ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-79

DATA INTERCHANGE ON 6,30 mm MAGNETIC TAPE CARTRIDGE USING IMFM RECORDING AT 252 ftpmm

September 1982

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BRIEF HISTORY

ECMA TC19 was set up by ECMA in January 1970 with aim of identifying and standardizing the physical properties and the relevant data format of a magnetic tape cassette for digital applications - below the performance range of existing magnetic tape standards - in order to ensure interchangeability.

After the issue of Standard ECMA-34 for Data Interchange on 3,81 mm Wide Magnetic Tape Cassettes Phase-Encoded at a physical recording density of 63 ftpmm and a data density of 4 cpmm per track, TC19 undertook a new project for a 6,30 mm Wide, 4-Track Magnetic Tape Cartridge Phase-Encoded at a physical recording density of 126 ftpmm and a data density of 8 cpmm per track. Standard ECMA-46 was issued in March 1976.

The final draft of the ECMA Standard was presented to ISO/TC97 as a proposed draft for an international standard. As a result, ISO 4057 was published in 1980.

Advances in magnetic recording technology have led to the use of a cartridge which has similar mechanical construction but a greatly increased performance. TC19 decided in 1980 to work on such an improved cartridge. This work led to the present Standard ECMA-79.

Whilst SRM 3216 is specified at 126 ftpmm, only, its performance at 252 ftpmm is sufficiently well established to be used as the basis for comparison in clause 4.3.4. In the event that a Standard Reference Material for 252 ftpmm is made available its use will be referenced in the next edition of this Standard.

This Standard ECMA-79 has been adopted by the General Assembly of ECMA on June 7, 1982.

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SECTION I

SCOPE
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1. SCOPE AND CONFORMANCE

1.1 Scope

This Standard ECMA-79 specifies the mechanical, physical and magnetic properties of a 6,30 mm wide, 4-track magnetic tape cartridge similar to that of Standard ECMA-46 but of improved performances.

This Standard specifies two types of cartridges, a Type A and a Type B which differ in length of tape and in the properties affected by this difference.

The cartridge shall be of the twin hub coplanar type, loaded with a 6,30 mm wide magnetic tape for digital recording at a physical recording density of 252 ftpmm. The tape shall be transported between hubs by an internal belt capstan to the external drive. No tape driving or positioning sensing elements shall penetrate the cartridge. The direction of magnetization shall be in the longitudinal direction of the tape.

1.2 Conformance

A 6,30 mm wide, 4-track magnetic tape cartridge shall be in conformance with this Standard if it meets either all mandatory requirements of this Standard specified for Type A or all mandatory requirements of this Standard specified for Type B.

2. DEFINITIONS

For the purpose of this Standard the following definitions apply:

2.1 Magnetic Tape

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

2.2 Reference Tape Cartridge

A tape cartridge selected for a given property for calibrating purposes.

2.3 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.

2.4 Reference Recording Field Tape Cartridge

The Reference Tape Cartridge selected as a standard for recording field.

NOTE:

This cartridge is the same as the Signal Amplitude Reference Tape Cartridge mentioned in 2.7.

2.5 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.

2.6 Reference Field

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

2.7 Test Recording Currents

The two recording currents between 145% and 155% of the currents required to produce the Reference Field at 126 ftpmm and 252 ftpmm respectively.

2.8 Signal Amplitude Reference Tape Cartridge

A reference tape cartridge selected as a standard for signal amplitude.

NOTE 1:

A Master Standard (Computer Amplitude Reference) Cartridge has been established by the US National Bureau of Standards. Secondary Standard Signal Amplitude Reference Tape Cartridges are available from NBS under Part No. SRM 3216.

2.9 Standard Reference Amplitude

The Standard Reference Amplitudes are the average signal amplitudes of the Signal Amplitude Tape Cartridge. These signal amplitudes shall be averaged over 4000 flux transitions.
SRA_{126} is the average peak-to-peak signal amplitude when recording at 126 ftpmm using the appropriate Test Recording Current.
SRA_{252} is the average peak-to-peak signal amplitude when recording at 252 ftpmm using the appropriate Test Recording Current.

2.10 Average Signal Amplitude

The average peak-to-peak value of the signal output measured over at least 4000 flux transitions.

2.11 In Contact

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

2.12 Track

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

2.13 Physical Recording Density

The number of recorded flux transitions per unit length of track.

2.14 Data Density

The number of data characters stored per unit length of tape (cpmm).

2.15 Position of Flux Transitions

The position of a flux transition is that which exhibits the maximum free space flux density normal to the tape surface.

2.16 Erasing Field

A unidirectional field of sufficient strength to remove the signals from the tape.

2.17 Reference Alignment Tape Cartridge

A tape cartridge containing a tape on which continuous information has been recorded. The Reference Alignment Tape Cartridge is optimized for perpendicularity of the written flux transition to the cartridge positioning plane.

SECTION II

ENVIRONMENT
TRANSPORTATION
FLAMMABILITY
TOXICITY

3. ENVIRONMENT AND TRANSPORTATION

3.1 Testing Environment

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

Temperature	: (23 ± 2) °C
RH	: 40% to 60%
Conditioning before testing	: 24 hours minimum

3.2 Operating Environment

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

Temperature	: 5 °C to 45 °C
RH	: 20% to 80%
Wet bulb temperature	: 26 °C maximum

The temperature is to 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.

It is recommended to condition the cartridge by exposure to the operating environment a time at least equal to the time away from the operating environment (up to a maximum of 8 hours). It is recommended that if a user of a cartridge knows or suspects that it has been exposed to a drop in temperature exceeding 17 °C since the last use, that its tape be rewound one complete cycle on the tape transport before using the cartridge for data interchange.

3.3 Storage Environment

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

Temperature	: 5 °C to 45 °C
RH	: 20% to 80%
Wet bulb temperature	: 26 °C maximum

NOTE 2:

Cartridges which have been exposed to temperatures exceeding the storage temperature range may exhibit degraded performance characteristics. Such cartridges should be subjected to a conditioning period of not less than 24 hours within the operating environment prior to use.

3.4 Transportation

3.4.1 Transportation environment

During transportation, the cartridge may be exposed to conditions outside the operating environment. The recommended limits are:

Temperature : -40 °C to 45 °C

RH : 20% to 80%

Wet bulb temperature : 26 °C maximum

3.4.2 Transportation procedures

Responsibility for ensuring that adequate precautions are taken during shipment shall be with the sender. For transport a rigid container free from dust or extraneous matter shall be used. The final package must 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.

3.5 Flammability

Tape or cartridge components which will ignite from a match flame, and when so ignited, will continue to burn in a still carbon dioxide atmosphere shall not be used.

3.6 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.

SECTION III

CHARACTERISTICS OF THE TAPE

4. CHARACTERISTICS OF THE TAPE

4.1 Mechanical Properties

4.1.1 Tape width

The width of the tape shall be:

$$6{,}30 \text{ mm } {}^{+\ 0{,}00 \text{ mm}}_{-\ 0{,}06 \text{ mm}}$$

4.1.2 Tape length

The length of the tape between the LP and the EW markers (see 4.1.4) shall be:

Type A : $91{,}5 \text{ m } {}^{+\ 3{,}0 \text{ m}}_{-\ 0{,}0 \text{ m}}$

Type B : $137{,}0 \text{ m } {}^{+\ 3{,}0 \text{ m}}_{-\ 0{,}0 \text{ m}}$

4.1.3 Tape thickness

The thickness of the tape and of its coating shall be:

	Overall thickness	Coating thickness
Type A	30 um nominal	6,5 um max.
Type B	20 um nominal	6,5 um max.

4.1.4 Markers

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

4.1.4.1 Beginning-of-Tape (BOT)

4.1.4.1.1 Definition and use

A BOT marker shall be a pair of 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 usable 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.

4.1.4.1.2 Dimension

The diameter of the BOT holes shall be:

$$1{,}17 \text{ mm} \pm 0{,}05 \text{ mm}$$

4.1.4.2 End-of-Tape (EOT)

4.1.4.2.1 Definition and use

An EOT marker shall be a single 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 shall indicate that the usable recording area has been exceeded. The two other markers shall be used to ensure reliability of detection.

4.1.4.2.2 Dimension

The diameter of the EOT holes shall be:

1,17 mm ± 0,05 mm

4.1.4.3 Load-Point (LP)

4.1.4.3.1 Definition and use

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

4.1.4.3.2 Dimension

The diameter of the LP hole shall be:

0,58 mm ± 0,05 mm

4.1.4.4 Early-Warning (EW)

4.1.4.4.1 Definition and use

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

4.1.4.4.2 Dimension

The diameter of the EW marker shall be:

0,58 mm ± 0,05 mm

4.1.5 Light transmittance

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

4.1.6 Elastoplastic properties

4.1.6.1 Tensile yield force

The tensile yield force of the tape - defined as the force required to elongate a sample by 3% - shall be:

Type A : 13,4 N minimum

Type B : 6,7 N minimum

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

4.1.7 Layer-to-layer adhesion

Layer-to-layer adhesion shall be sufficiently low to meet the test of Appendix B.

4.1.8 Cupping

Cupping, i.e. the departure across a tape (transversely to the tape motion) from a flat surface, shall be:

Type A : 0,13 mm maximum

Type B : 0,38 mm maximum

A length of tape of 6,30 mm shall be cut and placed concave side down on a flat surface. Measurement shall be made at least one hour after cutting.

