

Implementation of
ISO/IEC 8441-2:1991

Information technology — High density digital recording (HDDR) —

Part 2: Guide for interchange practice

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- British Gas plc
- British Tape Industry Association
- EEA (the Association of Electronics, Telecommunications and Business Equipment Industries)
- Engineering Integrity
- Fulmer Research Laboratory
- GAMBICA (BEAMA Ltd.)
- Institution of Electrical Engineers
- Ministry of Defence
- Tape Recorder and Instrumentation Users' and Manufacturers' Forum

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National foreword

This British Standard reproduces verbatim ISO/IEC 8441-2:1991 and implements it as the UK national standard.

This British Standard is published under the direction of the Information Systems Technology Standards Policy Committee whose Technical Committee IST/8 has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international committee any enquiries on interpretation, or proposals for change, and keep UK interests informed;
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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the ISO/IEC title page, pages ii to iv, pages 1 to 31 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

INTERNATIONAL STANDARD

ISO/IEC
8441-2

First edition
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Information technology — High density digital recording (HDDR) —

Part 2: Guide for interchange practice

*Technologies de l'information — Enregistrement numérique à haute
densité (HDDR) —*

Partie 2: Guide pour l'échange d'information



Reference number
ISO/IEC 8441-2:1991(E)

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Descriptors: Data processing, information interchange, digital recording methods, magnetic tapes, recording characteristics, specifications, dimensions, tests, performance tests, interchangeability.

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 8441-2 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.*

Annex A and Annex B of this part of ISO/IEC 8441 are for information only.

1 Scope

This part of ISO/IEC 8441 specifies the minimum performance levels necessary for the effective interchange of information using High Density Digital Recording (HDDR). It also describes methods of testing for determining these levels. It gives guidance on recorders/reproducer characteristics, modes of recording, and modulation patterns.

The imperial dimensions given in this part of ISO/IEC 8441 are the reference dimensions. The metric and imperial dimensions are, however, given to a sufficient degree of accuracy as to be totally interchangeable.

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/IEC 3788:1990, *Information processing — 9-track, 12,7 mm (0,5 in) wide magnetic tape for information interchange using phase encoding at 126 ftpmm (3 200 fpi), 63 cpmm (1 600 cpi)*.

ISO 6068:1985, *Information processing — Recording characteristics of instrumentation magnetic tape (including telemetry systems) — Interchange requirements*.

ISO/IEC TR 6371:1989, *Information processing — Interchange practices and test methods for unrecorded instrumentation magnetic tape*.

3 Definitions

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

3.1

aliasing

the false lower frequency components resulting from an insufficient sampling rate (i.e. less than required by the sampling theorem) when reconstructing an analogue signal from its sampled data representation

3.2

baseline restorer

a device to restore the d.c. component removed by the record/reproduce process

3.3

bit error

the incorrect interpretation of a binary bit by a message processing unit

3.4

bit error rate (BER)

the rate at which bit errors occur in a message processing unit, expressed in terms of the number of bit errors divided by the total number of bits processed in a given period of time, or from a given length of tape

3.5

bit packing density

the number of bits recorded per unit track length, usually expressed in terms of bits per millimetre (bit/mm) or kilobits per inch (kbit/in)

3.6

bit slip

the condition in a message processing unit where the bit rate clock has gained (or lost) more than 180° phasing with respect to synchronism with the binary message bits

3.7

bit synchronizer

an information processing unit intended to extract the binary message and associated bit rate clock included in a pulse code modulation (PCM) signal

3.8

cross play

the ability to record and reproduce on the same or a different machine, or record at one speed and reproduce at the same or different speed

3.9

cross talk

interference signals that are coupled from adjacent channels into a given processing unit channel, usually expressed in terms of decibels down from full scale amplitude of the unit channel

3.10

data azimuth

the instantaneous angle in the plane of the tape between a line perpendicular to the reference edge and either of the two parallel lines defining data scatter

NOTE 1 Data azimuth may be expressed as the sum of static and dynamic components in the form

$$A + Bf(t)$$

where

$$\int_0^t f(t) dt = 0$$

3.11**data azimuth (dynamic)**

the maximum angular deviation, over a period of time, of the data azimuth from its mean value as defined by data azimuth (static). For the purpose of this definition, the word “maximum” is interpreted as being at the 95 % probability level. For a Gaussian distribution, this is two standard deviations (2σ)

NOTE 2 Data azimuth (dynamic) is the maximum value of the quantity $Bf(t)$ in 3.10.

