International Standard 8462/1

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Information processing — Data interchange on 6,30 mm (0.25 in) magnetic tape cartridge using GCR recording at 394 ftpmm (10 000 ftpi), 39 cpmm (1 000 cpi) — Part 1 : Mechanical, physical and magnetic properties

First edition — 1986-02-15

UDC 681.327.64

Ref. No. ISO 8462/1-1986 (E)

Descriptors : data processing, information interchange, magnetic tapes, 6,3 mm magnetic tapes, cassettes for magnetic tapes, specifications, dimensions, tests, performance tests, storage, transportation.

Price based on 33 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8462/1 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

Contents

This page intentionally left blank

Information processing — Data interchange on 6,30 mm (0.25 in) magnetic tape cartridge using GCR recording at 394 ftpmm (10 000 ftpi), 39 cpmm (1 000 cpi) — Part 1 : Mechanical, physical and magnetic properties

1 Scope and field of application

ISO 8462 specifies the characteristics of a tape cartridge loaded with magnetic tape 6,30 mm (0.25 in) wide intended for digital recording at physical recording densities of 252 ftpmm (6 400 ftpi) and 394 ftpmm (10 000 ftpi).

ISO 8462/2 specifies a recording method and a data format intended for use in the streaming mode of operation. Two alternative track formats are specified :

— a 4-track format, and

— a 9-track format.

This part of ISO 8462 specifies the mechanical, physical and magnetic properties of a 6,30 mm (0.25 in) wide magnetic tape cartridge and methods for testing the surface quality of the tape.

It also specifies the environmental conditions under which the cartridge shall be tested and operated, and recommends conditions for storage.

ISO 8462/1 and ISO 8462/2 provide for the physical interchange of cartridges between data processing systems, and specify a data format. A labelling standard for tape cartridges used in the streaming mode is under study. The availability of such a labelling standard will provide for full data interchange between data processing systems.

NOTE — Numeric values in the SI and/or Imperial measurement system in this part of ISO 8462 may have been rounded off and therefore are consistent with, but not exactly equal to, each other. Either system may be used, but the two should be neither intermixed nor reconverted. The original design was made using the Imperial measurement system.

2 Conformance

A 6,30 mm (0.25 in) wide magnetic tape cartridge shall be in conformance with ISO 8462 if it meets either all mandatory requirements of both ISO 8462/1 and ISO 8462/2 specified for the 4-track format or all mandatory requirements of both ISO 8462/1 and ISO 8462/2 specified for the 9-track format. The two formats shall not exist on the same cartridge.

3 Reference

ISO 8462/2, *Information processing — Data interchange on* 6,30 mm (0.25 in) *magnetic tape cartridge using GCR recording at* 394 ftpmm (10 000 ftpi), 39 cpmm (1 000 cpi) — *Part 2 : Streaming mode.*

4 Definitions

For the purpose of this International Standard the following definitions apply.

4.1 magnetic tape : A tape which accepts and retains magnetic signals intended for input/output and storage purposes of information processing and associated systems.

4.2 Reference Tape Cartridge : A tape cartridge selected for a given property for calibrating purposes.

4.3 Secondary Reference Tape Cartridge : A tape cartridge intended for routine calibrating purposes, the performance of which is known and stated in relation to that of the Reference Tape Cartridge.

4.4 typical field : The minimum field which, when applied to the tape under test, causes a signal output equal to 95 % of the maximum signal output at the specified test density.

4.5 Reference Field : The minimum field which, when applied to the Signal Amplitude Reference Tape Cartridge causes a signal output equal to 95 % of the maximum signal output at the test density.

4.6 Test Recording Currents : The two recording currents

— between 148 % and 152 % of the current required to produce the Reference Field at 252 ftpmm (6 400 ftpi), and

— between 128 % and 132 % of the current required to produce the Reference Field at 394 ftpmm (10 000 ftpi).

4.7 Signal Amplitude Reference Tape Cartridge : A reference tape cartridge selected as a standard for signal amplitude and reference field.

