the post-stress length measurement.

NOTE 18 1,75 N/mm is equivalent to 4,53 kgf/in.

7.2.2 Requirement

The difference between the pre-stress and post-stress lengths for each sample shall not exceed 0,5 %.

7.2.3 Full reel moment of inertia

The maximum moments of inertia for full reels of tape are given in table 3.

8 Performance

8.1 Reference test system

8.1.1 System components

The reference test system shall consist of a reference tape and reference head mounted on a recorder/reproducer, referred to as the reference recorder, which shall have a wideband 2,0 MHz capability at 3,048 m/s (120 in/s) tape speed as defined in ISO 8441-2, and preferably a facility to clean the tape during recording and playback.

8.1.2 Preparation of recorder for testing

The reference recorder shall be set up as follows:

a) Thoroughly clean and demagnetize the recorder and adjust the heads for correct azimuth (see ISO 8441-2).

NOTE 19 Cleanliness is particularly critical in drop-out assessment (see 3.7).

b) Set the tape tension of 0,109 N/mm ± 0,033 N/mm of tape width (10 ozf/in ± 3 ozf/in of tape width).

NOTE 20 0,0109 N/mm ± 0,033 N/mm is equivalent to 282 gf/in ± 85 gf/in.

c) Ensure that the record and reproduce head segments and the head configuration comply with the dimensions given in table 2 or table 4 of ISO 8441-2 [14 tracks on 12,7 mm (0,5 in), or 28 tracks on 25,4 mm (1,0 in), using head segments with a track of 0,635 mm ± 0,025 mm (0,025 in ± 0,001 in)].

d) Perform the measurements at a tape speed of 3 048 m/s (120 in/s), except where another speed is specified.

e) Ensure that the recorder electronics are properly terminated.

f) Specify all test signals.

8.2 Sensitivity

8.2.1 Procedure

For each type of tape to be tested, establish the applicable reference output level to calibrate the reference recorder for the sensitivity measurement.

A 200 kHz signal shall be recorded at 6 dB below reference record level (see 3.13). Note the equalization settings and the reproduce amplifier gain settings when establishing the reference output level. Reproduce the tape and measure the recorder output.

8.2.2 Requirement

The output from a test sample, excluding the first and last 2 % of its length, shall not vary throughout its length from the reference output level by more than ± 2 dB.

8.3 Wavelength response

(See 3.17.)

8.3.1 Procedure

Repeat the procedure described in 8.2.1 at each frequency given in table 4 for each type of tape being tested, avoiding the use of edge tracks, and ignoring the first and last 2 % of the tape length.

Table 3 — Maximum moments of inertia for full reels

Nominal tape width	Nominal reel diameter											
	203 mm (8,0 in)		266 mm (10,5 in)		318 mm (12,5 in)		355 mm (14,0 in)		381 mm (15,0 in)		406 mm (16,0 in)	
	g·m²	lb·ft²	g·m²	lb·ft²	g·m²	lb·ft²	g·m²	lb·ft²	g·m²	lb·ft²	g·m²	lb·ft²
6,30 mm (0,25 in)	2,78	0,066	10,16	0,241	19,72	0,468	29,81	0,707	41,75	0,989	54,27	1,29
12,70 mm (0,50 in)	3,77	0,089	14,57	0,345	28,14	0,667	43,21	1,02	59,78	1,42	77,79	1,84
25,40 mm (1,00 in)	5,73	0,136	23,37	0,554	44,97	1,07	69,99	1,66	95,82	2,27	124,8	2,96
50,80 mm (2,00 in)	9,66	0,229	40,97	0,971	78,63	1,86	123,55	2,93	167,92	3,98	218,86	5,19

8.3.2 Requirement

The output at each frequency, when normalized to the output at 15 µm (600 µin) and compared to the response of the reference tape, shall be within the limits given in table 4.

Table 4 — Wavelength response

Test frequency at tape speed of 3,048 m/s (120 in/s)	Recorded wavelength	Requirement variation from reference tape
kHz	µm (in·10^{-3})	dB
0,8	3 810 (150)	± 2
12	254 (10)	± 2
120	25,4 (1,00)	± 2
480	6,35 (0,250)	± 2
960	3,18 (0,125)	± 2,5
1 200	2,54 (0,100)	± 2,5
1 500	2,03 (0,080)	± 3
2 000	1,52 (0,060)	± 3

8.4 Output level uniformity (long term)

(See 3.9.)

8.4.1 Procedure

For each type of tape, perform measurements on the following tracks:

a) 12,7 mm (0,5 in) tape tracks 1, 7, 8, 14 (see table 2 of ISO 8441-2);

b) 25,4 mm (1 in) tape tracks 1, 15, 16, 28 (see table 4 of ISO 8441-2).

At a tape speed of 3 048 m/s (120 in/s) record the 1 MHz test frequency at reference record level (see 3.13), with the bias current adjusted as recommended by the recorder manufacturer as optimum for the tape on test. Record this signal along the entire tape length.

Determine the tape output uniformity as defined in 3.9.

NOTE 21 The results obtained from this test shall specify whether or not a.c. bias was used.

8.4.2 Requirement

The value, expressed in decibels, shall not exceed ± 2 dB. The performance of the first and last 2 % of the tape length shall be ignored.

8.5 Instantaneous nonuniformity (dropouts)

8.5.1 Procedure

On at least every other track (seven tracks) of either the odd or the even head of a 28 track assembly, record either a 2 MHz square wave signal at 3 048 m/s (120 in/s), or a 1 MHz squarewave signal at 1,52 m/s (60 in/s) throughout the entire tape length. Set the reference record level (see 3.13). For play back, use a reproduce amplifier (with no AGC device) and a threshold detector with hysteresis able to monitor the output signal and detect any amplitude loss and recovery to the limit stated in 3.7. The signal-to-noise ratio of the test signal at the input to the threshold detector should be at least 25 dB. The reference level for dropout detection shall be established by averaging the test signal output amplitude over 10 m (33 ft) tape length in the vicinity of any dropout.

For each of the seven tracks tested, note the accumulated dropout count, where the count for each dropout corresponds to one-half the number of periods of the test frequency affected (see 3.7).

NOTE 22 Results obtained from this test shall state whether or not a.c. bias was used.

8.5.2 Requirement

The accumulated dropout count on any tested track shall be less than 1 per 10 m (1 per 32,8 ft) of tape length averaged along the entire length of the tape. The performance of the first and last 2 % of the tape length shall be ignored.

NOTE 23 A different dropout requirement may be agreed on between interchange parties to suit particular system requirements.

8.6 Signal-to-noise ratio

(See 3.16.)

8.6.1 Procedure

The appropriate centreline or reference tape shall be optimized to the reference recorder for the particular tape to be tested. A 200 kHz signal shall be recorded at reference record level. The reproduced signal output shall be noted. The tape shall be externally erased in a bulk degausser. The tape shall be re-recorded with no input signal but with the recorder inputs terminated with their proper impedance. The reproduced signal output noise shall be noted.

The instrument used for these measurements shall have no more than 3 dB attenuation at the reference