

ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

STANDARD ECMA-46

FOR

DATA INTERCHANGE ON 6,30 mm
MAGNETIC TAPE CARTRIDGE
(63 bpm, Phase Encoded)

March 1976

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ECMA European Computer Manufacturers Association
114 Rue du Rhône — 1204 Geneva (Switzerland)

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BRIEF HISTORY

ECMA TC19 was set up by ECMA in January 1970 with aim to 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 Phase-Encoded Magnetic Tape Cassettes at a density of 32 bpmm, TC19 undertook a new project for a 6,30 mm phase-encoded magnetic tape cartridge at a density of 63 bpmm.

The final draft of the ECMA Standard was presented to ISO/TC97 as a proposed draft for an international standard. Similar work was also in progress in the American National Standard Institute (ANSI). As a result ISO/TC97/SC11 eventually adopted a final draft for an international standard at their July 1974 meeting.

The present Standard ECMA-46 is in its content identical to the future ISO standard. It has been adopted by the General Assembly of ECMA in December 1975.

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1. SCOPE

- 1.1 To set a standard for a 6,30 mm magnetic tape cartridge to provide data interchange and physical interchangeability between information processing systems utilizing the ECMA 7-bit Coded Character Set (ECMA-6), its extensions (ECMA-35) and/or the ECMA 8-Bit Coded Character Set (ECMA-43).

The cartridge is of the twin hub coplanar type, loaded with a 6,30 mm wide magnetic tape for digital recording using the 63 bits per mm phase encoding method. The tape is transported between hubs by an internal belt capstan to the external drive. No tape driving or positioning sensing elements penetrate the cartridge. The direction of magnetization is in the longitudinal direction of the tape.

- 1.2 The Standard applies to cartridges used for data interchange. Where it applies for testing only, this is specifically stated.

2. DEFINITIONS AND EXPLANATION OF TERMS

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 arbitrarily 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 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 specified test packing density (see 4.3).

2.6 Test Recording Current

A recording current between 145 % and 155 % of the current required to produce the Reference Field.

2.7 Signal Amplitude Reference Tape Cartridge

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

Note : It is expected that a Master Standard for Signal Amplitude will be established by the National Bureau of Standards (NBS) in Washington.

Secondary Signal Amplitude Reference Tape Cartridges would then also be made available.

2.8 Standard Reference Amplitude

The Standard Reference Amplitude is the average peak-to-peak signal amplitude derived from the Signal Amplitude Reference Tape Cartridge, at a density of 126 ftpmm using the Test Recording Current (see 2.6). The signal amplitude shall be average over 4000 flux transitions (see 4.3).

2.9 Average Signal Amplitude

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

2.10 In contact

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

2.11 Track

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

2.12 Bit density

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

2.13 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.

2.14 Erasing field

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

2.15 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.

2.16 Typical Field

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

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 : $(23 \pm 2)^{\circ}\text{C}$
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 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 : 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.

4. CHARACTERISTICS OF THE TAPE

4.1 Mechanical properties

4.1.1 Tape width

The width of the tape shall be :

$$6,30 \text{ mm} \begin{matrix} + 0,00 \text{ mm} \\ - 0,06 \text{ mm} \end{matrix}$$

4.1.2 Tape length

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

$$91,5 \text{ m} \begin{matrix} + 3,0 \text{ m} \\ - 0,0 \text{ m} \end{matrix}$$

4.1.3 Tape thickness

The overall thickness of tape and coating shall be 31 um maximum with a maximum coating thickness of 6,5 um.

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 is 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 useable recording area is wound on the supply hub and is protected by at least one layer of tape. The two other markers are 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 is 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 indicates that the useable recording area has been exceeded. The two other markers are used to ensure reliability of detection.

4.1.4.2.2 Dimension

The diameter of the EOT holes shall be :

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

4.1.4.3 Load-Point (LP)

4.1.4.3.1 Definition and use

The LP marker is a single hole punched in the tape to indicate the beginning of the useable recording area in the forward direction.

4.1.4.3.2 Dimension

The diameter of the LP hole shall be :

0,58 mm \pm 0,05 mm

4.1.4.4 Early-Warning (EW)

4.1.4.4.1 Definition and use

The EW marker is a single hole punched in the tape for the purpose of indicating the approaching end of the useable recording area in the forward direction. Recording must halt before the EOT marker is sensed.

4.1.4.4.2 Dimension

The diameter of the EW marker shall be :

0,58 mm \pm 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 at least 13,4 N.

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 must 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 not exceed 0,13 mm.

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 Figure 2.

4.2 Electrical Properties

4.2.1 Surface Resistance

The surface resistance of the tape shall be between :

5. 10^5 and 10^9 Ohm per square

Note : 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 must be measured on the same relative pass for both the signal amplitude reference tape and the tape under test (read-while-write, or on equipment without read-while-write capability on the first forward-read-pass) on the same equipment.

4.3.1 Test density

Tape shall be tested at 126 ftpmm nominal.

4.3.2 Typical field

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

4.3.3 Average Signal Amplitude

When a tape has been recorded with the 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 within $\begin{matrix} + 25 \% \\ - 10 \% \end{matrix}$ of the Standard Reference Amplitude.

The output signal from the tape under test shall be measured on track # 1 (see 7.1).

4.3.4 Eraseure

4.3.4.1 Ease of erasure

When a tape has been recorded with the Test Recording Current, and then passed through a longitudinal steady erasure field of 79500 A per 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.

4.3.4.2 Eraseure Direction

The tape shall be magnetized so that the beginning of tape is a North-seeking pole.

4.3.5 Test for Missing Pulses and Extra Pulses

These tests shall be carried out in the in-contact condition and over the entire tested recording area using the Test Recording Current. The track spacing shall be as defined in 7.2.

4.3.5.1 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 35 % of half the Standard Reference Amplitude is a missing pulse (see 4.3.6).

4.3.5.2 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 is an extra pulse (see 4.3.6).

4.3.6 Rejected regions

A rejected region is an area of tape extending across the width of a track and not more than 25,4 mm in length, which on two consecutive tests exhibits extra pulses or missing pulses. The acceptable number of rejected regions in an interchange environment is a matter of agreement between interchange parties

4.3.7 Tested Recording Area

The Tested Recording Area is the 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 (see Fig. 10).

5. CHARACTERISTICS OF THE TAPE CARTRIDGE

5.1 General Description

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

5.1.1 Dimensions

The dimensions of the cartridge are as shown in Fig.3.

5.1.2 Cartridge Positioning Planes

The cartridge shall be referenced to the read/write machine only in the cross-hatched areas shown in Fig. 4. The application of forces suggested in Figure 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 machine in one position only; to ensure this, the cartridge has the following asymmetrical features (see Fig. 3).

- 1) a projection in one guide slot
- 2) the guide slots are accessible on the head opening edge only.

5.1.5 Light Sensing

The cartridge shall contain optical elements to permit photoelectric 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 is 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 Speeds

The cartridge may be used at any tape speed up to 2,29 m/s.

5.6 Driving Force

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

5.7 Total Inertia

The total equivalent mass of all moving cartridge elements shall, measured at the external driving surface of the capstan, not exceed 0,022 kg.

5.8 Dynamic Response

5.8.1 Definition

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

5.8.2 Requirement

The natural resonant frequency shall be at least 60 Hz.

5.8.3 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.

5.9 Tape Tension

When the cartridge is driven at a constant speed, the tape tension measured at the head location without the head engaged shall be between 0,28 N and 0,83 N.