4.1.9 Leaders and splices

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

4.1.10 Tape wind

The tape shall be wound on the hubs with the magnetic coating out, 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 Fig. 2.

4.2 Electrical Properties

4.2.1 Surface resistance

The surface resistance of the tape shall be between:

$5 \cdot 10^5$ and 10^9 Ohm per square

NOTE 3:

Resistance per square: The surface resistance of a square area of any size, measured between electrodes placed on two opposite sides of the square. The unit of the measurement is the Ohm.

4.3 Magnetic Properties

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

4.3.1 Test density

The test densities shall be 126 ftpmm and 252 ftpmm nominal. The densities to be used are specified for each test.

4.3.2 Test tracks

Testing shall be carried out on four tracks numbered 1 to 4. Track designation, location and width are specified in Section V.

4.3.3 Typical field

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

4.3.4 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 126 ftpmm : within +25% and -10% of SRA_{126}

at 252 ftpmm : within +25% and -25% of SRA_{252}

4.3.5 Erasure

When a tape has been recorded at 126 ftpmm with the appropriate Test Recording Current, and then passed through a longitudinal steady erasure field of 79500 A/m the Average Signal Amplitude of the remaining unwanted signal shall not exceed 3% of the Standard Reference Amplitude. The erasure field shall be reasonably uniform, e.g. 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.

4.3.6 Test for missing pulses and extra pulses

These tests shall be carried out on the test tracks in the in-contact condition and over the entire tested recording area (see 4.3.8) using the Test Recording Current for 252 ftpmm.

4.3.6.1 Missing pulses

When a tape has been recorded with the Test Recording Current, any playback signal, when measured base-to-peak, which is less than 40% of half the Standard Reference Amplitude shall be a missing pulse.

4.3.6.2 Extra pulses

When a tape has been recorded with a constant recording current equivalent to the Test Recording Current, any playback signal, when measured base-to-peak which exceeds 10% of half the Standard Reference Amplitude shall be an extra pulse.

4.3.7 Rejected regions

A rejected region shall be an area of tape extending across the width of a track and not more than 0,4 mm in length, which on two consecutive tests exhibits extra pulses or missing pulses. The acceptable number of rejected regions is a matter of agreement between interchange parties.

4.3.8 Tested Recording Area

The Tested Recording Area shall be that part of the tape tested according to 4.3.1 to 4.3.6. In forward direction, it begins at least 686 mm before the LP marker and ends at least 991 mm after the EW marker (see Fig. 1) and extends across the width of the tracks.

SECTION IV

CHARACTERISTICS OF THE CARTRIDGE

5. CHARACTERISTICS OF THE CARTRIDGE

5.1 General Description

The cartridge shall be of a compact coplanar design with the tape and hubs completely enclosed by the casing, except for 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 Fig. 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.

5.1.1 Dimension

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

5.1.2 Cartridge positioning planes

The cartridge shall be referenced to the read/write device only in the cross-hatched areas shown in Fig. 4. The application of forces suggested in Fig. 4 is one method of assuring conformance of the cartridge to the positioning plane.

5.1.3 Attachment

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

5.1.4 Mounting position

It shall be possible to mount the cartridge in the read/write device in one position only; to ensure this, the cartridge shall have the following asymmetrical features (see Fig. 3):

i) a projection in one guide slot,

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

5.1.5 Light sensing

The cartridge shall contain optical elements to permit photo-electric detection of the tape markers (see Fig. 5). The total light transmittance of both cover windows including the effects of reflection from the mirror surface from a (2000 ± 200) K and from a (900 ± 50) nm LED light source sensed by a silicon photo-transistor shall be at least 50%.

5.1.6 Cartridge-in-position sensing

The cartridge shall have a solid area on the front surface which shall be dimensioned as shown in Fig. 6 to be used for mechanically sensing that the cartridge is in position for writing and reading.

5.1.7 Cartridge door

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

5.2 File Protection

The cartridge shall have a rotatable plug to prevent writing or erasing the tape. See Fig. 6 for the file-protect plug location.

5.3 Physical Labels

5.3.1 Location and size

The rear surface of the cartridge, opposite the exposed tape, and a portion of the top side of the cartridge may be used for labels. The rear surface area allows the label to be read when in a stacked or inserted position. The position and size of the label shall be within the provided depression of the label area as shown in Fig. 8.

5.3.2 Interchange

Suitable labels shall be used for marking contents of cartridges. The use of pencil or erasable material is not allowed.

5.4 Tape Guides

The tape shall be guided by two tape guides contained within the cartridge (see Fig. 9). The read/write machine shall not contain any elements to restrict the tape path in the transverse direction.

5.5 Speed

The cartridge shall be used at any tape speed between 0,76 m/s and 2,29 m/s.

NOTE 4:

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

5.6 Instantaneous Speed Variation

The instantaneous speed variation is measured and specified as follows.

The same drive shall be used for writing and reading. It shall be so designed as not to affect the measurement.

5.6.1 Procedure

5.6.1.1 Write at the nominal density of 252 ftpmm on a tape running at any speed in the range 0,76 m/s to 2,29 m/s.

5.6.1.2 Read the tape at the same speed and demodulate the frequency-modulated signal.

5.6.1.3 Express the amplitude of the resulting signal as a percentage of the tape speed.

5.6.2 Requirements

The instantaneous speed variation shall be less than 1% in the range 4 kHz to 20 kHz.

5.7 Acceleration

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

5.8 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 N ± 0,3 N. The external radial load applied to the belt capstan when making this measurement shall be 5,6 N ± 0,6 N.

5.9 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 maximum.

5.10 Dynamic Response

5.10.1 Definition

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

5.10.2 Requirement

The natural resonant frequency shall be at least 60 Hz.

5.10.3 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 over-speed peaks is the natural resonant frequency.

5.11 Tape Tension

When the cartridge is driven at a constant speed, the tension along the tape measured at the head location without the head engaged shall be within 0,36 N and 0,83 N.

5.12 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.

5.13 Tape Path Length

The cartridge shall be used with drives causing an increase of the tape path length of 0,66 mm ± 0,05 mm.

NOTE 5:

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. To ensure reliable reading or writing immediately after mounting a cartridge in a drive the increase of length of the tape path should be the same on all drives.

SECTION V

LAYOUT OF TRACKS AND DATA REPRESENTATION

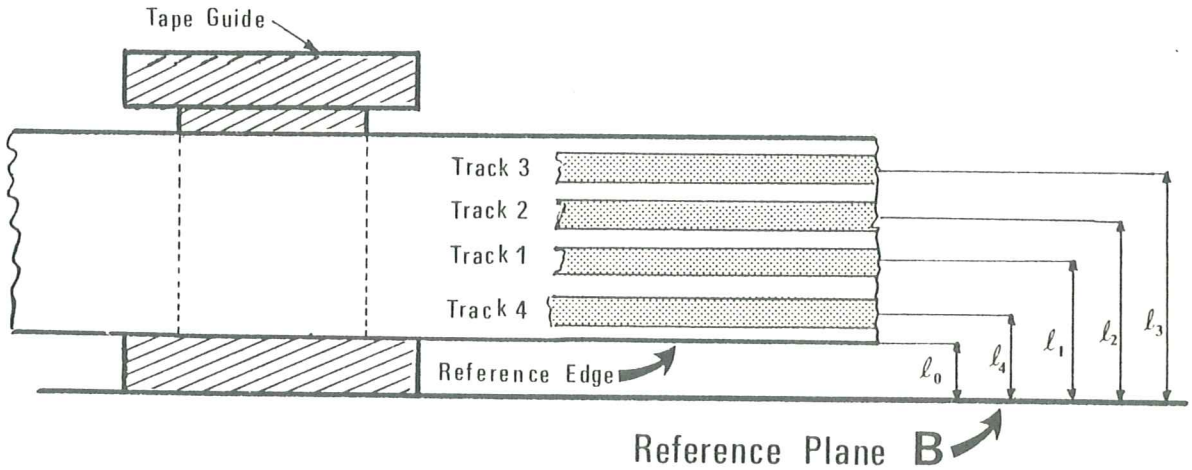
6. LAYOUT OF TRACKS

6.1 Reference Plane and Reference Edge

All positioning requirements shall be referred to the top of the base plate of the cartridge as Reference Plane. The Referende Edge shall be the edge of the tape positioned at a distance:

ℓ_0 = 1,78 mm ± 0,02 mm

from Reference Plane B.



6.2 Number of Tracks

There shall be four parallel tracks numbered track 4, track 1, track 2, and track 3. Track 4 is the track nearest to the Reference Edge, track 3 being the track farthest from the Reference Edge.

6.3 Track Centreline Location

The track centreline locations shall be:

For track 1 : ℓ_1 = 4,07 mm ± 0,32 mm

For track 2 : ℓ_2 = 5,70 mm ± 0,32 mm

For track 3 : ℓ_3 = 7,33 mm ± 0,32 mm

For track 4 : ℓ_4 = 2,45 mm ± 0,32 mm

6.4 Track Width

The track width shall be 0,914 mm ± 0,050 mm.

