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INTERNATIONAL STANDARD ⊕ISO 3562

Information processing — Interchangeable magnetic single disk cartridge (top loaded) — Physical and magnetic characteristics

Traitement de l'information — Chargeur interchangeable monodisque magnétique à chargement vertical — Caractéristiques mécaniques et magnétiques

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FOREWORD

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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.

International Standard ISO 3562 was drawn up by Technical Committee ISO/TC 97, *Computers and information processing*, and circulated to the Member Bodies in August 1974.

It has been approved by the Member Bodies of the following countries :

Australia	Ireland	Switzerland
Belgium	Italy	Turkey
Bulgaria	Japan	United Kingdom
Canada	Netherlands	U.S.A.
Czechoslovakia	New Zealand	U.S.S.R.
France	Poland	Yugoslavia
Germany	Romania	
Hungary	Spain	

No Member Body expressed disapproval of the document.

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1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the general, physical, and magnetic characteristics for the interchange of magnetic single disk cartridges (top loaded) in order to facilitate the interchange of data between electronic data processing systems.

It does not apply to a specific design. It defines only the parameters relevant for interchange.

2 GENERAL DESCRIPTION

2.1 General figures

A typical single disk cartridge is shown in figures 1 to 3.

2.2 Main elements

The main elements of this single disk cartridge are :

- the top cover

- the seal inserted in the rim of the top cover

- the recording disk

- the disk hub

- the armature plate

- the protective cover

- the removable cover

2.3 Other elements

Only the main elements are shown in the drawings. Usual disk cartridges may generally comprise also a handle, a mechanism for disconnecting the removable cover from the position of figure 2 so that it can be placed in the position of figure 3, and means for removing the disk cartridge from the drive. These other elements are not represented as they are not part of this International Standard.

2.4 Non-working and working positions

Figure 2 shows the cartridge in the unmounted condition, in which the removable cover is maintained in contact with the seal in the top cover so as to prevent ingress of dirt and contamination. A means must be provided to safely restrain the disk within the cartridge during operator handling, shipping, etc.

Figure 3 shows the cartridge in the mounted position, with the removable cover on top of the cartridge. In this position the rim of the removable cover lies on the upper surface of the rim of the top cover. Not represented is the mechanism of the disk drive which exerts a downward retaining force on the pressure area of the removable cover.

2.5 Direction of rotation

The recording disk shall rotate counter-clockwise when viewed from the top.

3 GENERAL REQUIREMENTS

3.1 Operating, storage and test environments

3.1.1 *Operating environment*

The operating temperature measured within the cartridge shall lie within the range 15 to 50 °C (60 to 120 °F) at a relative humidity of 8 to 80 %. The wet bulb reading shall not exceed 26 °C (78 °F). Before a cartridge is placed into operation, it shall be conditioned within its covers for a minimum of 2 h in the same environment as that in which the disk drive is operating. The above specified range does not necessarily apply to the disk drive.

3.1.2 *Storage environment*

3.1.2.1 Unrecorded disks

The storage temperature shall lie within the range − 40 °C to + 65 °C (− 40 °F to + 150 °F), the wet bulb reading not exceeding 30 °C (85 °F). For wet bulb temperatures between 0,5 °C (33 °F) and 30 °C (85 °F) the disk cartridge shall be able to withstand a relative humidity of 8 to 80 %.

3.1.2.2 Recorded disks

The storage temperature shall lie within the range − 40 °C to + 65 °C (− 40 °F to + 150 °F), the wet bulb reading not exceeding 30 °C (85 °F). For wet bulb temperatures between 0,5 °C (33 °F) and 30 °C (85 °F) the disk cartridge shall be able to withstand a relative humidity of 8 to 80 %.

The stray magnetic field intensity shall not exceed 4 000 A/m.

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3.1.3 *Test environment*

Unless otherwise stated, measurements shall be carried out at $23 \pm 3\,^{\circ}\text{C}$ ($73 \pm 5\,^{\circ}\text{F}$), 40 to 60 % relative humidity after 24 h of acclimatization. Tests shall be carried out with the disk cartridge in the upright position, unless otherwise stated.

3.2 Resistance to shock and vibration

The disk cartridge shall withstand the exposure to shock and/or vibration expected during normal operator usage and still meet all dimensional and functional specifications of this International Standard. Protection against shock and vibration during transportation and storage shall be subject to agreement between supplier and user.

3.3 Materials

Unless otherwise stated, the disk cartridge may be constructed from any suitable material so long as the dimensional, inertial and other functional requirements of this International Standard are maintained. The coefficient of thermal expansion of the disk material should preferably be :

$$\frac{\Delta l}{l \times \Delta t} = \frac{l_2 - l_1}{l\,(t_2 - t_1)} = (24 \pm 2) \times 10^{-6}/^{\circ}\text{C}$$

$$[(13.3 \pm 1) \times 10^{-6}/^{\circ}\text{F}]$$

where

l_1 is the length at $t_1 = 15\,^{\circ}\text{C}$ ($60\,^{\circ}\text{F}$);

l_2 at $t_2 = 50\,^{\circ}\text{C}$ ($120\,^{\circ}\text{F}$);

$l = (l_2 + l_1)/2$.

4 PHYSICAL REQUIREMENTS

4.1 Dimensions

4.1.1 *Overall external dimensions* (see figure 4)

4.1.1.1 EXTERNAL DIAMETER

The external diameter is equal to the outside diameter d_1 of the rim of the top cover (see 4.1.2.2).

4.1.1.2 EXTERNAL HEIGHT

The external height is

$$h_1 \leqslant 62 \text{ mm } (2.44 \text{ in}).$$

4.1.2 *Top cover with protective cover* (see figures 5 to 8)

4.1.2.1 REFERENCE AXIS

The reference axis is a line through the centre of the cartridge from which all angles and certain dimensions are deriv͏ͅ   figure 6).

4.1.2.2 OUTSIDE DIAMETER OF THE RIM

The outside diameter of the rim of the top cover is

$$d_1 = 381,3 \pm 0,5 \text{ mm } (15.010 \pm 0.020 \text{ in}).$$

4.1.2.3 INSIDE DIAMETER OF THE RIM

The inside diameter of the rim of the top cover is

$$d_2 = 370,3 \pm 0,4 \text{ mm } (14.580 \pm 0.015 \text{ in}).$$

This dimension must be met above and immediately below the rim.

4.1.2.4 HEIGHT BELOW THE RIM

The height of the top cover below its rim is

$$h_2 = 32,90 \pm 0,13 \text{ mm } (1.295 \pm 0.005 \text{ in}).$$

4.1.2.5 HEAD WINDOW

4.1.2.5.1 Location

The location of the head window is defined by the angles

$$\beta_1 = 11^{\circ}\ 0' \pm 15'\text{ and}$$

$$\beta_2 = 7^{\circ}\ 0' \pm 15'.$$

4.1.2.5.2 Edges

The distance of the upper edge of the head window from the rim of the top cover is

$$h_3 \leqslant 4,0 \text{ mm } (0.16 \text{ in}).$$

The distance of the lower edge of the head window from the rim of the top cover is

$$h_4 \geqslant 30,7 \text{ mm } (1.21 \text{ in}).$$

4.1.2.6 BRUSH WINDOW

4.1.2.6.1 Location

The location of the brush window is defined by the angles

$$\gamma_1 \geqslant 58^{\circ}\text{ and}$$

$$\gamma_2 \leqslant 18^{\circ}\ 31'.$$

4.1.2.6.2 Edges

The distance of the upper edge of the brush window from the rim of the top cover is

$$h_5 \leqslant 7,0 \text{ mm } (0.27 \text{ in}).$$

The distance of the lower edge of the brush window from the rim of the top cover is the same as h_4 (see 4.1.2.5.2).

4.1.2.7 BRUSH AREA (see figure 7)

4.1.2.7.1 Location

The location of the brush area is defined by the angle δ and the radius r_1 :

$$\delta = 52° \text{ nominal, and}$$

$$r_1 = 220 \text{ mm (8.66 in) nominal.}$$

4.1.2.7.2 Dimension

The brush area has the form of a sector of a circle, its minimum surface is defined by the radius r_2 centred as defined by δ and r_1 :

$$r_2 = 120 \text{ mm (4.72 in) nominal.}$$

4.1.2.8 NOTCHES (see figures 5 and 6)

The top cover comprises four notches N_1, N_2, N_3, N_4.

4.1.2.8.1 Location of the notches

Notch N_1 : The location of notch N_1 is defined by the angle

$$\alpha_1 = 20° \, 0' \text{ nominal.}$$

Notch N_2 : The location of notch N_2 is defined by the angle

$$\alpha_2 = 20° \, 0' \text{ nominal.}$$

Notch N_3 : The location of notch N_3 is defined by the angle

$$\alpha_3 = 64° \, 0' \text{ nominal.}$$

Notch N_4 : The location of notch N_4 is defined by the angle

$$\alpha_4 = 51° \, 0' \pm 15'.$$

4.1.2.8.2 Depth of the notches

All four notches have the same minimum depth defined by the radius

$$r_8 \leqslant 176,83 \text{ mm (6.962 in).}$$

4.1.2.8.3 Width of the notches

Notches N_1, N_2 and N_3 have the same width

$$w_1 \geqslant 12,7 \text{ mm (0.50 in).}$$

Notch N_4 has a width

$$w_2 = 8,23 \pm 0,13 \text{ mm (0.324} \pm \text{0.005 in).}$$

4.1.2.8.4 Edge

The distance of the upper edge of the notches from the rim of the top cover is

$$h_6 \leqslant 23,0 \text{ mm (0.91 in).}$$

4.1.2.8.5 Inside radii

All inside radii shall not exceed 0,5 mm (0.02 in).

4.1.2.9 SEAL

4.1.2.9.1 Location

The seal is inserted in the lower surface of the rim of the top cover defined by the diameters d_1 and d_2 (see 4.1.2.2 and 4.1.2.3).

4.1.2.9.2 Other requirements

The material of the seal must be such that the seal does not protrude from the lower surface of the rim, when the cartridge is in the mounted position with the removable cover in the position of figure 3 and with the proper pressure applied to it (see 4.4.1).

4.1.2.10 OPENING FOR THE INDEX TRANSDUCER

4.1.2.10.1 Location

The location of the opening for the index transducer is defined by the distance a and radius r_3 :

$$a = 14,5 \pm 0,5 \text{ mm (0.571} \pm \text{0.020 in) and}$$

$$r_3 = 112,5 \pm 0,5 \text{ mm (4.430} \pm \text{0.020 in).}$$

4.1.2.10.2 Width

The width of the opening for the index transducer is

$$w_3 = 29,0 \pm 0,5 \text{ mm (1.142} \pm \text{0.020 in).}$$

4.1.2.10.3 Depth

The distance of the bottom of the opening for the index transducer below the rim of the top cover is

$$h_7 \leqslant 25,7 \text{ mm (1.01 in).}$$

4.1.3 Removable cover, pressure area (see figure 9)

The removable cover comprises a pressure area which is defined as follows, when the removable cover is in the working position :

4.1.3.1 NOMINAL RADIUS

The nominal radius of the pressure area is

$$r_4 = 169,0 \text{ mm (6.65 in) nominal.}$$

4.1.3.2 LIMITS

The limits of the pressure area are defined by the radii

$$r_5 = 167,0 \text{ mm (6.57 in) nominal, and}$$

$$r_6 = 182,0 \text{ mm (7.17 in) nominal.}$$

4.1.3.3 HEIGHT OVER THE RIM OF THE TOP COVER

The height of the pressure area at radius r_4 over the lower surface of the rim of the top cover is

$$h_8 = 45,5 \pm 1 \text{ mm } (1.79 \pm 0.04 \text{ in}).$$

4.1.3.4 SLOPE

At radius r_4 the slope of the pressure area is defined by the angle

$$\epsilon = 13 \pm 2^\circ.$$

4.1.3.5 RIGIDITY

The rigidity of the removable cover must be such that under the locking force specified in 4.4.2, it retains all the dimensions listed above.