5.10 Drive Ratio

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

5.11 Tape Path Length

The cartridge shall be used with drives causing a tape path length increase of $0,66 \text{ mm} \pm 0,05 \text{ mm}$.

NOTE :

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

6. RECORDING

6.1 Method of recording

The method of recording shall be phase encoding, described as follows :

- 6.1.1 The tape before the first block, the interblock gaps and that part of the tape following the last block written, shall be erased with the same polarity.

This polarity is such that the beginning of the relevant track is a North-seeking pole.

This erasing process forms part of the recording procedure.

- 6.1.2 A ZERO bit is a flux transition to the polarity opposite to that of the interblock gap, when reading in the forward direction.
- 6.1.3 A ONE bit is a flux transition to the polarity of the interblock gap, when reading in the forward direction.
- 6.1.4 Additional flux transitions shall be written at the nominal mid-points between bit flux transitions as defined in 6.1.2 and 6.1.3 if required, to establish the proper polarity for the succeeding bits. These flux transitions shall be called phase flux transitions.

6.2 Equipment

The equipment and cartridge used for interchange must satisfy the requirements of sections 6.3 to 6.5 inclusive. All signal measurements are made at a point in the read chain where the amplitude is proportional to the rate of change of the longitudinal component of the flux at the tape surface. For the purpose of relating bit spacing along the tape to cartridge driving speed, the ratio of tape speed to the surface speed of the capstan shall be assumed to be exactly 0,76.

6.3 Density of recording

- 6.3.1 The density of recording is 63 bpmmm nominal.
- 6.3.2 The long term average bit spacing is the spacing between bit flux transitions that have been recorded continuously at a nominal density of 63 ftpmm and must be measured over a length of tape of not less than 3,81 m.

The long term average bit spacing shall be within $\pm 3\%$ of the nominal bit spacing of 15,9 μm .

- 6.3.3 The short term average bit spacing referred to a particular bit spacing is the average of the preceding four bit spacings.

The short term average bit spacing shall be within the limits of $\pm 7\%$ of the long term average bit spacing.

In addition, the short term average bit spacing shall not change at a rate greater than 2% per bit.

6.4 Flux transition spacing

- 6.4.1 The spacing between successive bit flux transitions without an intervening phase flux transition shall be between 88% and

105 % of the short term average bit spacing. The spacing between successive bit flux transitions with an intervening phase flux transition shall be between 95 % and 112 % of the short term average bit spacing.

- 6.4.2 The spacing between a bit flux transition and any adjacent phase flux transition shall be between 44 % and 56 % of the short term average bit spacing.

6.5 Signal Amplitude

6.5.1 Average Signal Amplitude

The average peak-to-peak signal amplitude of the interchanged tape cartridge at 126 ftpmm shall not deviate by more than + 50 %, -35 % from the Standard Reference Amplitude. Averaging shall be done over a minimum of 4000 flux transitions, which for the interchange cartridge may be segmented into blocks.

6.5.2 Maximum Signal Amplitude

The peak-to-peak signal amplitude at 63 ftpmm shall be less than three times the Standard Reference Amplitude.

6.5.3 Minimum Signal Amplitude

No tape when interchanged shall contain any adjacent flux transitions whose peak-to-peak signal amplitude is less than 20 % of the Standard Reference Amplitude.

6.6 Azimuth Alignment

When adjusted for maximum output, the read azimuth angles for a Reference Alignment Cartridge and for the interchange cartridge shall not differ by more than ± 10 minutes of arc.

7. FORMAT

7.1 Number of Tracks

There shall be up to four tracks numbered # 1 to # 4. Each track is a data track and will be independent of the other tracks. Individual read/write units may provide one, two, or four tracks. Track # 1 shall be readable on all units. Track # 2 shall be readable on either two or four track units (i.e., track positions, track widths, and erased areas must be compatible between units with a varying number of tracks), Track designations are shown in Fig. 10.

7.2 Track Location and Width

Track locations and width are shown in Fig. 10. The nominal track width is 1,22 mm. The nominal spacing between track centre-lines is 1,625 mm.

7.3 Use of Tracks

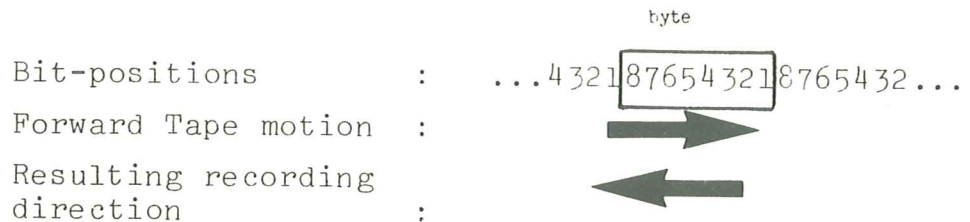
Each track shall be written serially starting near the BOT and continuing toward the EOT, with a rewind to BOT before initiating writing on the next track. All tracks are primarily data tracks, however, if one or more tracks are used for other than data, track # 1 must always be a data track

7.4 Location of characters on the tracks

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

7.5 Sequence of recording

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



7.6 Code

The characters shall be represented by means of the ECMA 7-Bit Coded Character Set (Standard ECMA-6) and, where required, of its extensions (Standard ECMA-35).

7.6.1 Recording of 7-bit Coded Characters

Each 7-bit coded character shall be recorded in bit-positions 1 to 7 of a byte; bit-position 8 is recorded with value 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-position in the byte :	8	7	6	5	4	3	2	1

7.6.2 Recording of 8-bit Coded Characters

Each 8-bit coded character shall be recorded in bit-positions 1 to 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-position in the byte :	8	7	6	5	4	3	2	1

7.7 Sequence of characters

The sequence of characters from start towards end of a block shall correspond to the normal left to right sequence of a written line.

7.8 Data block

A data block shall consist of a preamble, data, CRC and a postamble. The data part of a data block shall contain a minimum of 6 bytes and a maximum of 2048 bytes.

7.9 Control block

A control block (known as tape mark) shall consist of a preamble, two bytes of eight ZERO each, and a postamble.

7.10 Gaps

7.10.1 Integrity of Gaps

The gaps shall be DC erased. Immediately before and after each block there shall be a length of at least 2,5 mm in which, exclusive of residual edge signals, there is no flux discontinuity capable of producing a read signal of more than 10 % of half the Standard Reference Amplitude.

In the remaining part of the gap one burst of spurious transitions can be tolerated, provided that the total number of spurious transitions is at most 7.

7.10.2 Interblock gaps

The interblock gap, i.e. the distance between two successive data blocks, shall have a minimum length of 30,5 mm and a maximum length of 1220 mm. Any gap in excess of 2000 mm shall be considered end of data on this track.

7.10.3 Initial gap

The gap between the LP marker and the first bit of the first data block shall be at least 152,4 mm.

7.10.4 Gap Polarity

The polarity of all gaps shall be in the direction specified in 4.3.4.2.

7.11 Preamble and Postamble

7.11.1 Preamble

Immediately preceding data in each block the preamble consisting of 15 ZEROS and 1 ONE shall be written. When reading in the forward direction, the first flux transition shall be

a ZERO transition. The preamble may be used to establish a timing sequence so that the data can be read in the forward direction.

7.11.2 Postamble

Immediately following data and the CRC in each block the postamble consisting of 1 ONE and 15 ZEROS shall be written. When reading in the forward direction, the first flux transition shall be the ONE transition. The postamble may be used to establish a timing sequence so that the data can be read in the reverse direction.

