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Information processing — Data interchange on 12,7 mm (0.5 in) wide magnetic tape cartridges — 18 tracks, 1 491 data bytes per millimetre (37 871 data bytes per inch)

Traitement de l'information — Échange d'information sur cartouche de bande magnétique de 12,7 mm *de large* (0,5 in) *— 18 pistes, 1 491 caractères par millimètre (37 871 caractères par inch)*

Reference number
ISO 9661 : 1988 (E)

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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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 9661 was prepared by the European Computer Manufacturers Association (as Standard ECMA-120) and was adopted, under a special "fast-track procedure", by Technical Committee ISO/TC 97, *Information processing systems,* in parallel with its approval by the ISO member bodies.

Annexes C, E, F and G form an integral part of this International Standard. Annexes A, B, D and H are for information only.

Information processing — Data interchange on 12,7 mm (0.5 in) wide magnetic tape cartridges — 18 tracks, 1 491 data bytes per millimetre (37 871 data bytes per inch)

Section 1 : General

1.1 Scope

This International Standard specifies the physical and magnetic characteristics of a 12,7 mm (0.5 in) wide, 18-track magnetic tape cartridge to enable interchangeability of such cartridges. It also specifies a format and recording method thus allowing, together with ISO 1001 for magnetic tape labelling, full data interchange by means of such magnetic tape cartridges.

NOTE — Numeric values in the SI and/or Imperial measurement system in this International Standard 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 SI units.

1.2 Conformance

A magnetic tape cartridge shall be in conformance with this International Standard if it meets all mandatory requirements specified herein. The tape requirements shall be satisfied throughout the extent of the tape.

1.3 Normative references

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

ISO 646 : 1983, *Information processing — ISO 7-bit coded character set for information interchange.*

ISO 683-13 : 1986, *Heat-treatable steels, alloy steels and free-cutting steels — Part 13: Wrought stainless steels.*

ISO 1001 : 1986, *Information processing — File structure and labelling of magnetic tapes for information processing interchange.*

ISO 1302 : 1978, *Technical drawings — Method of indicating surface texture on drawings.*

ISO 2022 : 1986, *Information processing — ISO 7-bit and 8-bit coded character sets — Code extension techniques.*

ISO 4873 : 1986, *Information processing — ISO 8-bit code for information interchange — Structure and rules for implementation.*

1.4 Definitions

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

1.4.1 Average Signal Amplitude: The average peak-to-peak value of the signal output of the read head measured over a minimum of 25,4 mm (1 in) of tape exclusive of missing pulses.

1.4.2 back surface: The surface of the tape opposite the magnetic coating used to record data.

1.4.3 byte: An ordered set of eight bits acted upon as a unit and recorded as a 9-bit pattern.

1.4.4 cartridge: A container holding a supply reel of magnetic tape with an attached leader block.

1.4.5 Cyclic Redundancy Check Character: A character represented by two bytes, placed at the end of a data block and used for error detection.

1.4.6 data density: The number of 8-bit bytes stored per unit length of tape, expressed in bytes per millimetre (bytes per inch).

1.4.7 Error Correcting Code: A mathematical procedure yielding bits used for the detection and correction of errors.

1.4.8 flux transition position: That point which exhibits maximum free-space flux density normal to the tape surface.

1.4.9 flux transition spacing: The distance along a track between successive flux transitions.

1.4.10 magnetic tape: A tape which will accept and retain the magnetic signals intended for input, output and storage purposes on computers and associated equipment.

1.4.11 Master Standard Reference Tape: A tape selected as the standard for Reference Field, Signal Amplitude, Resolution and Overwrite.

NOTE — A Master Standard Reference Tape is being established at the National Bureau of Standards (NBS) for this International Standard.

1.4.12 physical recording density: The number of recorded flux transitions per unit length of track, expressed in flux transitions per millimetre (ftpmm) (flux transitions per inch, [ftpi]).

1.4.13 Postamble: A repeated 9-bit pattern at the end of a Recorded Data block providing electronic synchronization when reading in the reverse direction.

1.4.14 Preamble: A repeated 9-bit pattern at the beginning of a Recorded Data Block providing electronic synchronization when reading in the forward direction.

1.4.15 Reference Field: The Typical Field of the Master Standard Reference Tape.

1.4.16 Secondary Standard Reference Tape: A tape the performance of which is known and stated in relation to that of the Master Standard Reference Tape.

NOTE — Secondary Standard Reference Tapes are being developed at the National Bureau of Standards (NBS) and will be available from the NBS Office of Standard Reference materials, Room B311, Chemistry Building, National Bureau of Standards, Gaithersburg, MA 20899, USA.

It is intended that these be used for calibrating tertiary reference tapes for use in routine calibration.

1.4.17 Standard Reference Amplitude: The Average Signal Amplitude from the Master Standard Reference Tape when it is recorded with the Test Recording Current on the NBS measurement system at 972 ftpmm (24 689 ftpi).

Traceability to the Standard Reference Amplitude is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

1.4.18 Standard Reference Current: The current that produces the Reference Field.

1.4.19 Test Recording Current: The current that is 1,5 times the Standard Reference Current.

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

1.4.21 Typical Field: In the plot of the Average Signal Amplitude against the Recording Field at the physical recording density of 972 ftpmm (24 689 ftpi), the minimum field that causes an Average Signal Amplitude equal to 85 % of the maximum Average Signal Amplitude.

1.5 Environment and safety

Unless otherwise stated, the conditions specified below refer to the ambient conditions in the test or computer room and not to those within the tape equipment.

1.5.1 Cartridge/tape testing environment

Unless otherwise stated, tests and measurements made on the tape cartridge to check the requirements of this International Standard shall be carried out under the following conditions:

temperature	: 23 °C ± 2 °C (73 °F ± 4 °F)
relative humidity	: 40 % to 60 %
conditioning period before testing	: 24 h

1.5.2 Cartridge operation environment

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

temperature	: 16 °C to 32 °C (60 °F to 90 °F)
relative humidity	: 20 % to 80 %
wet bulb temperature	: 25 °C max. (78 °F max.)

The average temperature of the air immediately surrounding the tape shall not exceed 40,5 °C (105 °F).

NOTE — Localized tape temperatures in excess of 49 °C (120 °F) may cause tape damage.

Conditioning before operating: If a cartridge has been exposed during storage and/or transportation to conditions outside the above values, it shall be conditioned for a period of at least 24 h.

1.5.3 Cartridge storage environment

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

temperature	: 5 °C to 32 °C (40 °F to 90 °F)
relative humidity	: 5 % to 80 %
wet bulb temperature	: 26 °C max. (80 °F max.)

1.5.4 Safety requirements

1.5.4.1 Safety

The cartridge and its components shall not constitute any safety or health hazard when used in its intended manner or in any foreseeable misuse in an information processing system.

1.5.4.2 Flammability

The cartridge and its components shall be made from materials which, if ignited from a match flame, do not continue to burn in a still carbon dioxide atmosphere.

1.5.5 Transportation

This International Standard does not specify parameters for the environment in which cartridges should be transported. Annex A gives some recommendations for transportation.

Section 2: Tape requirements

2.1 Characteristics of the tape

2.1.1 Material

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. The back surface of the tape may also be coated with a ferromagnetic or non-ferromagnetic material.

2.1.2 Tape length

The length of the tape shall not be less than 165 m (541 ft).

2.1.3 Tape width

The width of the tape shall be 12,650 mm ± 0,025 mm (0.498 0 in ± 0.001 0 in). The width shall be measured across the tape from edge-to-edge when the tape is under a tension of less than 0,28 N (1.0 ozf).

2.1.4 Tape discontinuity

There shall be no discontinuities in the tape such as those produced by tape splicing or perforations.

2.1.5 Total thickness of tape

The total thickness of the tape at any point shall be between 0,025 9 mm and 0,033 7 mm (1 020 µin and 1 330 µin).

2.1.6 Base material thickness

The thickness of the base material shall be 0,023 4 mm (921 µin) nomimal.

2.1.7 Longitudinal curvature

The radius of curvature of the edge of the tape shall not be less than 33 m (108 ft).

Procedure:

Allow a length of tape of 1 m (39 in) to unroll and assume its natural curvature on a flat smooth surface. Measure the deviation from a 1 m (39 in) chord. The deviation shall not be greater than 3,8 mm (0.150 in). This deviation corresponds to the minimum radius of curvature of 33 m (108 ft) if measured over an arc of a circle.

2.1.8 Out-of-plane distortions

All visual evidence of out-of-plane distortion shall be removed when the tape is subjected to a uniform tension of 0,6 N (2.16 ozf). Out-of-plane distortions are local deformations which cause portions of the tape to deviate from the plane of the surface of the tape. Out-of-plane distortions are most readily observed when the tape is lying on a flat surface under no tension.

2.1.9 Cupping

The departure across the width of tape from a flat surface shall not exceed 0,3 mm (0.011 8 in).

Procedure:

Cut a length of tape of 1,0 m ± 0,1 m (39.4 in ± 3.9 in). Condition it for a minimum of 3 h in the test environment by hanging it so that the coated surface is freely exposed to the test environment. From the centre portion of the conditioned tape cut a test piece of length 25 mm (1 in). Stand the test piece on its end in a cylinder which is at least 25 mm (1 in) high with an inside diameter of 13,0 mm ± 0,2 mm (0.511 8 in ± 0.007 9 in). With the cylinder standing on an optical comparator measure the cupping by aligning the edges of the test piece to the reticle and determining the distance from the aligned edges to the corresponding surface of the test piece at its centre.

2.1.10 Dynamic frictional characteristics

In the tests of 2.1.10.1 and 2.1.10.2 the specified forces of 1,0 N and 1,5 N (3.6 ozf and 5.4 ozf), respectively, comprise both the force component of the dynamic friction and the force of 0,64 N (2.30 ozf) applied to the sample of tape.

NOTE — Particular attention should be given to keeping the surfaces clean.

2.1.10.1 Frictional drag between the recording surface and the tape back surface

The force required to move the recording surface in relation to the back surface shall not be less than 1,0 N (3.6 ozf).

Procedure

a) Wrap a test piece of tape around a 25,4 mm (1 in) diameter circular mandrel with the back surface of the sample facing outward.

b) Place a second test piece of tape, with the recording surface facing in, around the first sample for a total angle of wrap of 90°.

c) Apply a force of 0,64 N (2.30 ozf) to one end of the outer test piece of tape. Secure its other end to a force gauge which is mounted on a motorized linear slide.

d) Drive the slide at a speed of 1 mm/s (0.039 in/s).

2.1.10.2 Frictional drag between the tape recording surface and ferrite after environmental cycling

The force required to move the tape at a point 1,34 m from the leader block of the cartridge shall not be greater than 1,5 N. The force required at a point 4,3 m from the junction of the tape with the cartridge hub shall not exceed the first force by more than a factor of 4.

Procedure:

a) Wind tape on to a spool hub of diameter 50 mm (2 in) to an outside diameter of 97 mm (4 in) with a winding tension of 2,2 N ± 0,2 N (7.91 ozf ± 0.72 ozf).

b) Repeat the following two steps five times:

1) Store for 48 h at a tempeature of 50 °C (122 °F) and a relative humidity of 10 % to 20 %.

2) Condition in the testing environment for 2 h and rewind with a tension of 2,2 N ± 0,2 N (7.91 ozf ± 0.72 ozf).

c) Condition the tape for 48 h at a temperature of 30,5 °C (87 °F) and a relative humidity of 85 %. The tape shall remain in this environment for steps d) and e).

d) Apply a force of 0,64 N (2.30 ozf) to one end of a test piece of tape of not more than 1 m (39 in), taken 1,34 m (52.75 in) from the leader block. Pass the test piece over a ferrite rod of diameter 25,4 mm (1 in) with the recording surface in contact with the rod for a total angle of wrap of 90°.

The rod shall be made from the ferrite specified in annex C. It shall be polished to a roughness value R_a of 0,05 µm (roughness grade N2, ISO 1302). Pull the other end of the test piece horizontally at 1 mm/s (0.039 in/s).

e) Repeat step d) for a similar test piece taken 4,3 m (14,11 ft) from the junction of the tape with the cartridge hub.

2.1.11 Coating adhesion

The force required to peel any part of the coating from the tape base material shall not be less than 1,5 N (5.4 ozf).

Procedure:

a) Take a test piece of the tape approximately 380 mm (15 in) long and scribe a line through the recording coating across the width of the tape 125 mm (5 in) from one end.

b) Using a double-sided pressure sensitive tape, attach the full width of the test piece to a smooth metal piece plate, with the recording surface facing the plate, as shown in figure 1.

c) Fold the test piece over 180°, attach the metal plate and the free end of the test piece to the jaws of a universal testing machine and set the speed of the jaw separation to 254 mm/min (10 in/min).

d) Note the force at which any part of the coating first separates from the base material. If this is less than 1,5 N (5.4 ozf), the test has failed. If the test piece peels away from the double-sided pressure sensitive tape before the force exceeds 1,5 N (5.4 ozf), an alternative type of double-sided pressure sensitive tape shall be used.

e) If the back surface of the tape is coated, repeat a) to d) for the back coating.

2.1.12 Flexural rigidity

The flexural rigidity of the tape in the longitudinal direction shall be between 0,06 N · mm² and 0,16 N · mm² (0.21 × 10⁻⁴ lbf · in² and 0.56 × 10⁻⁴ lbf · in²).

Procedure:

Clamp a 180 mm (7.1 in) test piece of tape in a universal testing machine, allowing a 100 mm (3.9 in) separation between the machine jaws. Set the jaw separation speed at 5 mm/min (0.2 in/min). Plot the force against the distance. Calculate the flexural rigidity using the slope of the curve between 2,2 N and 6,7 N (0.5 lbf and 1.5 lbf) by the formula:

$$E = \frac{\delta F / WT}{\delta L / L}$$

$$I = WT^3/12$$

$$\text{Flexural rigidity} = EI = \frac{\delta F T^2}{12 \delta L / L}$$

where

δF is the change in force in newtons;

T is the measured thickness in millimetres;

W is the measured width in millimetres;

$\delta L/L$ is the change in length of test piece between the jaws divided by original length between the jaws.

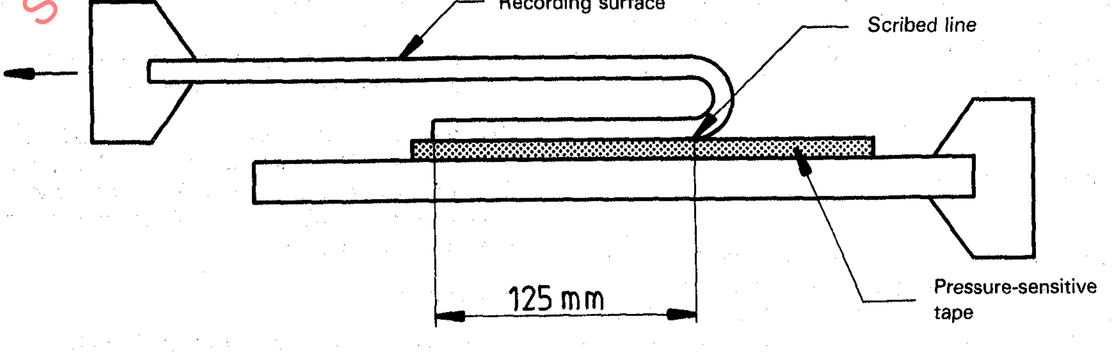


Figure 1 — Coating adhesion

2.1.13 Electrical resistance of coated surfaces

The electrical resistance of any square area of the recording surface shall be within the range

- $10^5\ \Omega$ to $5 \times 10^8\ \Omega$ for non-backcoated tapes;
- $10^5\ \Omega$ to $5 \times 10^9\ \Omega$ for backcoated tapes.