4.1.4 Disk (see figures 10 and 11)

4.1.4.1 DIAMETER

The diameter of the disk is

$$d_3 = 356,25 \pm 0,15 \text{ mm } (14.026 \pm 0.006 \text{ in}).$$

4.1.4.2 THICKNESS

The thickness of the disk is

$$e_1 = 1,27 \pm 0,05 \text{ mm } (0.050 \pm 0.002 \text{ in}).$$

4.1.4.3 DISK EDGE RELIEF

For a distance

$$b \leqslant 1,3 \text{ mm } (0.05 \text{ in})$$

from the outside edge of the disk, the disk contour may be relieved within the extended boundaries of the disk surfaces.

4.1.4.4 LOCATION OF MAGNETIC SURFACE

The area of the magnetic coating extends from an inside diameter of 208,3 mm (8.20 in) maximum to an outside diameter of 353,6 mm (13.92 in) minimum.

4.1.5 Disk hub (see figure 10)

4.1.5.1 DIAMETER

The diameter of the disk hub is

$$d_4 \leqslant 187,45 \text{ mm } (7.38 \text{ in}).$$

Up to a height

$$h_9 = 7,5 \text{ mm } (0.295 \text{ in})$$

from the lower surface of the armature plate, the diameter of the hub is

$$d_5 \leqslant 145,0 \text{ mm } (5.70 \text{ in}).$$

4.1.5.2 BORE

4.1.5.2.1 Angle

The angle of the conical bore is

$$\theta = 40^\circ \, 0' \, {}^{+ \, 10'}_{ 0}$$

4.1.5.2.2 Upper diameter

The diameter of the upper hole of the hub is

$$d_6 = 8,00 \pm 0,25 \text{ mm } (0.314 \pm 0.010 \text{ in}).$$

4.1.5.2.3 Finish

The finish shall be of class N8 (maximum arithmetical mean deviation : 3,2 μm (126 μin), see ISO/R 1302).

4.1.5.3 COMPLIANCE

With the disk hub supported by the armature plate, a centrally applied force of 67 N (15 lbf) shall result in a 0,15 to 0,28 mm (0.006 to 0.011 in) deflection.

4.1.6 Armature plate (see figures 10 and 12)

4.1.6.1 DIAMETERS

The outer diameter of the armature plate is

$$d_7 = 145,8 \pm 0,2 \text{ mm } (5.740 \pm 0.008 \text{ in}).$$

The inner diameter is

$$d_8 = 101,6 \pm 0,5 \text{ mm } (4.00 \pm 0.02 \text{ in}).$$

4.1.6.2 THICKNESS

The thickness of the armature plate is

$$e_2 = 2,34 \pm 0,03 \text{ mm } (0.092 \pm 0.001 \text{ in}).$$

4.1.6.3 INDEX SLOT

4.1.6.3.1 Depth

The minimum depth of the index slot is defined by the radius

$$r_7 \leqslant 71,2 \text{ mm } (2.808 \text{ in}).$$

4.1.6.3.2 Width

The width of the index slot is

$$w_4 = 2,03 \, {}^{0}_{- \, 0,13} \text{ mm } (0.080 \, {}^{0}_{- \, 0.005} \text{ in}).$$

4.1.7 *Disk and disk hub relationship* (see figure 10)

4.1.7.1 DISK HEIGHT OVER ARMATURE PLATE

The height of the lower surface of the disk above the lower surface of the armature plate is

$$h_{10} = 15,09 \pm 0,28 \text{ mm } (0.594 \pm 0.011 \text{ in}).$$

4.1.7.2 AXIAL RUNOUT OF THE DISK

The axial runout of the disk at any diameter, and any speed up to 2 500 rev/min, is included in the dimension h_{10}, but shall not exceed 0,28 mm (0.011 in).

4.1.7.3 ACCELERATION OF AXIAL RUNOUT

The acceleration of the disk surface in the axial direction shall not exceed 140 m/s² (5 500 in/s²) at any speed within the range 2 350 to 2 450 rev/min.

4.1.7.4 RADIAL RUNOUT OF DISK

The total indicated radial runout is

$$0,5 \text{ mm } (0.02 \text{ in}) \text{ maximum.}$$

4.1.7.5 ANGULAR SHIFT BETWEEN THE DISK AND THE DISK HUB

After the cartridge has experienced a positive or negative acceleration up to 3 000 rad/s², the angular shift between the disk and the disk hub must remain equal to zero, when measured with a device capable of detecting a shift of 3″ of arc.

4.1.8 *Armature plate and disk hub relationship* (see figure 10)

4.1.8.1 REFERENCE PLANE

The reference plane is the plane on which rests a reference ball of diameter

$$d_9 = 12,7 \text{ mm } (0.500 \text{ in}).$$

The rotational axis of the disk cartridge is perpendicular to the reference plane.

4.1.8.2 HEIGHT OF THE ARMATURE PLATE

The relationship between armature plate and the bore of the hub in the unmounted position is given by the height over the reference plane

$$h_{11} = 1,70 \pm 0,05 \text{ mm } (0.067 \pm 0.002 \text{ in}).$$

4.1.8.3 RADIAL RUNOUT OF THE ARMATURE PLATE

The total indicated radial runout of the armature plate is

$$0,4 \text{ mm } (0.016 \text{ in}) \text{ maximum.}$$

4.1.9 *Armature plate and top cover relationship* (see figure 10)

The height of the top cover rim of the lower surface of the armature plate in the mounted position is

$$h_{12} = 33,15 \pm 0,25 \text{ mm } (1.305 \pm 0.010 \text{ in}).$$

4.1.10 *Drive spindle and disk hub relationship* (see figure 10)

The drive spindle shall penetrate through the bore of the disk hub into a zone defined by

$$h_{13} = 18,83 \text{ mm } (0.741 \text{ in}) \text{ nominal, and}$$

$$h_{14} = 19,09 \text{ mm } (0.752 \text{ in}) \text{ nominal.}$$

4.2 Moment of inertia

The moment of inertia of the rotating parts of the disk cartridge shall not exceed 10 g·m² (34 lb·in²).

4.3 Maximum speed

The rotating parts of the disk cartridge shall be capable of withstanding the effect of stress at a speed of 2 500 rev/min.

4.4 Locking forces

4.4.1 *Hub locking force*

The disk hub shall be held to the disk drive spindle by a force of 155 ± 22 N (35 ± 5 lbf), exerted downwards on the armature plate.

4.4.2 *Removable cover locking force*

The covers of the disk cartridge in the mounted position shall be held against the disk drive by a force of 25 ± 10 N (5.60 ± 2.25 lbf), exerted downwards on the pressure area of the removable cover.

4.5 Balance

The rotating components of the disk cartridge shall be balanced within 100 g·mm (0.14 oz·in) when measured at 2 400 rev/min in a single plane parallel to the disk surface at h_{10}.

4.6 Operational earthing

The disk cartridge shall provide a discharge path from the disk to the drive spindle through the hub mechanism.

4.7 Material of the armature plate

The material of the armature plate shall permit the achievement of the specified hub locking force by magnetic means. It shall be electrically conductive.

4.8 Physical characteristics of magnetic surface

4.8.1 *Surface roughness*

The finished magnetic surface shall have a surface roughness less than 0,09 μm (3.5 μin) arithmetic average, with a maximum deviation in height of 0,76 μm (30 μin) from the average, when measured with a 2,5 μm (0.000 1 in) radius stylus and a 0,75 mm (0.03 in) cutoff range.

4.8.2 *Head gliding requirements*

In the band defined by the diameters 208,3 mm (8.20 in) and 353,6 mm (13.92 in), see 4.1.4.4, there shall be no head-to-disk contacts with heads flying at 1,25 μm (50 μin) at the inner diameter and increasing linearly to 1,65 μm (65 μin) at the outer diameter.

4.8.3 *Durability of magnetic surface*

4.8.3.1 RESISTANCE TO CHEMICAL CLEANING FLUID

The magnetic surface of the disk shall not be adversely affected when cleaned with a mixture consisting of 91 parts by volume of reagent grade isopropyl alcohol and 9 parts by volume of distilled or deionized water.

4.8.3.2 COATING ADHESION

The nature of the coating shall be such as to ensure the maintenance of adhesion under operating conditions. A possible test method is given in annex A.

4.8.3.3 ABRASIVE WEAR RESISTANCE

The coating shall be able to withstand operational wear. A possible test method is described in annex A.

5 MAGNETIC REQUIREMENTS

5.1 General geometry, surfaces and heads

The recording transducers shall be disposed as in figure 13. Head and surface details are as below.

Number (head or surface)	Head orientation
0 (Upper)	Down
1 (Lower)	Up

5.2 Track geometry

5.2.1 *Number of tracks*

There shall be 204 discrete concentric tracks per disk surface.

5.2.2 *Width of tracks*

The recorded track width on the disk surface after straddle erase shall be

$$0,175 \,_{-\,0,025}^{\quad 0} \text{ mm } (0.006\,9\,_{-\,0.001}^{\quad 0} \text{ in}).$$

The area between the tracks shall be erased. A suggested method of measuring effective track width is given in annex B.

5.2.3 *Track locations*

5.2.3.1 NOMINAL LOCATIONS

The geometry of the head disk system is defined in figure 13. The nominal radii of the centrelines of all tracks can be calculated by using the equation :

$$R_n = R_{73} - (n - 73) \times S$$

with the centreline radius of track 73 at 23,0 °C (73.4 °F)

$$R_{73} = 148,175 \text{ mm } (5.833\,7 \text{ in}),$$

the incremental head movement

$$S = 0,254 \text{ mm } (0.010\,0 \text{ in}),$$

the track number

$$n = 0 \text{ to } 203.$$

5.2.3.2 TRACK LOCATION TOLERANCE

The centrelines of the recorded tracks measured at 23,0 °C (73.4 °F) shall be within ± 0,025 mm (0.001 in) of the nominal positions.

NOTES

1 As track 73 is used to set up the drive, it is to be expected that the position of track 73 will be within ± 7,5 μm (0.000 3 in) of the nominal position.

2 At other temperatures (within those specified in this International Standard) the nominal track centreline can be calculated using a linear coefficient of thermal expansion of 24 × 10^{-6}/°C (13.33 × 10^{-6}/°F).

5.2.3.3 RECORDING OFFSET ANGLE

At the instant of writing or reading a magnetic transition, the transition may have an angle of ± 30′ maximum with the line of access.

5.2.4 *Identification*

For the purpose of testing, the following identifying system is used.

5.2.4.1 TRACK IDENTIFICATION

Track identification shall be by a three-digit decimal number (000 to 203) which counts tracks consecutively starting at the outermost track of each surface.

5.2.4.2 SURFACE IDENTIFICATION

The surfaces shall be numbered 0 and 1 to correspond to 5.1.

5.2.4.3 CYLINDER ADDRESS

A cylinder is defined as the tracks on the disk with a common track identification number.

5.2.4.4 TRACK ADDRESS

A four-digit decimal number shall be used for track address, with the three most significant digits defining the cylinder address and the remaining digit defining the surface address.

5.2.5 *Index*

Index is the point which determines the beginning and the end of a track. At the instant of detection of the leading edge of the index slot of the armature plate, the index is under the read-write gap on its line of access which forms an angle of $180°$ nominal with the leading edge of the index slot (see figure 14).

5.2.6 *Test areas*

5.2.6.1 HEADER AREA

For the purpose of testing, the header area is defined as that area starting not later than $120 \, \mu s$ after index and ending not sooner than $370 \, \mu s$ after index with the disk rotating at 2 400 rev/min.