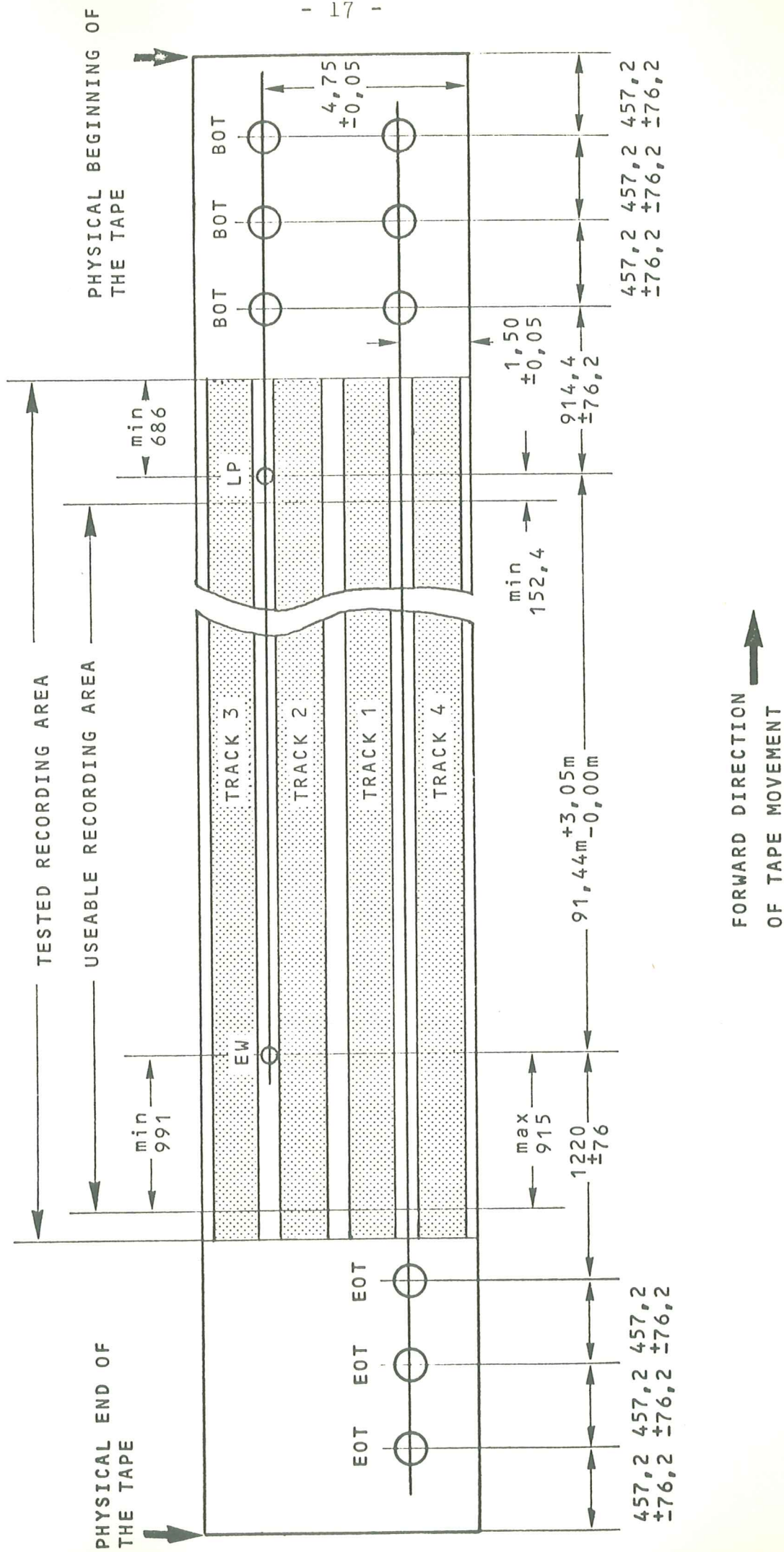
7.12 Cyclic Redundancy Check (CRC)

The 16-bit CRC shall be written in each data block following the data and immediately preceding the postamble. It is recorded in two bytes with the least significant bit recorded first. The polynomial generating the CRC is :

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

7.13 Useable Recording Area

All data to be interchanged shall be written within the useable recording area, which, in forward direction, extends from at least 152,4 mm after the LP marker to at most 915 mm after the EW marker (see Fig. 1).