The electrical resistance of any backcoating shall be less than $10^6\ \Omega$.

Procedure:

Condition a test piece of tape in the test environment for 24 h. Position the test piece over two 24-carat gold-plated, semi-circular electrodes having a radius r = 25,4 mm (1 in) and a finish of at least N4, so that the recording surface is in contact with each electrode (see figure 2). These electrodes shall be placed parallel to the ground and parallel to each other at a distance d = 12,7 mm (0.5 in) between their centres. Apply a force F of 1,62 N (0.36 lbf) to each end of the test piece. Apply a d.c. voltage of 500 V ± 10 V across the electrodes and measure the resulting current flow. From this value, determine the electrical resistance.

Repeat for a total of five positions along the test piece and average the five resistance readings. For back-coated tape repeat the procedure with the backcoating in contact with the electrodes.

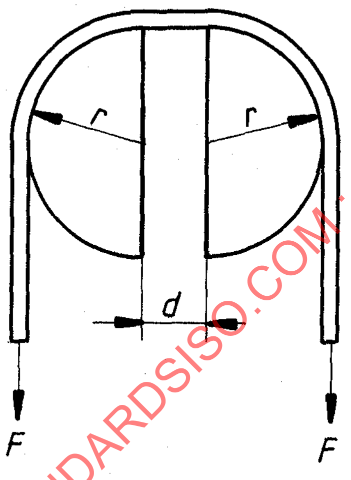


Figure 2 — Position of test piece over two semi-circular electrodes

When mounting the test piece, make sure that no conducting paths exist between the electrodes except that through the coating under test.

NOTE — Particular attention should be given to keeping the surfaces clean.

2.1.14 Tape durability

This International Standard does not specify parameters for assessing tape durability.

However, a recommended procedure is descibed in annex D.

2.1.15 Inhibitor tape

This International Standard does not specify parameters for assessing whether or not a tape is an inhibitor tape.

However, annex B gives further information on inhibitor tapes.

2.1.16 Tape abrasivity

Tape abrasivity is the tendency of the tape to wear the tape transport. The length of the wear pattern on a wear bar shall not exceed 56 µm (2 200 µin) when measured as specified in annex C.

2.1.17 Pre-recording condition

Prior to recording data or to testing, the tape shall have been erased using alternating fields of decaying levels (anhysteretic process) to ensure that the remanent magnetic moment of the recording surface does not exceed 20 % of the maximum remanent magnetic moment. Annex E specifies the method of measurement.

In addition no low density transitions shall be present on the tape.

2.1.18 Magnetic recording characteristics

The magnetic recording characteristics shall be as defined by the testing requirements given below.

When performing these tests, the output or resultant signal shall be measured on the same relative pass for both a tape calibrated to the Master Standard Reference Tape and the tape under test (i.e. read-while-write or first forward-read-pass) on the same equipment.

The following conditions shall apply to the testing of all magnetic recording characteristics, unless otherwise stated.

tape condition	: pre-recording condition
tape speed	: not greater than 2,5 m/s (98.47 in/s)
read-track	: within the written track
azimuth alignment	: not greater than 6′ between the mean write transitions and the read gap
write-gap length	: 1,4 µm ± 0,2 µm (55.1 µin ± 7.9 µin)
write head saturation density	: 0,34 T ± 0,03 T (3 400 gauss ± 300 gauss)
tape tension	: 2,2 N ± 0,2 N (7.91 ozf ± 0.72 ozf)
recording current	: Test Recording Current

2.1.18.1 Typical Field

The Typical Field of the tape shall be between 90 % and 110 % of the Reference Field.

Traceability to the Reference Field is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

2.1.18.2 Signal amplitude

The Average Signal Amplitude at the physical recording density of 972 ftpmm (24 689 ftpi) shall be between 70 % and 140 % of the Standard Reference Amplitude.

Traceability to the Standard Reference Amplitude is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

2.1.18.3 Resolution

The ratio of the Average Signal Amplitude at the physical recording density of 1 458 ftpmm (37 033 ftpi) to that at the physical recording density of 972 ftpmm (24 689 ftpi) shall be between 80 % and 120 % of the same ratio for the Master Standard Reference Tape.

Traceability to the resolution of the Master Standard Reference Tape is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

2.1.18.4 Overwrite

Overwrite is the ratio of the Average Signal Amplitude of the residual of the fundamental frequency of a tone pattern after being overwritten at 972 ftpmm (24 689 ftpi) to the Average Signal Amplitude of the 972 ftpmm (24 689 ftpi) signal. The Average Signal Amplitude of the tone pattern is the peak-to-peak amplitude of the sinusoidal signal with equal rms power.

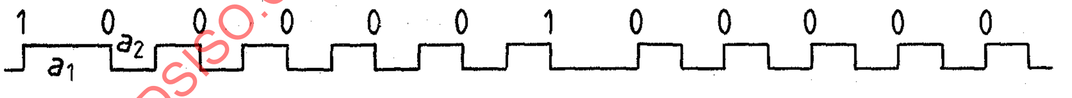
2.1.18.4.1 Requirement

The Overwrite for the tape shall be less than 120 % of the Overwrite for the Master Standard Reference Tape.

Traceability to the Overwrite of the Master Standard Reference Tape is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

Procedure

Record a tone pattern which shall be the following sequence of flux transitions:



where

a_1 = 1,029 µm (40.512 µin)

a_2 = 0,514 µm (20.236 µin)

Record a 972 ftpmm (24 689 ftpi) signal over the tone pattern. Measure the Average Signal Amplitude of the residual of the fundamental frequency of the tone pattern [one sixth of the frequency of the 972 ftpmm (24 689 ftpi) signal] and the Average Signal Amplitude of the 972 ftpmm (24 689 ftpi) signal. Both amplitude measurements should be made using suitable filters.

2.1.18.5 Narrow-band signal-to-noise ratio (NB-SNR)

The narrow-band signal-to-noise ratio is the average signal amplitude rms power divided by the average integrated (side band) rms noise power, and is expressed in decibels.

2.1.18.5.1 Requirement

The NB-SNR ratio shall be equal to, or greater than, 30 dB when normalized to a track width of 410 µm (0.016 14 in). The normalization factor is $dB(410) = dB(W) + 10 \log 410/W$, where W is the track width used when measuring $dB(W)$.

2.1.18.5.2 Procedure

The NB-SNR ratio shall be measured using a spectrum analyzer with a resolution bandwidth (RBW) of 1 kHz and a video bandwidth (VBW) of 10 Hz. The tape speed shall be 762 mm/s (30 in/s) for the frequencies specified below.

The NB-SNR ratio shall be measured as follows:

a) Measure the read-signal amplitude of the 972 ftpmm (24 689 ftpi) signal, taking a minimum of 150 samples over a minimum length of tape of 46 m (151 ft).

b) On the next pass (read only) measure the rms noise power over the same section of tape and integrate the rms noise power (normalizing for the actual resolution bandwidth) over the range from 332 kHz to 366 kHz.

For other tape speeds all the frequencies shall be linearly scaled.

2.1.19 Tape quality

The tape quality (including the effects of exposure to storage and transportation environments) is defined by the testing requirements given in the following clauses. The following conditions shall apply to all quality testing requirements.

environment	: operating environment
tape condition	: pre-recording condition
tape speed	: 2 m/s (78.7 in/s)
read-track width	: 410 µm (0.016 14 µin)
physical recording density	: 972 ftpmm (24 689 ftpi)
write-gap length	: 1,4 µm ± 0,2 µm (55.1 µin ± 7.9 µin)
azimuth alignment	: not greater than 6′ between the mean write transitions and the read gap
write head saturation	: 0,34 T ± 0,03 T (3 400 gauss ± 300 gauss)
recording current	: Test Recording Current
format	: 18 tracks
tape tension	: 2,2 N ± 0,2 N (7.91 ozf ± 0.72 ozf)

2.1.19.1 Missing pulses

A missing pulse is a loss of read signal amplitude. A missing pulse exists when the base-to-peak read signal amplitude is 25 %, or less, of half the Average Signal Amplitude for the preceding 25,4 mm (1 in) of tape.

2.1.19.2 Missing pulse zones

A missing pulse zone begins with a missing pulse and ends when 64 consecutive flux transitions are detected or a length of 1 mm of tape has been measured.

The missing pulse zone rate shall be less than one in 8 × 10^6 flux transitions recorded.

2.1.19.3 Coincident missing pulse zones

There are two 9-track groups in the 18-track format. One group comprises the odd-numbered tracks, the other group comprises the even-numbered tracks. A simultaneous missing pulse zone condition on two or more tracks of a 9-track group is a coincident pulse missing zone.

If a coincident missing pulse zone occurs at the same time in both groups of tracks, it shall be considered as a single coincident missing pulse zone. Its length shall begin with the start of the earliest coincident missing pulse zone and terminate with the end of the latest coincident missing pulse zone.

No 165 m (541 ft) length of tape shall have more than 12 coincident missing pulse zones.

No coincident missing pulse zone shall exceed 50 mm (2 in).

Section 3: Cartridge requirements

3.1 Dimensional and mechanical characteristics of the cartridge

The cartridge shall consist of the following elements

- a case;
- a reel for the magnetic tape;
- a magnetic tape wound on the hub of the reel;
- a locking mechanism for the reel;
- a write-inhibit mechanism;
- a leader block;
- a latching mechanism for the leader block.

Dimensional characteristics are specified for those parameters deemed mandatory for interchange and compatible use of the cartridge. Where there is freedom of design, only the functional characteristics of the elements described are indicated. In the figures a typical implementation is represented in third angle projection.

Where they are purely descriptive the dimensions are referred to three Reference Surfaces A, B and C forming a geometrical trihedral (see figure 3). Where the dimensions are related to the position of the cartridge in the drive, they may be referred to another surface of the cartridge. Figures 4 to 11 show the dimensions of the empty case.

Figure 3 is a general view of the whole cartridge;

Figure 4 shows the front side of the case which lies on reference surface A;

Figure 5 shows the top side of the case;

Figure 6 shows the rear side of case;

Figure 7 shows the bottom side of the case which lies in reference surface C;

Figure 8 shows the side of the case which lies in reference surface B;

Figure 9 shows an enlarged view of a part of figure 4;

Figure 10 shows an enlarged cross-section of a location notch;

Figure 11 shows an enlarged cross-section of a detail of the opening of the case;

Figure 12 shows an enlarged partial cross-section of the cartridge in hand;

Figure 13 shows the same cross-section as figure 11 but of the cartridge in the drive;

Figure 14 shows schematically the teeth of the toothed rim;

Figure 15 shows two views and an enlarged cross-section of the leader block;

Figure 16 shows the fixation of the tape to the leader block, and

Figure 17 shows the leader block inserted in the case.

3.1.1 Overall dimensions (figures 4 to 6)

The overall dimensions of the case shall be

l_1 = 125,00 mm ± 0,32 mm (4.921 in ± 0.013 in)

l_2 = 109,00 mm ± 0,32 mm (4.291 in ± 0.013 in)

l_3 = 24,50 mm $^{+0,50}_{-0,32}$ mm $\left(0.965 \text{ in } ^{+0.019}_{-0.013} \text{ in}\right)$

The corners of the case shall be rounded off as specified by

r_1 = 3,00 max. (0.118 1 in max.)

r_2 = 4,00 max. (0.157 5 in max.)

r_3 = 3,00 min. (0.118 1 in min.)

3.1.2 Write-inhibit mechanism (figures 4 and 5)

The write-inhibit mechanism shall have a flat surface identified by a visual mark, for example a white spot, when in the position in which writing is inhibited. This International Standard does not prescribe the actual implementation of the write-inhibit mechanism. For example, it can be a rotatable or a slidable element.

The front side of the case shall have a window specified by

l_4 = 11,80 mm ± 0,25 mm (0.465 in ± 0.010 in)

l_5 = 15,60 mm ± 0,25 mm (0.614 in ± 0.010 in)

l_6 = 7,40 mm ± 0,25 mm (0.291 in ± 0.010 in)

l_7 = 12,00 mm ± 0,25 mm (0.472 in ± 0.010 in)

In the write-inhibit position the flat surface of the write-inhibit mechanism shall be behind this window at a distance

l_8 = 2,55 mm min. (0.100 4 in min.)

from the front side of the case.

In the write-enable position this surface shall be within 0,25 mm (0,010 in) of the front side of the case.

The force required for the operation of the write-inhibit mechanism shall be in the range

2 N to 9 N (0.45 lbf to 2.02 lbf)

when applied tangentially to the surface of the case.

3.1.3 Label area of the rear side (figures 5 and 6)

On the rear side of the case there shall be a label area specified by

l_9 = 7,00 mm ± 0,25 mm (0.276 in ± 0,010 in)

l_{10} = 80,00 mm $^{+0,30}_{-0,16}$ mm $\left(3.149 \text{ 6 in } ^{+0.011\ 8}_{-0.006\ 3} \text{ in}\right)$

l_{11} = 12,30 mm ± 0,25 mm (0.484 in ± 0.010 in)

l_{12} = 0,50 mm ± 0,25 mm (0.020 in ± 0.010 in)

r_4 = 1,00 mm max. (0.039 4 in max.)

3.1.4 Label area of the top side (figure 5)

On the top side of the case there shall be a label area, recessed by 0,50 mm ± 0,25 mm (0.020 in ± 0.010 in), specified by l_9, l_{10}, l_{12} and in addition by

l_{13} = 31,00 mm ± 0,25 mm (1.220 in ± 0.010 in)

$l_{14} = 75{,}00 \text{ mm } ^{+0{,}30}_{-0{,}16} \text{ mm } \left(2.952\,8 \text{ in } ^{+0.011\,8}_{-0.006\,3} \text{ in}\right)$

3.1.5 Case opening (figures 4, 5, 7 and 9)

The case shall have an opening for the tape in which the leader block can be inserted (see also figure 17). This opening shall be specified by

l_{15} = 4,70 mm ± 0,25 mm (0.185 in ± 0.010 in)

l_{16} = 14,90 mm ± 0,32 mm (0.587 in ± 0.013 in)

l_{17} = 7,50 mm ± 0,25 mm (0.295 in ± 0.010 in)

l_{18} = 87,10 mm ± 0,25 mm (3.429 in ± 0.010 in)

l_{19} = 4,00 mm ± 0,25 mm (0.157 in ± 0.010 in)

r_5 = 4,00 mm ± 0,25 mm (0.157 in ± 0.010 in)

α = 50° ± 1°

Figure 9 shows at a larger scale the details of the configuration of the case opening as seen at the right-hand side of figure 4.

l_{61} = 3,9 mm ± 0,5 mm (0.154 in ± 0.020 in)

$l_{62} = 16{,}9 \text{ mm } ^{+0{,}5}_{-0{,}4} \text{ mm } \left(0.665 \text{ in } ^{+0.020}_{-0.016} \text{ in}\right)$

l_{63} = 3,0 mm ± 0,5 mm (0.118 in ± 0.020 in)

l_{64} = 11,6 mm ± 0,5 mm (0.457 in ± 0.020 in)

ω_1 = 1° ± 30′

ω_2 = 20° ± 2°

3.1.6 Locating notches (figures 7, 8 and 10)

There shall be two locating notches open towards the bottom side. These location notches shall be specified by

l_{20} = 106,00 mm ± 0,25 mm (4.173 in ± 0.010 in)

l_{21} = 5,00 mm ± 0,25 mm (0.197 in ± 0.010 in)

l_{22} = 7,00 mm ± 0,25 mm (0.276 in ± 0.010 in)

l_{23} = 104,00 mm ± 0,25 mm (4.094 in ± 0.010 in)

l_{24} = 2,50 mm ± 0,25 mm (0.098 in ± 0.010 in)

β = 1° 30′ ± 30′

γ = 2° ± 30′

3.1.7 Locating areas (figure 7)

The bottom side of the case shall have three circular locating areas a_1, a_2 and a_3 which shall lie in the same horizontal plane within 0,25 mm (0.010 in).