5.2.6.2 DATA AREA

For the purpose of testing, the data area is defined as that area starting not later than $370 \, \mu s$ after index and continuing to the next index with the disk rotating at 2 400 rev/min.

5.3 Test conditions and equipment

5.3.1 *General conditions*

5.3.1.1 ROTATIONAL SPEED

The rotational speed shall be 2 400 ± 24 rev/min in any test period, the disk rotating counter-clockwise when viewed from above.

5.3.1.2 TEMPERATURE

The temperature of the air entering the disk cartridge shall be 27 ± 1 °C (81 ± 2 °F).

5.3.1.3 RELATIVE HUMIDITY

The relative humidity of the air entering the disk cartridge shall be between 40 and 60 %.

5.3.1.4 CONDITIONING

Before measurements commence, the disk cartridge shall be conditioned for 24 h in the same environment as that in which the test equipment is operating.

5.3.2 *Standard reference surfaces*

There are two standard reference surfaces which are held by approved agencies[1] as the references by which all secondary standards will be calibrated.

5.3.2.1 STANDARD AMPLITUDE REFERENCE SURFACE

5.3.2.1.1 Characteristics

The standard amplitude reference surface shall be characterized in areas designated by a scratch and defined as beginning $50 \, \mu s$ after the edge of the scratch and ending $275 \, \mu s$ from this edge.

This surface when recorded at $1f$ (see 5.3.4.3) without tunnel erase, using an amplitude test head (see 5.3.3.1), gives the following output :

at a radius of 115,087 ± 0,254 mm (4.531 ± 0.010 in) :

7,0 mV peak-to-peak,

at a radius of 166,726 ± 0,254 mm (6.564 ± 0.010 in) :

11,5 mV peak-to-peak.

5.3.2.1.2 Secondary standard amplitude reference surface

This is a surface whose output is related to the standard amplitude reference surface via a calibration factor C_{AD}.

The calibration factor C_{AD} is defined as :

$$C_{AD} = \frac{\text{standard amplitude reference surface output}}{\text{secondary standard amplitude reference surface output}}$$

To qualify as a secondary standard amplitude reference surface, the calibration factor C_{AD} for such disks shall satisfy $0,90 \leqslant C_{AD} \leqslant 1,10$ in the measured areas as defined in 5.3.2.1.1.

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1) A calibration service is available from the National Bureau of Standards (NBS) in Gaithersburg, Maryland, U.S.A. and the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany.

5.3.2.2 STANDARD DATA REFERENCE SURFACE

5.3.2.2.1 Characteristics

The standard data reference surface shall be characterized in an area designated by a scratch and defined as beginning 50 μs after the edge of the scratch and ending 275 μs from this edge.

The surface when recorded with straddle erase using a data test head (see 5.3.3.2) at a radius of 115,087 $\pm$ 0,254 mm (4.531 $\pm$ 0.010 in) gives an output of

4,0 mV peak-to-peak if recorded at 2f;

2,0 mV peak-to-peak if recorded at 4f (see 5.3.4.3).

5.3.2.2.2 Secondary standard data reference surface

This is a surface whose output is related to the standard data reference surface via the calibration factors C_{DD2} (for 2f) and C_{DD4} (for 4f).

The calibration factor C_{DD} is defined as :

$$C_{DD} = \frac{\text{standard data reference surface output}}{\text{secondary standard data reference surface output}}$$

To qualify as a secondary standard data reference surface, the calibration factors C_{DD} shall satisfy $0,90 \leqslant C_{DD} \leqslant 1,10$ for both frequencies in the measured area as defined in 5.3.2.2.1.

5.3.3 *Test heads*

5.3.3.1 AMPLITUDE TEST HEADS

Amplitude test measurements shall be taken with a suitable test head.[1] To qualify as an amplitude test head the head calibration factor C_{AH} shall satisfy $0,90 \leqslant C_{AH} \leqslant 1,10$.

The calibration factor C_{AH} is defined as :

$$C_{AH} = \frac{\text{standard amplitude reference surface output}}{\text{(actual head voltage measured)} \times C_{AD}}$$

when measured on the two radii of the secondary standard amplitude reference surface at 1f (see 5.3.2.1.2).

5.3.3.2 DATA TEST HEADS

All measurements other than amplitude test measurements shall be taken with a suitable test head.[2] To qualify as a data test head, the head calibration factor C_{DH} shall satisfy $0,90 \leqslant C_{DH} \leqslant 1,10$.

The calibration factor C_{DH} is defined as :

$$C_{DH} = \frac{\text{standard data reference surface output}}{\text{(actual head voltage measured)} \times C_{DD2}}$$

when measured on a secondary standard data reference surface at 2f (see 5.3.2.2.2) at the 115,087 mm (4.531 in) radius.

5.3.3.2.1 Resolution

The resolution of the data test head is defined as the ratio of the 4f to 2f average read amplitudes at the 115,087 mm (4.531 in) radius on the standard data reference surface, when measured over the same 225 μs sector. The resolution of a data test head shall be 40 to 60 %.

5.3.3.2.2 Resonant frequency

The resonant frequency of each of the read/write coils, when measured at the head-cable connector, shall be 4,2 MHz minimum.

5.3.4 *Specific conditions*

5.3.4.1 CONDITIONS FOR AMPLITUDE TEST HEAD MEASUREMENTS

5.3.4.1.1 Write current

The 1f current waveform measured at the head termination connector shall conform to figure 15, where :

$$\text{Write current } I_W = \frac{I_{W1} + I_{W2}}{2} = 35 \pm 1 \text{ mA}$$

$$\text{Overshoot} = 5 \text{ to } 10 \text{ % of } I_W$$

The difference between the positive and negative amplitudes of the stationary write current I_W shall be

$$|I_{W1} - I_{W2}| < 1 \text{ mA}$$

$$T_R = 140 \text{ to } 200 \text{ ns}$$

$$T_F = 140 \text{ to } 200 \text{ ns}$$

$$|T_R - T_F| \leqslant 20 \text{ ns}$$

Two consecutive half-periods T_1, T_2 shall not differ by more than 2 %.

5.3.4.1.2 DC erase current

The DC erase current supplied to one of the read/write coils when DC erase is specified shall be

$$I_E = 35 \pm 1 \text{ mA}$$

5.3.4.1.3 Read electronics

The differential input impedance of the read electronics shall be $7,5 \pm 0,37$ kΩ in parallel with a distributed and lumped capacitance of 45 ± 5 pF measured at the head termination connector (see figure 16). The amplifier shall have a passband flat within 5 % from 0,1 to 2,0 MHz.

---

1) For example, IBM 2316 (2311 type) amplitude test head is a suitable test head.

2) For example, IBM 2316 (2314 type) data test head is a suitable test head.

5.3.4.2 CONDITIONS FOR DATA TEST HEAD MEASUREMENTS

5.3.4.2.1 Write current

The $2f$ write current waveform measured at the head termination connector shall conform to figure 15, where :

$$I_W = \frac{I_{W1} + I_{W2}}{2} = 35 \pm 1 \text{ mA for track 000 to track 127,}$$

$$I_W = 30 \pm 1 \text{ mA for track 128 to track 203,}$$

$$\text{overshoot} \leqslant 8 \% \text{ of } I_W$$

The difference between the positive and negative amplitudes of the stationary write current I_W shall be

$$|I_{W1} - I_{W2}| < 1 \text{ mA}$$

$$T_R = 120 \text{ to } 160 \text{ ns}$$

$$T_F = 120 \text{ to } 160 \text{ ns}$$

$$|T_R - T_F| \leqslant 20 \text{ ns}$$

Two consecutive half-periods T_1, T_2 shall not differ by more than 2 %.

5.3.4.2.2 DC erase current

The DC erase current supplied to one of the read/write coils when DC erase is specified shall be

$$I_E = 35 \pm 1 \text{ mA for track 000 to track 127,}$$

$$I_E = 30 \pm 1 \text{ mA for track 128 to track 203.}$$

5.3.4.2.3 Read electronics

The differential input impedance of the read electronics shall be $4{,}20 \pm 0{,}21 \text{ k}\Omega$ in parallel with a distributed and lumped capacitance of $30 \pm 5 \text{ pF}$ measured at the head termination connector (see figure 16).

The read electronics shall be capable of accepting low impedance signal levels between 0,6 and 10,0 mV peak-to-peak. Linearity shall be within 3 % or 0,050 mV (whichever is larger) at frequencies between 0,5 and 3,0 MHz.

5.3.4.3 TEST SIGNALS

The frequencies specified as $1f$, $2f$ and $4f$ shall be

$$1f = (1\ 250 \pm 1{,}25) \times 10^3 \text{ transitions/s}$$

$$2f = (2\ 500 \pm 2{,}50) \times 10^3 \text{ transitions/s}$$

$$4f = (5\ 000 \pm 5{,}00) \times 10^3 \text{ transitions/s}$$

5.3.4.4 DC EDGE ERASURE

Edge erasure shall be used for all surface tests and track quality tests unless otherwise specified.

When using the tunnel erase (TE) amplitude test head, the edge erasure current shall be

$$I_{TE} = 40 \pm 2 \text{ mA.}$$

When using the straddle erase (SE) data test head, the edge erasure current shall be

$$I_{SE} = 35 \pm 1 \text{ mA.}$$

5.3.4.5 MAGNETIC RECORDING

Unless otherwise specified, all write operations shall be preceded by a DC erase operation (see 5.3.4.1.2 and 5.3.4.2.2).

5.3.4.6 LOCATIONS

The track quality test requirements (see 5.4.2) shall also be met with an offset of 0,025 mm (0.001 in) from the nominal track position as defined in 5.2.3.

5.3.4.7 HEAD LOADING FORCE

The net head loading force shall be $3{,}43 \pm 0{,}10 \text{ N}$ (350 ± 10 gf), centre pivot loading or equivalent.

5.4 Functional testing

5.4.1 *Surface tests*

5.4.1.1 AMPLITUDE TEST

5.4.1.1.1 Procedure

Write on any part of the recording surface at $1f$ using an amplitude test head and read back.

5.4.1.1.2 Result

The corrected read-back amplitude averaged over the highest $50\ \mu s$ sector shall be within the following peak-to-peak amplitude limits :

Maximum amplitude shall be 9,3 mV at the 115,087 mm (4.531 in) radius and increase proportionally to, but not exceed, 15,1 mV at the 166,726 mm (6.564 in) radius.

Minimum amplitude shall be 6,3 mV at the 115,087 mm (4.531 in) radius and increase proportionally to, or exceed 10,0 mV at the 166,726 mm (6.564 in) radius.

5.4.1.2 RESOLUTION TEST

5.4.1.2.1 Procedure

On any part of the recording surface write at $2f$ and read back using a data test head. After DC erasing write at the same position at $4f$ and read back.

5.4.1.2.2 Result

In all cases the ratio $\dfrac{\text{amplitude at } 4f}{\text{amplitude at } 2f}$ averaged over the same $50\ \mu s$ sector shall be 0,55 ± 0,20.

3562-76   48519O3 OO26364 5

5.4.1.3 OVERWRITE TEST

5.4.1.3.1 Procedure

Write on track 000 at $2f$ and measure the average amplitude of $2f$ signal with a frequency-selective voltmeter. Without a DC erase overwrite once at $4f$, measure the average amplitude of $2f$ signal with a frequency-selective voltmeter. Qualified overwrite heads (see 5.4.1.3.3) shall be used.

5.4.1.3.2 Overwrite residual amplitude

The overwrite residual amplitude is defined as

$$r = \frac{\text{(average amplitude of selectively measured } 2f \text{ signal after overwrite with } 4f) \times 100}{\text{(average amplitude of selectively measured } 2f \text{ signal before overwrite with } 4f)}$$

5.4.1.3.3 Qualified overwrite heads

A data test head is qualified as an overwrite test head when the overwrite residual amplitude r of the standard data reference surface written and overwritten with this head is between 3 and 5 %.