FORWARD DIRECTION
OF TAPE MOVEMENT

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

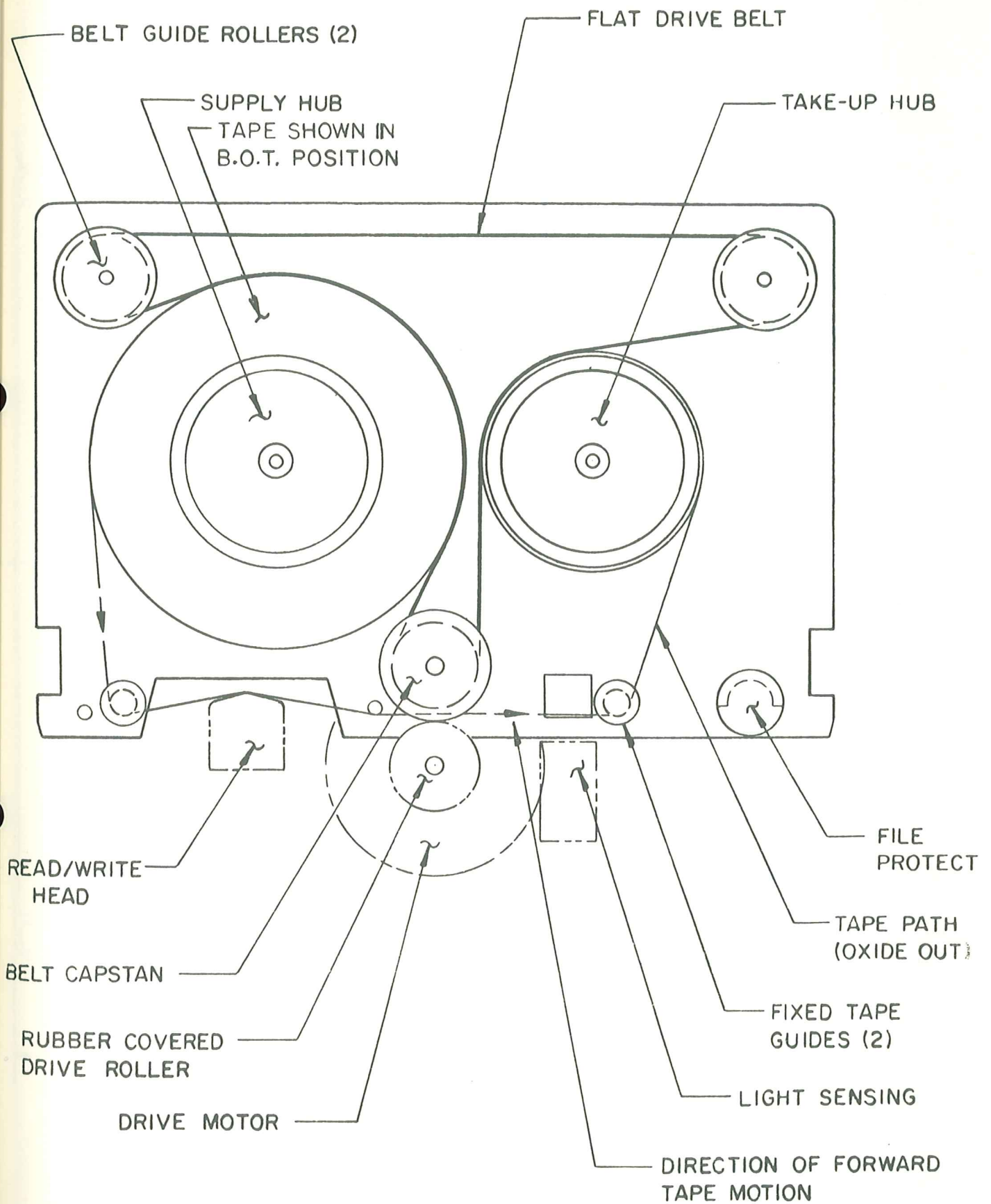


Fig. 2 CARTRIDGE DIAGRAM