Areas a_1 and a_2 shall have a diameter of 10,00 mm ± 0,25 mm (0.394 in ± 0.010 in). The positions of their centres shall be specified by

l_{25} = 108,50 mm ± 0,25 mm (4.272 in ± 0.010 in)

l_{26} = 3,50 mm ± 0,25 mm (0.138 in ± 0.010 in)

l_{27} = 105,50 mm ± 0,25 mm (4.154 in ± 0.010 in)

Area a_3 shall have a diameter of 14,00 mm ± 0,25 mm (0.551 in ± 0.010 in). The position of its centre shall be specified by

l_{28} = 31,25 mm ± 0,25 mm (1.230 in ± 0.010 in)

l_{29} = 54,50 mm ± 0,25 mm (2.146 in ± 0.010 in)

3.1.8 Inside configuration of the case around the case opening (figures 7 and 11)

Figures 7 and 11 show the inside configuration of the case around the opening of the case. This configuration shall be defined as follows (see also 3.1.10)

l_{30} = 3,30 mm ± 0,25 mm (0.130 in ± 0.010 in)

l_{31} = 18,40 mm ± 0,25 mm (0.724 in ± 0.010 in)

r_6 = 1,50 mm ± 0,25 mm (0.059 in ± 0.010 in)

r_7 = 1,50 mm ± 0,25 mm (0.059 in ± 0.010 in)

The oblique edge of the cae shall be tangential to the arc of circle defined by r_6 at an angle of

λ = 40° ± 30′

3.1.9 Other external dimensions of the case (figure 8)

The external form of the case shall be further specified by

l_{32} = 113,2 mm ± 0,3 mm (4.457 in ± 0.012 in)

l_{33} = 26,00 mm ± 0,25 mm (1.024 in ± 0.010 in)

r_8 = 145,50 mm ± 0,25 mm (5.728 in ± 0.010 in)

r_9 = 145,50 mm ± 0,25 mm (5.728 in ± 0.010 in)

δ = 30° ± 30′

3.1.10 Central window (figure 7)

The bottom side of the case shall have a central window. The location of its centre shall be specified by l_{29} and

l_{34} = 61,00 mm ± 0,25 mm (2.402 in ± 0.010 in)

Its diameter shall be

$d_1 = 43{,}5 \text{ mm } ^{+2{,}0}_{-1{,}0} \text{ mm } \left(1.713 \text{ in } ^{+0.079}_{-0.039} \text{ in}\right)$

The angle with its apex at the centre of this window and formed by the two lines tangential to the parts shown in figure 7 in cross-section shall be

θ = 16° ± 30′

3.1.11 Stacking ribs

The bottom side of the case shall have two parallel stacking ribs. Their dimensions shall be

l_{35} = 5,00 mm ± 0,25 mm (0.197 in ± 0.010 in)

l_{36} = 1,00 mm ± 0,16 mm (0.039 4 in ± 0.006 3 in)

l_{37} = 74,50 mm ± 0,25 mm (2.933 in ± 0.010 in)

Their locations shall be

l_{38} = 31,00 mm ± 0,25 mm (1.220 in ± 0.010 in)

l_{39} = 7,50 mm ± 0,32 mm (0.295 in ± 0.013 in)

l_{40} = 79,50 mm ± 0,25 mm (3.130 in ± 0.010 in)

3.1.12 Flexibility of the case

The flexibility of the top and bottom sides of the case (see figure 3) is the amount of deflection observed when they are submitted to a perpendicular force F.

3.1.12.1 Requirements

The amount of deflection d shall meet the following requirements:

Deflection of the top side:

$0{,}025\,6\,F \leqslant d \leqslant 0{,}38 + 0{,}054\,F$ ($0.004\,5\,F \leqslant d \leqslant 0.015 + 0.095\,F$)

Deflection of the bottom side:

$0{,}022\,8\,F \leqslant d \leqslant 0{,}38 + 0{,}040\,F$ ($0.004\,0\,F \leqslant d \leqslant 0.015 + 0.007\,0\,F$)

where

d is the measured deflection in millimetres (inches) 4,5 N $< F <$ 54,0 N (1.0 lbf $\leqslant F <$ 12,1 lbf)

3.1.12.2 Procedure

Measure the flexibility of the case in a universal testing machine operating in the compression mode. Use a suitable load cell for the test. Apply a single point load with a radius of 10 mm ± 1 mm (0.394 in ± 0.039 in) on the bottom and subsequently on the top of the cartridge at the points shown in figures 5 and 7, and specified by

l_{65} = 86,9 mm nom. (3.421 in nom.)

l_{66} = 54,5 mm nom. (2.146 in nom.)

3.1.13 Tape reel (figures 12 and 13)

Figures 12 and 13 show the tape reel mounted within the case. Figure 12 specifies the different dimensions of the reel when the cartridge is in hand, figure 13 when it is within the drive. For clarity the stacking ribs are not shown in figures 12 and 13.

3.1.13.1 Locking mechanism (figure 13)

This International Standard does not specify the actual implementation of the locking mechanism. However, functionally it shall satisfy the following requirements in the locked position:

— the angular resolution shall not be greater than 6°;

— the reel shall not rotate by more than 10° when a torque not greater than 0,32 N·m (2.83 lbf·in) is applied in the direction that will cause the tape to unwind.

The button of the locking mechanism shall be made of nylon 6/6 with 2 % ± 1 % molybdenum disulphide.

Its dimensions shall be

d_9 = 2,0 mm ± 0,5 mm (0.079 in ± 0.020 in)

d_{10} = 10,0 mm ± 0,2 mm (0.393 7 in ± 0.007 9 in)

ϱ = 15° ± 2°

3.1.13.2 Axis of rotation of the reel

The axis of rotation of the reel shall be perpendicular to plane P (see 3.13.7) and pass through the centre of the central window as specified by l_{29} and l_{34}.

3.1.13.3 Metallic insert

The reel shall have a metallic insert made of stainless steel (ISO 683-13, type 3 or 7). It shall withstand a pull out force of 300 N min. (67.4 lbf min.). Its dimensions shall be

$d_2 = 35{,}00 \text{ mm} ^{+0{,}20}_{-1{,}20} \text{ mm} \left(1.378 \text{ in} ^{+0.008}_{-0.047} \text{ in}\right)$

d_3 = 11,15 mm ± 0,05 mm (0.439 0 in ± 0.002 0 in)

e_1 = 1,51 mm ± 0,10 mm (0.059 in ± 0.004 in)

Its central opening (diameter d_3) shall be concentric with the axis of rotation of the reel within 0,15 mm (0.006 in).

The metallic insert shall be parallel to plane P within 0,15 mm (0.006 in).

3.1.13.4 Toothed rim

The reel shall have a toothed rim accessible through the central window. Its dimensions shall be

$d_4 = 36{,}00 \text{ mm} ^{+0{,}50}_{-0{,}00} \text{ mm} \left(1.417 \text{ in} ^{+0.020}_{-0.000} \text{ in}\right)$

d_5 = 41,00 mm ± 0,25 mm (1.614 in ± 0.010 in)

Ψ = 11° 3′ ± 5′

3.1.13.5 Hub of the reel

The hub of the reel shall have a diameter

$d_6 = 50{,}0 \text{ mm} ^{+0{,}0}_{-0{,}2} \text{ mm} \left(1.968\,5 \text{ in} ^{+0.000\,0}_{-0.007\,9} \text{ in}\right)$

Further dimensions of the hub shall be

l_{41} = 13,05 mm $^{+0,20}_{-0,10}$ mm $\left(0.513\ 8 \text{ in } ^{+0.007\ 9}_{-0.004\ 0} \text{ in}\right)$

when measured at the hub surface, and

r_{10} = 0,08 mm max. (0.003 1 in max.)

The hub shall meet the following requirements:

— the straightness of the hub surface shall be within 0,04 mm (0.001 57 in);

— the perpendicularity to the plane P through the pitch line of the teeth of the rim (see 3.13.7) shall be within 0,07 mm (0.002 76 in);

— the ratio of the difference in the diameters d_6 of any two sections (perpendicular to the axis) to the distance between these sections shall not exceed 0,003 8;

— the rate of change across the width of the hub surface shall not exceed 0,025 mm/mm (0.001 in per 0.039 4 in);

— the total runout of the hub related to the cylinder perpendicular to the circular pitch line (see 3.13.7) of the teeth of the toothed rim shall not exceed 0,2 mm (0.008 in) total indicator reading (TIR).

3.1.13.6 Relative positions

3.1.13.6.1 With the cartridge in hand (figure 12)

— the distance of the tip of the button of the locking mechanism to the reference surface C shall be

l_{42} = 1,90 mm $^{+1,40}_{-0,90}$ mm $\left(0.075 \text{ in } ^{+0.055}_{-0.035} \text{ in}\right)$

— the distance from the bottom surface of the metallic insert to the reference surface C shall be

l_{43} = 0,4 mm $^{+1,0}_{-0,5}$ mm $\left(0.016 \text{ in } ^{+0.039}_{-0.020} \text{ in}\right)$

3.1.13.6.2 Whether the cartridge is in hand or in the drive (figures 12 and 13)

— the distance from the bottom surface of the metallic insert to plane P shall be

l_{44} = 2,27 mm ± 0,12 mm (0.089 4 in ± 0.004 7 in)

— the distance of the inside of the lower flange of the reel to plane P shall be

l_{45} = 0,65 mm ± 0,09 mm (0.025 6 in ± 0.003 5 in)

3.1.13.6.3 With the cartridge in the drive (figure 13)

— the distance from the tip of the button of the locking mechanism to the reference surface C shall be

l_{46} = 8,1 mm ± 0,2 mm (0.318 9 in ± 0.007 9 in)

— the force required to move the button into this position shall not exceed 12,25 N (2.75 lbf)

— the distance from the centreline of the tape to the reference surface C shall be

l_{47} = 12,25 mm nom. (0.482 in nom.)

— the distance from the reference surface C to plane P (see 3.14.7) shall be

l_{60} = 5,04 mm ± 0,20 mm (0.198 4 in ± 0.007 9 in)

3.1.13.7 Characteristics of the toothed rim (figure 14)

The toothed rim shall comprise 60 teeth spaced at an angle of

6° ± 5′ non-cumulative

The teeth are specified at the pitch diameter d_5 by

l_{48} = 4 mm nom. (0.157 5 in nom.)

l_{49} = 2 mm nom. (0.078 7 in nom.)

φ = 30° nom.

The pitch line is the circumference of the teeth taken at the distance l_{49}. The plane in which it lies is the plane P.

The blend radius at the bottom of the teeth shall be

r_{11} = 0,25 mm max. (0.009 8 in max.)

The blend radius at the tip of the teeth shall be

0,10 mm $\leqslant r_{12} \leqslant$ 0,30 mm (0.003 9 in $\leqslant r_{12} \leqslant$ 0.011 8 in)

3.1.14 Leader block (figure 15)

The leader block shall have the following dimensions:

l_{50} = 31,80 mm ± 0,04 mm (1.252 0 in ± 0.001 6 in)

l_{51} = 6,8 mm ± 0,1 mm (0.267 7 in ± 0.003 9 in)

l_{52} = 21,8 mm ± 0,2 mm (0.858 3 in ± 0.007 9 in)

l_{53} = 10,93 mm $^{+0,06}_{-0,08}$ mm $\left(0.430\ 3 \text{ in } ^{+0.002\ 4}_{-0.003\ 1} \text{ in}\right)$

l_{54} = 5,46 mm ± 0,10 mm (0.215 0 in ± 0.003 9 in)

l_{55} = 6,00 mm ± 0,25 mm (0.236 in ± 0.010 in)

l_{56} = 16,5 mm $^{+0,0}_{-0,2}$ mm $\left(0.649\ 6 \text{ in } ^{+0.000\ 0}_{-0.007\ 9} \text{ in}\right)$

l_{57} = 5,2 mm ± 0,2 mm (0.204 7 in ± 0.007 9 in)

r_{13} = 25,00 mm ± 0,25 mm (0.984 in ± 0.010 in)

r_{14} = 1,4 mm ± 0,2 mm (0.055 1 in ± 0.007 9 in)

r_{15} = 5,50 mm ± 0,25 mm (0.217 in ± 0.010 in)

d_7 = 7,0 mm ± 0,2 mm (0.275 6 in ± 0.007 9 in)

d_8 = 4,0 mm ± 0,2 mm (0.157 5 in ± 0.007 9 in)

μ_1 = 90° ± 2°

μ_2 = 8° $^{+0°}_{-3°}$

μ_3 = 44° $^{+0°}_{-3°}$

3.1.15 Attachment of the tape to the leader block (figure 16)

There shall be a cylindrical insert for attaching the tape to the leader block. It shall cover the full width of the tape and not protrude beyond the surfaces of the leader block.

In zone Z the bottom edge of the tape (as seen in figure 16) shall be parallel to the edge of the leader block within 0,12 mm and shall be at a distance

l_{58} = 1,90 mm ± 0,26 mm (0.075 in ± 0.010 in)

from it, when measured while the tape is under tension.

When fixed to the leader block the end of the tape shall not protrude above the surface of the leader block by more than

l_{59} = 2,5 mm (0.10 in)

The leader block shall remain attached to the tape when a force of 10 N (2,25 lbf) is applied at an angle

μ_4 = 38° ± 2°

as shown in figure 16.

3.1.16 Latching mechanism (figure 17)

This International Standard does not specify the actual implementation of the latching mechanism for the leader block. It specifies the position of the leader block and the forces required to pull out and to insert it.

When the leader block is latched into the case, the point defined by l_{51} and l_{54} (see figure 15) shall fall within a circle of radius 0,5 mm max. (0.02 in max.) the centre of which is defined by the intersection of the two lines specified by the nominal values of l_{17} and l_{18} (see figure 5).