5.4.1.3.4 Result

The ratio of the overwrite residual amplitude of the disk to be tested to the overwrite residual amplitude of the data reference surface shall not exceed 1,3.

5.4.1.4 POSITIVE MODULATION TEST

5.4.1.4.1 Procedure

Using a data test head, write a track at $2f$ and read back.

5.4.1.4.2 Result

The average base-to-peak amplitude measured at the highest amplitude 50 μs sector of that track location shall be less than 146 % of the average base-to-peak amplitude of the full track.

5.4.1.5 NEGATIVE MODULATION TEST

5.4.1.5.1 Procedure

Using a data test head, write a track at $2f$ and read back.

5.4.1.5.2 Result

The average base-to-peak amplitude measured at the lowest amplitude 50 μs sector of that track location shall be greater than 75 % of the average base-to-peak amplitude of that track.

5.4.2 *Track quality tests*

Data test heads shall be used for all track quality tests.

Two methods, A and B, are described below for the track quality tests. Although it is recognized that neither of them gives absolute correlation between computer and test equipment, both give acceptable correlation.

Method A is based on a fixed voltage reference.

Method B is based on track relative voltage references.

The method to be used shall be agreed between the interchange parties.

5.4.2.1 MISSING PULSE TEST

5.4.2.1.1 Method A

Procedure

Write on each track at $2f$ and read back.

Result

A missing pulse is any read pulse whose base-to-peak amplitude is less than 25 % of the standard data reference surface output at $2f$ (peak-to-peak), see 5.3.2.2.1, based on the peak amplitude occurring from 150 to 250 ns after the zero cross-over point of the analogue signal.

5.4.2.1.2 Method B

Procedure

Write on each track at $2f$ and read back.

Result

A missing pulse is any read pulse whose base-to-peak amplitude is less than 60 % of the average base-to-peak amplitude of the preceding 50 μs sector.

5.4.2.2 EXTRA PULSE TEST

5.4.2.2.1 Method A

Procedure

Write on each track at $2f$ and read back. Then DC erase and read the residual amplitude.

Result

An extra pulse is any spurious read pulse whose amplitude is more than 40 % of the average base-to-peak $2f$ amplitude of the tested track.

The maximum base-to-peak amplitude of any spurious read pulse(s) shall not exceed 22,5 % of the standard data reference surface output at $2f$ (peak-to-peak), see 5.3.2.2.1.

5.4.2.2.2 Method B

Procedure

Write on each track at $2f$. Read back and note the highest peak-to-peak amplitude averaged over 50 μs of track signal. Call this V_A. DC erase as in 5.3.4.2.2 and read the residual amplitude.

Result

Any read back signal, measured base-to-peak, shall not exceed 25 % of 1/2 V_A.

5.4.2.3 EASE OF ERASURE TEST

5.4.2.3.1 Method A

Procedure

Write on each track at $2f$ and read back. DC erase as in 5.3.4.2.2 and read the residual amplitude.

Result

The peak-to-peak amplitude of the residual signal averaged over any 50 μs sector of the erased track shall not exceed 4 % of the highest peak-to-peak amplitude averaged over a 50 μs sector of that track. (The residual signal is measured independent of test system noise.)

The maximum peak-to-peak amplitude of the residual signal shall not exceed 10 % of the standard data reference surface output at $2f$, see 5.3.2.2.1.

5.4.2.3.2 Method B

Procedure

Write on each track at $2f$, read back and note highest peak-to-peak amplitude averaged over 50 μs of track signal.

Call this V_A. DC erase as in 5.3.4.2.2 and read the residual amplitude.

Result

The average level of the highest 50 μs sector of the read back signal shall not exceed 10 % of V_A.

5.4.3 *Rejection criteria*

5.4.3.1 SURFACE TEST CRITERIA

The disk shall meet the requirements of all the tests specified in 5.4.1.

5.4.3.2 TRACK QUALITY CRITERIA

5.4.3.2.1 Error

An error is a failure to meet any of the requirements of 5.4.2 (according to the agreed method).

5.4.3.2.2 Error-free areas

There shall be no errors in track of address 0000 nor in any header area (see 5.2.6.1). In addition, for purposes of data interchange, there shall be at least 400 error-free tracks on the disk. Further there shall be up to 6 additional error-free tracks for possible track re-assignment. (Complete error-free disks shall be subject to agreement between supplier and user.)

— Top cover

— Seal

— Clamp

— Disk

— Disk hub

— Armature plate

— Protective cover

— Removable cover

FIGURE 1 — **Exploded view**

Seal

Clamp

Disk

Disk hub

Top cover

Armature plate

Removable cover
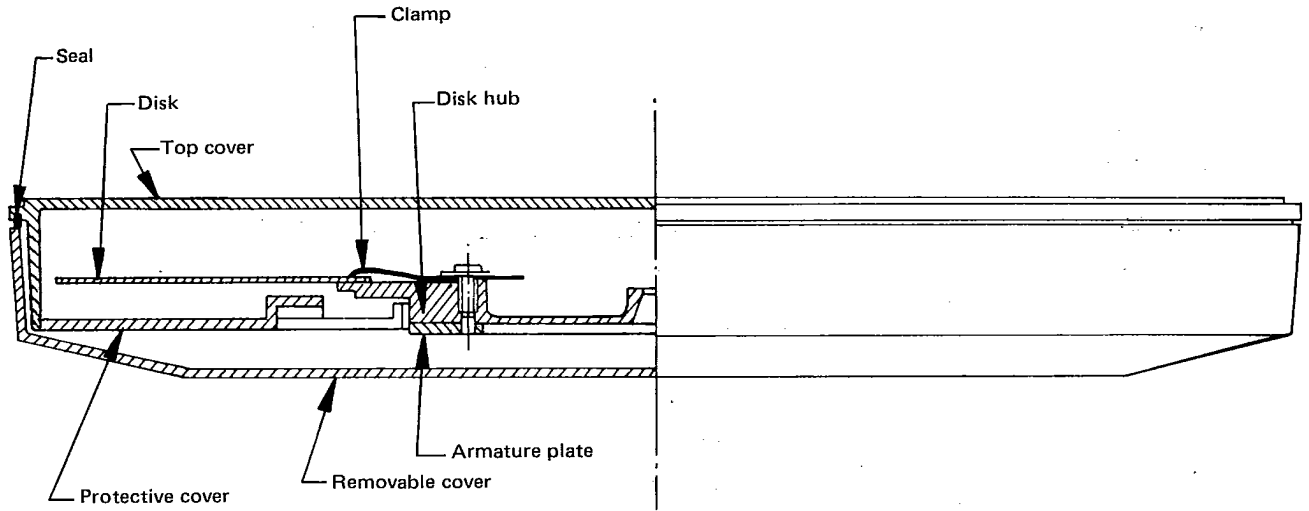
Protective cover

FIGURE 2 — **Front view with partial cross-section**

Removable cover
in working position
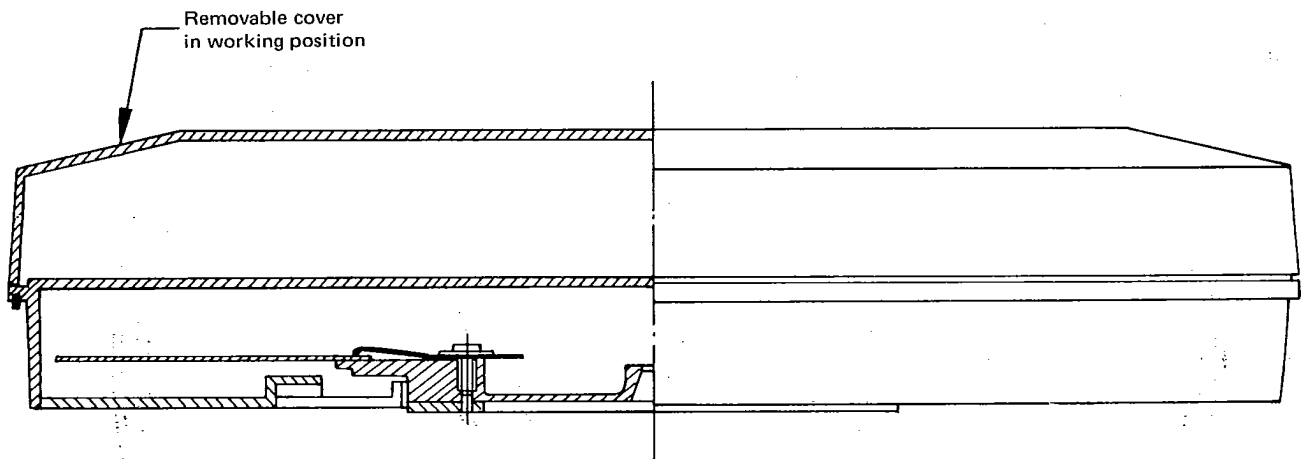
FIGURE 3 — **Front view with partial cross-section with the removable cover
in the working position**

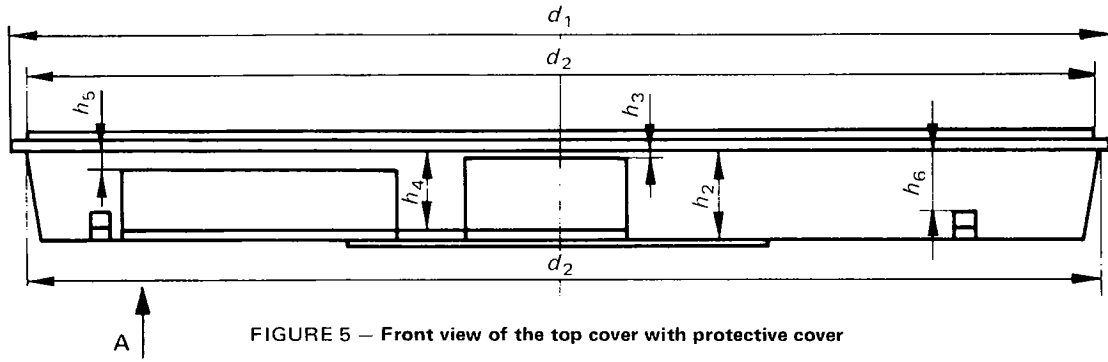d_1

h_1
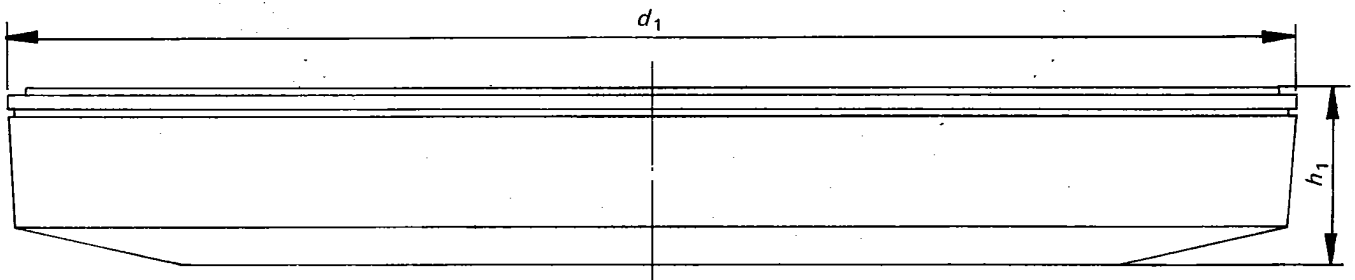
FIGURE 4 — **Front view of the whole cartridge**