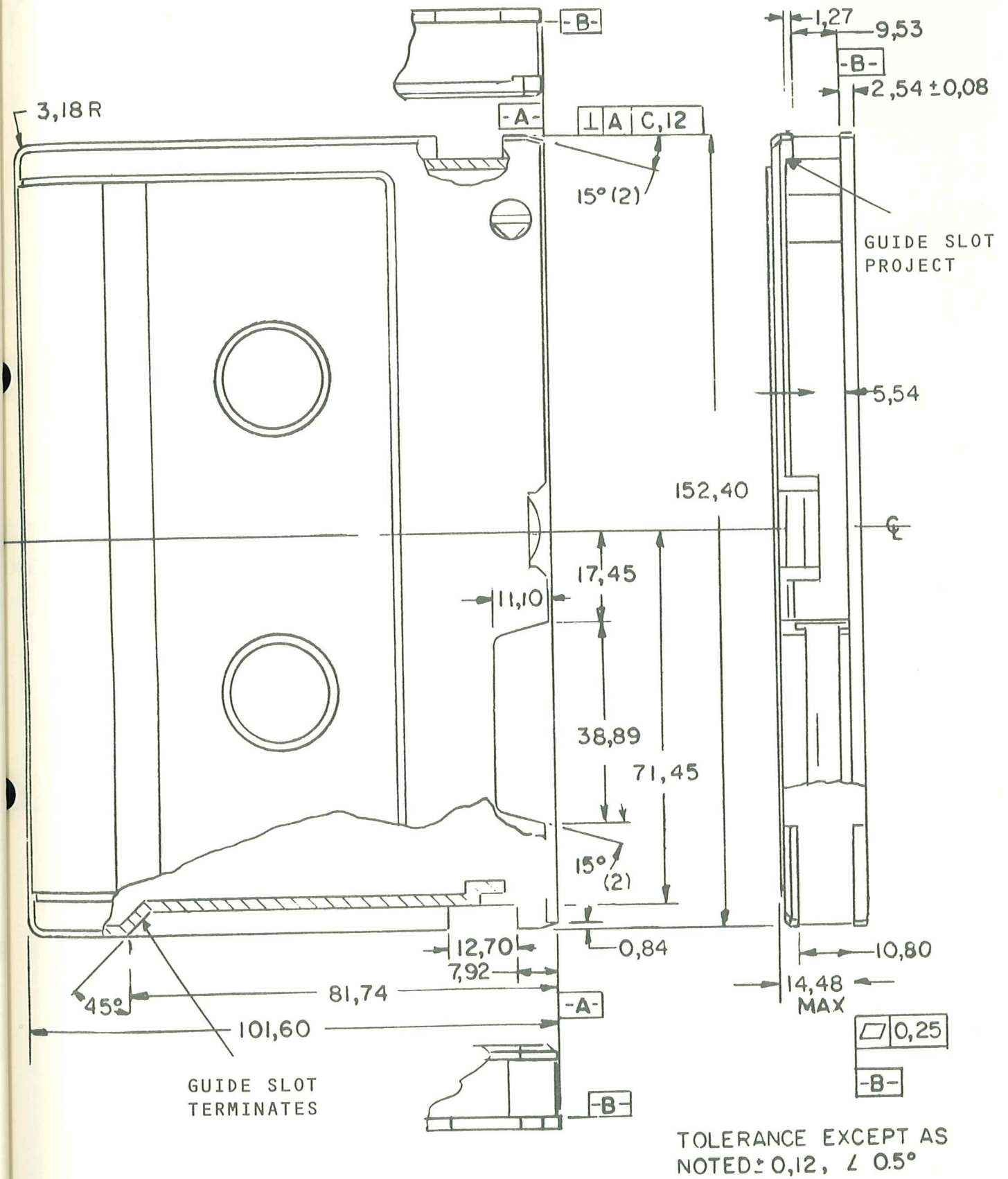


Fig. 3 CARTRIDGE DIMENSIONS

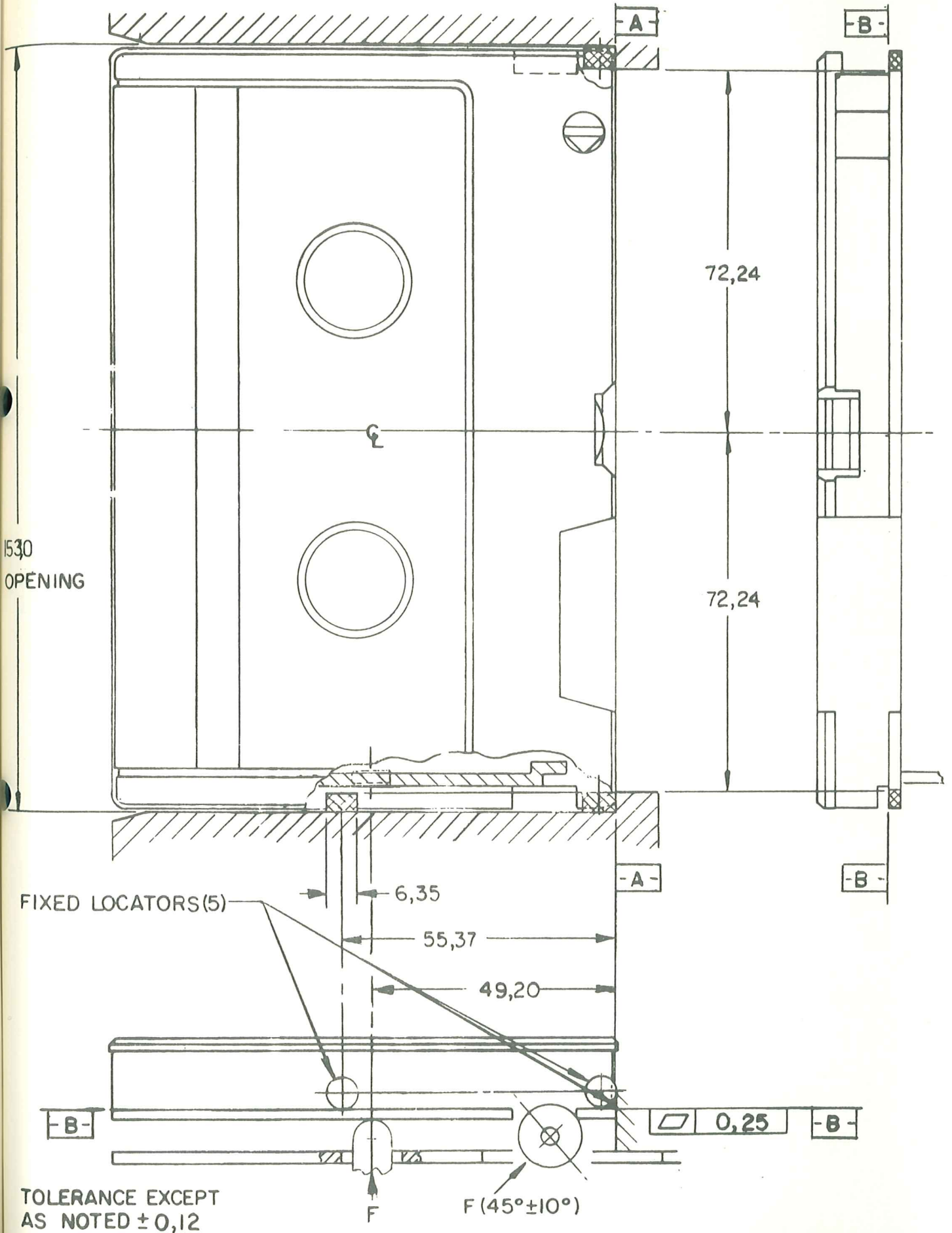
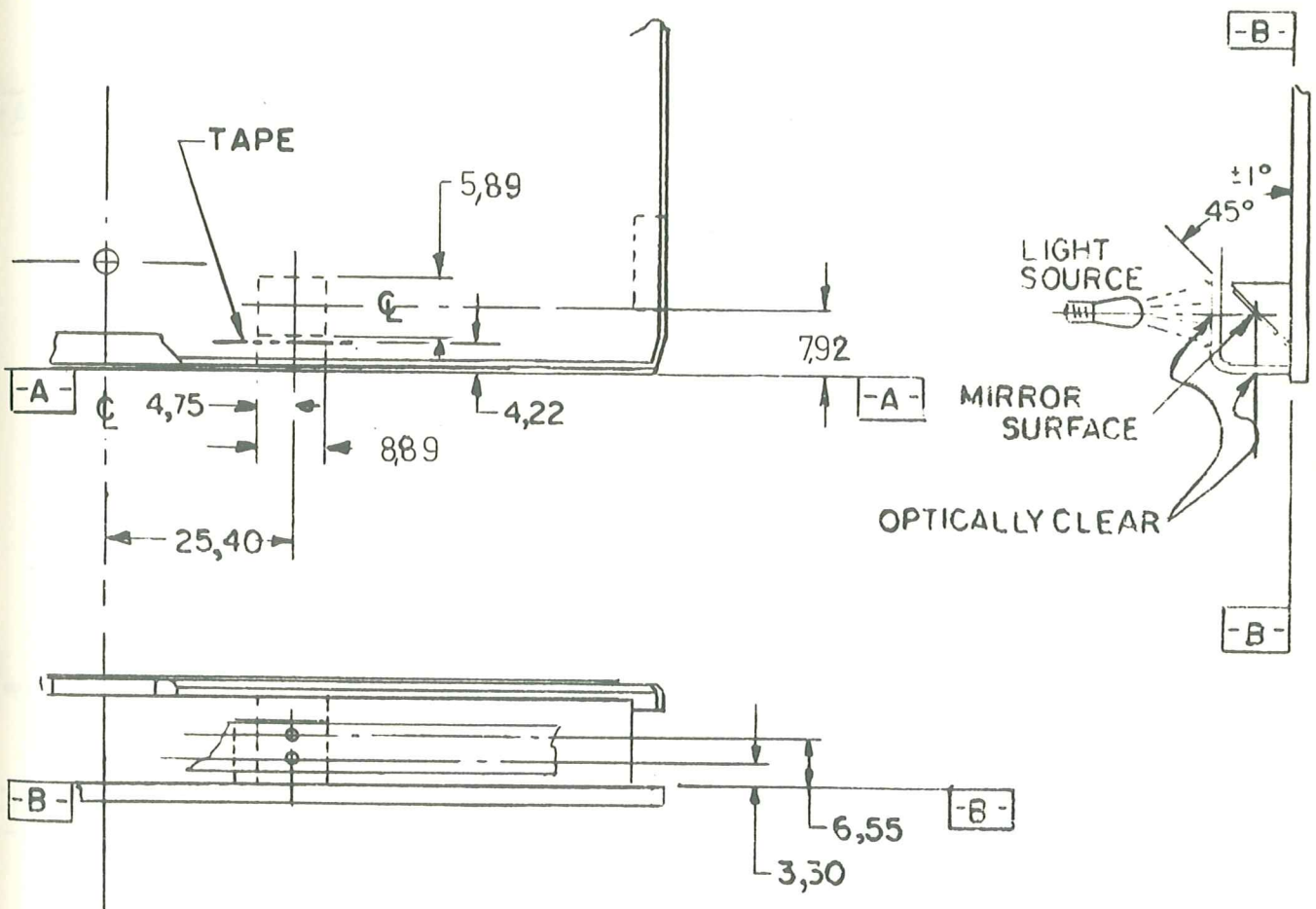
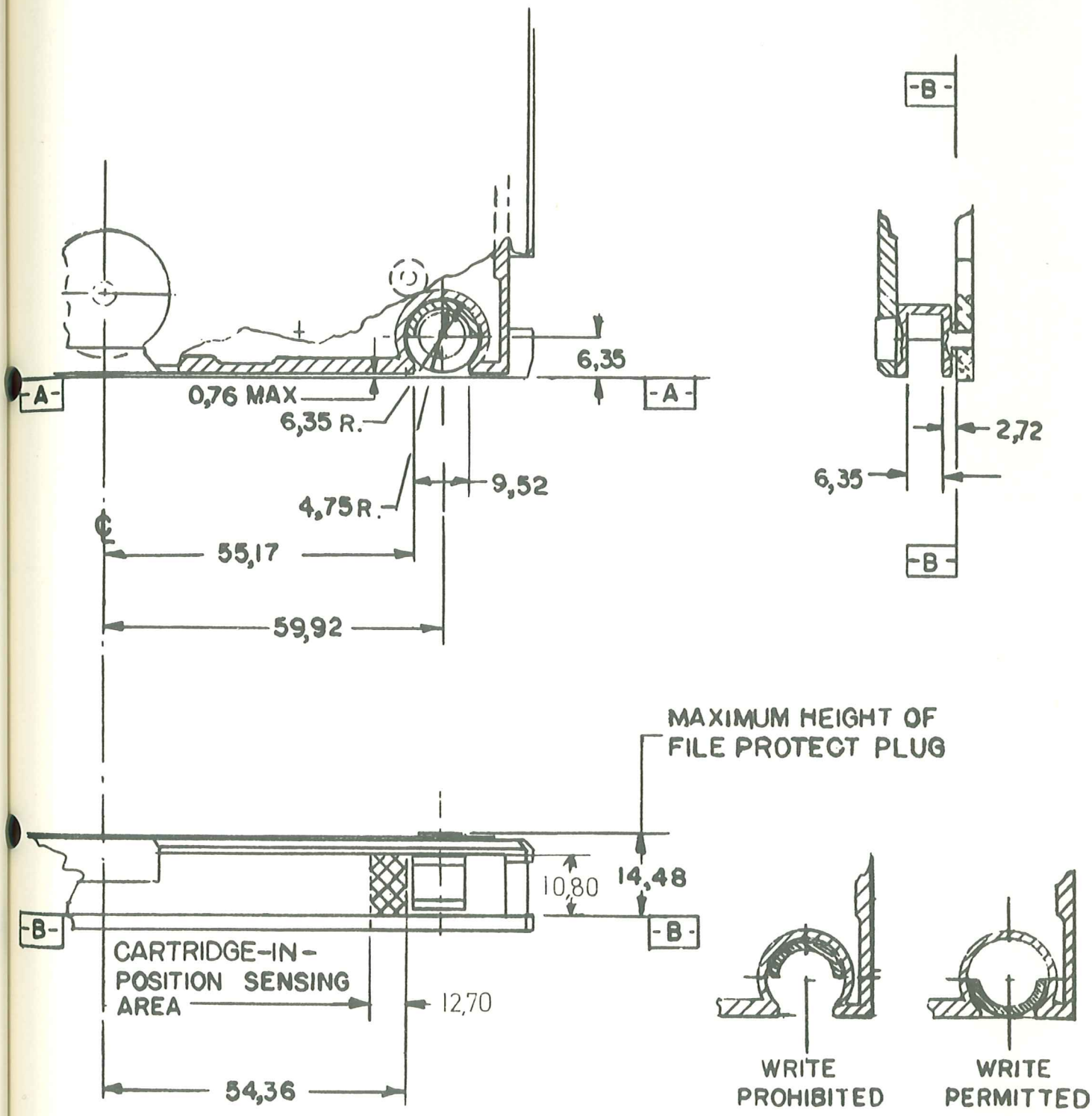