The pull-out force, i.e. the force required to pull the leader block and the tape attached to it out of the cartridge shall satisfy both of the following conditions:

- to be in the range 2,0 N to 7,5 N (0.45 lbf to 1.69 lbf), and
- the product of the maximum value of the pull-out force and the displacement distance shall be less than 13 N·mm (0.115 lbf·in).

The insertion force shall be measured at the same angle and jaw separation speed as the pull-out force.

Procedure: Clamp the cartridge in a universal testing machine that can extract the leader block at the angle μ_5 starting at the pickup point (see figure 17). The leader block pickup point is located by the intersection of the centre lines positioned by dimensions l_{17}, l_{18}. Set the jaw separation speed to 10 mm/min (0.4 in/min), pull the leader block allowing it to pivot on the pulling pin as it exits the cartridge. Measure the distance between the point where the force first exceeds 0,5 N (0.112 lbf) and the point where the maximum pull-out force is observed. The force shall be measured with a pin that fits into diameters d_7 and d_8 (see figure 15).

The insertion force, i.e. the force required to push the leader block into the latched position in the cartridge, shall not be greater than 12 N when measured at an angle

μ_5 = 48° ± 3°.

3.1.17 Tape wind

When the cartridge is viewed from the top, the tape shall be wound counter-clockwise and with the recording surface towards the hub.

3.1.18 Wind tension

The tape shall be wound with a tension of

2,2 N ± 0,3 N (7.9 ozf ± 1.1 ozf)

3.1.19 Circumference of the tape reel

The tape shall be wound to a circumference of between 280 mm and 307 mm (11.02 in and 12.09 in).

3.1.20 Moment of inertia

The moment of inertia of the tape reel is the ratio of the torque applied to it (complete with tape, hub and flanges) when it is free to rotate about a given axis to the angular acceleration thus produced about that axis.

The moment of inertia of the reel and tape shall be

- between 145×10^{-6} kg·m^2 (0.495 lb·in^2) and 180×10^{-6} kg·m^2 (0.615 lb·in^2) when the circumference is not less than 280 mm (11.02 in) but less than 289 mm (11.38 in);
- between 160×10^{-6} kg·m^2 (0.547 lb·in^2) and 195×10^{-6} kg·m^2 (0.666 lb·in^2) when the circumference is not less than 289 mm (11.38 in) but less than 298 mm (11.73 in);
- between 180×10^{-6} kg·m^2 (0.615 lb·in^2) and 216×10^{-6} kg·m^2 (0.738 lb·in^2) when the circumference is not less than 298 mm (11.73 in) and not greater than 307 mm (12.09 in);
- the empty reel moment of inertia shall be

$33{,}00 \times 10^{-6}$ kg·m^2 ± $3{,}63 \times 10^{-6}$ kg·m^2 (0.113 lb·in^2 ± 0.012 lb·in^2).

Procedure: Torsionally oscillate the reel on an inertial dynamics unit. The oscillation period shall be measured electronically with a universal counter. The oscillation time shall then be converted to its rotational inertial value.

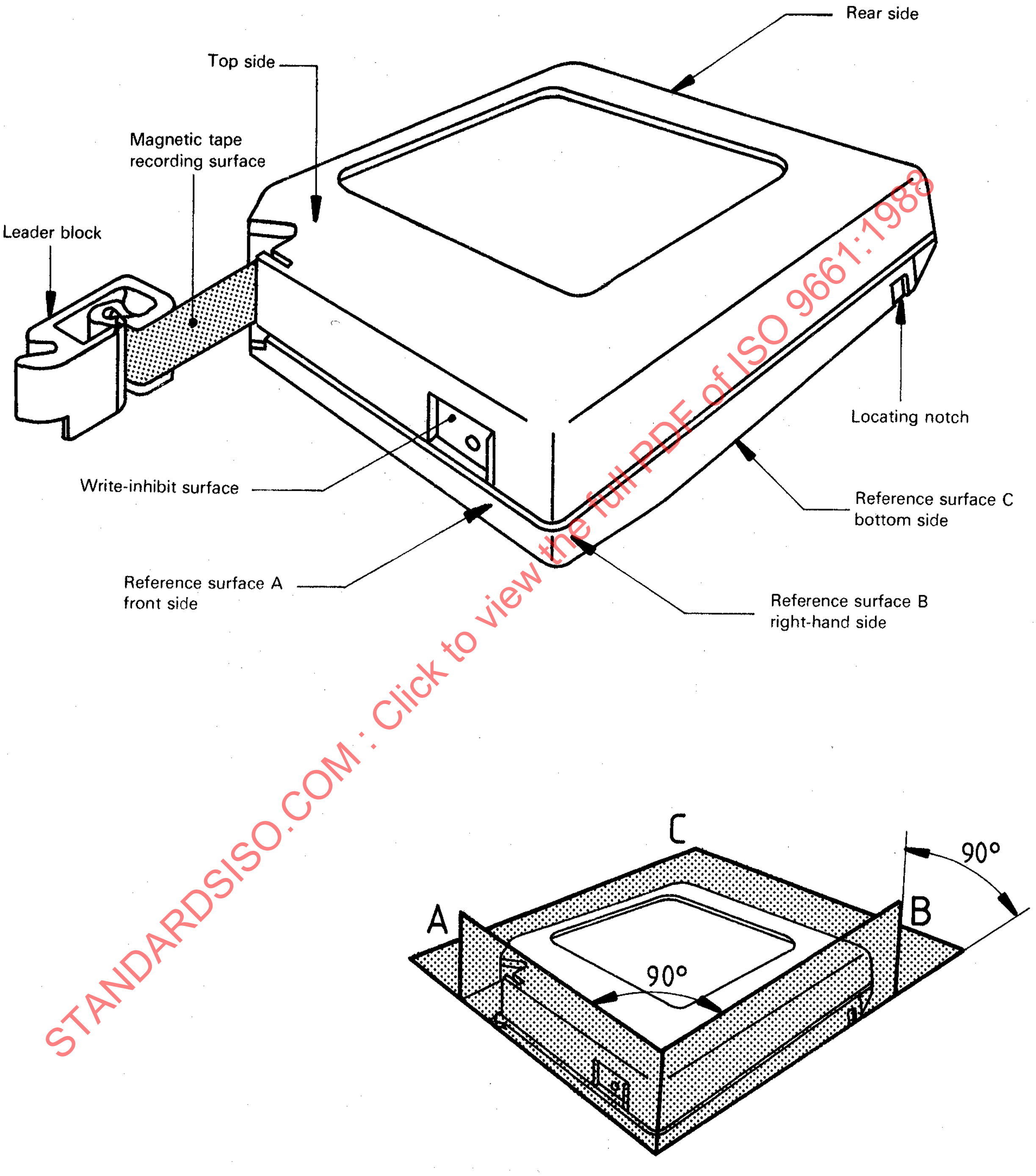


Figure 3 — Cartridge

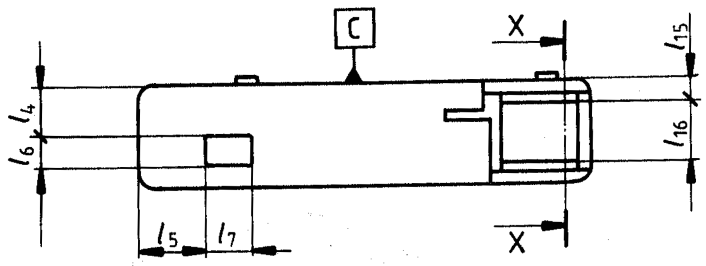


Figure 4 — Front side of case

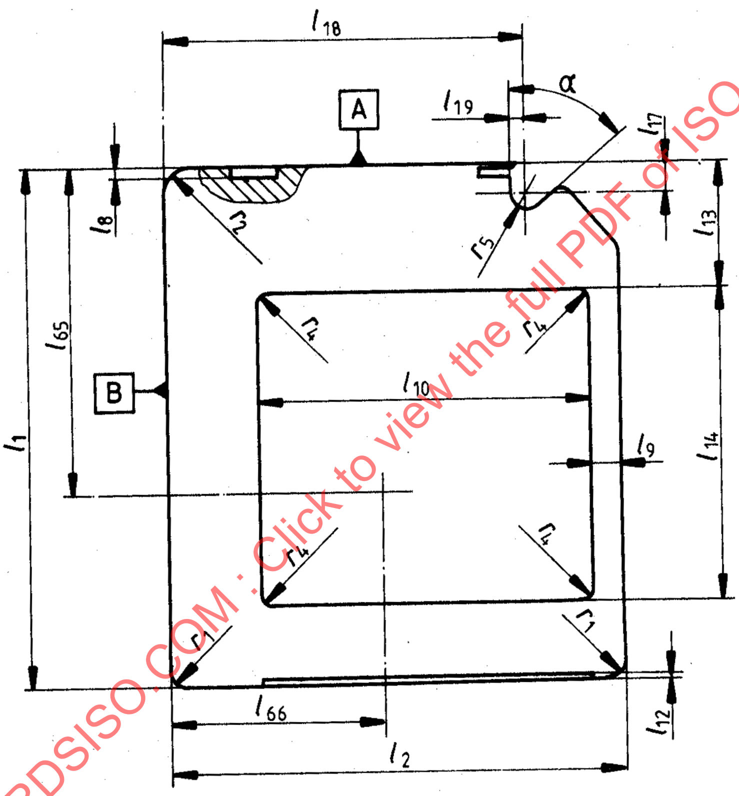


Figure 5 — Top side of case

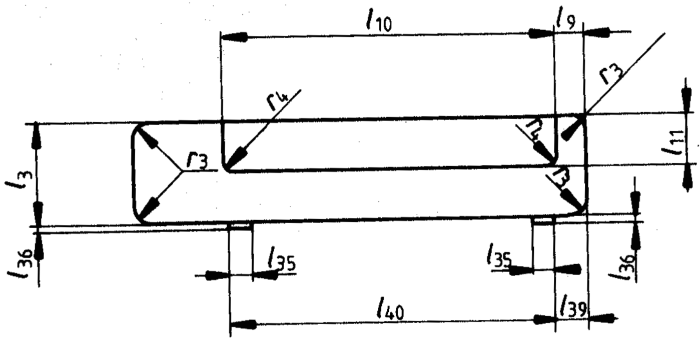


Figure 6 — Rear side of case

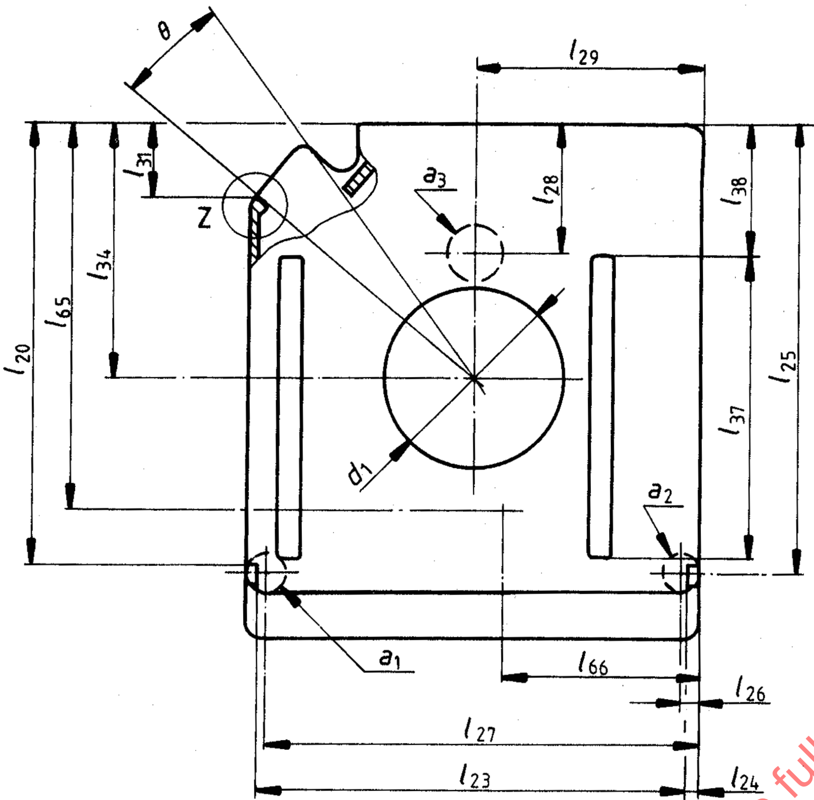


Figure 7 — Bottom side of case

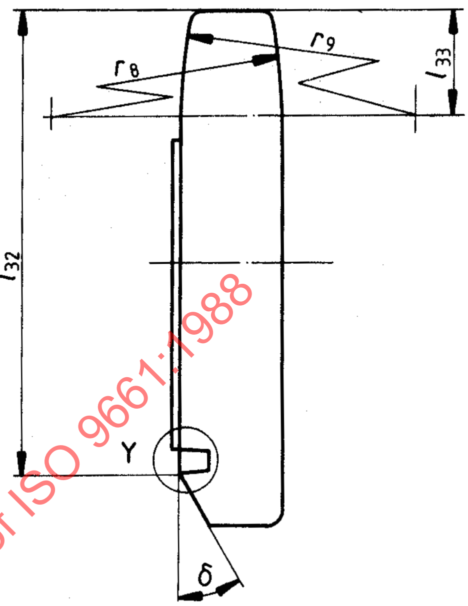


Figure 8 — Side of case

X-X (5:1)

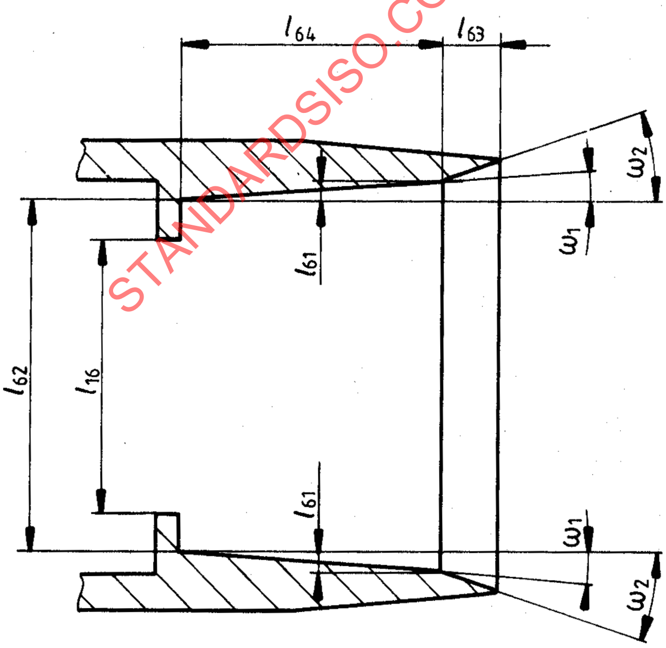


Figure 9 — Enlarged view

Y (5:1)

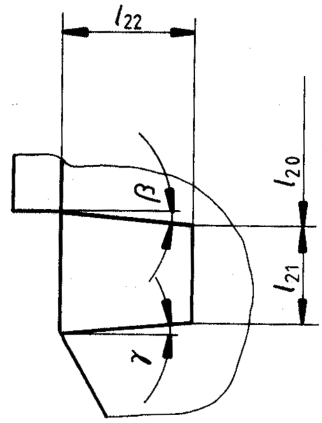


Figure 10 — Cross-section of a location notch

Z (5:1)