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FIGURE 5 — **Front view of the top cover with protective cover**
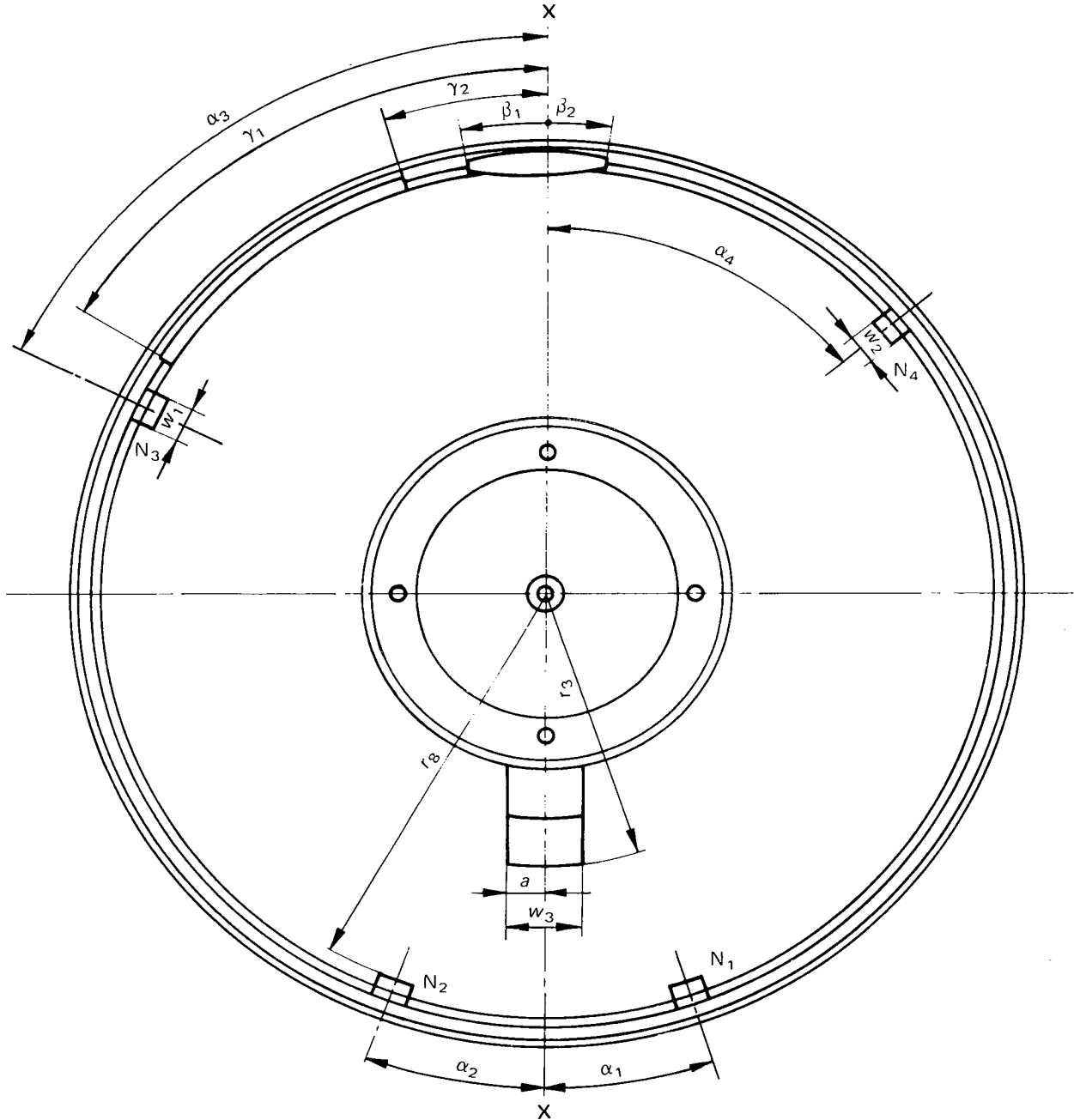
FIGURE 6 — **View in direction of arrow A in figure 5**

3562-76 ▮ 4851903 0026369 4 ▮
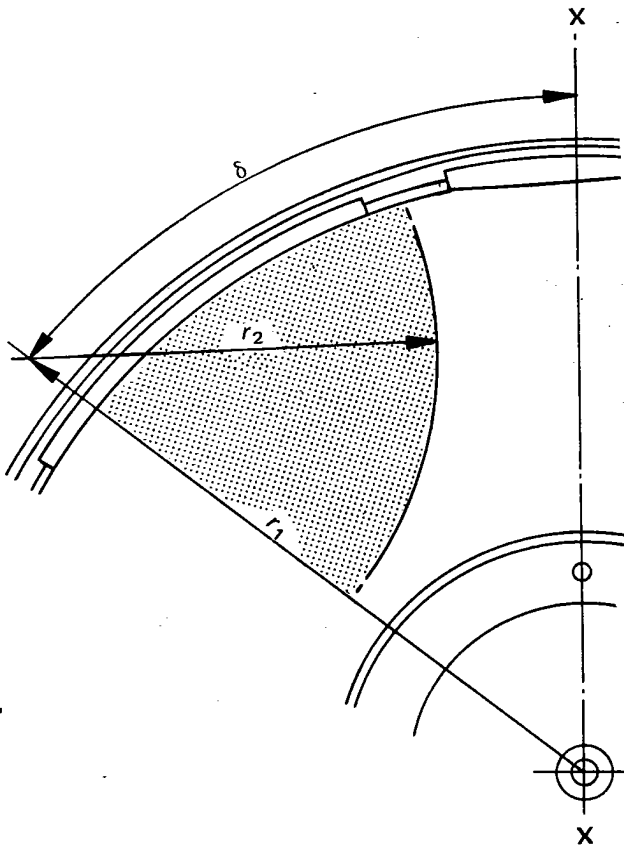
FIGURE 7 — Part of figure 6 with the brush area
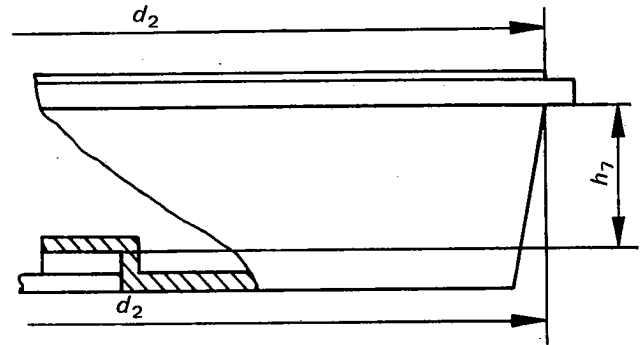
FIGURE 8 — Partial cross-section through the opening for the index transducer
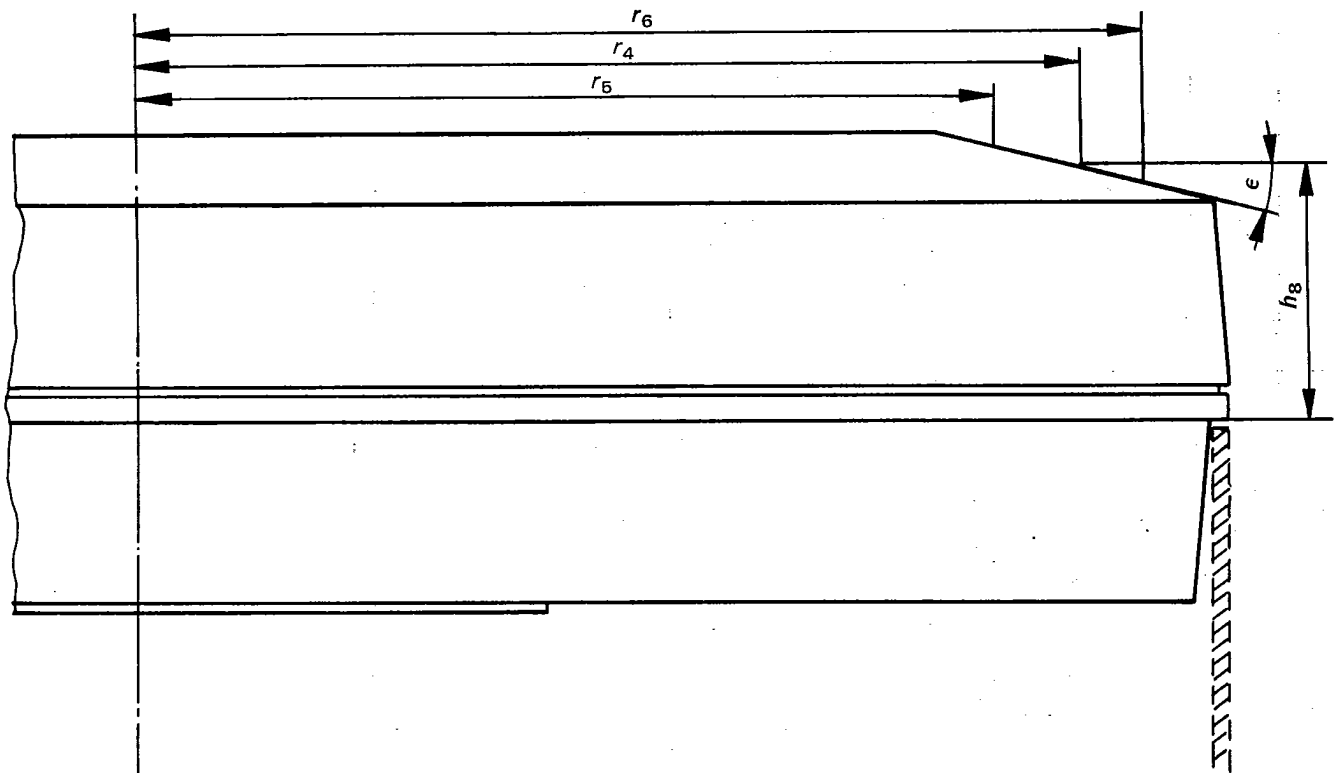
FIGURE 9 — Partial front view of the removable cover in the working position

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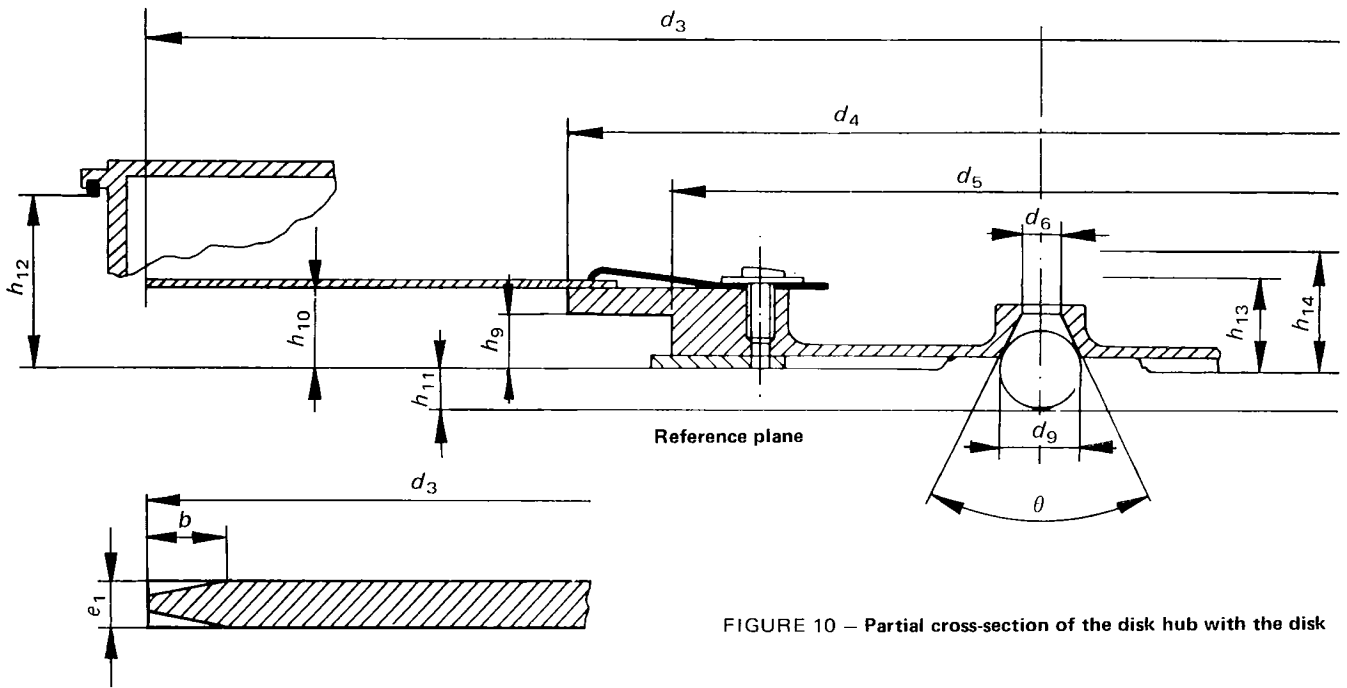
FIGURE 10 — Partial cross-section of the disk hub with the disk