NOTE — A Master Standard (Computer Amplitude Reference) Cartridge has been selected by the US National Bureau of Standards (NBS) to establish the reference level for average peak-to-peak signal amplitudes when recorded at

- 252 ftpmm (6 400 ftpi);
- 394 ftpmm (10 000 ftpi).

Secondary Standard Amplitude Reference Tape Cartridges are available from NBS under Part Number SRM 3217 [1].

4.8 Standard Reference Amplitude (SRA) : The average peak-to-peak signal amplitudes of the Signal Amplitude Reference Tape Cartridge. These signal amplitudes shall be averaged over 10 000 flux transitions.

SRA_{252} is the average peak-to-peak signal amplitude when recording at 252 ftpmm (6 400 ftpi) using the appropriate Test Recording Current.

SRA_{394} is the average peak-to-peak signal amplitude when recording at 394 ftpmm (10 000 ftpi) using the appropriate Test Recording Current.

4.9 Average Signal Amplitude : The average peak-to-peak value of the signal output measured over at least 8 000 consecutive flux transitions.

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

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

4.12 physical recording density : The number of recorded flux transitions per unit length of track; flux transitions per millimetre (ftpmm) [flux transitions per inch (ftpi)].

4.13 data density : The number of data characters stored per unit length of tape; characters per millimetre (cpmm) [characters per inch (cpi)].

4.14 position of flux transitions : That position which exhibits the maximum free space flux density normal to the tape surface.

4.15 Reference Alignment Tape Cartridge : A tape cartridge containing a tape on which continuous information has been recorded.

A Reference Alignment Tape Cartridge is optimized for perpendicularity of the written flux transitions to the cartridge positioning plane.

4.16 recording area : That part of the tape satisfying the requirements for magnetic properties.

4.17 erasing field : A field of sufficient strength to remove the signals from the tape.

5 Environment and transportation

5.1 Testing environment

Tests and measurements made on the cartridge to check the requirements of this part of ISO 8462 shall be carried out under the following conditions :

temperature : 23 ± 2 °C (73 ± 4 °F);

relative humidity : 40 % to 60 %;

conditioning before testing : 24 h min.

wet-bulb temperature : 18 °C max. (64 °F max.)

5.2 Operating environment

Cartridges used for data interchange shall be operated under the following conditions :

temperature : 5 to 45 °C (41 to 113 °F);

relative humidity : 20 % to 80 %

wet-bulb temperature : 26 °C max. (79 °F max.)

The temperature shall be measured in the air immediately surrounding the cartridge. Rapid temperature variations should be avoided.

There shall be no deposit of moisture on or in the cartridge.

5.3 Storage environment

During storage it is recommended that recorded cartridges are kept within the following conditions :

temperature : 5 to 45 °C (41 to 113 °F);

relative humidity : 20 % to 80 %;

wet-bulb temperature : 26 °C max. (79 °F max.)

1) NBS, Office of Standard Reference Materials, Room 311, Chemistry Building, Gaithersburg, MD 20899, USA.

5.4 Transportation

5.4.1 Transportation environment

During transportation, the cartridge may have been exposed to conditions outside the operating environment. It is recommended that the following conditions are not exceeded :

temperature : −40 to 45 °C (−40 to 113 °F);

relative humidity : 20 % to 80 %;

wet-bulb temperature : 26 °C max. (79 °F max.)

5.4.2 Transportation procedures

Responsibility for ensuring that adequate precautions are taken during transportation shall be with the sender. For transportation a rigid container free from dust or extraneous matter shall be used. The final package shall have a clean interior and a construction preventing ingress of dust or water. It is recommended that a sufficient space exists between cartridge and outer surface of the final container, so that risk of damage due to stray magnetic fields will be negligible.

5.5 Conditioning of the cartridge

Before use the cartridge shall be conditioned by exposure to the operating environment for a time at least equal to the period during which it has been out of the operating environment (up to a maximum of 8 h).