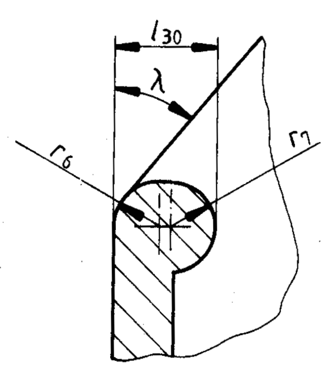


Figure 11 — Cross-section of a detail of the opening of case

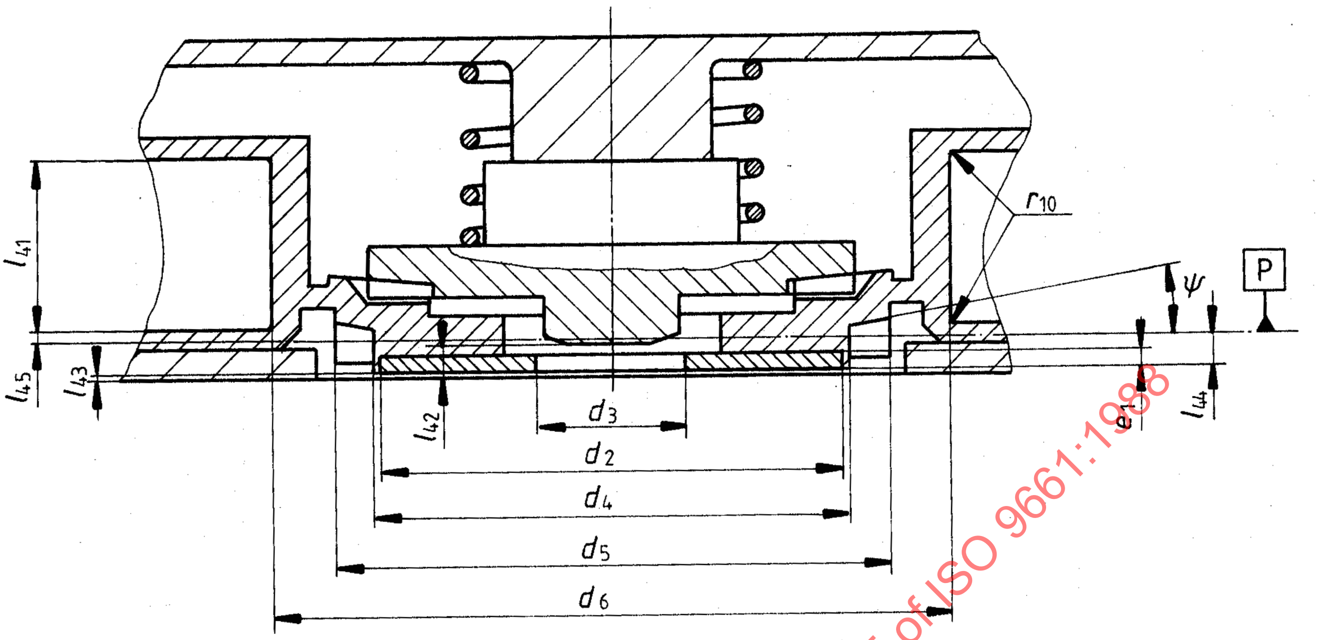


Figure 12 — Cross-section of the cartridge in hand

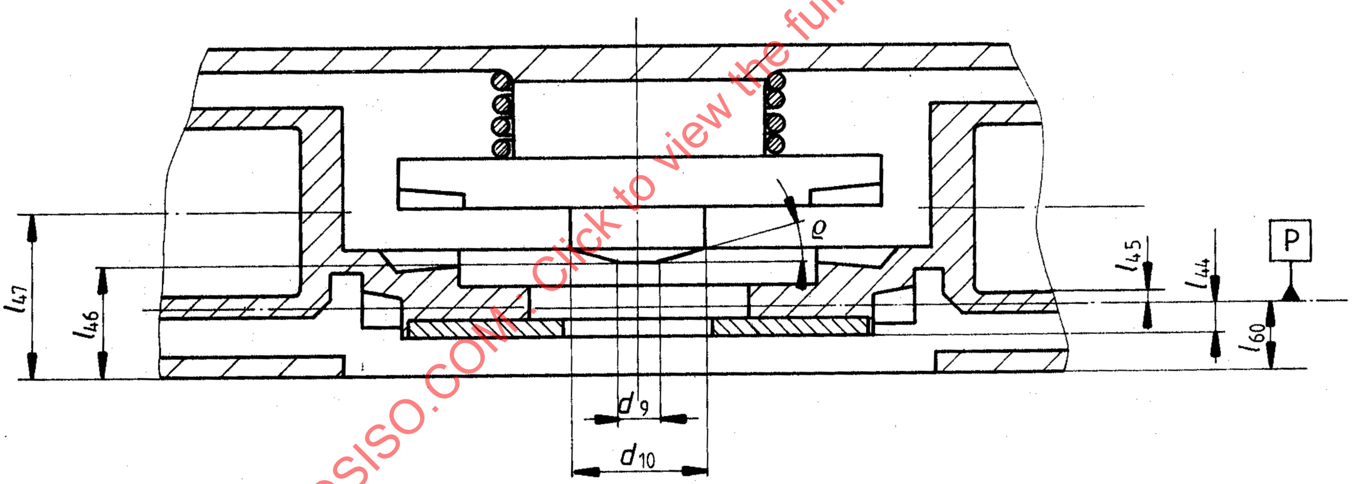


Figure 13 — Cross-section of the cartridge in the drive

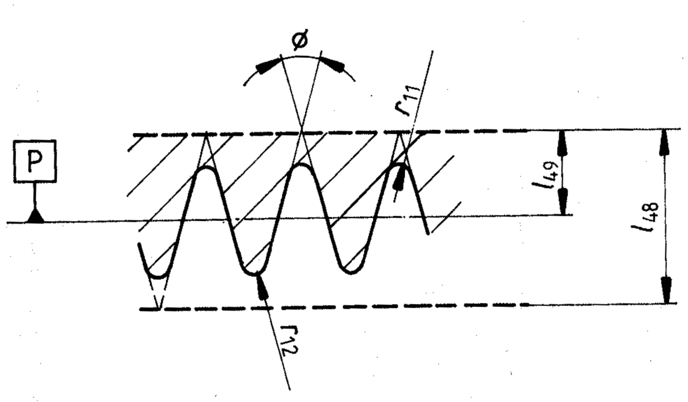


Figure 14 — Teeth of the toothed rim

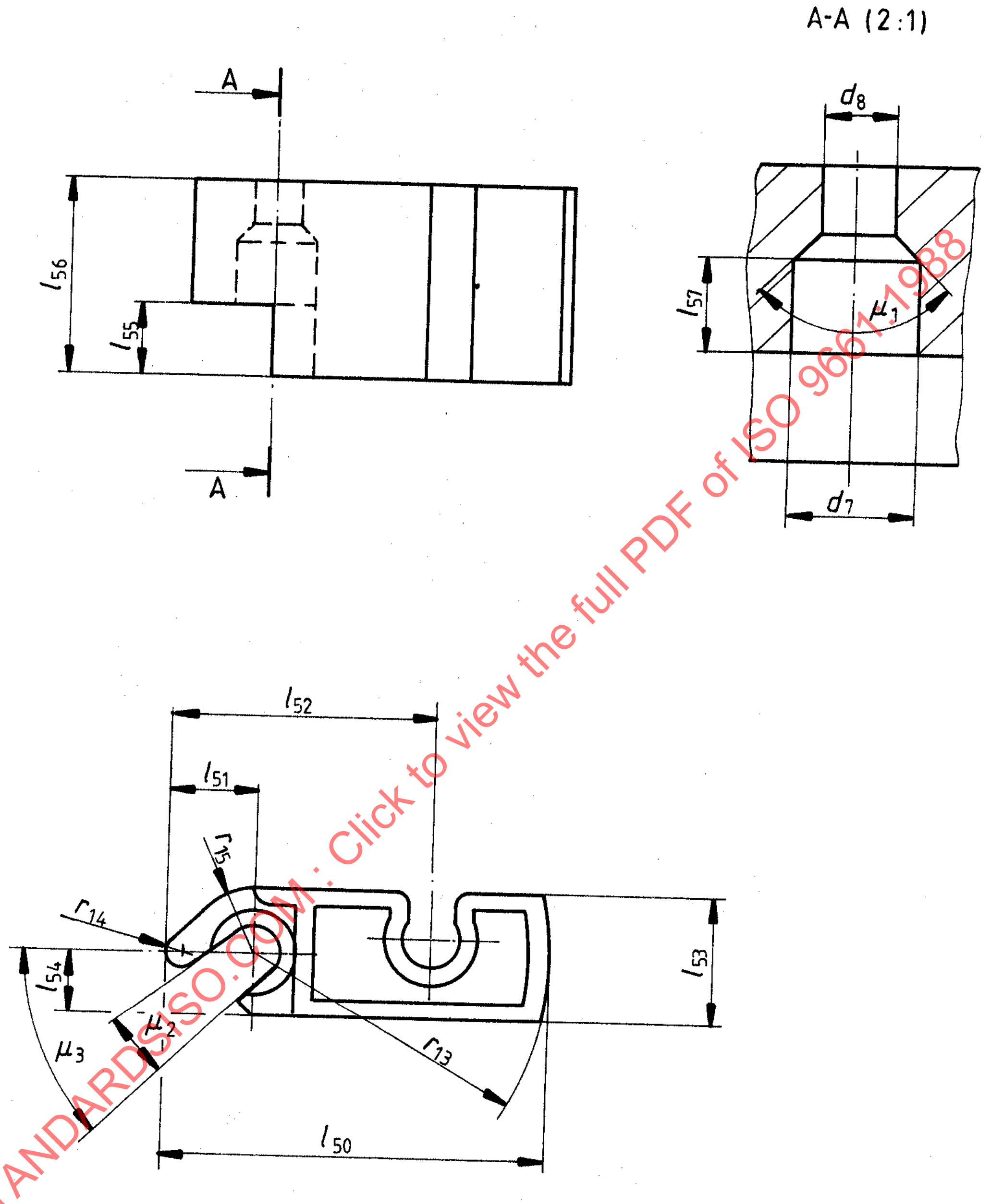


Figure 15 — Cross-section of leader block

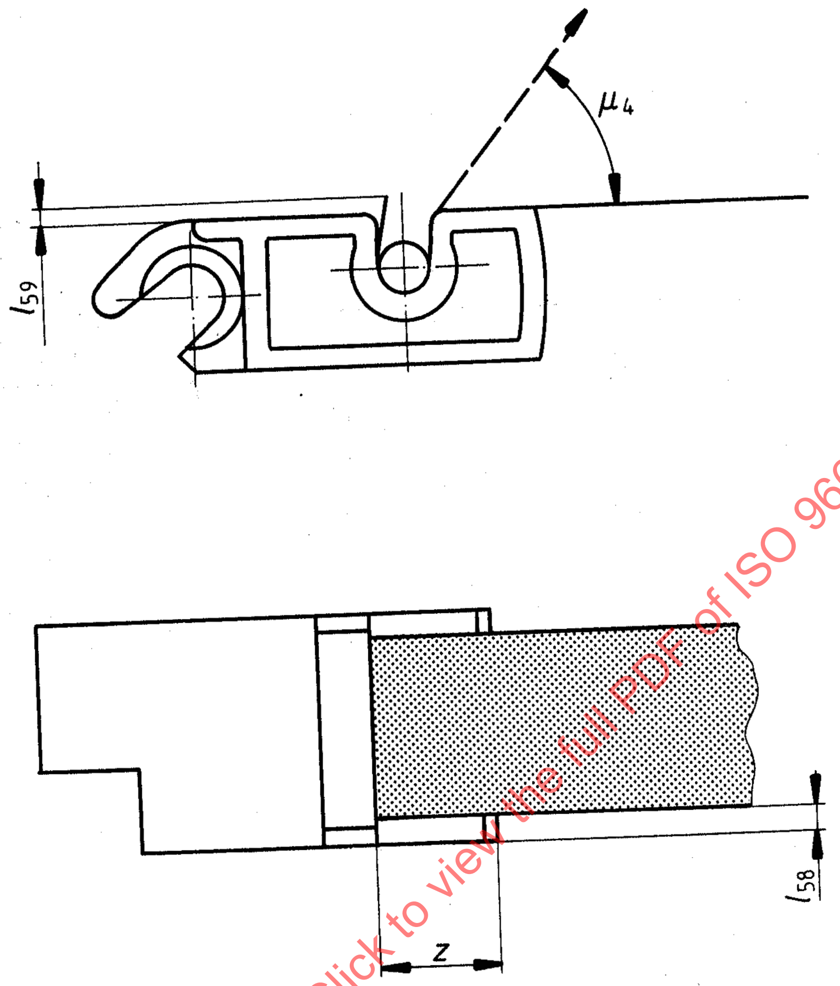


Figure 16 — Fixation of tape to leader block

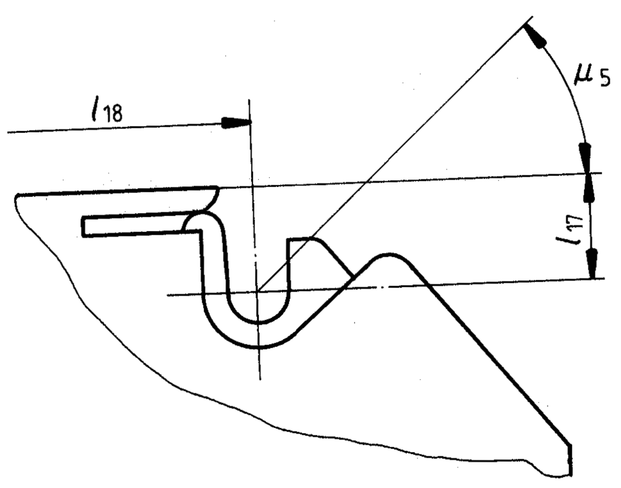


Figure 17 — Leader block in case

Section 4: Recording requirements

4.1 Method of recording

The method of recording shall be as follows:

— a ZERO is represented by a flux transition at the beginning of a bit cell followed by a flux transition at the centre of the bit cell;

— a ONE is represented by a flux transition at the beginning of a bit cell.

4.1.1 Physical recording density

The physical recording density shall be

— for all ZEROs: 1 944 ftpmm (49 378 ftpi)

— for all ONEs: 972 ftpmm (24 689 ftpi)

4.1.2 Bit cell length

The resulting nominal bit cell length is 1,029 µm (40.504 µin).

4.1.3 Average bit cell length

The average bit cell length shall be the sum of *n* bit cell lengths divided by *n*.

4.1.4 Long-term average bit cell length

The long-term average bit cell length shall be the average bit cell length taken over a minimum of 972 000 bit cells. The long-term average bit cell length shall be within ± 4 % of the nominal bit cell length.

4.1.5 Short-term average bit cell length

The short-term average bit cell length (STA) shall be the average bit cell length taken over 16 bit cells. The short-term average bit cell length shall be within ± 7 % of the nominal bit cell length.