7. DATA REPRESENTATION

Characters shall be represented by means of the 7-bit Coded Character Set (Standard ECMA-6) and, where required, by its 7-bit or 8-bit extensions (Standard ECMA-35) or by means of the 8-bit Coded Character Set (Standard ECMA-43).

7.1 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:

Bits of the 7-bit combination	0	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

7.2 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:

Bits of the 8-bit combination	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

SECTION VI

METHOD OF RECORDING AND TRACK LAYOUT

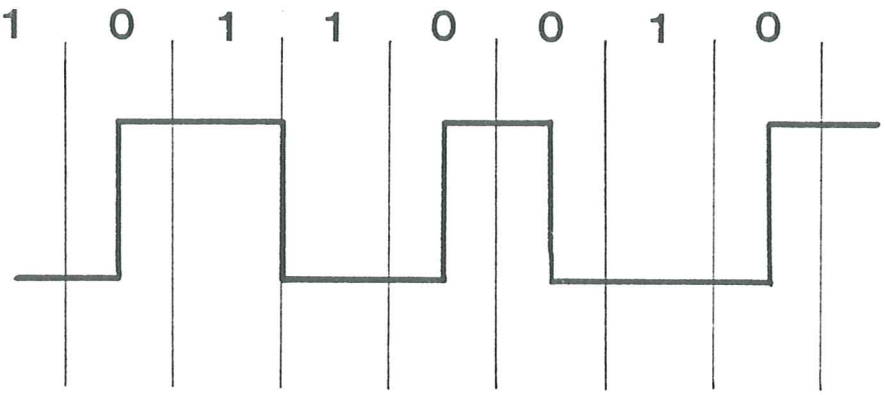
8. RECORDING

8.1 Method of Recording

The recording method shall be Inverted Modified Frequency Modulation (IMFM) for which the conditions shall be:

i) a flux transition shall be written at the centre of a bit cell containing a ZERO,

ii) a flux transition shall be written at the cell boundary between consecutive bit cells containing ONEs.



8.2 Measurement

All signal measurements shall be made at the point in the read chain where the amplitude is proportional to the rate of change of flux in the read head. The ratio of tape speed to the surface speed of the belt capstan shall be assumed to be exactly 0,76.

8.3 Density of Recording

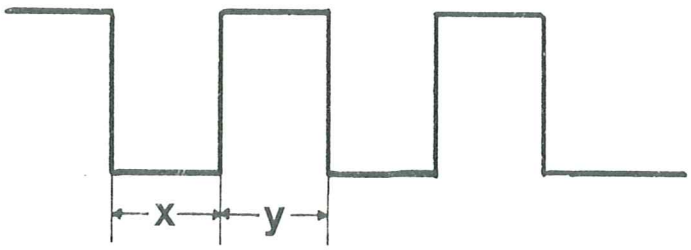
8.3.1 The nominal recording density shall be 252 ftpmm. The nominal bit cell length shall be 3,97 um.

8.3.2 The long-term average bit cell length shall be the average bit cell length measured over at least 500 000 flux transitions. It shall be within ± 3% of the nominal bit cell length.

8.3.3 The short-term average bit cell length, referred to a particular bit cell, shall be the average of the lengths of the preceding four bit cells. It shall be within ± 7% of the long-term average bit cell length and shall not change at a rate greater than 1% per bit cell.

8.4 Flux Transition Spacing

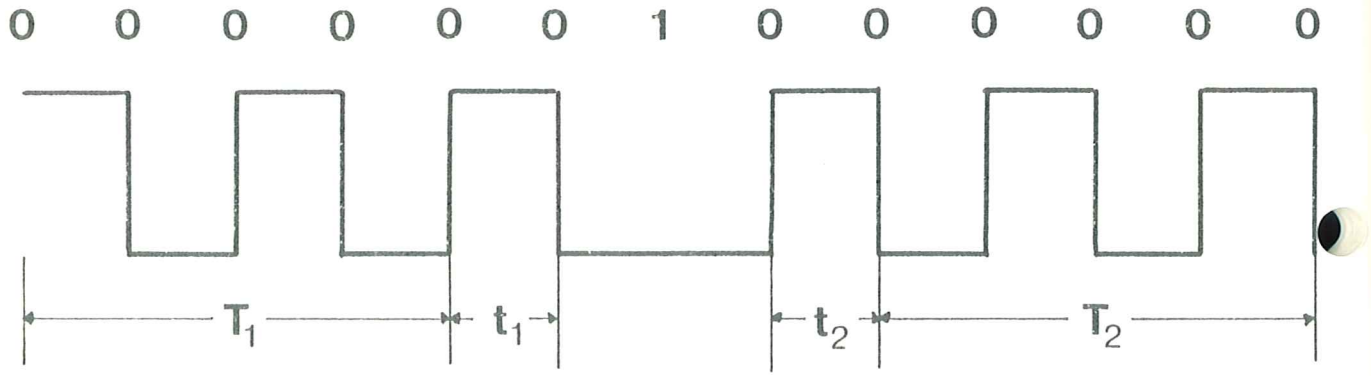
8.4.1 At nominal density the variation of spacing between consecutive flux transitions shall not be greater than 2%.



$$\frac{|X-Y|}{\frac{X+Y}{2}} \leq 0{,}02$$

8.4.2 In a sequence of flux transitions defined by bit pattern 0000001000000 the spacing t_1 between the two ZERO flux transitions preceding the ONE bit cell shall not exceed the average of the four earlier flux transition spacings by more than 12%.

Similarly, the spacing t_2 between the two ZERO flux transitions following the ONE bit cell shall not exceed the average of the four subsequent flux transition spacings by more than 12%.



$$\frac{|t_1 - 0{,}25\,T_1|}{0{,}25\,T_1} \leqslant 0{,}12 \geqslant \frac{|t_2 - 0{,}25\,T_2|}{0{,}25\,T_2}$$

8.5 Average Signal Amplitude of the Interchanged Cartridge

8.5.1 The average peak-to-peak signal amplitude at 252 ftpmm shall not deviate by more than +50%, -35% from SRA_{252}.

8.5.2 The average peak-to-peak signal amplitude at 126 ftpmm shall be less than 2,5 times SRA_{252}.

8.5.3 Averaging shall be done over a minimum of 6400 flux transitions, which may be segmented into blocks.

8.6 Minimum Signal Amplitude

No cartridge when interchanged shall contain flux transitions the base-to-peak amplitudes of which are less than 35% of half SRA_{252}.

8.7 Erasure

After erasure any signal amplitude shall be less than 3% of the SRA_{126}.

8.8 Azimuth

The mean azimuth line is the best-fit-single line parallel to the individual track azimuth recorded signal lines. The angular deviation of this line for any recorded signal from a line which is perpendicular to the Reference Plane B of the cartridge shall be less than 8'. The individual track angular deviation from the mean azimuth line shall be less than 2'.

9. TRACK LAYOUT

9.1 Use of Tracks

Each track shall be a data track and shall be written serially in the direction from the BOT marker to the EOT marker. No data for interchange shall be written between the BOT marker and the LP marker. Data for interchange shall be written after sensing the LP marker and may continue to be written after sensing the EW marker.

9.2 Location of Characters on the Tracks

Each character shall be located in a byte of eight bit positions along the track numbered from 1 to 8 in order of recording.

9.3 Sequence of Recording

The least significant bit shall be recorded first. The information to be interchanged shall be recorded serially by bit and by character.

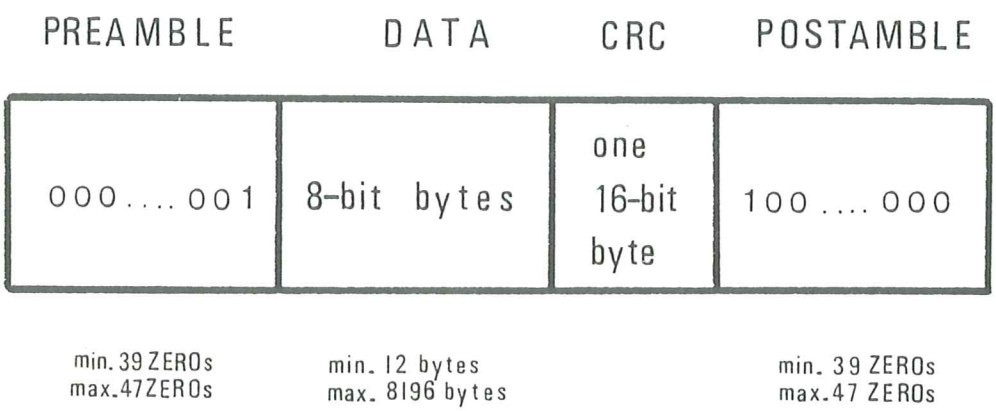
Bit-positions : ...4321[87654321]8765432...

Forward tape motion : 

Resulting recording direction : 

9.4 Data Block

A data block shall consist of a preamble, a data portion, a CRC character and a postamble.



9.4.1 Preamble

Immediately preceding data in each data block the preamble consisting of at least 39 ZEROs and at most 47 ZEROs, followed by a single ONE shall be written.

9.4.2 Data portion

The data portion of a data block shall contain a minimum of 12 data bytes and a maximum of 8196 data bytes.