3.12**data azimuth (static)**

the mean value, over a period of time, of the data azimuth

NOTE 3 Data azimuth (static) is the quantity A in 3.10.

3.13**data scatter**

the minimum distance between two parallel lines, in the plane of the tape, enclosing all data transitions recorded simultaneously on all tracks in the same head

NOTE 4 The errors in location and angular relation among transient data recorded simultaneously on all odd or even tracks are defined by the terms: data azimuth, data scatter, and individual track data azimuth difference. These are approximately equivalent to the terms: head azimuth, gap scatter, and head segment gap azimuth difference; however, guiding misalignment is included in the data location error definition.

3.14**data spacing**

the distance on the tape between simultaneous events recorded on odd and even numbered tracks when interlaced heads are used

NOTE 5 When recording, this is equal to the head spacing, but on reproducing it is equal to head spacing only when the record and reproduce tensions and head spacing are equal.

3.15**decoder**

information recovery device that accepts digital signals from the tape reproducer and converts them into a form suitable for the output interface

3.16**digital recording code**

the on-tape digital coding of the recorded binary message

3.17**dropout**

reduction in the reproduce signal amplitude severe enough to cause bit errors

3.18**duty factor (of a pulse)**

the ratio of pulse duration to pulse period, often expressed as a percentage

3.19**edge margin (M)**

the distance between the outside edge of the highest numbered track and the tape edge (see Figure 3)

3.20**edge margin, minimum (M_m)**

the minimum value of the edge margin

NOTE 6 This value places an additional constraint on track configurations since, in general, the simultaneous application of all worst-case tolerances for track width, track location, and tape width will result in a value of edge margin less than M_m .

3.21**encoder**

a processing device that accepts a data stream at its input and converts it to appropriate digital signals to be recorded on tape

3.22**error detection**

the process of detecting bit errors

3.23**error correction**

the process of correcting detected bit errors

3.24**eye pattern**

the pattern as displayed on an oscilloscope, that results from the superpositioning of the waveforms of the different symbols in a digital data sequence. It is used for assessing the quality of the replayed digital signal

3.25**flaw**

an imperfection in the tape oxide coating due to oxide or slitting debris, foreign particulate matter, absence of coating, etc.

NOTE 7 Such imperfections are the major source of dropouts. Other imperfections such as failure to maintain slitting tolerances and other physical nonuniformities can cause poor tracking which results in reproduce signal fluctuations similar to dropouts.

3.26**flutter**

tape speed errors at frequencies above 0,5 Hz

3.27**flux transition**

a 180° change in the flux pattern in a magnetic medium, brought about by the reversal of the magnetic poles within the medium

3.28**flux transition density**

the number of flux transitions (i.e. flux reversals) per unit track length

3.29**frame synchronizer**

a processing device to detect and synchronize frames and subframes of a pulse code modulation bit stream

3.30**gap length**

distance from the leading edge to the trailing edge of head gap measured perpendicular to the track width (see Figure 1)

3.31**gap scatter**

the minimum distance between two parallel lines, in the plane of the tape, between which all the gap trailing edges of a record head are embraced (see Figure 1)

3.32**head**

a group of individual head segments in a fixed assembly

3.33**head azimuth**

the angle formed in the plane of the tape, between a line passing through the gap centres of the two outside head segments and a line perpendicular to the head reference plane (see Figure 1)

3.34**head 1**

the first record or reproduce head over which an element of tape passes when moving in the normal operating direction (see also 3.39)

3.35**head reference plane**

a plane, which may be imaginary, that is parallel to the reference edge of the tape and perpendicular to the plane of the tape

NOTE 8 For the purpose of this definition the tape is considered as perfect (see Figure 1).