4.1.6 Rate of change

The rate of change of the short-term average bit cell length shall not exceed 1,6 %.

4.1.7 Bit shift

The maximum displacement of any ONEs zero crossing, exclusive of missing pulses, shall not deviate by more than 28 % from the expected nominal position as defined by the average bit cell length. See annex G for the test procedure.

4.1.8 Total character skew

No bit belonging to the same written transverse column shall be displaced by more than 19 bit cell lengths when measured in a direction parallel to the Reference Edge (see 4.2.2) of the tape.

4.1.9 Read signal amplitude

The average signal amplitude of an interchanged cartridge averaged over 4 000 flux transitions at 972 ftpmm (24 689 ftpi) shall be between 60 % and 150 % of the Standard Reference Amplitude. Averaging for the interchanged cartridge may be segmented into blocks.

Traceability to the Standard Reference Amplitude is provided by the calibration factors supplied with each Secondary Standard Reference Tape.

4.1.10 Coincident missing pulses

No block shall be recorded over a coincident missing pulse zone (see also 4.4.4).

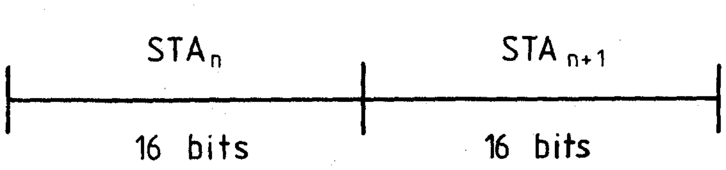
4.2 Track format

4.2.1 Number of tracks

There shall be 18 tracks.

4.2.2 Reference Edge

The Reference Edge of the tape is its bottom edge when viewing the recording surface of the tape with the hub end of the tape to the observer's right (see 4.4.8.2)



$$100 \times \frac{|STA_n - STA_{n+1}|}{STA_n} \leqslant 1,6\ \%$$

Figure 18 — Rate of change

4.2.3 Track positions

The distance from the centrelines of the tracks to the Reference Edge shall be

Track 1 : 11,68 mm (0.459 8 in)
Track 2 : 11,05 mm (0.435 0 in)
Track 3 : 10,42 mm (0.410 2 in)
Track 4 : 9,79 mm (0.385 4 in)
Track 5 : 9,16 mm (0.360 6 in)
Track 6 : 8,53 mm (0.335 8 in)
Track 7 : 7,90 mm (0.311 0 in)
Track 8 : 7,27 mm (0.286 2 in)
Track 9 : 6,64 mm (0.261 4 in)
Track 10: 6,01 mm (0.236 6 in)
Track 11: 5,38 mm (0.211 8 in)
Track 12: 4,75 mm (0.187 0 in)
Track 13: 4,12 mm (0.162 2 in)
Track 14: 3,49 mm (0.137 4 in)
Track 15: 2,86 mm (0.112 6 in)
Track 16: 2,23 mm (0.087 8 in)
Track 17: 1,60 mm (0.063 0 in)
Track 18: 0,97 mm (0.038 2 in)

The tolerance shall be ± 0,04 mm (0.001 6 in) for all tracks.

4.2.4 Track width

The width of a written track shall be 0,540 mm ± 0,017 mm (0.021 26 in ± 0.000 67 in).

4.2.5 Azimuth

On any track the angle that a flux transition across the track makes with a line perpendicular to the Reference Edge shall be not greater than 3′ of arc.

NOTE — At the time of writing the tape, the azimuth should be less than 1′ of arc. The remaining 2′ of arc is the allowance for tape distortion caused by environmental conditions and aging.

4.3 Data format

Prior to recording, the data shall be arranged in groups completed with computed check characters. These data groups shall be in turn arranged in a given sequence together with additional groups of bytes having prescribed bit patterns. The so arranged data bytes and additional bytes shall then be recorded on the tape according to a specific coding scheme.

4.3.1 Types of bytes

4.3.1.1 Data bytes

Data Bytes are 8-bit bytes available for the recording of the information to be interchanged and/or stored.

4.3.1.1.1 Coded Representation of characters in data bytes

Characters shall be represented by means of the 7-bit Coded Character Set (ISO 646) and, where required, by its 7-bit or 8-bit extensions (ISO 2022) or by means of the 8-bit Code (ISO 4873).

a) Recording of 7-bit coded characters

Each 7-bit coded character shall be recorded in bit positions B_1 to B_7 of a byte; bit-position B_8 shall be recorded with ZERO. The relationship shall be as follows:

Table 1 — 7-bit coding

Binary weight	–	64	32	16	8	4	2	1
Bit designation	–	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Bit-positions in the byte	B_8	B_7	B_6	B_5	B_4	B_3	B_2	B_1

b) Recording of 8-bit coded characters

Each 8-bit coded character shall be recorded in bit positions B_1 to B_8 of a byte. The relationship shall be as follows:

Table 2 — 8-bit coding

Binary weight	128	64	32	16	8	4	2	1
Bit designation	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
Bit-positions in the byte	B_8	B_7	B_6	B_5	B_4	B_3	B_2	B_1

NOTE — If each character has a coded representation consisting of one single 7-bit or 8-bit byte, the number of characters is equal to the number of data bytes. Code extension techniques allow multiple-byte representation. In this case the number of characters is equal to the number of data bytes divided by the number of bytes of the coded representation of a single character.

4.3.1.1.2 Representation of binary data in data bytes

When the coding method requires it, the coded reprsentations to be recorded in data bytes shall be regarded as an ordered sequence of bit positions, each containing a bit, which can be either a ZERO or a ONE.

The binary weights, bit designations and bit positions shall be as given in 4.3.1.1.1 a)

4.3.1.2 Pad bytes

Pad bytes are 8-bit bytes having a bit pattern consisting of eight ZEROs.

4.3.1.3 Block-ID bytes

There shall be four 8-bit bytes for the representation of the Block-ID. These four bytes shall follow the last data byte. The 32 bits are numbered from 1 (most significant) to 32 (least significant). These bits shall have the following values:

Bit 1 shall be ZERO.

Bits 2 to 8 shall express in binary notation the value of a Physical Position Indicator. This value shall be rounded up to the next positive integer satisfying the condition

$$1 \leqslant \left[62{,}5 \left(\frac{\sqrt{625 + R_0^2 - R^2}}{R} - \frac{25}{R_0} \right) \right] \leqslant 91$$

where

R_0 is the initial radius of the fully loaded reel of tape;

R is the current radius of the reel of tape.

NOTE — The purpose of the Physical Position Indicator is to provide a coarse, fast indication of the location of the data without having to read the data or all Block-ID bytes.

Bits 9 to 12 shall be ZEROs.

Bits 13 to 32 shall express in binary notation a Count which is increased by 1 for each Data Block (see 4.3.3) and each tape mark (see 4.4.5). The Count is set to 0 for the first Recorded Data Block (see 4.3.6) or Tape Mark following the initial Interblock Gap (see 4.4.3).

These 32 bits shall be assigned to the following positions.

Table 3 — Block-ID bytes

Byte sequence	1	2	3	4
Bits	1 to 8	9 to 16	17 to 24	25 to 32
Bit position in the byte	8 to 1	8 to 1	8 to 1	8 to 1

4.3.2 Frame

A frame shall be a section across all 18 tracks which contain logically related 8-bit bytes, one byte per track. Each byte in a frame is recorded along a track and is represented by a 9-bit pattern (see 4.3.5).

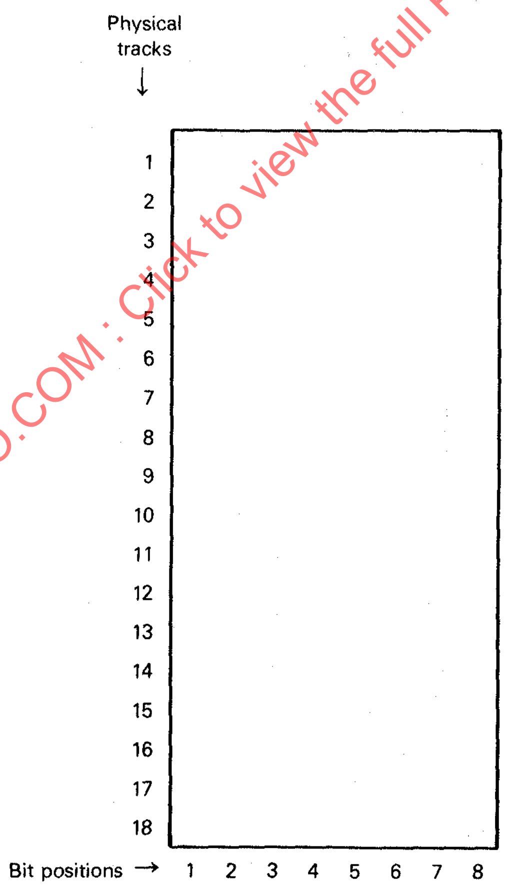


Figure 19 — Frame

4.3.3 Data block

A Data Block shall contain at least 1 and at most 32 768 data bytes.

NOTE — The interchange of cartridges recorded with larger data blocks requires agreement between the interchanging parties.

A Data Block shall have the following structure:

- First 2 frames:
  Prefix
- Further frames up to 2 340 frames grouped in clusters:
  Data Frames
- Next frames, up to 2 frames:
  Residual Frame 1 and Residual Frame 2, or Residual Frame 2 only
- Last 2 frames:
  Suffix.

4.3.3.1 Prefix

The Prefix shall consist of two frames containing pad bytes in each track.

4.3.3.2 Data Frames

Each Data Frame shall consist of

- the first 7 data bytes recorded in odd tracks 1 to 13;
- the next 7 data bytes recorded in even tracks 2 to 14;
- a Diagonal Redundancy Check Byte (DRC-A) recorded in track 15 (see 4.3.4.1 and 4.3.4.3);
- a Vertical Redundancy Check Byte (VRC-A) recorded in track 17 (see 4.3.4.2 and 4.3.4.3);
- a Diagonal Redundancy Check Byte (DRC-B) recorded in track 16 (see 4.3.4.1 and 4.3.4.3);
- a Vertical Redundancy Check Byte (VRC-B) recorded in track 18 (see 4.3.4.2 and 4.3.4.3);

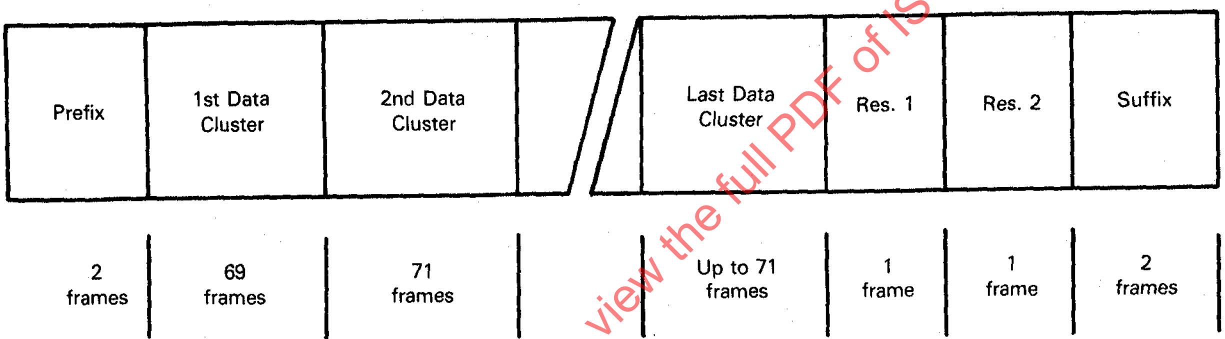


Figure 20 — Data block

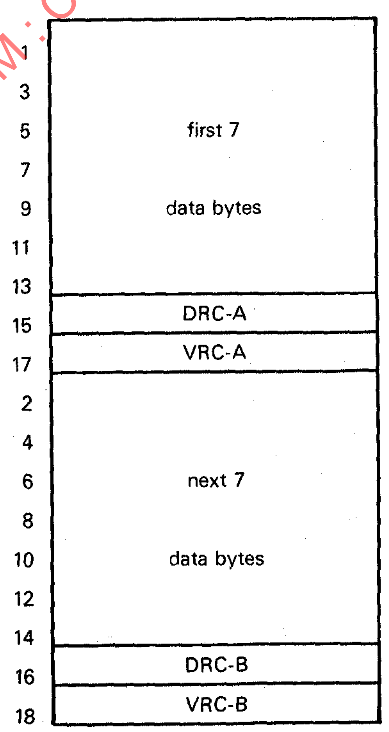


Figure 21 — Data Frame

The Data Frames are grouped in clusters as follows:

— the first cluster shall contain up to 69 frames of data bytes;

— the next clusters, if provided, shall each contain 71 frames of data bytes;

— the last cluster shall contain up to 71 frames of data bytes.

4.3.3.3 Residual Frame 1

If after the last Data Frame of the last Data cluster 8 or 9 data bytes remain to be recorded, there shall be a Residual Frame 1. If the number of remaining data bytes is less than 8 there shall be no Residual Frame 1.

The structure of the Residual Frame 1 shall be

— 8 or 9 data bytes;

— four Block-ID bytes;

— 1 or 2 pad bytes, depending on the number of remaining data bytes;

— in tracks 15 and 17 the DRC-A and the VRC-A, respectively;

— in tracks 16 and 18 the DRC-B and the VRC-B, respectively.

4.3.3.4 Residual Frame 2

If there is no Residual Frame 1, i.e. if there are seven or less remaining data bytes, these data bytes followed by the 4 Block-ID bytes followed by pad bytes shall be recorded in odd tracks 1 to 13 and even tracks 2 to 8. If there are no remaining data bytes, the 4 Block-ID bytes shall be recorded in odd tracks 1 to 7, followed by pad bytes in odd tracks 9 to 13 and even tracks 2 to 8.

If there is a Residual Frame 1, odd tracks 1 to 13 and even tracks 2 to 8 shall be recorded with pad bytes.

In either case

— track 10 shall be recorded with the Residual Byte (see 4.3.3.4.1);

— tracks 12 and 14 with the CRC Byte 1 and the CRC Byte 2, respectively (see 4.3.3.4.2);

— tracks 15 and 17 with the DRC-A and the VRC-A, respectively;

— tracks 16 and 18 with the DRC-B and the VRC-B respectively.

1, 3, 5, 7, 9, 11, 13	7 data bytes
15	DRC-A
17	VRC-A
2	1 data byte
4	1 data or Block ID
6, 8, 10	3 Block ID bytes
12	Block ID or pad
14	1 pad byte
16	DRC-B
18	VRC-B

Figure 22 — Residual Frame 1

1, 3, 5, 7, 9, 11, 13	up to 7 data bytes or up to 4 Block ID or up to 7 pad bytes
15	DRC-A
17	VRC-A
2, 4, 6, 8	up to 4 Block ID or pad bytes
10	Residual Byte
12, 14	2 CRC bytes
16	DRC-B
18	VRC-B

Figure 23 — Residual Frame 2

4.3.3.4.1 Residual Byte

The Residual Byte shall be recorded in track 10 of the Residual Frame 2. Its bits are numbered from 1 (most significant) to 8 (least significant).