9.4.3 Cyclic Redundancy Check (CRC)

The 16 bits following the data portion of a data block shall be a Cyclic Redundancy Check (CRC) character. This 16-bit character shall be written in each data block following the data portion and immediately preceding the postamble, the least significant bit being recorded first. The polynomial generating the CRC shall be:

$$x^{16} + x^{15} + x^{2} + 1$$

9.4.4 Postamble

Immediately following the CRC in each data block the postamble consisting of a ONE followed by at least 39 ZEROs and at most 47 ZEROs shall be written.

9.5 Control Block

A control block shall consist of a preamble, two bytes of eight ZEROs, and a postamble.

9.6 Gaps

9.6.1 Integrity of gaps

The gaps shall be erased.

9.6.2 Initial gap

The gap between the LP marker and the first data block shall be 152,4 mm minimum.

9.6.3 Interblock gaps

The interblock gap shall have a minimum length of 31 mm and a maximum length of 1,2 m. Any gap in excess of 1,2 m shall be considered end of data on this track.

NOTE 6:

The ability to start or stop within a gap of a given length is dependent on the tape speed selected from the range specified in 5.5 and the acceleration specified in 5.7.

SECTION VII

DRAWINGS

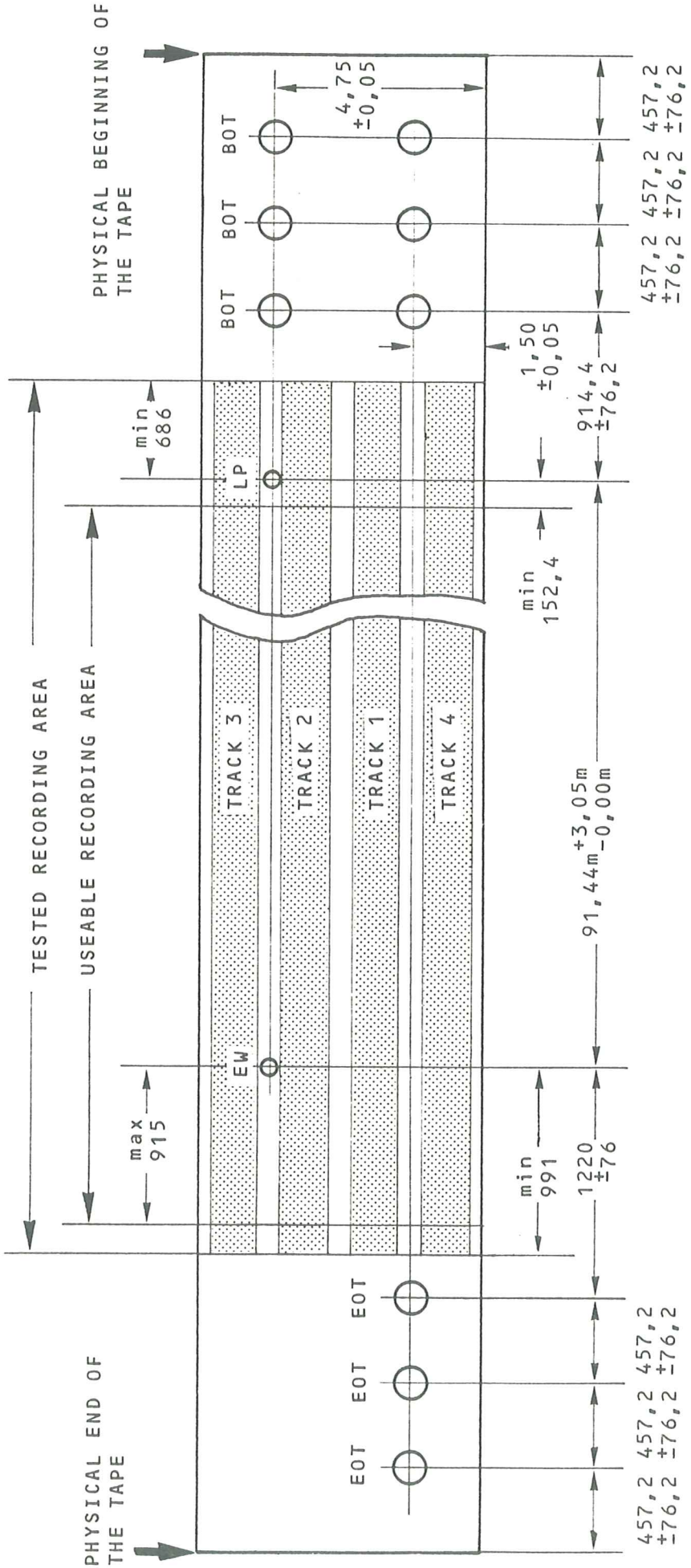


Fig. 1 - POSITION OF THE MARKERS (OXIDE SIDE SHOWN)