The cartridge shall be conditioned by running the tape one complete end-to-end pass in any of the following cases :

a) each time it is inserted in a drive;

b) after prolonged operation over a limited area;

c) when the temperature change to which the cartridge has been exposed is greater than 17 °C (30 °F).

5.6 Flammability

Tape or cartridge components shall be made from materials that, if ignited from a match flame, do not continue to burn in a still carbon dioxide atmosphere.

5.7 Toxicity

Tape or cartridge components which may cause bodily harm by contact, inhalation or ingestion during normal use of the cartridge shall not be used.

6 Characteristics of the tape

6.1 Mechanical properties

6.1.1 Tape width

The width of the tape shall be

$$6{,}30\ ^{0}_{-0{,}06}\ \text{mm}\ \ (0.247\ 0\ ^{+\ 0.001\ 0}_{-\ 0.001\ 5}\ \text{in})$$

NOTE — Although the tolerances are expressed differently in the two measurement systems, the dimensions are equivalent.

6.1.2 Tape length

The length of the tape between the LP and the EW markers (see 6.1.4) shall be

$$137{,}0\ ^{+\ 4{,}6}_{0}\ \text{m}\ \ (450\ ^{+15}_{0}\ \text{ft})$$

6.1.3 Tape thickness

The thickness of the tape and of its coating shall be

— overall thickness : 19 µm max. (0.000 75 in max.)

— coating thickness : 6,6 µm max. (0.000 26 in max.)

6.1.4 Markers

In the tape there shall be a number of markers, the relative positions of which are shown in figure 1.

6.1.4.1 Beginning-of-Tape (BOT)

A BOT marker shall be a pair of circular holes punched in the tape. There shall be three such markers, the innermost of which is used for the purpose of identifying the storage position for the cartridge. In the storage position, all of the recording area shall be wound on the supply hub and shall be protected by at least one layer of tape. The two other markers shall be used to ensure reliability of detection when rewinding.

The diameter of the BOT holes shall be 1,17 ± 0,05 mm (0.046 ± 0.002 in).

6.1.4.2 End-of-Tape (EOT)

An EOT marker shall be a single circular hole punched in the tape. There shall be three such markers along a single line. The first to pass the photo sensor during forward operation indicates that the recording area has been exceeded. The two other markers shall be used to ensure reliability of detection.

The diameter of the EOT holes shall be 1,17 ± 0,05 mm (0.046 ± 0.002 in).

6.1.4.3 Load-Point (LP)

The LP marker shall be a single circular hole punched in the tape to indicate the beginning of the recording area in the forward direction.

The diameter of the LP hole shall be 1,17 ± 0,05 mm (0.046 ± 0.002 in).

6.1.4.4 Early-Warning (EW)

The EW marker shall be a single circular hole punched in the tape for the purpose of indicating the approaching end of the recording area in the forward direction. Recording shall stop before the EOT marker is sensed.

The diameter of the EW marker shall be 1,17 ± 0,05 mm (0.046 ± 0.002 in).

6.1.5 Light transmittance

The tape shall have a light transmittance of less than 0,5 % measured according to annex A.

6.1.6 Tensile yield force

The tensile yield force of the tape, defined as the force required to elongate a sample by 3 %, shall be 6,7 N min. (1.5 lbf min.)

This elongation shall be measured with a static weighing tester at a constant rate of grip separation. A specimen of tape of at least 178 mm (7 in) shall be clamped with an initial separation of 102 mm (4 in) between the jaws. This specimen shall be elongated at a rate of 51 mm/min until an elongation of at least 10 % is reached. The tensile yield force is the force required to produce the elongation of 3 %.

6.1.7 Layer-to-layer adhesion

Layer-to-layer adhesion shall be sufficiently low to meet the requirements of the test given in annex B.

6.1.8 Cupping

Cupping is the departure across a tape (transversely to the tape motion) from a flat surface.