Bits 1 and 2 shall be unspecified, they can be a ONE or a ZERO.

Bits 3 and 4 shall be ONEs.

Bits 5 to 8 shall express in binary notation the total number of pad bytes in the Residual Frame(s).

The allocation of bits to the bit positions in the Residual Byte shall be

Bit	1 to 8
Bit position	8 to 1

4.3.3.4.2 Cyclic Redundancy Check Character (CRC)

The 16-bit CRC shall be represented by two bytes recorded in tracks 12 and 14 of the Residual Frame 2. The CRC shall be computed from the generator polynomial.

$$x^{16} + x^{15} + x^8 + x + 1$$

The CRC is computed over the data, the Block-ID and the pad bytes. It does not include the ECC bytes.

The bits of the bytes of the CRC shall be processed starting with bit 1, i.e. the least significant bit and ending with bit 8, i.e. the most significant bit.

NOTE — As this polynomial is symmetrical it yields the same value when read in either direction.

The allocation of bits to bit positions in the two CRC bytes is

Table 4 — CRC bytes

	CRC Byte 1	CRC Byte 2
Bits	9 to 16	1 to 8
Bit position	8 to 1	8 to 1

4.3.3.5 Suffix

The Suffix shall consist of two frames containing

- in odd tracks 1 to 13 : pad bytes
- in track 15 : DRC-A
- in track 17 : VRC-A
- in even tracks 2 to 14 : pad bytes
- in track 16 : DRC-B
- in track 18 : VRC-B

4.3.4 Error Correcting Code (ECC)

The error correcting code yields the following check bits:

- the Diagonal Redundancy Check (DRC)
- the Vertical Redundancy Check (VRC).

Computation of the DRCs and VRCs starts with the Prefix and ends with the Suffix.

In 4.3.4.1 and 4.3.4.2 the following notation is used:

Tn_m = the mth bit of the nth track

4.3.4.1 Diagonal Redundancy Check (DRC)

The two DRCs shall be recorded in tracks 15 and 16, respectively. The bits in each of these tracks shall be computed from the bits in all other tracks, except tracks 17 and 18. The mth bit in each of these tracks is specified by

$$m\text{th bit of track 15} = \left\{ \sum_{n=0}^{6} T(2n+1)_{m-n-1} + \sum_{n=1}^{8} T(2n)_{m-n-7} \right\} \text{(modulo 2)}$$

$$m\text{th bit of track 16} = \left\{ \sum_{n=0}^{6} T(2n+1)_{m+n+14} + T(15)_{m-15} + \sum_{n=1}^{7} T(2n)_{m+n-8} \right\} \text{(modulo 2)}$$

4.3.4.2 Vertical Redundancy Check (VRC)

The two VRCs shall be recorded in tracks 17 and 18, respectively. The bits in each of these tracks shall be computed from the bits of the eight other tracks having the same index parity. The mth bit in each of these tracks is specified by

$$m\text{th bit of track 17} = \left\{ \sum_{n=0}^{7} T(2n+1)_m \right\} \text{(modulo 2)}$$

$$m\text{th bit of track 18} = \left\{ \sum_{n=1}^{8} T(2n)_m \right\} \text{(modulo 2)}$$

4.3.4.3 ECC Format

In each frame the eight bits of each DRC and each VRC shall be considered as 8-bit Check Bytes.

4.3.4.4 Summary of ECC*

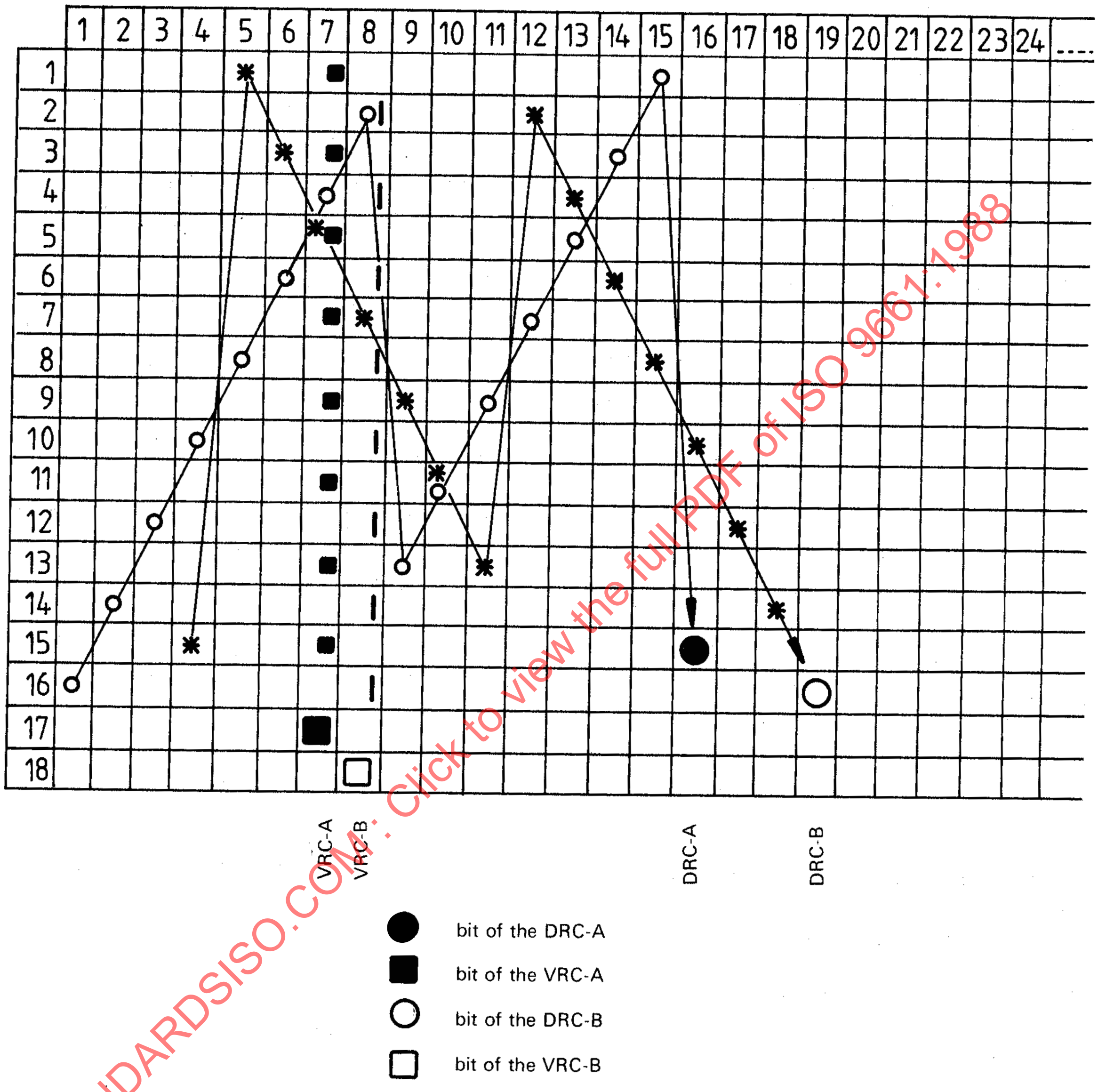


Figure 24 — Summary of ECC

* For a complete description of this ECC scheme, see A.M. PATEL: Adaptive cross parity (AXP) code for a high-density magnetic tape subsystem, in *IBM Journal of Research and Development*. Vol. 29, No. 6 of November 1985.

4.3.5 Recording of 8-bit bytes on the tape

Each 8-bit byte in the Prefix, in the Data Frames, in the Residual Frame(s) and in the Suffix shall be represented by a 9-bit pattern on the tape.

Annex F specifies the 9-bit pattern representing each 8-bit byte. The bit of the 9-bit pattern in the lowest bit position shall be recorded first.

4.3.6 Recorded Data Block

When recorded on the tape each Data Block shall have the following structure and be called a Recorded Data Block.

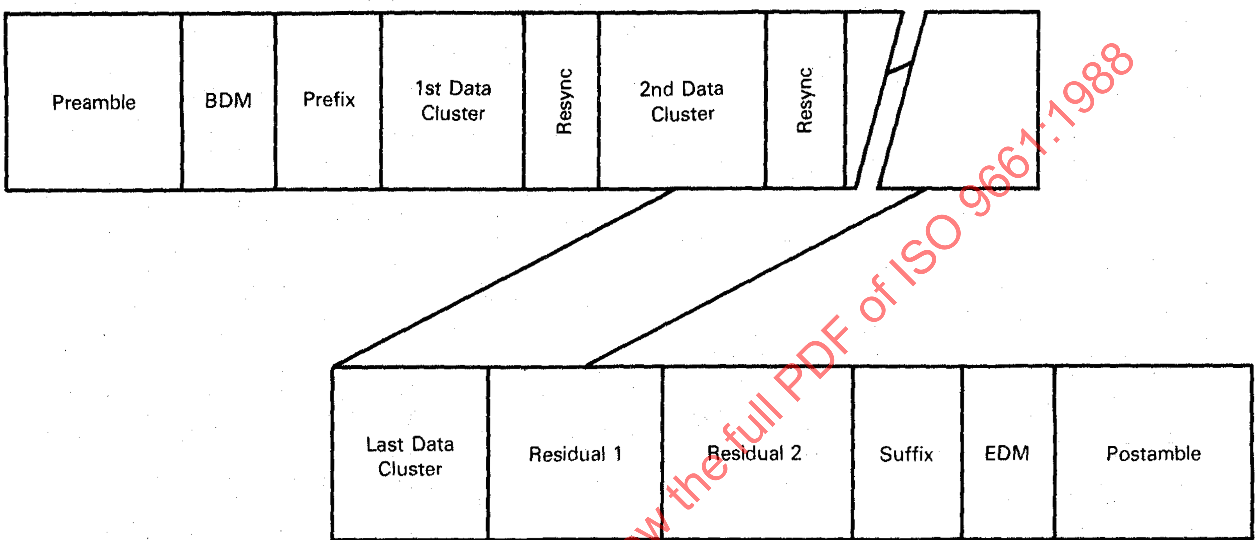


Figure 25 — Recorded Data Block

4.3.6.1 Preamble

The Preamble shall consist of between nine and 13 frames recorded with the 9-bit pattern 111111111 in all tracks.

4.3.6.2 Beginning of Data Mark (BDM)

The BDM shall consist of two frames recorded with the 9-bit pattern 100010001 in all tracks.

4.3.6.3 Resync Control Frame

A Resync Control Frame shall have the 9-bit pattern 100010001 in all tracks. A Resync Control Frame shall be recorded after each 71 frames starting with the Prefix frames. If the Resync Control Frame would immediately precede the EDM, it shall not be recorded.

4.3.6.4 End of Data Mark (EDM)

The EDM shall consist of two frames recorded with the 9-bit pattern 100010001 in all tracks.

4.3.6.5 Postamble

The Postamble shall consist of between nine and 13 frames recorded with the 9-bit pattern 111111111 in all tracks.

4.3.7 Data density

Due to the ECC bytes, the 8-bit to 9-bit conversion and to the Resync Control Frames the maximum density of data bytes is

$$14 \times 972 \times \frac{1}{8} \times \frac{8}{9} \times \frac{71}{72} = 1\,491 \text{ data bytes per millimetre (37 871 data bytes per inch)}$$

where

14 is the number of data bytes per frame;

972 is the number of flux transitions per millimetre for the all ONEs density (24 689 ftpi);

$\frac{1}{8}$ is the inverse value of the number of bits per byte;

$\frac{8}{9}$ corresponds to the recording scheme of 4.3.5;

$\frac{71}{72}$ corresponds to the Resync Control Frames.

4.4 Tape format

The format of the tape is defined by the following control blocks separating and/or qualifying the Recorded Data Blocks.

- the Density Identification Burst;
- the ID Separator Burst;
- Interblock Gaps;
- Erase Gaps;
- Tape Marks.

The five control blocks have the following recording characteristics:

a) the 18 tracks are divided into six zones

- zone A : tracks 1, 7, 13
- zone B : tracks 2, 8, 14
- zone C : tracks 3, 9, 15
- zone D : tracks 4, 10, 16
- zone E : tracks 5, 11, 17
- zone F : tracks 6, 12, 18

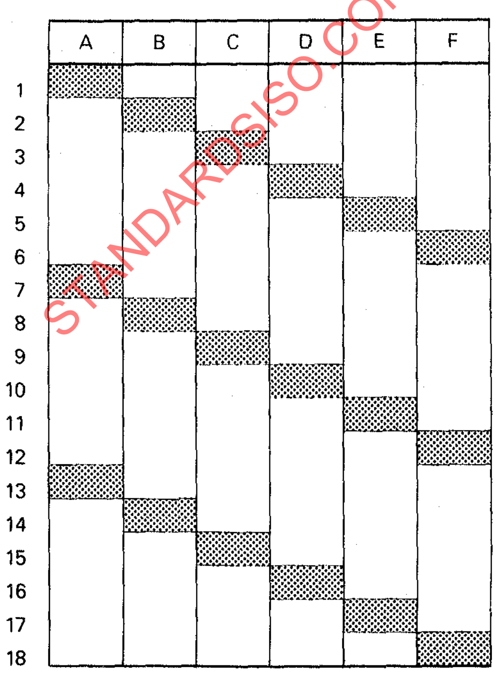


Figure 26 — Zones

b) The tracks of each zone are recorded either with the all ONEs pattern or with the repeated 6-bit pattern 100000 called tone.

4.4.1 Density Identification Burst

The Density Identification Burst shall be characterized by

- all ONEs in zones A, C, F;
- tone in zones B, D, E.

Its length shall be

nominal : 2 375 mm (94 in)

minimum : 2 250 mm (89 in)

maximum : 3 060 mm (120 in)

The Density Identification Burst shall be the first recording on the tape.

4.4.2 ID Separator Burst

The ID Separator Burst shall be characterized by

- all ONEs in all zones.

Its length shall be

nominal : 2,0 mm (0.078 7 in)

minimum : 1,9 mm (0.074 8 in)

maximum : 2,1 mm (0.082 7 in)

4.4.3 Interblock Gaps

The Interblock Gaps shall be characterized by

- all ONEs in zones A, D, F;
- tone in zones B, C, E.

The length of each Interblock Gap shall be

nominal : 2,0 mm (0.079 in)

minimum : 1,6 mm (0.063 in)

maximum : 3,0 mm (0.118 in)

Any discontinuity across all tracks in an Interblock Gap (for example due to start/stop mode) shall not be greater than 0,03 m (0.001 2 in). Such discontinuity shall not occur less than 0,5 mm (0.02 in) before the Preamble of a Recorded Data Block or within 0,5 mm (0.02 in) after the Postamble of such a block.

An Interblock Gap shall be recorded immediately after the ID Separator Burst. It shall also be recorded before and after each Recorded Data Block, each Erase Gap (see 4.4.4) and each Tape Mark (see 4.4.5), except after the last Tape Mark on the tape (see 4.4.7).

4.4.4 Erase Gaps

Erase Gaps shall be characterized by

- all ONEs in zones B, C, F;
- tone in zones A, D, E.