3.36**head segment**

a single transducer that records or reproduces one track (see Figure 1)

3.37**head segment gap azimuth**

the angle, formed in the plane of the tape, between a line perpendicular to the head reference plane and a line parallel to the trailing edge of the gap in a record head segment (see Figure 1)

3.38**head segment gap azimuth difference**

the angular deviation of the azimuth of a head segment gap from the head azimuth

3.39**head segment number**

the number of the head segment corresponding to the track number on the magnetic tape on which that head segment normally operates (see Figure 2)

NOTE 9 Head 1 of a pair contains all odd-numbered segments, while head 2 contains all even-numbered segments (see Figure 1 and Figure 2).

3.40**head spacing (S)**

the distance along the tape path between the gap centrelines of head 1 and head 2, when interlaced heads are used (see Figure 2)

3.41**head tilt**

the angle between the plane tangent to the front (active) surface of the head at the centreline of the head segment gaps, and a line perpendicular to the head reference plane (see Figure 1)

3.42**high density digital recording (HDDR)**

recording of digital data on a magnetic medium, having a flux transition density in excess of 590 transitions per millimetre (15 000 transitions per inch) per track

3.43**individual track data azimuth difference**

the angular deviation of the data azimuth of individual odd or even recorded tracks from the data azimuth of other odd or even tracks

NOTE 10 The difficulty in making direct optical angular measurements requires this error to be expressed as a loss of signal amplitude when the tape is reproduced with an ideal head, whose gap is aligned to coincide with the data azimuth of all odd or even tracks, as compared to the maximum signal amplitude obtainable by optimizing the reproduce head azimuth for the individual tracks (see Figure 1).

3.44**in-line heads**

an arrangement in which all record or all reproduce gaps are in line on a single head stack

3.45 interlaced heads

an arrangement whereby pairs of head stacks are mounted so that alternate tracks are contained in separate head stacks of a pair (see Figure 2)

3.46 jitter amplitude

the variation in the timing of one clock transition relative to that of the preceding transition, expressed as a percentage of the mean interval between the clock transitions

3.47 jitter rate

the rate of change of the jitter amplitude expressed in hertz

3.48 overbias

when the bias current is continuously increased from an initial low level while recording a relatively long wavelength signal on tape, the reproduce output first increases with increasing bias until it reaches a maximum, after which further increases in bias cause a reduction in output. A typical bias adjustment procedure involves finding the level corresponding to maximum (or peak) output and then increasing the bias to cause a specified reduction in reproduce amplitude where the amount of this reduction, usually expressed in decibels, is known as the amount of overbias

3.49 overhead bits

bits added to the bit stream to facilitate the transmission and recovery of the bit stream (e.g. frame synchronization words, check bits)

3.50 parallel HDDR

the recording of multiple PCM data streams that are synchronous to a common clock on multitrack recorders/reproducers so that synchronization can be restored at playback

3.51 pseudorandom sequences/patterns

repeating sequences exhibiting many of the statistical properties of uniformly distributed random number sequences

3.52 pulse code modulation (PCM)

a modulation method in which information to be recorded is encoded into digital symbols (see 3.21 and Figure A.1)

3.53 reference edge

the edge of the tape nearest to track 1 (see Figure 3)

3.54 reference track location (*G*)

location of the centreline of track 1 relative to the reference edge of the tape (see Figure 3)

3.55 signal-to-noise ratio (SNR)

the ratio of signal power to noise power, expressed in decibels

3.56 single track serial HDDR

the recording of one or more digital data streams on to a single recording track

3.57 synchronization word

a fixed pattern of bits inserted in a digital bit stream to synchronize the frame synchronizer

3.58 synchronous

having the same rate and phase

3.59 tape skew

motion of tape such that the tape tracks are not perpendicular to the gap centre line. Skew can have both static and dynamic components (see 3.10, 3.11 and 3.12)

3.60 tape speed, actual (v_{act})

the tape speed during recording and reproducing

NOTE 11 In general, the actual tape speed will not be equal to the nominal tape speed (see 4.2.1).

3.61 tape speed, effective (v_{eff})

the tape speed corrected for the effects on the tape of operating conditions, i.e. tensile force, tape materials, thickness, and environment (temperature and humidity)

3.62 tape speed, nominal (v)

a set of defined nominal tape speeds for tapes operating at the reference tensile force (see 4.4.7), and in standard test environmental conditions of $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($+73\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$) and relative humidity 45 % to 55 %

3.63 tape speed error

departure of the average speed from the nominal value