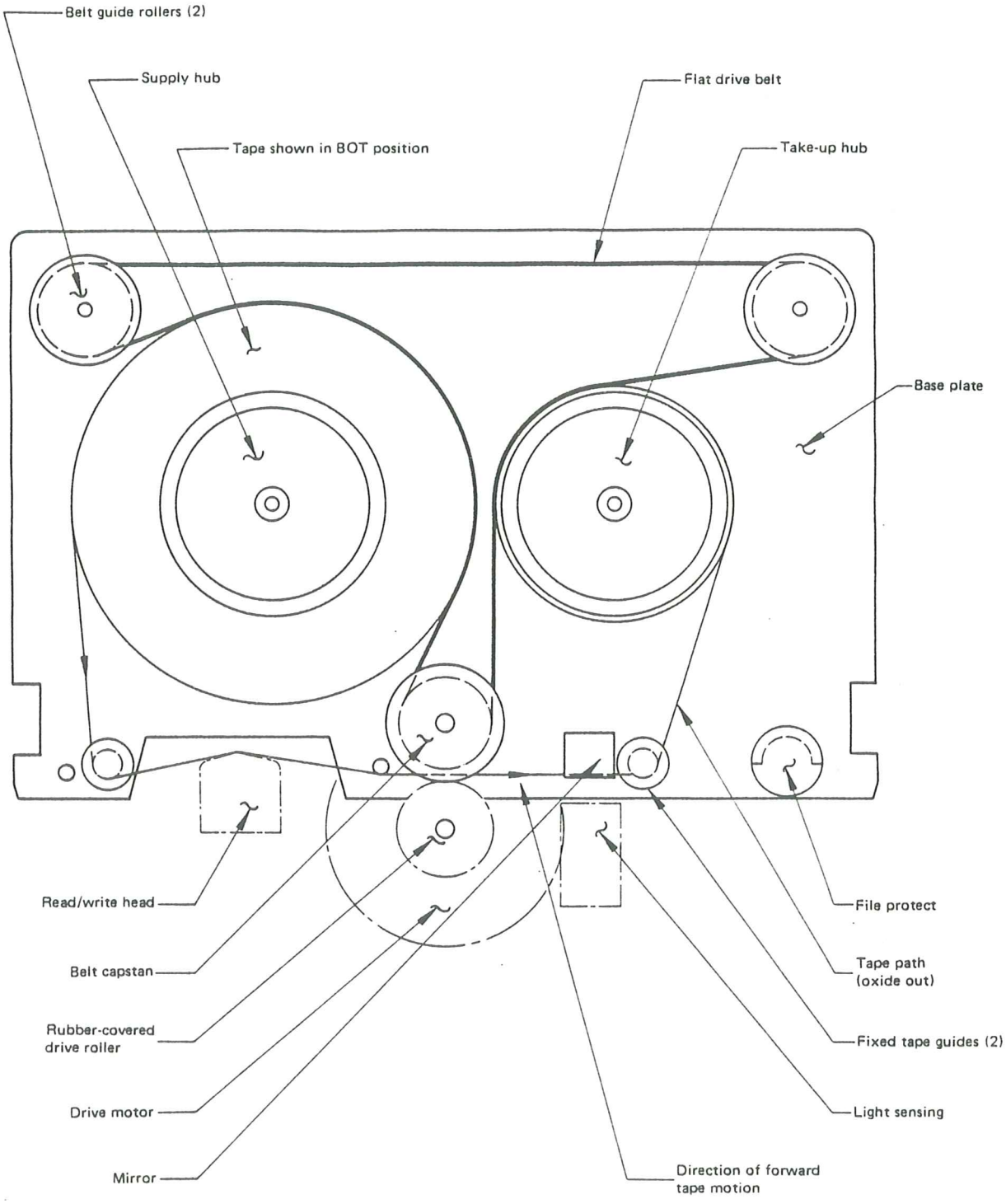


Fig. 2 - CARTRIDGE DIAGRAM

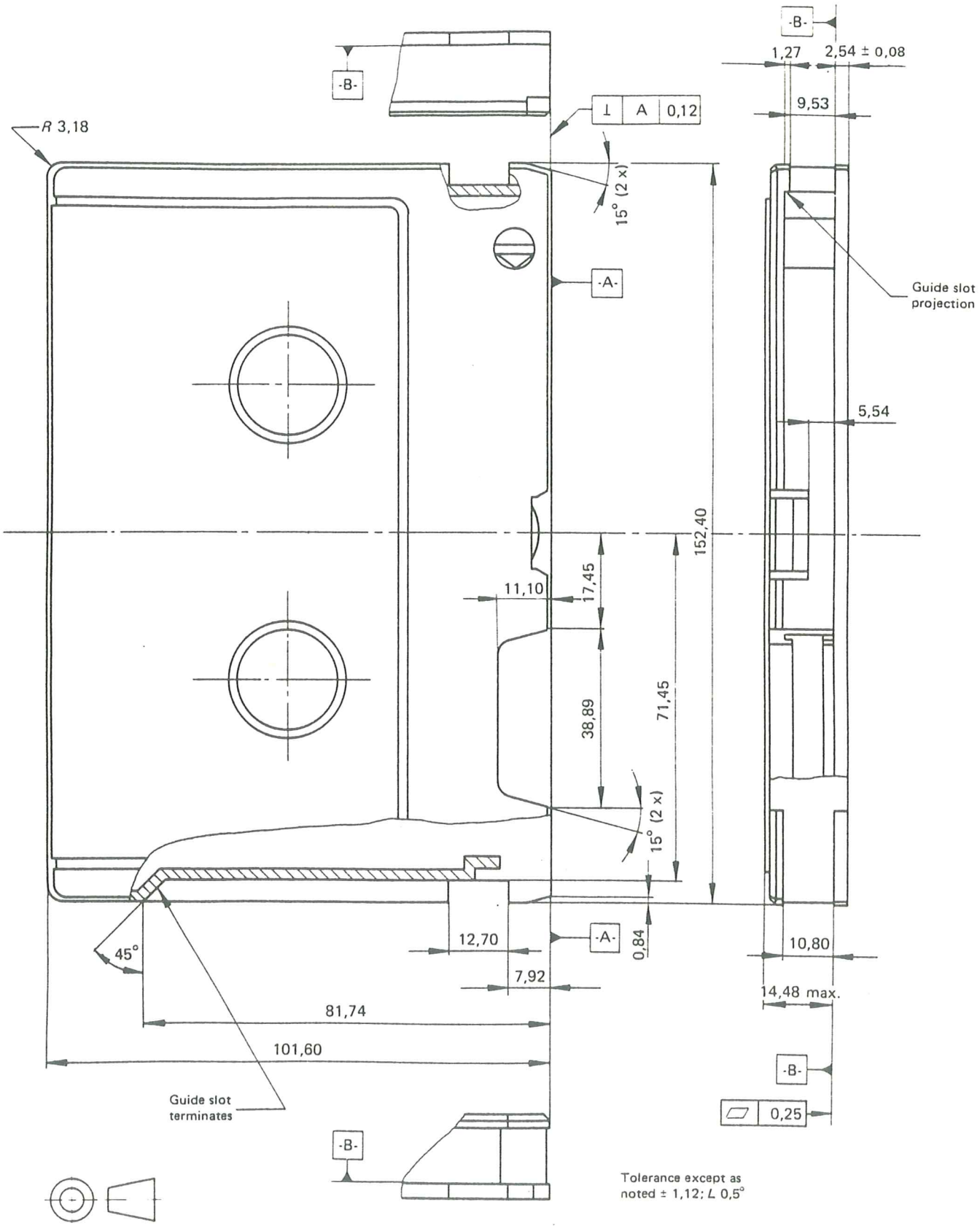


Fig. 3 - CARTRIDGE DIMENSIONS

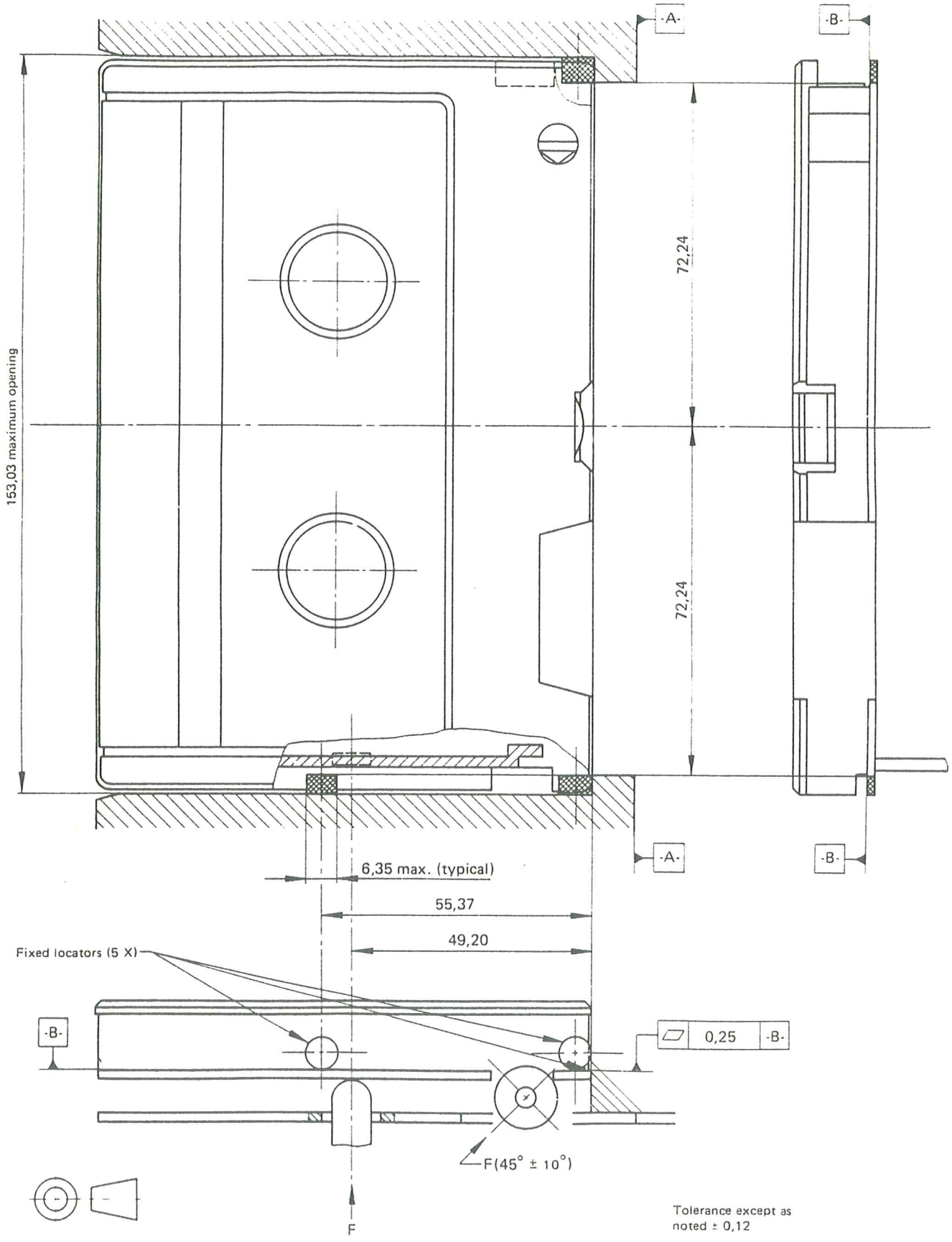


Fig. 4 - CARTRIDGE LOCATING PLANES

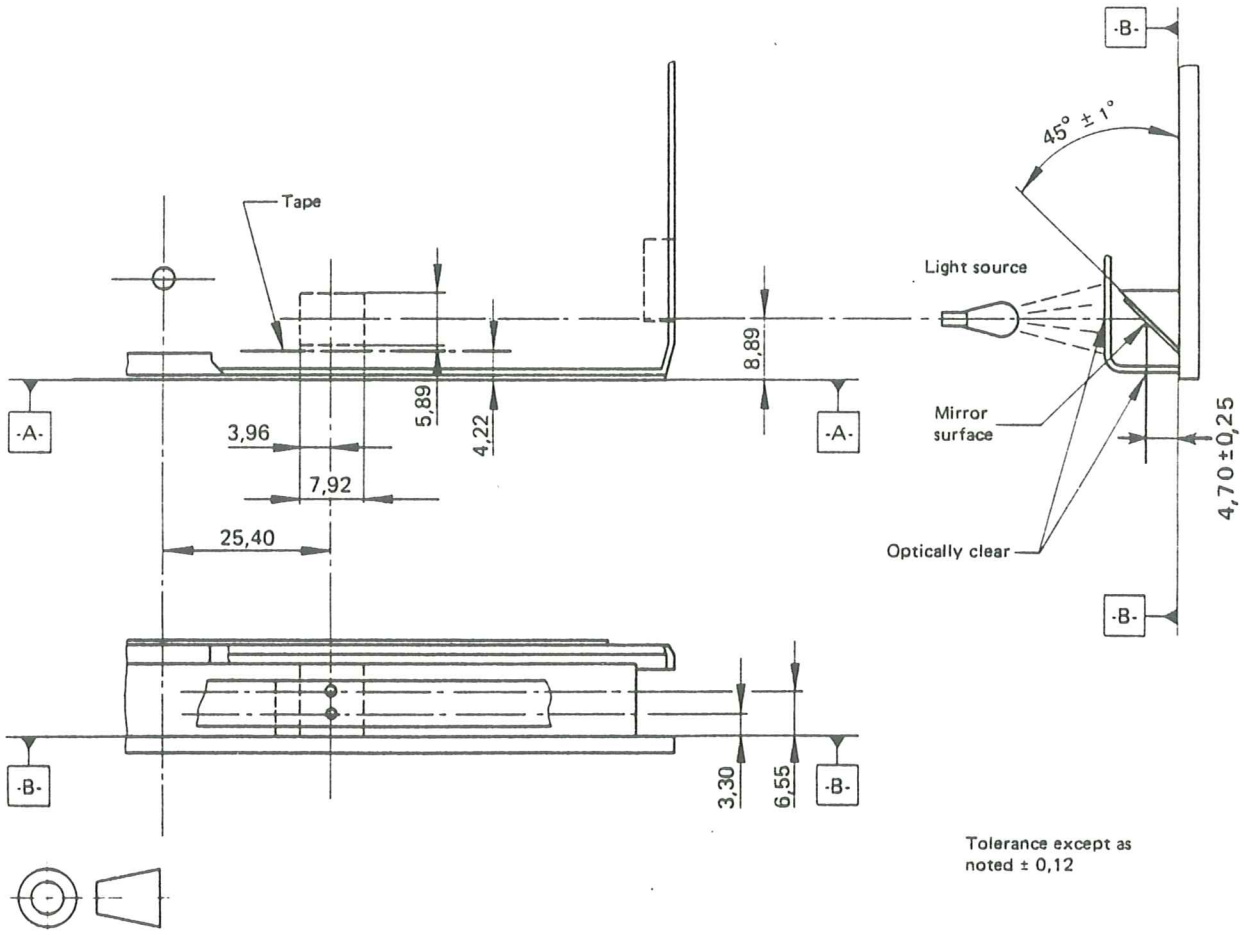


Fig. 5 - LIGHT SENSING

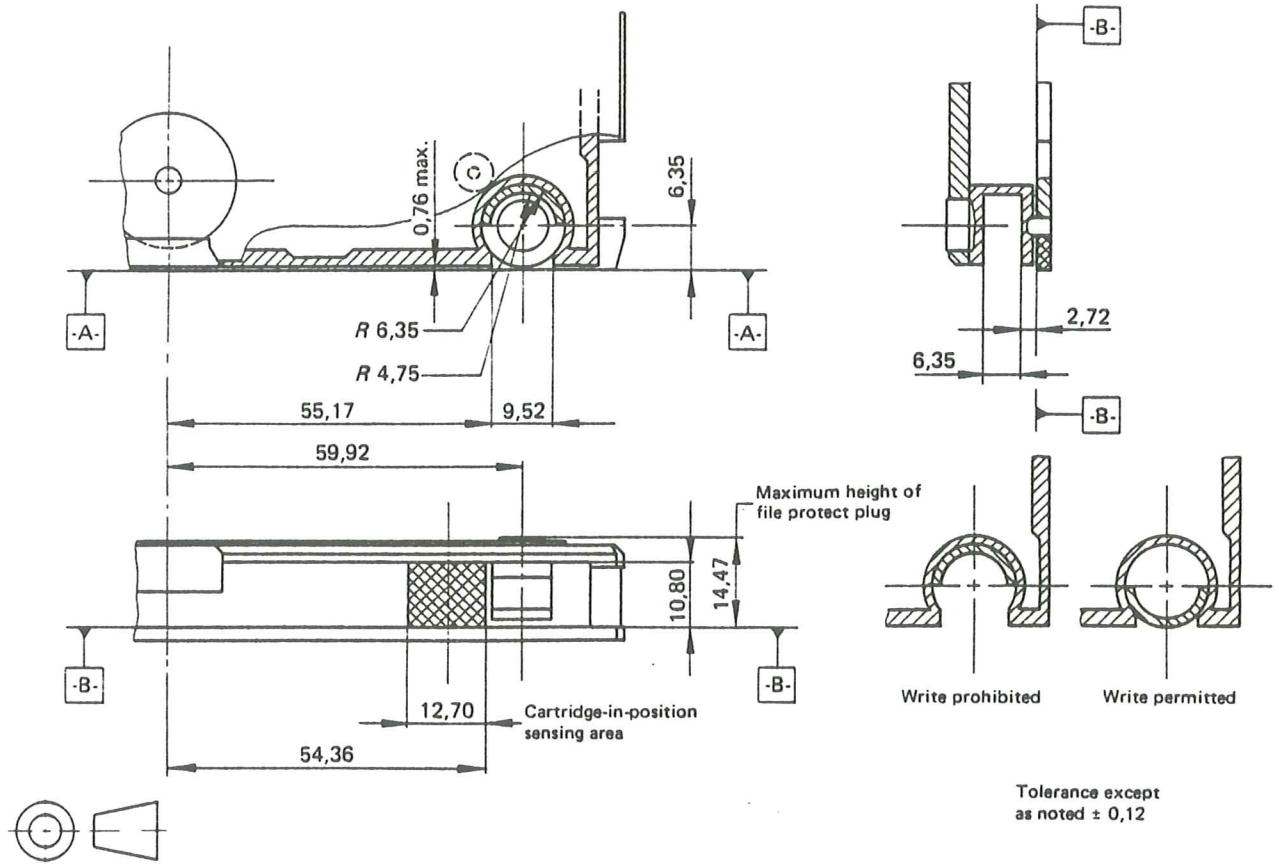


Fig. 6 - FILE PROTECT AND CARTRIDGE-IN-POSITION SENSING

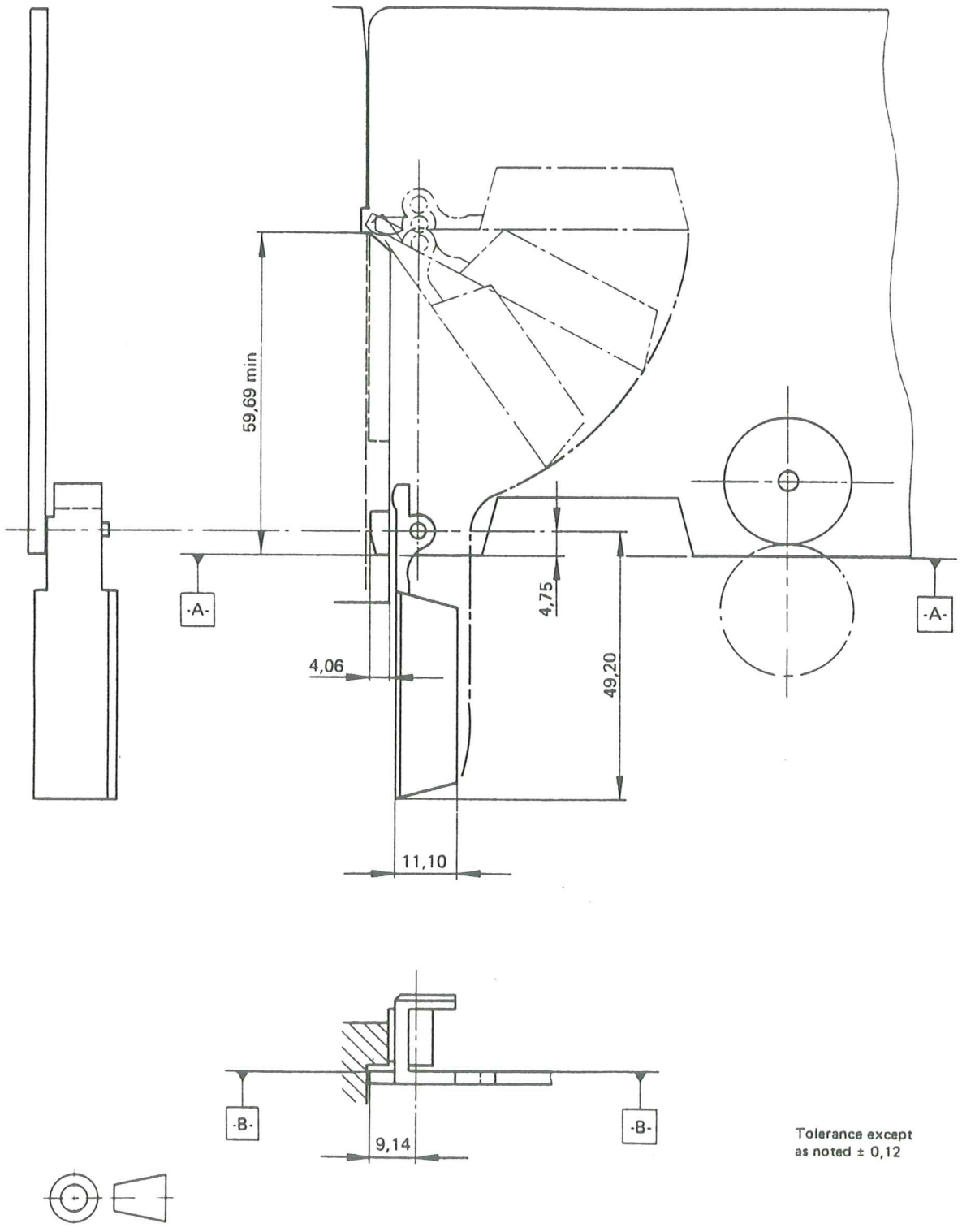


Fig. 7 - CARTRIDGE DOOR PROFILE

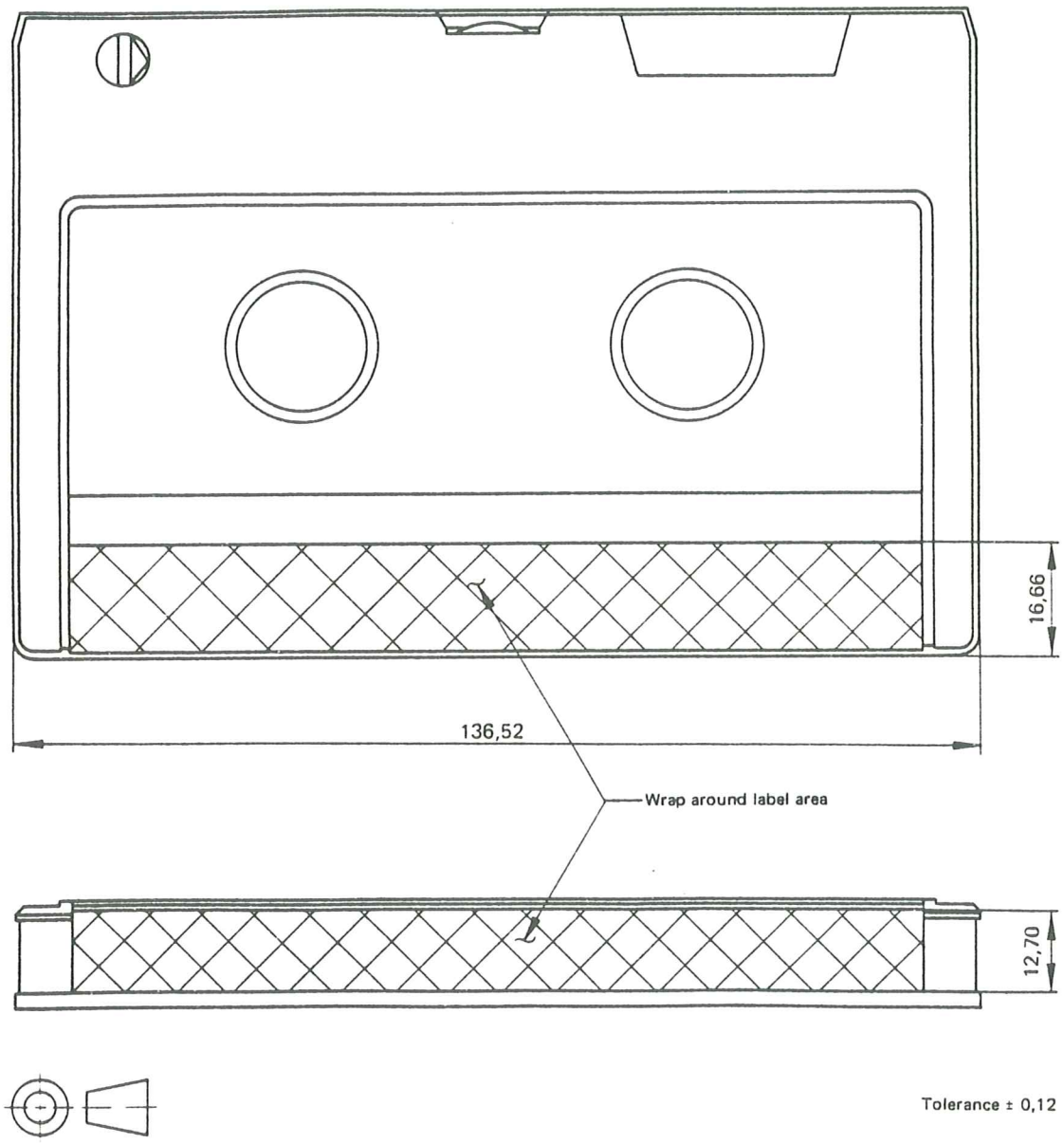


Fig. 8 - LABEL AREA

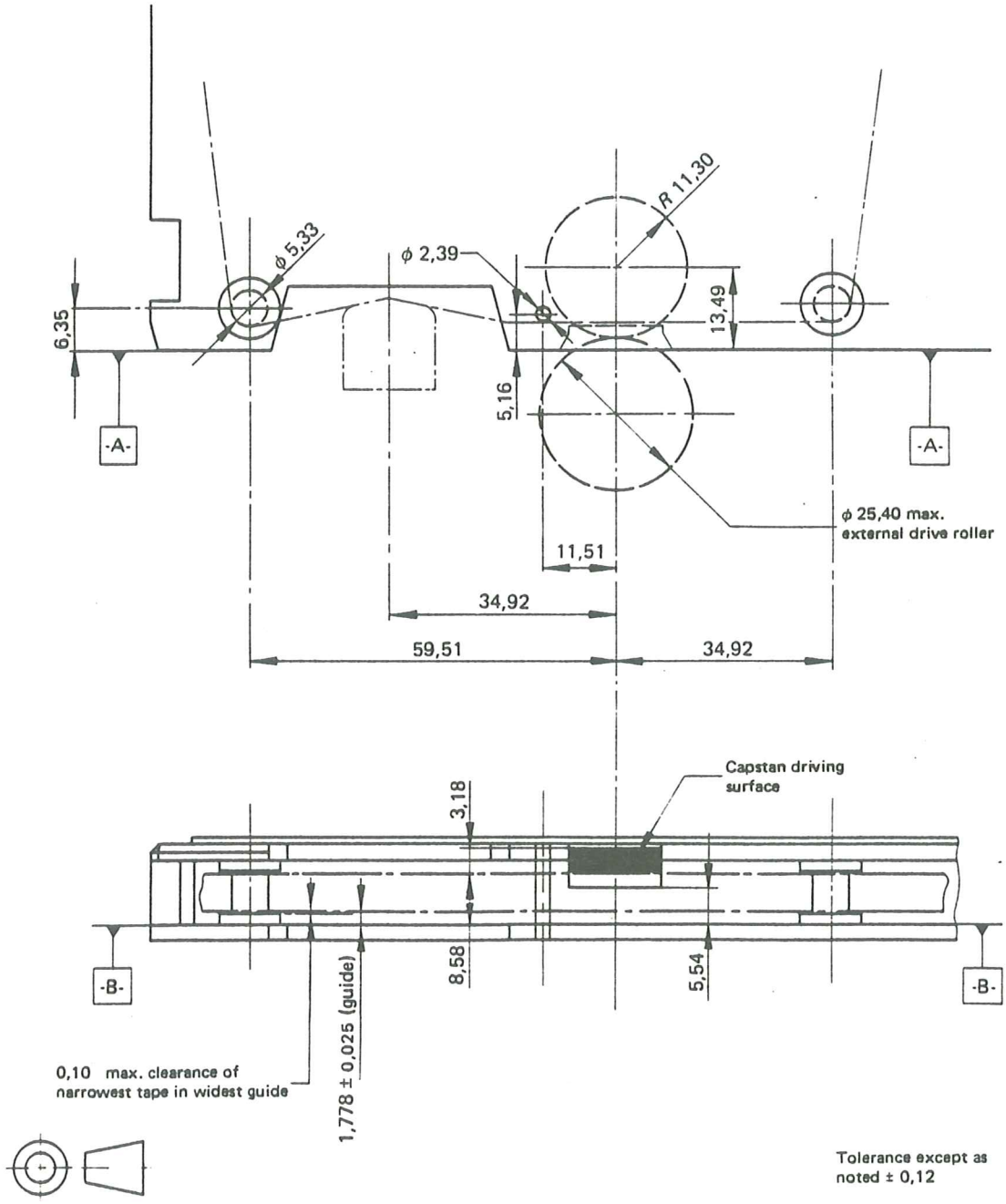


Fig. 9 - TAPE PATH AND DRIVE DIMENSIONS

SECTION VIII

APPENDICES

APPENDIX A

MEASUREMENT OF LIGHT TRANSMITTANCE

A.1 INTRODUCTION

The description in the following paragraphs outlines the general principle of a test device and the test method to be employed when measuring the radiation (light) transmittance of magnetic tape for each of two radiation sources.