Erase Gaps shall be recorded over a length of tape where an unsuccessful write operation occurred or upon an erase instruction.

4.4.4.1 Normal Erase Gaps

The length of a Normal Erase Gap shall be

nominal : 7,8 mm (0.307 in)

minimum : 7,4 mm (0.291 in)

maximum : 8,2 mm (0.323 in)

It is permitted to write up to 20 successive Normal Erase Gaps, separated by Interblock Gaps, to cover a defective area.

4.4.4.2 Elongated Erase Gaps

The length of an Elongated Erase Gap shall be

maximum: 200 mm (7.87 in)

An Elongated Erase Gap shall be recorded when a Normal Erase Gap and/or the following Interblock Gap are not recognized as such. Within an Elongated Erase Gap partial Interblock Gaps of not more than 1 mm (0.039 in) may appear.

4.4.5 Tape Marks

Tape Marks shall be characterized by

- all ONEs in zones B, D, E;
- tone in zones A, C, F.

The length of each Tape Mark shall be

nominal : 1,0 mm (0.039 in)

minimum : 0,7 mm (0.028 in)

maximum : 1,3 mm (0.051 in)

One or more Tape Marks may be used to delimit sequences of Recorded Data Blocks.

4.4.6 Relation between Interblock Gaps, Erase Gaps and Tape Marks

Where an Interblock Gap precedes or follows an Erase Gap or a Tape Mark, respectively, in six of the nine tracks the prescribed tone pattern shall be preceded or followed by 18 ONE bits.

4.4.6.1 Interblock Gap followed by a Tape Mark

On tracks 1, 6, 7, 12, 13 and 18:

- the tone pattern of the Tape Mark is preceded by 18 ONE bits.

On tracks 2, 5, 8, 11, 14 and 17:

- the tone pattern of the Interblock Gap ends with 18 ONE bits.

4.4.6.2 Tape Mark followed by an Interblock Gap

On tracks 1, 6, 7, 12, 13 and 18:

- the tone pattern of the Tape Mark ends with 18 ONE bits.

On tracks 2, 5, 8, 11, 14 and 17:

- the tone pattern of the Interblock Gap is preceded by 18 ONE bits.

4.4.6.3 Interblock Gap followed by an Erase Gap

On tracks 1, 4, 7, 10, 13 and 16:

- the tone pattern of the Erase Gap is preceded by 18 ONE bits.

On tracks 2, 3, 8, 9, 14 and 15:

- the tone pattern of the Interblock Gap ends with 18 ONE bits.

4.4.6.4 Erase Gap followed by an Interblock Gap

On tracks 1, 4, 7, 10, 13 and 16:

- the tone pattern of the Erase Gap ends with 18 ONE bits.

On tracks 2, 3, 8, 9, 14 and 15:

- the tone pattern of the Interblock Gap is preceded by 18 ONE bits.

4.4.6.5 Summary of the relation between Interblock Gaps, Erase Gaps and Tape Marks

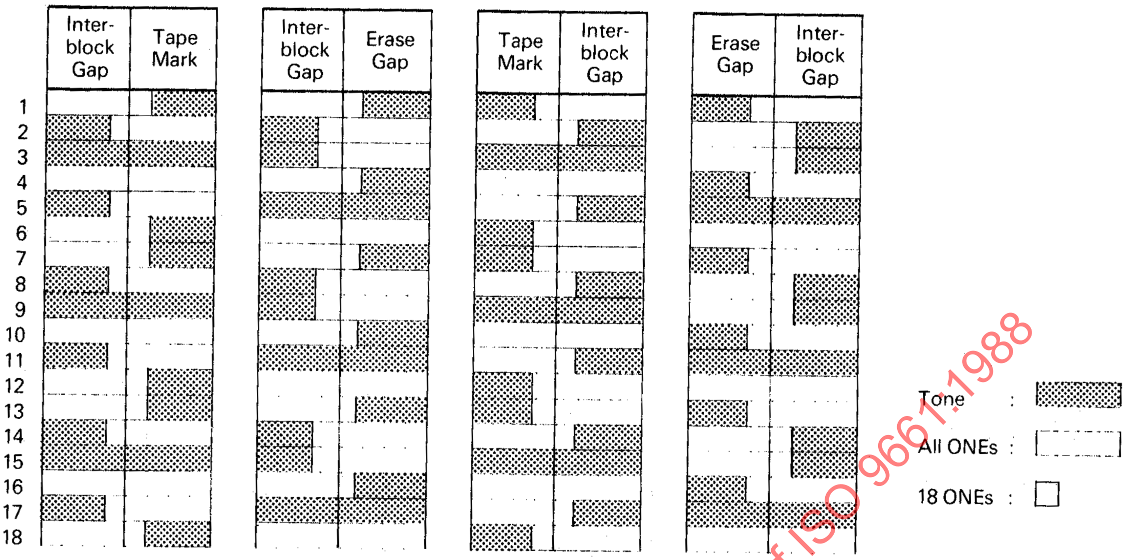


Figure 27 — Summary of the relation between gaps and Tape Marks

4.4.7 First and last recording on the tape

The first recording on the tape shall be a Density Identification Burst. It shall begin not more than 1,34 m (53 in) from the leader block of the cartridge and end not less than 3,28 m (129 in) from it.

The last recording on the tape shall be a Tape Mark optionally followed by an Interblock Gap. It shall end not less than 4,3 m (169 in) from the junction of the tape to the hub of the cartridge.

4.4.8 Summary of the tape format

4.4.8.1 Characteristics of Recording other than Recorded Data Blocks

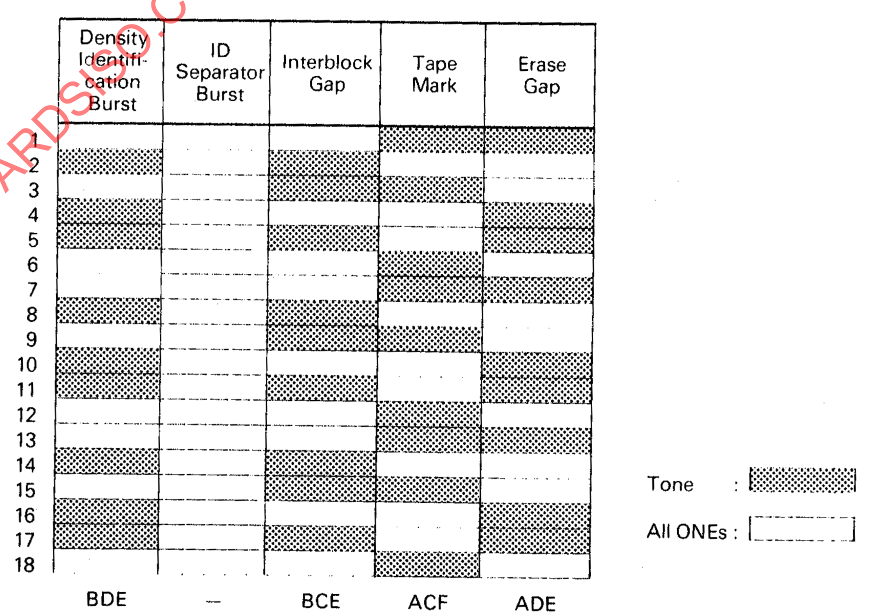


Figure 28 — Recordings other than Recorded Data Blocks

4.4.8.2 Arrangement of Recording on the Tape

Dimensions in millimetres

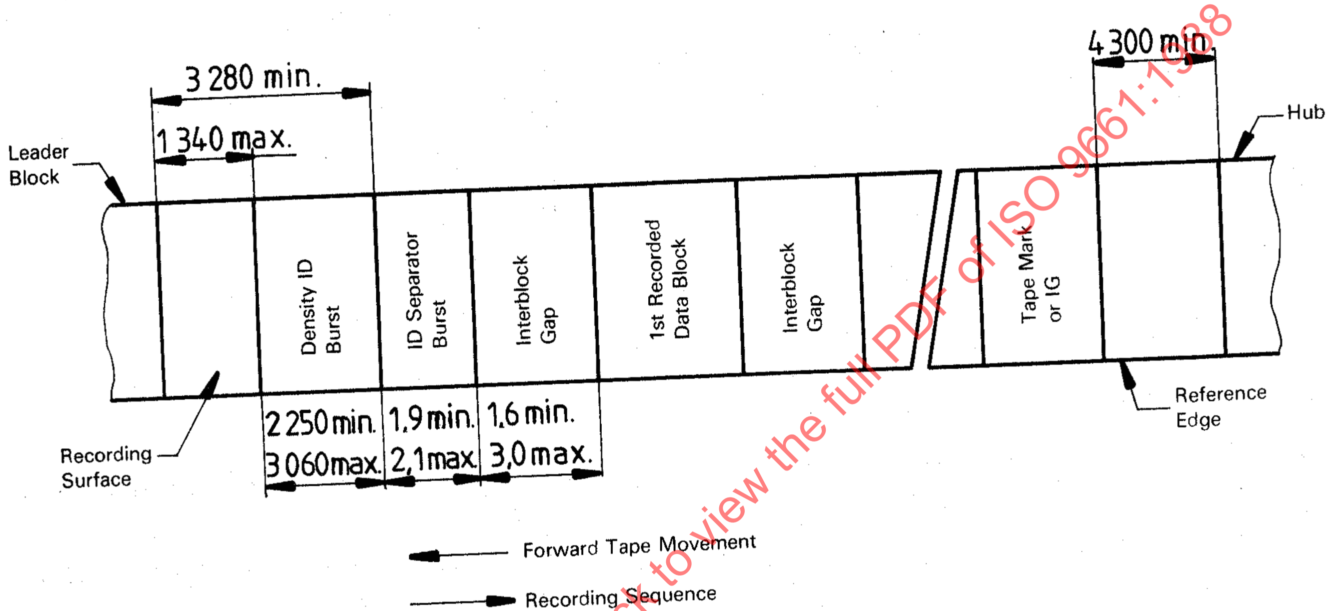


Figure 29 — Tape layout

Annex A
(informative)

Recommendations for transportation

A.1 Environment

It is recommended that during transportation the cartridges are kept under the following conditions:

A.1.1 Unrecorded cartridges

temperature : – 23 °C to 48 °C (– 9 °F to 120 °F)

relative humidity : 5 % to 100 %

wet bulb temperature: 26 °C max. (80 °F max.)

duration : 10 consecutive days maximum

There shall be no condensation in or on the cartridge.

A.1.2 Recorded cartridges

temperature : 5 °C to 32 °C (40 °F to 90 °F)

relative humidity : 5 % to 80 %

wet bulb temperature: 26 °C max. (80 °F max.)

There shall be no condensation in or on the cartridge.

A.2 Hazards

Transportation of recorded cartridges involves three basic potential hazards.

A.2.1 Impact loads and vibration

The following recommendations should minimize damage during transportation.

a) Avoid mechanical loads that would distort the cartridge shape.

b) Avoid dropping the cartridge more than 1 m (39 in).

c) Cartridges should be fitted into a rigid box containing adequate shock-absorbent material.

d) The final box shall have a clean interior and a construction that provides sealing to prevent the ingress of dirt and water.

e) The orientation of the cartridges within the final box should be such that their axes are horizontal.

f) The final box should be clearly marked to indicate its correct orientation.

A.2.2 Extremes of temperature and humidity

a) Extreme changes in temperature and humidity should be avoided whenever possible.

b) Whenever a cartridge is received it should be conditioned in the operating environment for a period of at least 24 h.

A.2.3 Effects of stray magnetic fields

A nominal spacing of not less than 80 mm (3.15 in) should exist between the cartridge and the outer surface of the shipping container. This should minimize the risk of corruption.

Annex B
(informative)

Inhibitor tape

Any tape that reduces the performance of the tape drive or other tapes is called an inhibitor tape. Certain tape characteristics can contribute to poor tape drive performance. These characteristics include: high abrasiveness, high static friction to tape path components, poor edge conditions, excessive tape wear debris, interlayer slippage, transfer of the oxide coating to the back of the next tape layer, separation of tape constituents causing deposits that may lead to tape sticking or poor performance of other tapes. Tapes that have these characteristics may not give satisfactory performance and can result in excessive errors.

Tapes to be used in a cartridge should not be inhibitor tapes.

Annex C
(normative)

Tape abrasivity measurement procedure

C.1 General

Tape abrasivity is the tendency of the tape to wear the tape transport.

C.2 Test fixture

Install a clean ferrite wear bar made as shown in figure C.1 on a holding fixture similar to that shown in figure C.2. The test edge facing upward shall be unworn and free of chips or voids greater than 1 µm (39 µin) in size. The radius of the test edge shall not be greater than 13 µm (512 µin).

The ferrite bar shall be composed of single-phase polycrystaline ferrite.[1] It shall have the following weight percentages:

ZnO	22 %
NiO	11 %
Fe_2O_3	67 %

Its average grain size shall be 7,2 µm ± 2 µm (281 µin ± 78 µin). Its density shall not be less than 5,32 g/cm³ (3.076 oz/in³).

The surface finish on all four sides of the bar shall be at least of roughness grade N2 (ISO 1302).

C.3 Procedure

Install the test fixture (clause C.2) on a tape transport so that the wrap angle of the tape over the bar is 8° on each side for 16° of total wrap.

Set the tape tension at the bar at 1,4 N (5.04 ozf).

With a tape speed of 1 m/s (39 in/s), make one pass of the tape over the wear bar. The length of tape passing over the wear bar shall be 520 m ± 2,5 m (1 706 ft ± 8.2 ft). This length may be segmented into the appropriate number of cartridges.

Remove the holding fixture from the tape transport and measure the length of the flat worn on the wear bar. This measurement is most easily made using a microscope of known magnification, a camera, and a reference reticule. A magnification of X300 or higher is recommended.

Carry out the measurements across the 1/4, 1/2 and 3/4 points of the 12,65 mm (0.498 in) width of the wear pattern. Take the average length calculated from the three readings. Figure C.3 shows a typical wear pattern and the points of measurement.

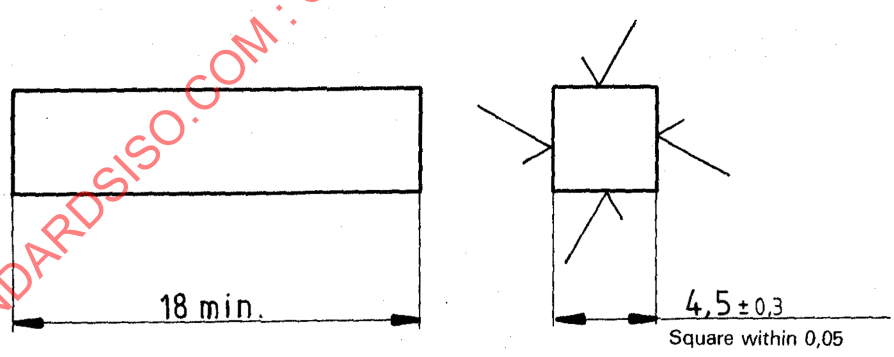


Figure C.1 — Ferrite wear bar

1) Such material should be available as Sumitomo H4R or H4R3 which is the trade-name of a product supplied by Sumitomo Special Metals Div. Torrance California, USA. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.