The maximum cupping of a 6,30 mm (0.25 in) long length of tape shall not exceed 0,38 mm (0.015 in) when placed concave side down on a smooth, flat surface. The time between cutting and the measurement shall be at least 1 h.

6.1.9 Leaders and splices

The cartridge shall contain no splices or spliced-in leaders.

6.1.10 Tape wind

The tape shall be wound on the hubs with the magnetic coating on the outside, and in such a way that during forward read/write operations the tape is unwound in a counter-clockwise direction viewed from above as shown in figure 2.

6.2 Electrical surface resistance

The electrical resistance of the magnetic surface of any square sample of tape shall be within the range of

5×10^5 to 10^9 Ω

measured between electrodes placed on two opposite sides of the square, using a voltage of 500 ± 10 V.

6.3 Magnetic properties

The magnetic properties of the tape are defined by the testing requirements given below. When performing the tests, the output or resultant signal shall be measured on the same pass for both the Signal Amplitude Reference Tape Cartridge and the tape under test (i.e. either the read-whilst-write, or on equipment without read-whilst-write capability on the first forward-read-pass) on the same equipment.

The in-contact condition shall be used for all tests.

6.3.1 Test densities

The test densities shall be 252 ftpmm (6 400 ftpi) and 394 ftpmm (10 000 ftpi) nominal. The densities to be used are specified for each test.

6.3.2 Test tracks

The test tracks shall be located centrally on the tape. The width of the test tracks is not specified; it shall be noted and used for calculating Defect Density (see 6.3.6).

6.3.3 Typical field

The typical field of the tape under test shall be within ± 20 % of the Reference Field.

6.3.4 Average Signal Amplitude

When a tape has been recorded with the appropriate Test Recording Current, then played back on a system which has been calibrated by means of a Signal Amplitude Reference Tape Cartridge recorded under the same conditions, the Average Signal Amplitude of the tape under test shall be

— at 252 ftpmm (6 400 ftpi) : within ± 25 % of SRA_{252};

— at 394 ftpmm (10 000 ftpi) : within ± 25 % of SRA_{394}.

6.3.5 Ease of erasure

When a tape has been recorded at 63 ftpmm (1 600 ftpi) with a recording current equal to 150 % of the Test Recording Current for 252 ftpmm (6 400 ftpi), and then passed through a longitudinal steady erasing field of 79 600 A/m (1 000 Oe) any remaining signal shall not exceed 3 % of the Standard Reference Amplitude SRA_{252}. The erasure field shall be reasonably uniform, for example the field in the middle of a solenoid. This measurement shall be made with a band pass filter passing at least the first three harmonics.

6.3.6 Defect density

6.3.6.1 Definitions

6.3.6.1.1 Threshold Level (TL) : The TL is measured relative to the Standard Reference Amplitude (SRA) and is expressed as a percentage of the SRA.

6.3.6.1.2 Track Width (TW) : The width of that part of the recorded track sensed by the Read Head.

6.3.6.1.3 tested surface area : That surface containing recorded signals, exclusive of erased gaps or other non-used recording areas where errors are not detectable.

It is the product of TW and the total length of data track areas tested.

6.3.6.1.4 Rejected Region : Any 25,4 mm (1 in) length of tested track containing one or more missing pulses. Any head-to-tape separation, or anomaly in the oxide surface, which produces a loss of amplitude of the playback signal below TL is a missing pulse.

6.3.6.1.5 defect density : The total number of Rejected Regions observed, divided by the tested surface area.

It is expressed in defects per square millimetre, D/mm^2 (or defects per square inch, D/in^2).

6.3.6.1.6 Effective Defect Diameter (EDD) : The EDD is calculated as follows :

$$EDD = (1 - TL/100) \times TW$$

6.3.6.2 Requirement

The Defect Density shall be less than, or equal to,

$$0{,}034\ 1 \times e^{(-19{,}3\ EDD)}\ D/mm^2\ [22 \times e^{(-490\ EDD)}\ D/in^2]$$

6.3.6.3 Procedure

The test shall be carried out on any number of tracks over the entire length of the Recording Area (6.3.7).