FIGURE 11 — Enlarged cross-section of the disk edge
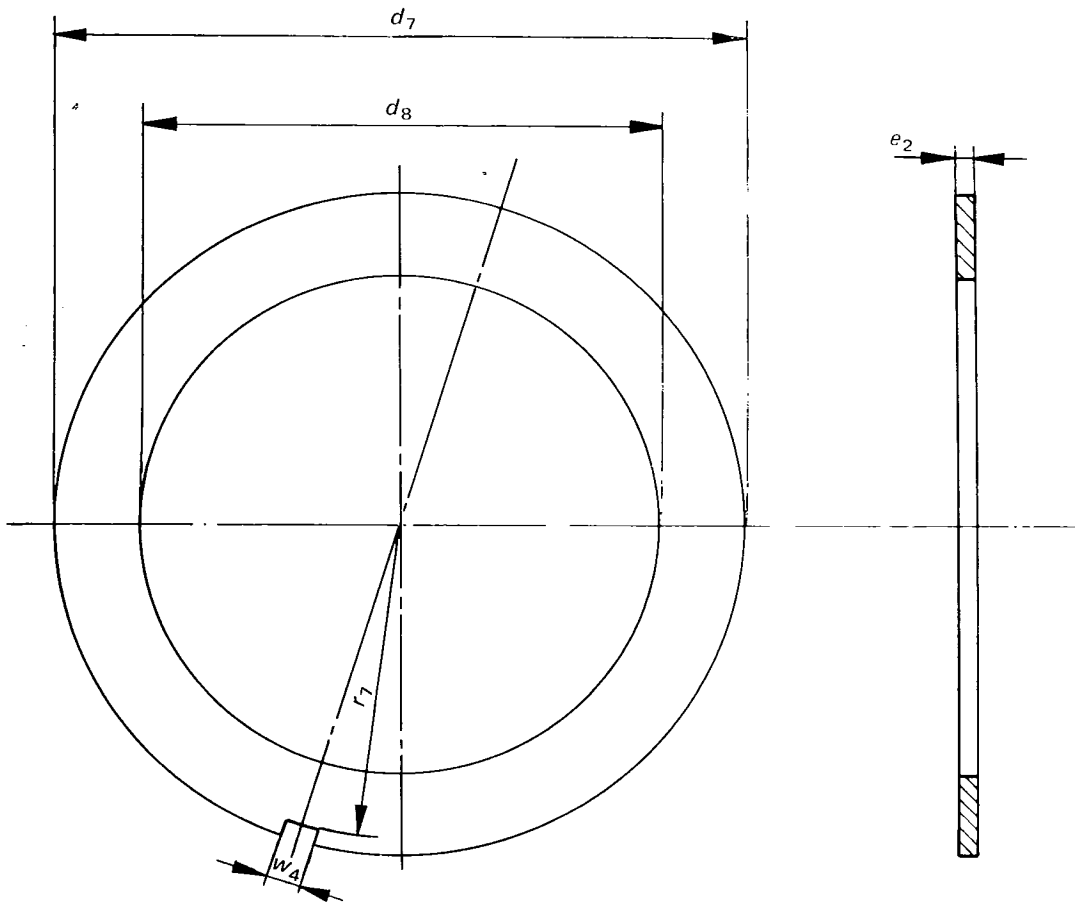
FIGURE 12 — Armature plate
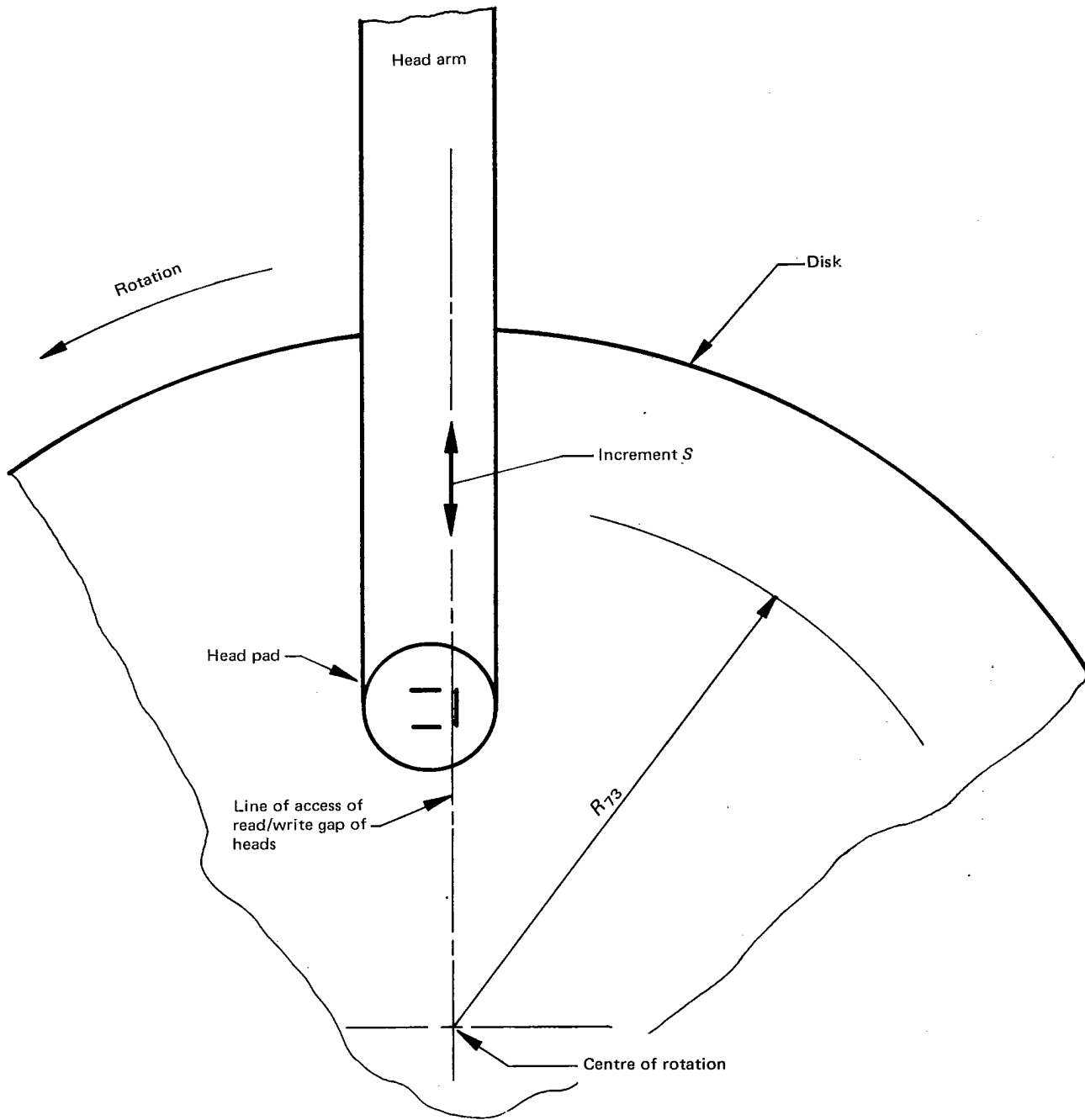
FIGURE 13 — Geometry of the head disk system
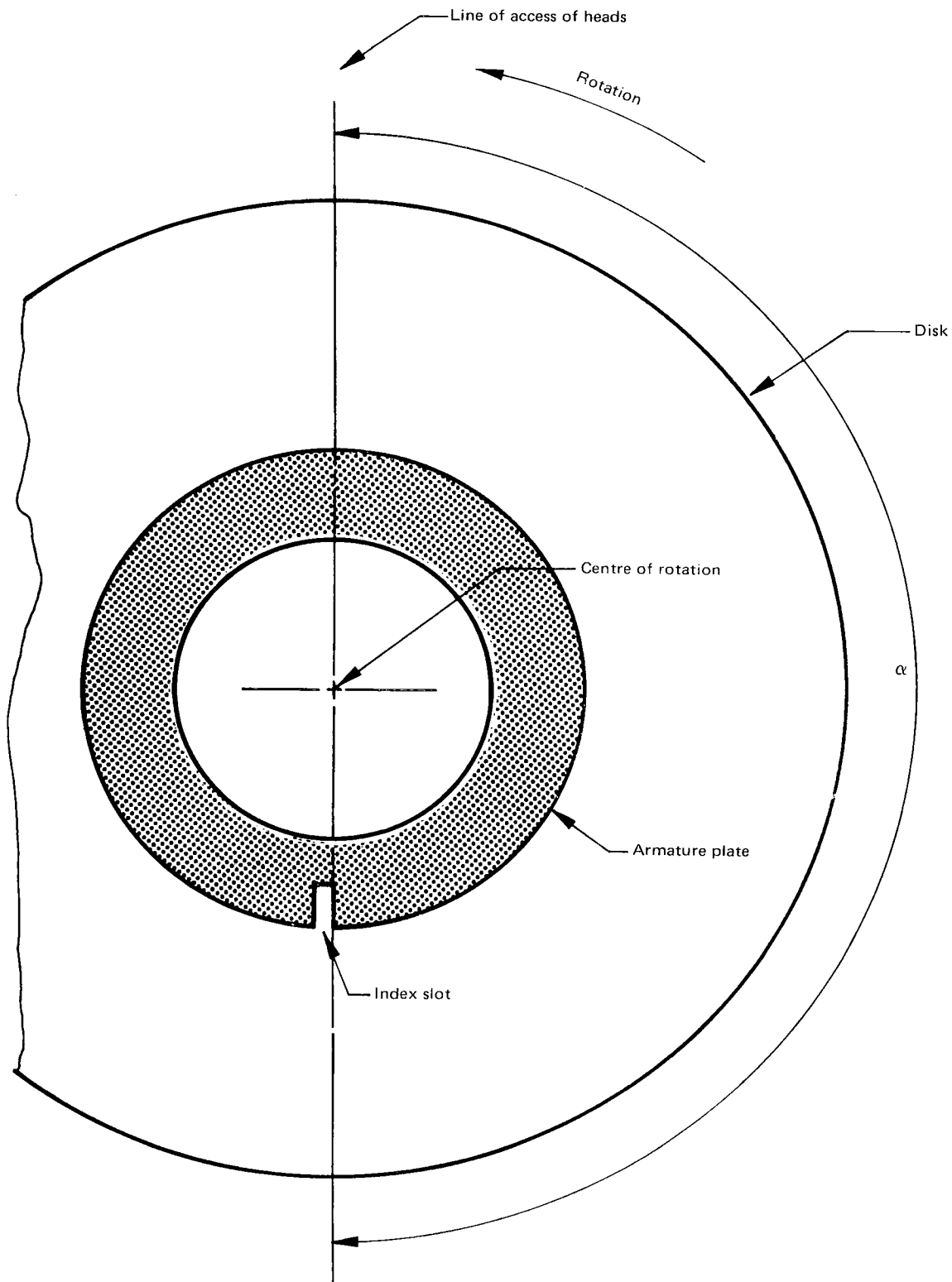
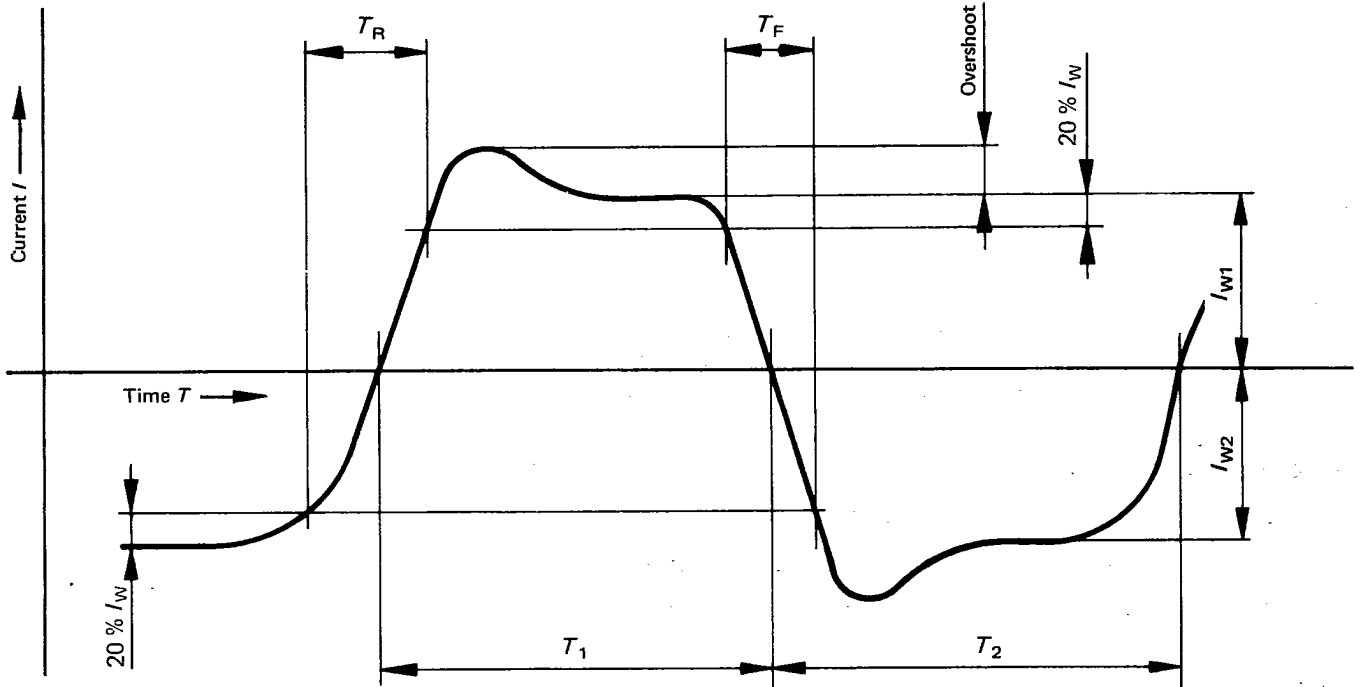FIGURE 14 — **Track index** (top view on the armature plate)
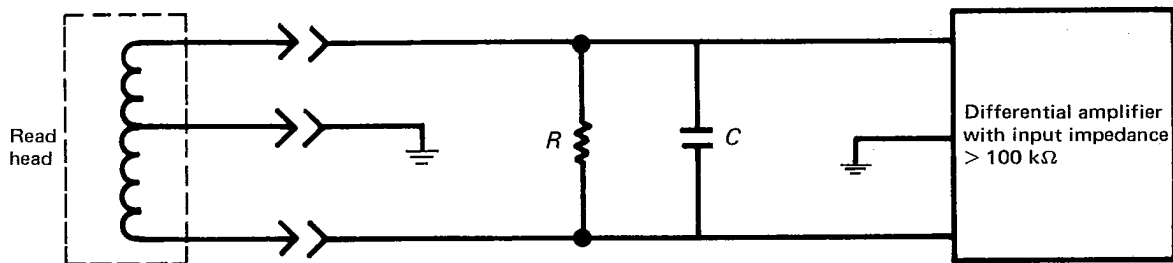
FIGURE 15 — Write current waveform