Fig. 4 CARTRIDGE LOCATING PLANES



TOLERANCE EXCEPT
AS NOTED: $\pm 0,12$

Fig. 5 LIGHT SENSING



TOLERANCE EXCEPT AS NOTED: $\pm 0,12$

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

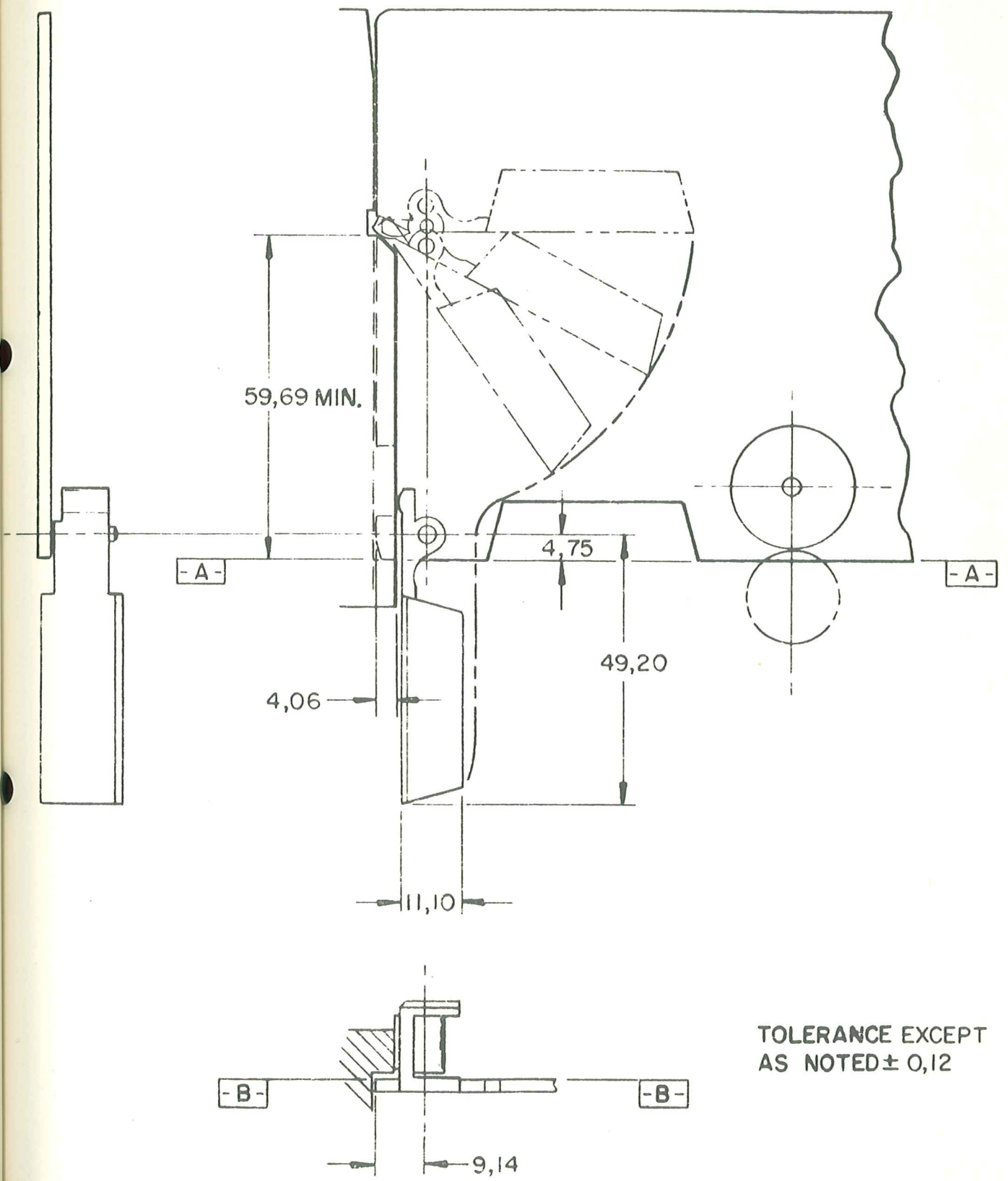
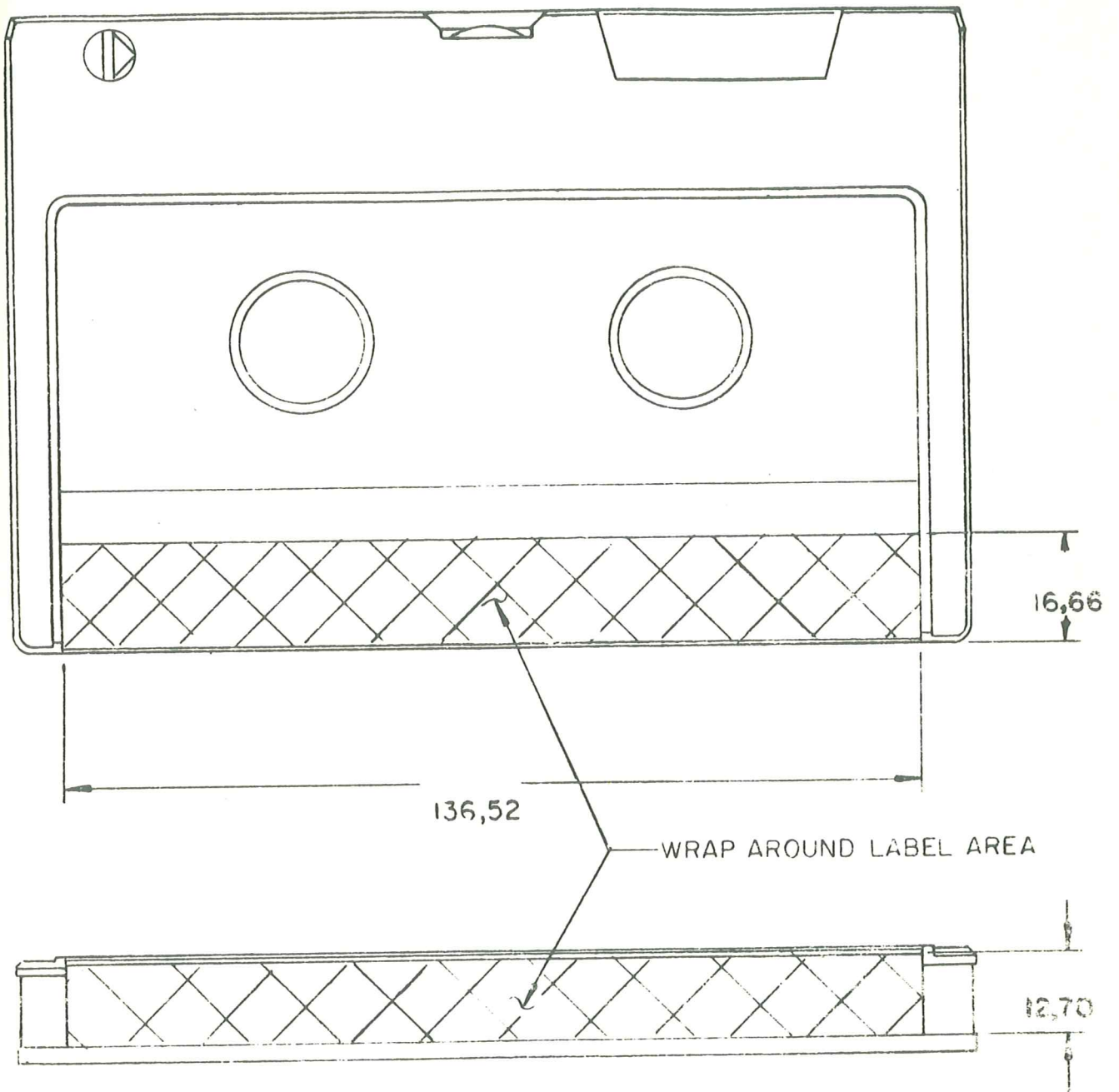