The physical recording density shall be 394 ftpmm (10 000 ftpi).

The recording current shall be the Test Recording Current for 394 ftpmm (10 000 ftpi).

The Threshold Level (TL) shall be selected.

6.3.7 Recording area

The recording area shall be that part of the tape tested according to 6.3.1 to 6.3.6. In the forward direction, it begins at least 686 mm (27 in) before the LP marker and ends at least 991 mm (39 in) after the EW marker (see figure 1) and extends across the width of the tape.

7 Characteristics of the cartridge

7.1 General description

The cartridge shall be of a twin hub coplanar design with the tape and hubs completely enclosed by the casing, except for the belt capstan and head openings. The drive shall be by means of a tensioned belt which is driven by the internal belt capstan which receives motion from an external motor (see figure 2). Tape guides shall be located inside the cartridge. A clear plastic top shall allow visual monitoring of the tape and shall not extend beyond the base except at the notches.

7.1.1 Dimension

The dimensions of the cartridge shall be as shown in figure 3.

7.1.2 Cartridge positioning planes

The cartridge shall be referenced to the drive only in the cross-hatched areas shown in figure 4. The application of forces suggested in figure 4 is one method of assuring conformance of the cartridge to the positioning plane.

7.1.3 Attachment

The ends of the tape shall not be attached to the hubs.

7.1.4 Mounting position

It shall be possible to mount the cartridge in the drive in one position only; to ensure this, the cartridge shall have the following asymmetrical features (see figure 3) :

a) a projection in one guide slot;

b) the guide slots shall be accessible on the head opening edge only.

7.1.5 Light sensing

The cartridge shall contain optical elements to permit photoelectric detection of the tape markers (see figure 5). The total light transmittance of both cover windows, including the effects of reflection from the mirror surface, sensed by a silicon photo-transistor shall be at least 50 % (see annex A).

This requirement shall be satisfied for both

— a 2 000 ± 200 K incandescent light source, and

— a 940 ± 5 nm LED light source.

7.1.6 Cartridge-in-position sensing

The cartridge shall have a solid area on the front surface the dimensions of which are shown in figure 6. This area shall be used for mechanically sensing that the cartridge is in position for writing and reading.

7.1.7 Cartridge door

The cartridge shall have a door for protection of the tape during storage and transportation. Requirements for opening the door are shown in figure 7.

7.2 File protection

The cartridge shall have a rotatable plug to prevent writing or erasure of the tape. See figure 6 for the file protect plug location.

7.3 Physical labels

7.3.1 Location and size

The rear surface of the cartridge and a part of the top side of the cartridge shall allow the use of labels (see figure 8).

7.3.2 Interchange

Labels shall be used for marking the contents of cartridges. The use of pencil or erasable material is not permitted.

7.4 Tape guides

The tape shall be guided by two tape guides contained within the cartridge (see figure 9). The drive shall not contain any elements that might restrict the tape path in the transverse direction.

7.5 Speed

The cartridge shall be capable of use at any nominal tape speed in the range of 0,76 m/s (30 in/s) to 2,29 m/s (90 in/s).

NOTE — When using the higher speeds reliable data transfer is specially dependent on the careful design of the head-to-tape contact.

7.6 Instantaneous speed variation (ISV)

An Instantaneous Speed Variation Event is said to have occurred when the residual Time Displacement Error (TDE) exceeds 156 ns when measured at 0,76 m/s (30 in/s) and 252 ftpmm (6 400 ftpi). The number of ISV events shall be a matter for agreement between the parties concerned.

See annex C for the method of test.

7.7 Low-frequency speed variation

The speed variation due to the sum of the components of the rate of change of speed in the range 0 to 1 000 Hz shall not exceed 4 % of the nominal speed.

7.8 Acceleration

The cartridge shall be capable of withstanding acceleration and deceleration of the linear tape speed of 50,8 m/s^2 (2 000 in/s^2).