For the purpose of this document "light transmittance" is defined by convention as the relationship between the reading obtained from the test device with the tape sample inserted and the reading obtained when no sample is present. The transmittance value is expressed as the percentage ratio of the two readings.

The essential elements of the test device are:

the radiation sources
the optical path
the measuring mask
the photocell
the measuring equipment

A.2 DESCRIPTION OF THE TEST DEVICE

A.2.1 Radiation Sources

A tungsten lamp is used as one radiation (light) source and should be operated in an under-run state.

The colour temperature should be 2000 K ± 200 K and a resulting illumination at the surface of the tape sample of about 5000 lux is recommended. A light emitting diode is used as the second radiation source. The output wavelength shall be 900 nm ± 50 nm.

A.2.2 Optical Path

The radiation should be perpendicular to the tape sample and be of substantially uniform intensity. Typically the tape sample should be separated from the source by a distance of 150 mm.

A diaphragm of the form shown in Fig. A 1 is recommended in order to sensibly ensure that scattered radiation does not enter the mask area.

A.2.3 Measuring Mask Geometry

The measuring mask shall be constructed in one piece according to the drawing shown in Fig. A 2. A good matt black finish capable of absorbing infra-red radiation is necessary.

Special care must be taken to ensure that the tape sample to be measured is maintained flat in contact with the inner face of the mask.