Fig. 7 CARTRIDGE DOOR PROFILE



TOLERANCE $\pm 0,12$

Fig. 8 LABEL AREA

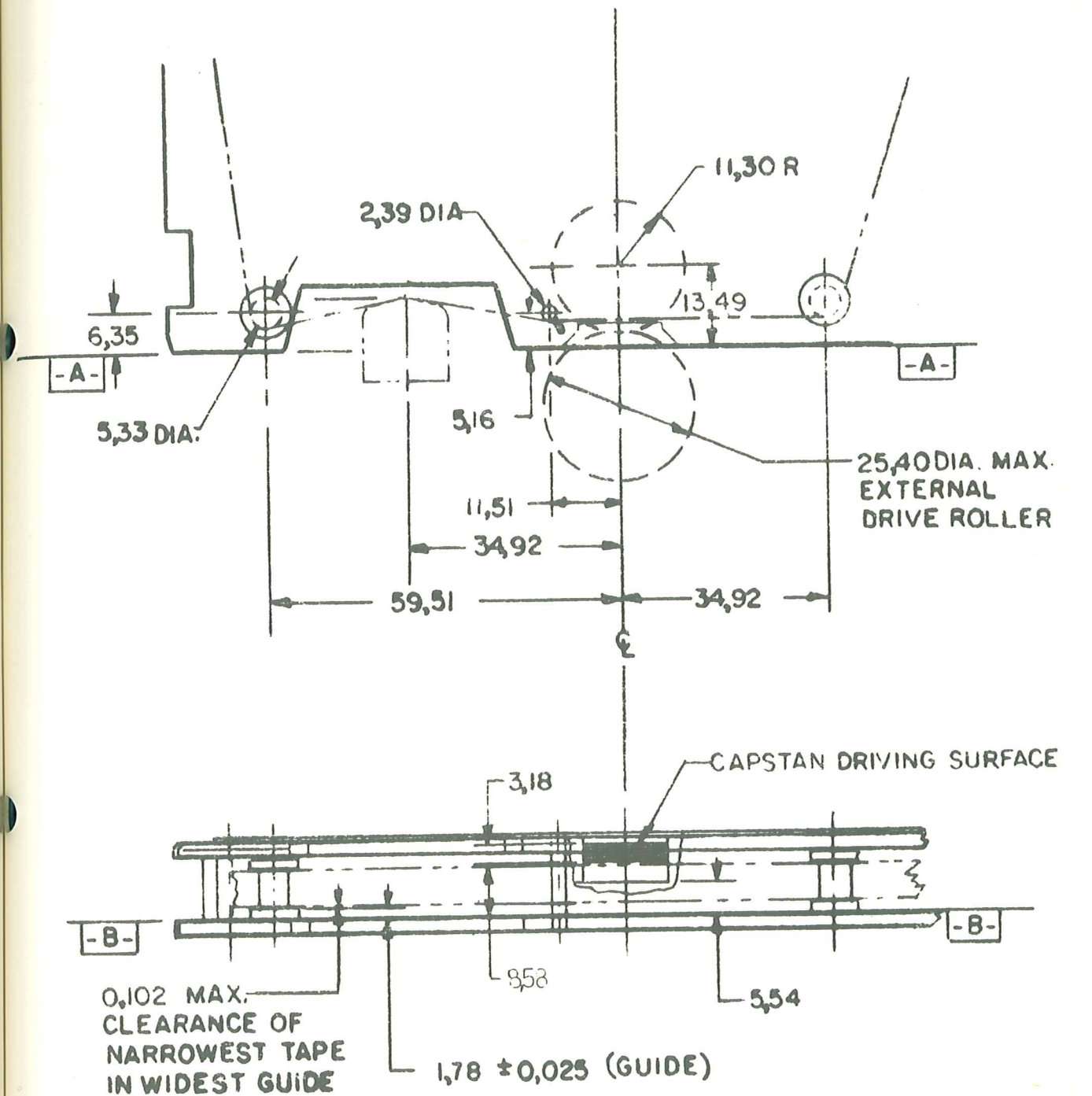
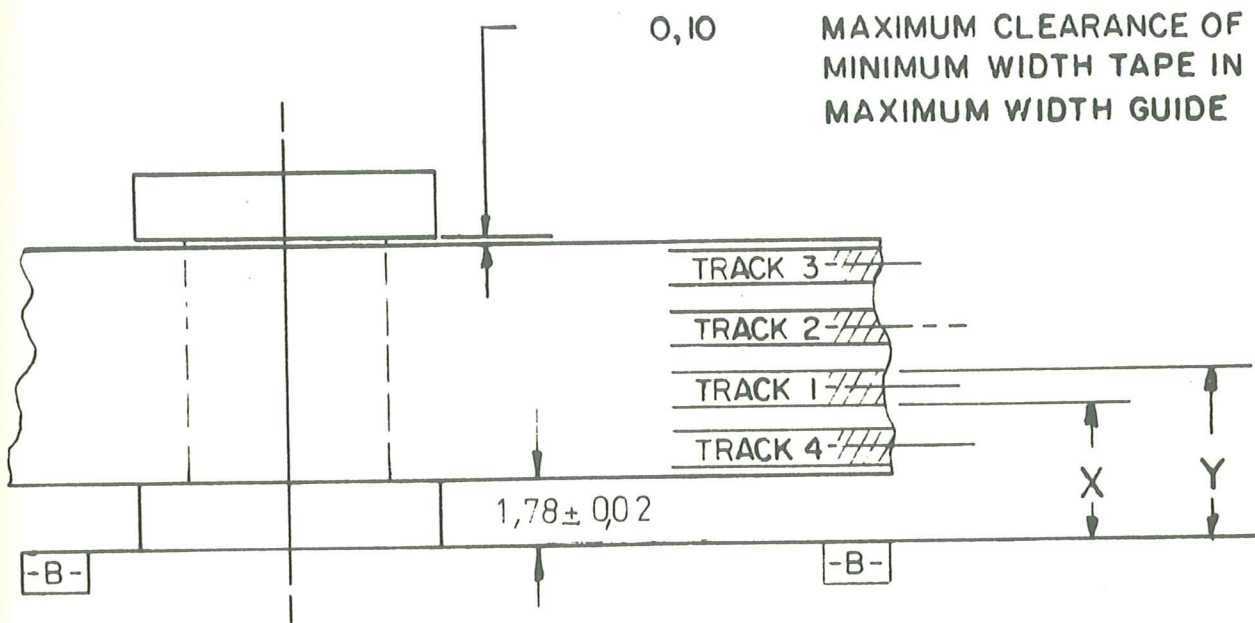