7.9 Driving force

The tangential force required at the external driving surface of the belt capstan to maintain a constant operating speed shall be 1,0 ± 0,3 N (3.5 ± 1.0 ozf). The external radial load applied to the belt capstan when making this measurement shall be 5,6 ± 0,6 N (20 ± 2 ozf).

7.10 Total inertia

The total equivalent mass of all moving cartridge elements, when measured at the external driving surface of the capstan, shall be 0,022 kg max. (0.002 ozf·s^2/in max.).

7.11 Dynamic response

7.11.1 Definition

The speed response of tape motion to a step driving function applied to the belt capstan.

7.11.2 Requirement

The natural resonant frequency shall be at least 60 Hz.

7.11.3 Procedure

A drive capable of producing a pronounced overshoot of the tape speed should be used. The drive servo should be critically damped so that the overshoot observed is not that of the drive. The reciprocal of the time measured between the first two overspeed peaks is the natural resonant frequency.

7.12 Tape tension

7.12.1 Definitions

7.12.1.1 tape tension : The resultant force in the longitudinal direction of the tape on a cross-section of the tape taken through the tape perpendicular to the longitudinal direction.

7.12.1.2 instantaneous tension : The force as measured at the cross-section of the tape located at the head position of the free tape path and averaged over 10 ms.

7.12.1.3 average tension (at a point along the length of the tape) : The average value of instantaneous tension measured over 1 m (3 ft) of tape symmetrically located around that point.

7.12.1.4 dynamic tape tension (at a point along the length of the tape) : The maximum variation of instantaneous tension over the 1 m (3 ft) of tape symmetrically located around that point.

7.12.1.5 transverse tape tension variation : That variation across the tape produced by the difference in free tape path length between the two edges of the tape.

7.12.2 Requirements

7.12.2.1 Value of instantaneous tension

a) In the testing environment the instantaneous tension at any point along the length of the tape between LP and EW shall be between 0,28 N (1.0 ozf) and 0,98 N (3.5 ozf).

b) In the operating environment the instantaneous tension shall be between 0,14 N (0.5 ozf) and 1,12 N (4.0 ozf). When the temperature is brought back to that of the testing environment the requirements of a) shall be met.

7.12.2.2 Value of dynamic tension

The dynamic tension at any point along the length of the tape between LP and EW shall not exceed 0,21 N (0.75 ozf).

7.12.2.3 Requirement for transverse tension variation

The test rod shall not deviate from the horizontal by more than 4° at any point along the length of tape from LP to EW.

7.12.3 Procedures

For test procedures see annex D.

7.13 Drive ratio

The ratio of the tape speed to the surface speed of the external driving surface of the belt capstan shall be 0,76 ± 0,02.

7.14 Tape path length

The cartridge shall be used with drives causing an increase of the tape path length in the range 0,38 mm (0.015 in) to 1,40 mm (0.055 in).

NOTE — The length of the tape path is the length of the straight tangent common to the tape guides when the cartridge is not mounted in the drive. It is measured between the two contact points of the tape with the guides. When the cartridge is mounted in the drive, the head and/or other parts of the drive provoke an increase of this tape path length which affects the initial tape tension.

7.15 Dynamic tape skew

Dynamic tape skew is the variation of the angle that the centreline of the tape makes with Reference Plane B. It shall not exceed 7′ of arc.

Measurement : Write flux transitions simultaneously on two test tracks over the entire recording area of the tape at a speed v.

Using the same two gaps, read the tape in the forward and reverse directions, measuring the time differences between corresponding flux transitions.

The maximum time difference t and the distance d between the centrelines of the two test tracks shall be used to caiculate the dynamic tape skew as follows :

$$\arctan\left(\frac{t\,v}{d}\right) < 7'$$

7.16 Electrical resistance of the belt capstan

The electrical resistance of the belt capstan shall not exceed 1 MΩ when measured using the test equipment and test procedure described in annex E.