A.2.4 Photocell

A flat silicon photocell should be used. Its dimensions must be such that the active area of the photocell exceeds the diameter of the mask orifice. It should be mounted parallel and in close proximity to the outer face of the mask.

A.2.5 Measuring Equipment

The measuring equipment should be connected directly across the photocell to measure the output current. In order to be able to set the measuring equipment to full scale deflection (100%) a shunt potentiometer in the circuit must be provided or a fine adjustment of the lamp power supply voltage is required.

The load impedance across the photocell should be as low as possible and must not exceed 500 Ohm. The instrument should have a nominal accuracy of ± 0,05%.

A.3 TEST PROCEDURE

A.3.1 For the purpose of the test a sample strip of tape not shorter than 250 mm (10 in) is used.

- The measuring equipment is set to full scale reading representing (100%).
- The sample strip is inserted and 45 observations on different points along the sample are recorded.
- The sample strip is then withdrawn and full scale deflection (100%) is re-checked. If the reading lies outside the range of 99% to 101% the equipment is reset to 100% and a new set of 45 observations is recorded.

A.3.2 A statistical maximum value of light transmittance shall be determined according to the following formula:

$$T = \bar{x} + K \cdot \sigma$$

where x = mean value of n observations,
σ = accurate estimate of the lot standard deviation,
K = constant specified by the selected plan of inspection,
n = number of observations on the sample specified by the selected plan of inspection.

The T value so calculated is for use where inspection of lots of tape is by variables. Lot quality is judged in terms of percent defective and acceptance is lot by lot.

The plan is based upon single sampling (with σ known) and gives an

Acceptable Quality Level (AQL) of 0,5% defective

and a

Lot Tolerance Percent Defective (LTPD) of 1,26%.

The selected plan has a sample size letter of 0 and gives the values for:

κ = 2,33 and

n = 45 *

If T $\leqslant$ T max, the lot is accepted.
If T > T max, the lot is rejected.

where T max = maximum value of transmittance permitted.

A.4 GUIDANCE ON CONSTRUCTION

A.4.1 Experience has shown that a projector lamp is most suited as the tungsten source. When selecting a lamp, care must be taken to avoid a lamp with optical inhomogenities in the glass envelope. Also, if mirrors or lenses are used in the optical path, they must be placed such that no filament image occurs in the proximity of the mask and photocell area. It is necessary to operate the radiation sources from a stabilized, regulared power supply.

A.4.2 Special attention must be paid to all surfaces parallel to the optical path and in close proximity to the mask and photocell to avoid reflection of light. Similarly, the method of inserting the tape must ensure that no ambient light leaks through any slot arrangement.

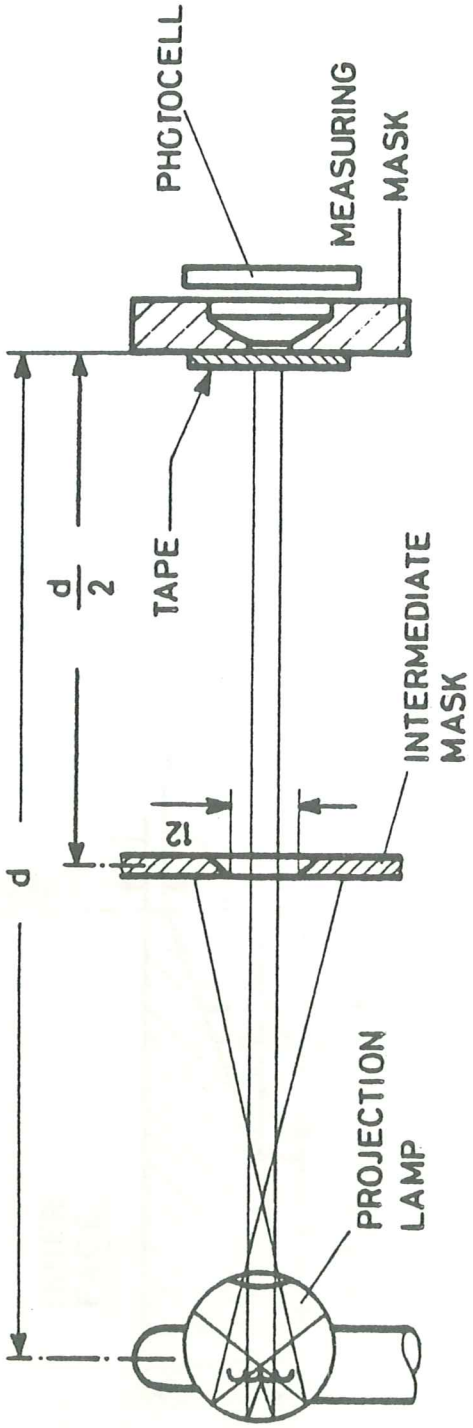
A.4.3 The accuracy of the measurement is dependent not only on attaining the dimensional tolerances shown in Fig. A 2, but also on the subsequent coating of the surfaces with a high quality optical matt black paint. The mask should be checked after coating to ensure that the small hole remains in tolerance. The method of holding the sample must be such that the tape is maintained flat in contact with the face of the mask. However, it must allow the sample to be moved without physical damage or distortion.

A.4.4 The photocell must be mounted with care, taking special precaution that the photocell leads do not interfere with the mounting arrangement. It is advisable that the face of the photocell presses slightly on the outer face of the mask.

A.4.5 An effective means of providing periodical calibration should be incorporated by inserting an opaque object for 0% light transmittance and a filter glass for 75% light transmittance.

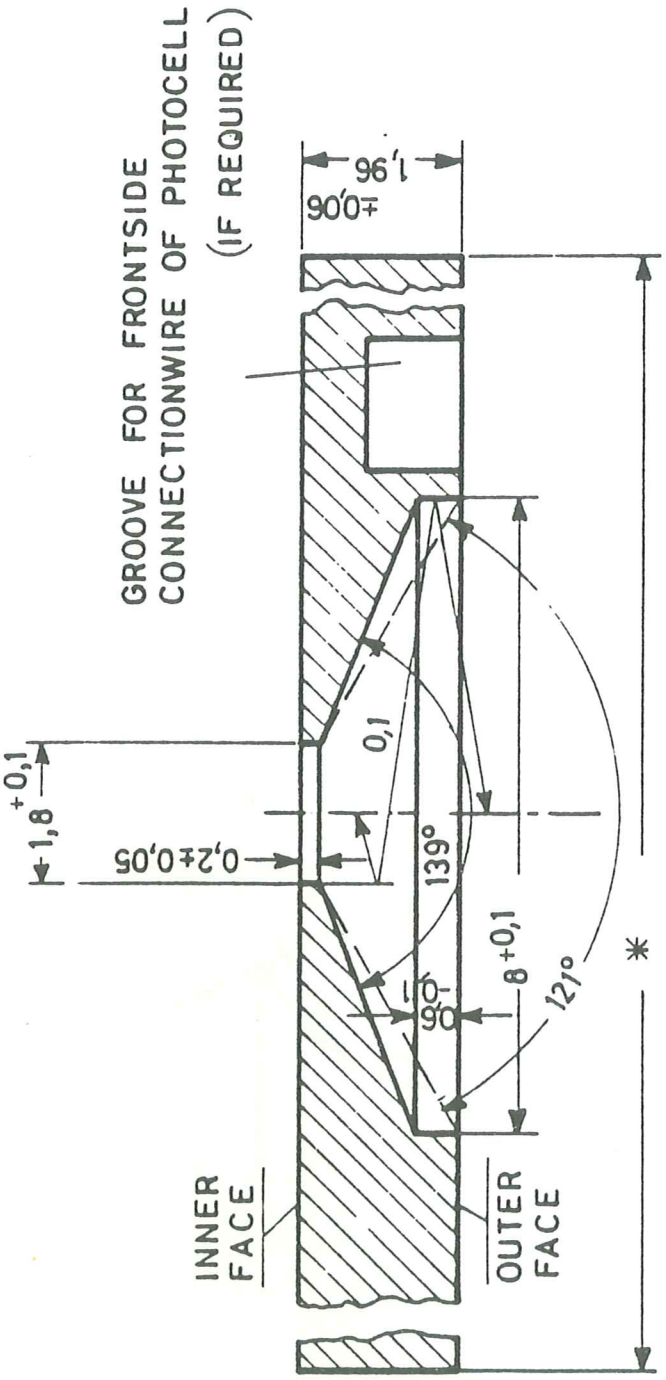
A.4.6 The test device should be cleaned periodically.

* *References:* *A.H. Bowker*
H.P. Goode
"Sampling Inspection by Variables"
McGraw-Hill 1952



d = approx. 150 mm

FIGURE A1 MEASURING DEVICE (DIAGRAM)



* DETERMINED BY USER

FIGURE A2 MEASURING MASK

APPENDIX B

LAYER-TO-LAYER ADHESION

A piece of the tape to be tested, about 1 m in length, shall be wound around a glass pipe, 36 mm in diameter, with a tension of 3 N, and fixed at the end. This shall be stored for 24 hours at a temperature of (45 ± 3) ^{o}C, and at 80% RH. After this period it shall be stored for another 24 hours in the testing environment specified in Section 3. The tape shall then be unwound with a mass of 8,3 g at the end of tape as shown below, and the angle (θ) shall be smaller than 45^{o}.