Fig. 9 TAPE PATH AND DRIVE DIMENSIONS



TRACK DIMENSIONS TO CARTRIDGE REFERENCE

TRACK #	DIMENSION X		DIMENSION Y	
	MAX	MIN	MAX	MIN
1	3,71	3,30	4,93	4,52
2	5,33	4,93	6,55	6,15
3	6,96	6,55	8,18	7,77
4	2,08	1,68	3,30	2,90

Fig.10 TAPE GUIDE AND TRACK DIMENSIONS

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 photo cell
- 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 $2000\text{ K} \pm 200\text{ K}$ 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 $900\text{ nm} \pm 50\text{ nm}$.

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 $\pm 0,05 \%$.

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 \bar{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 O and gives the values for

$k = 2,33$ and

(*) $n = 45$

If $T \leq T_{max}$, 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, regulated power supply.

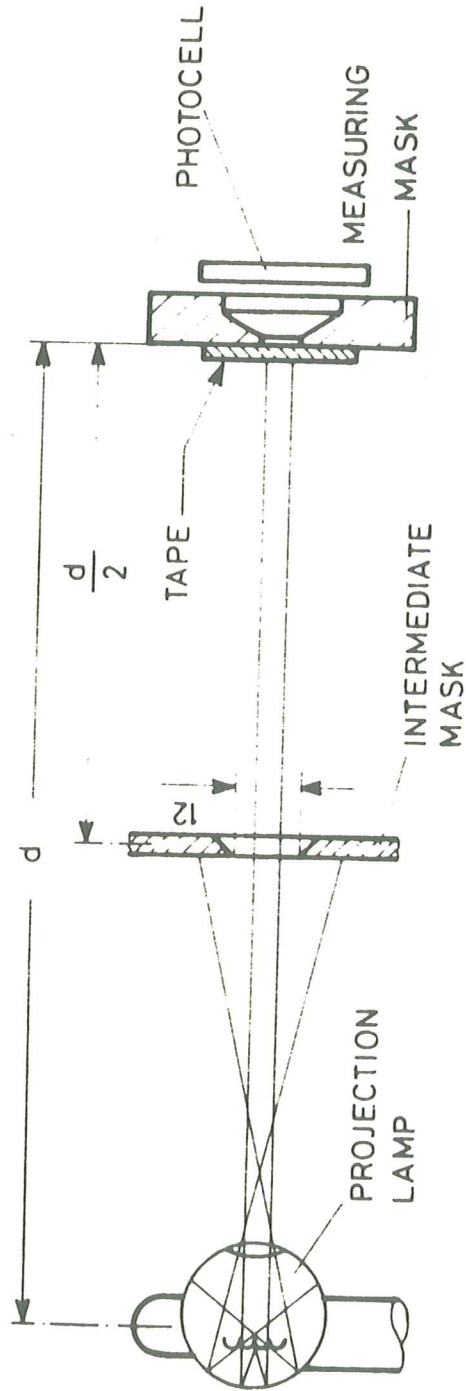
A 4.2 Special attention must be paid to all surfaces parallel to the optical path and in close proximity to the mask and photocell to avoid reflection of light. Similarly, the method of inserting the tape must ensure that no ambient light leaks through any slot arrangement.

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

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

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.

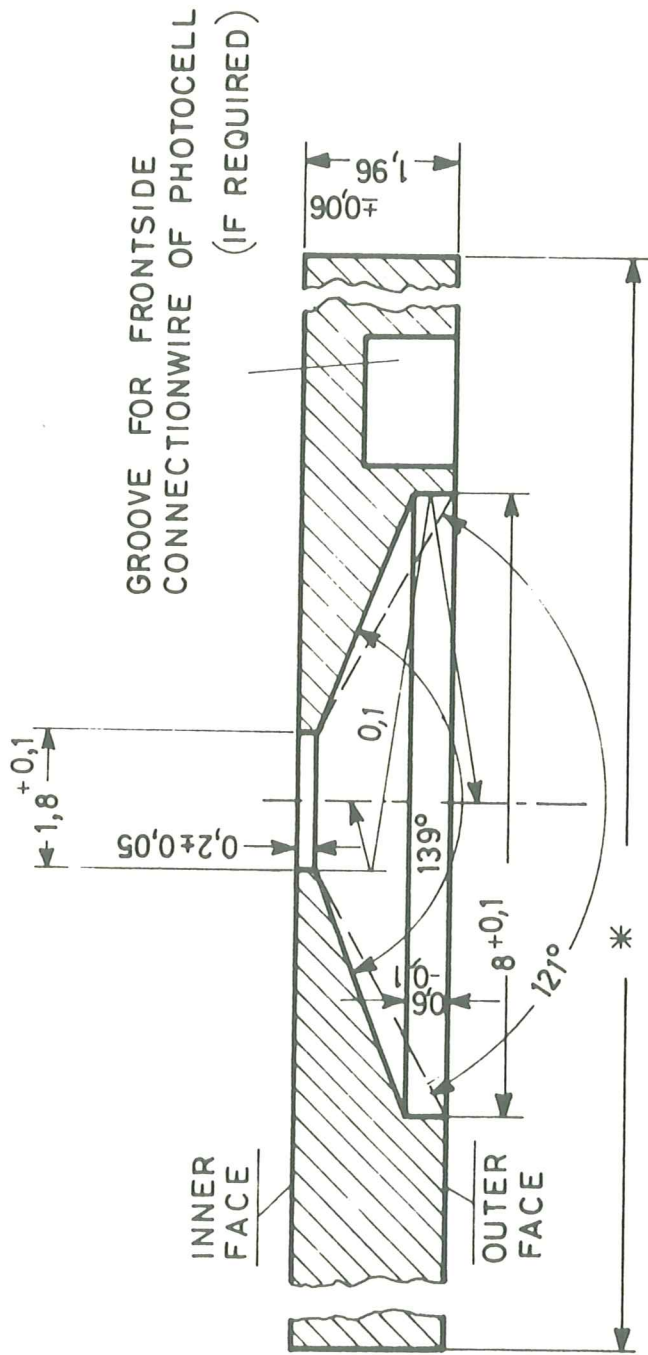
- A 4.4 The photocell must be mounted with care, taking special precaution that the photocell leads do not interfere with the mounting arrangement. It is advisable that the face of the photocell presses slightly on the outer face of the mask.
- A 4.5 An effective means of providing periodical calibration 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.



d = approx. 150 mm

FIGURE A1 MEASURING DEVICE (DIAGRAM)

tion



* 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 $(45 \pm 3)^{\circ}\text{C}$, 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° .