FIGURE 16 — Read circuit

ANNEX A

(Not part of the standard)

COATING ADHESION AND ABRASIVE WEAR RESISTANCE[1]

A.1 COATING ADHESION

A.1.1 Criterion

The adhesion of the coating to the substrate should be maintained following bending around the $25,4 \pm 3,2$ mm $(1.0 \pm 0.125$ in) diameter of the conical mandrel specified in ASTM D 522-60. The criterion for failure is coating removal exceeding 10 % of the area after peeling of the prescribed pressure-sensitive tape.

A.1.2 Equipment and materials

a) Conical mandrel tester (ASTM D 522-60).

b) Number 1 brown kraft wrapping paper, substance 30, lubricated with talc (see ASTM D 522-60).

c) Pressure-sensitive tape (3M Company No. 202 masking tape or equivalent).

A.1.3 Test sample

The test sample shall be as shown in figure 17; $a = 119,4 \pm 5,1$ mm $(4.7 \pm 0.2$ in).

A.1.4 Procedure

a) Clean the sample with isopropyl alcohol.

b) Mount the sample in the conical mandrel tester as shown in figure 17; $b = 25 \pm 2,5$ mm $(1 \pm 0.1$ in).

c) Bend as described in ASTM D 522-60 (the lubricated kraft paper is used in this step).

d) Maintain the sample in the bent condition. Clamping the operating lever to the base plate is desirable.

e) Wipe the upper surface with a soft paper tissue. (Loose talc which would reduce the effectiveness of the pressure-sensitive tape should be removed by this wiping.)

f) Apply a 6,35 mm (0.25 in) wide strip of pressure-sensitive tape to the upper surface as shown in figure 17.

g) Peel the tape at an angle of 90° and a rate of approximately 25 mm/s (1 in/s). The peel force should be $3,0 \pm 0,5$ N $(300 \pm 50$ gf) on unbent samples if the tape was properly applied.

h) Examine for coating removal.

A.2 ABRASIVE WEAR RESISTANCE

A.2.1 Criterion

Coating wear in the modified Taber Abraser[2] test shall be less than $0,000\ 6$ mm² $(10^{-6}$ in²) of cross-sectional area in a test performed with the equivalent of a 6 μm silicon carbide abrasive.

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1) See 4.8.3.2 and 4.8.3.3.

2) Trademark of the Taber Instrument Corporation   11 Goundry Street, North Tonawanda, New York.

A.2.2 Equipment and materials

a) Taber Abraser[1] wear tester, model 503 or equivalent. Abrasive mounting wheel positioned to provide a 66,55 mm (2.62 in) diameter wear scar (see figure 18).

b) Thin double-backed tape (Scotch[2] double-stick tape, 3M Company catalog No. 136 or equivalent).

c) Silicon carbide-coated abrasives of approximately 3 and 8 μm particle size (Charles Pfizer Company silicon carbide Ultralap[3] abrasive on 0,073 mm (0.003 in) polyester backing or equivalent).

d) Acrylic plastic sheet of 1,27 mm (0.05 in) thickness (Rohm and Haas Company grade G Plexiglas[4] or equivalent).

e) Profilometer having a 0,002 5 mm (0.000 1 in) radius stylus.

A.2.3 Test sample

The test sample shall be as shown in figure 18.

A.2.4 Procedure

a) Fasten a strip of new abrasive to the periphery of the mounting wheel with double-backed tape. The strip should be 3,2 to 4,8 mm (1/8 to 3/16 in) wide and firmly attached with a minimum amount of tension. The ends must not overlap but should have less than 0,8 mm (1/32 in) spacing.

b) Place the wheel and sample on the Taber Abraser. It should be noted that the Taber Abraser vacuum attachment is not required in this test.

c) Abrade samples with the nominal 3 and 8 μm silicon carbide abrasives. The test should be performed using a 440 g total load (wheel plus arm) and 50 revolutions of the sample.

d) Record the profile of the wear scar at the eight locations shown in figure 18. The cross-sectional area of the profilometer trace of the wear scar may be determined after drawing a straight line representing the unworn surface. The nominal 3 and 8 μm abrasives will be calibrated by means of tests employing acrylic plastic samples. The measured wear values will be used to determine the equivalent standard particle size by referring to the calibration curve. In subsequent tests of actual coatings the wear values are then plotted versus the standard particle size. The wear value for a 6 μm abrasive is obtained by drawing a straight line between wear values obtained with abrasives both coarser and finer than 6 μm.
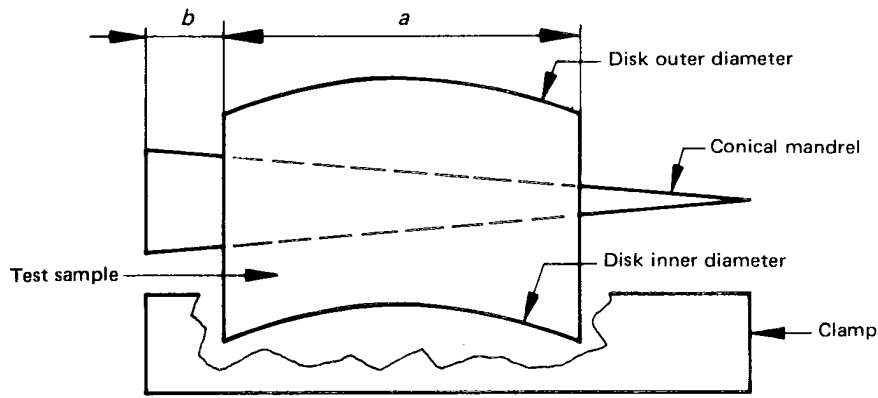
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1) Trademark of the Taber Instrument Corporation, 111 Goundry Street, Tonawanda, New York.

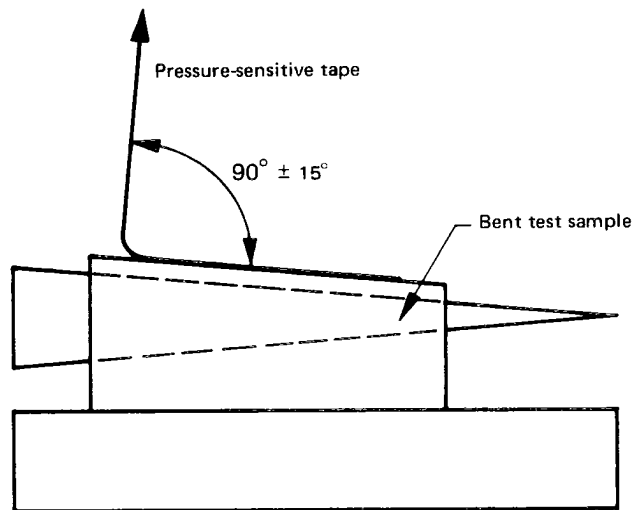2) Trademark of 3M Company, 3M Center, St. Paul, Minn.

3) Trademark of Charles Pfizer and Company, Inc., 325 East 42nd Street, New York, N.Y.

4) Trademark of Rohm and Haas Company, Independence Hall, West Philadelphia, Pennsylvania.
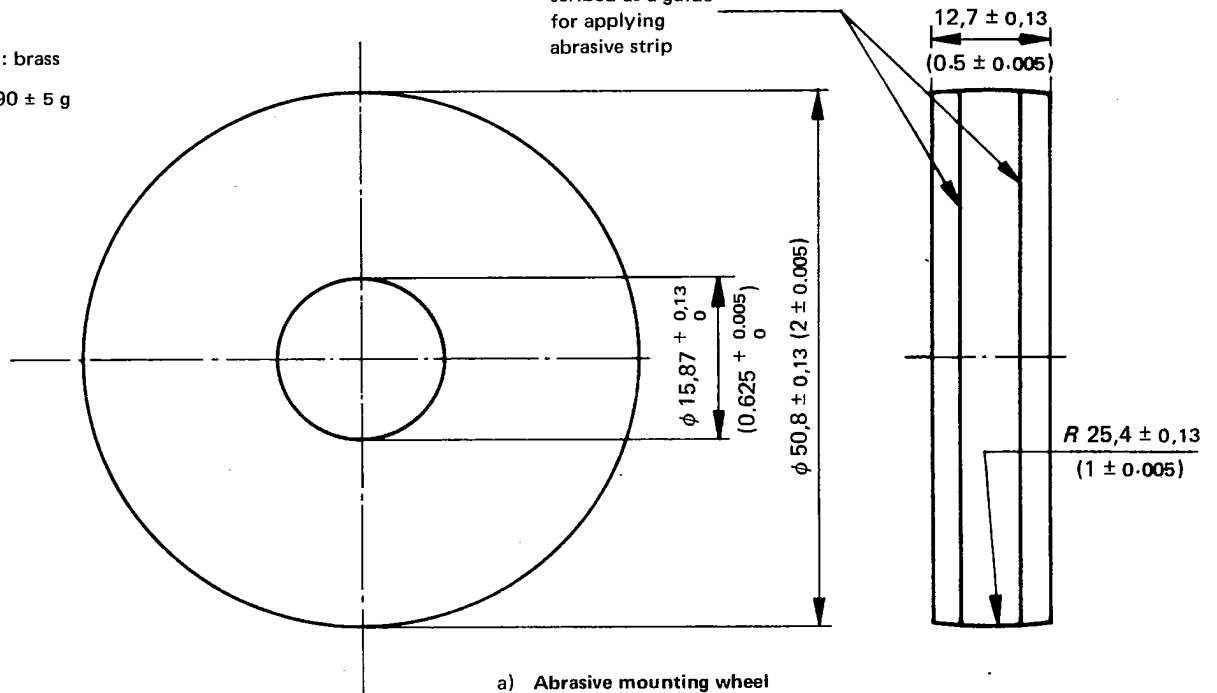
a) Sample configuration and mounting location

b) Fastening and removal of pressure-sensitive tape
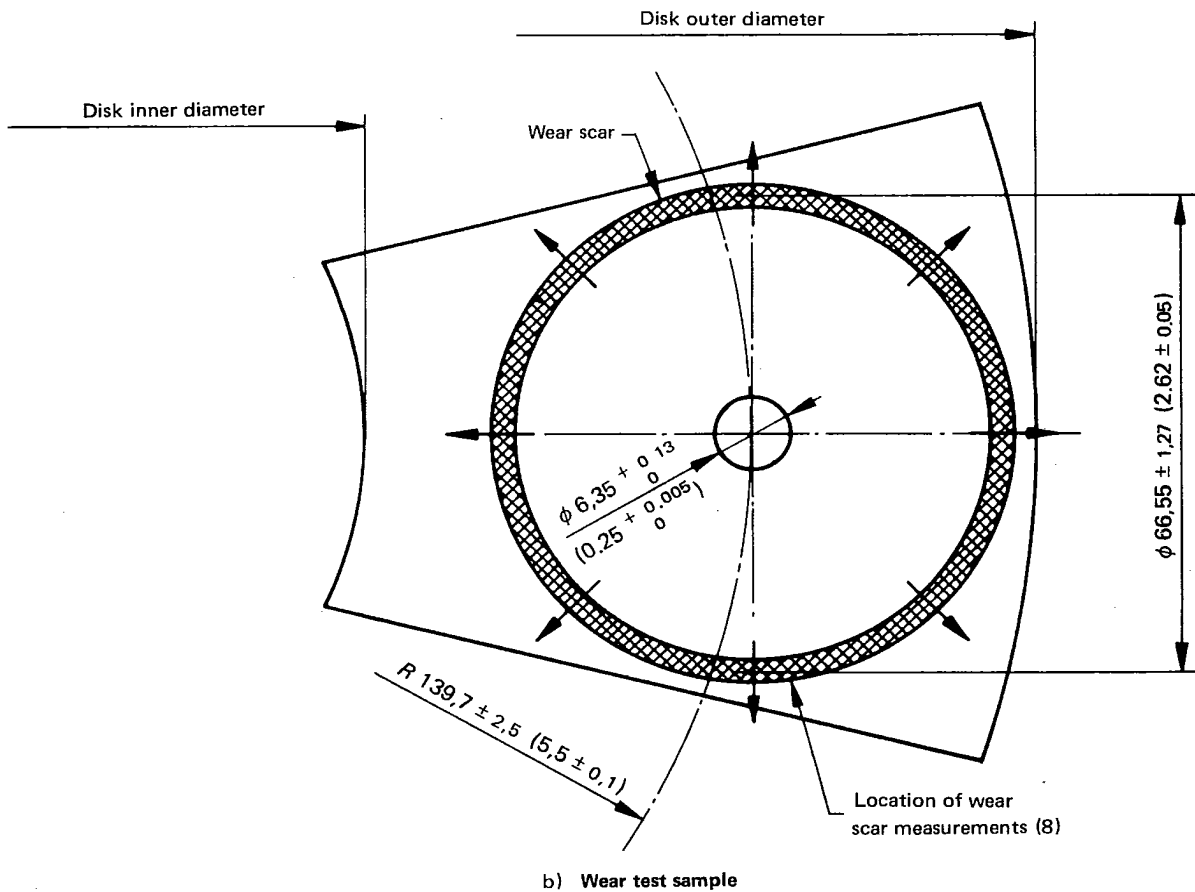
FIGURE 17 — Adhesion test

Dimensions in millimetres
(Inch dimensions in parentheses)

Material : brass

Mass : 190 ± 5 g

Lines may be
scribed as a guide
for applying
abrasive strip

12,7 ± 0,13
(0.5 ± 0.005)

ϕ 15,87 $^{+\ 0,13}_{\ 0}$
(0.625 $^{+\ 0.005}_{\ 0}$)

ϕ 50,8 ± 0,13 (2 ± 0.005)

R 25,4 ± 0,13
(1 ± 0.005)

a) **Abrasive mounting wheel**

Disk outer diameter

Disk inner diameter

Wear scar

ϕ 6,35 $^{+\ 0\ 13}_{\ 0}$
(0.25 $^{+\ 0.005}_{\ 0}$)

ϕ 66,55 ± 1,27 (2.62 ± 0.05)

R 139,7 ± 2,5 (5,5 ± 0,1)

Location of wear
scar measurements (8)

b) **Wear test sample**

FIGURE 18 — **Abrasive wear resistance test**

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ANNEX B

(Not part of the standard)

MEASURING EFFECTIVE TRACK WIDTH

DC erase a seven-track wide band with track location 199 in the centre of the band and record a $2f$ frequency pattern in track location 199 using a data test head. Straddle erase shall be used. The read-back signal amplitude in this position is called 100 %. Then move the head radially over the disk in increments not greater than 0,01 mm (0.000 4 in) to the left or to the right of track 199 until the read-back signal becomes zero. Determine read-back signal amplitude at each incremental move and plot amplitude (y-axis) versus displacement (x-axis).

See figure 19 for reading track width.

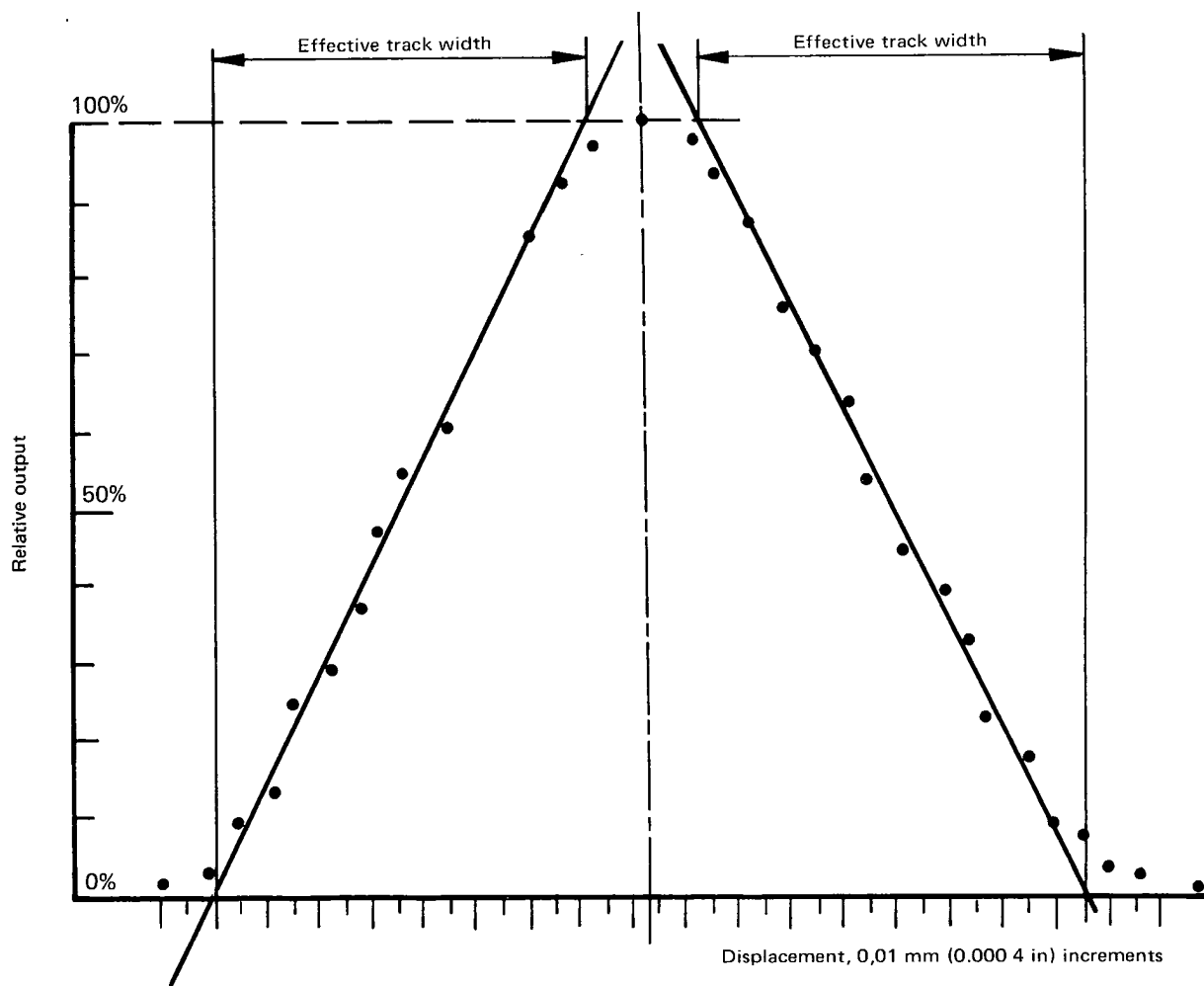The fringing at both ends of the curve shall be ignored when the track width is determined.

FIGURE 19 — **Track width diagram**