

Specification for

**Magnetic eleven-disk
packs for data
processing —
Mechanical and
magnetic properties**

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- Data Processing Management Association
- Department of the Environment
- Institute of Electronic and Radio Engineers
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- Scientific Instrument Manufacturers' Association

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Contents

	Page
Cooperating organizations	Inside front cover
Foreword	ii
Section 1. General	
1 Scope	1
2 References	1
3 General requirements	1
4 Description	1
Section 2. Dimensions	
5 Reference line	1
6 Top cover	1
7 Hub	1
8 Spindle lock	1
9 Index disk	2
10 Disk support	2
11 Recording disk	2
12 Location of disks	2
13 Minimum clearance of lowest element	3
14 Overall height	3
15 Hub/disks relationship	3
16 Location of magnetic surface	3
Section 3. Mechanical characteristics	
17 Environment	4
18 General	4
19 Physical characteristics of magnetic surfaces	5
Section 4. Magnetic characteristics	
20 Track and recording information	5
21 Test conditions and equipment	6
22 Functional testing	8
23 Disk track radii	10
Appendix A Recommended accelerated storage life test	12
Appendix B Recommended procedures for testing vibration and shock	12
Appendix C Dynamic dimensional disk characteristics and moment of inertia	12
Appendix D Coating adhesion and abrasive wear	14
Appendix E Measuring effective track width	16
Figure 1 — Disk pack without covers	16
Figure 2 — Disk pack with top and bottom covers	16
Figure 3 — Cross section of the hub (simplified)	17
Figure 4 — Enlarged cross section of the lower end of the spindle	17
Figure 5 — Index disk viewed from above	18
Figure 6 — Enlarged cross section of the disk pack (simplified)	18
Figure 7 — Disk rotation and designations of disk surfaces and heads	19
Figure 8 — Geometry of the head disk system	20
Figure 9 — Track index (top view of the index disk)	20
Figure 10 — Write current waveform	21
Figure 11 — Read circuit	21
Figure 12 — Position limits of disk surfaces	21
Figure 13 — Displacement, velocity, acceleration	22

	Page
Figure 14 — Circuit arrangement	23
Figure 15 — Moment of inertia measurement	23
Figure 16 — Adhesion test	23
Figure 17 — Abrasive wear resistance test	24
Figure 18 — Calibration curve for silicon carbide abrasives with acrylic plastics test samples	25
Figure 19 — Track width diagram	25
Table 1 — Nominal track locations	11
Table 2 — Shock tests	13
Publications referred to	Inside back cover

Foreword

This British Standard has been authorized by the Data Processing Industry Standards Committee.

Work on magnetic disk packs began at the International Organization for Standardization (ISO) in 1968 with the setting up of a working group, now a subcommittee, under the secretariat of Germany. The first project to be undertaken, the standardization of a six-disk pack, has now been completed. Work on a British Standard for the six-disk pack went ahead simultaneously and resulted in the publication of BS 4850:1972 (Parts 1 and 2).

Attention was then turned to projects dealing with a magnetic eleven-disk pack and a magnetic single-disk cartridge of the type which is loaded onto its drive spindle from the top. BS 5356-1 (based on ISO 3562) specifies the physical and magnetic characteristics and BS 5356-2 (based on ISO 3563) specifies the track format of the single-disk cartridge.

This British Standard is based on ISO 3564, to which it conforms in all essential particulars. The principle adopted has been to specify those characteristics which are necessary for interchange, so that manufacturers will be able to retain some individual design features, whilst incorporating those essential for interchange. Although the parameters quoted have been based on existing materials and methods, where-ever possible the use of alternatives which would maintain the original requirements has been permitted.

Although this standard is intended to permit unrecorded disk packs from any source being successfully used on any system, practical difficulties are envisaged when attempting to interchange data on an eleven-disk pack between systems of different manufacture. For this reason, there has been little incentive to standardize the track format to be used to record data, and this is left to the individual equipment manufacturer. Consequently, there is no International Standard or British Standard for track format on this disk pack.

Certification. Attention is drawn to the certification facilities described on the inside back cover of this standard

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 26, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This British Standard specifies the mechanical and magnetic characteristics necessary for interchange of unrecorded magnetic eleven-disk packs from different sources between data processing systems.

NOTE The track format is not standardized for data interchange.

2 References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3 General requirements

After exposure to the range of conditions specified herein, the disk pack shall meet all the other requirements of this standard.

4 Description

Figure 1 to Figure 6 show a typical disk pack assembly. The terms for elements of the disk pack are given in Figure 1 and Figure 2.

Section 2. Dimensions

(to be measured under the conditions specified in 17.3)

5 Reference line (see Figure 3 and Figure 6)

For the purpose of determining height, the disk pack is considered to be resting on a reference ball having a diameter of 38.894 mm (1.531 25 in), the line through the base of which is the reference line (see Figure 3 and Figure 6).

6 Top cover (see Figure 2)

6.1 Outside diameter. The outside diameter d_1 of the top cover shall be 373.9 mm maximum.

6.2 Concentricity. The top cover shall be concentric with the cover centreline within 1.65 mm total indicated runout¹⁾

6.3 Clearance. The vertical clearance h_2 between the lower edge of the top cover and the reference line shall be 15.9 ± 3.2 mm.

7 Hub (see Figure 3)

7.1 Body height. The height h_3 of the tapered portion of hub body shall be 35.3 ± 0.4 mm.

7.2 Bore relief. The bore may be relieved within a zone of height $h_4 = 20.6 \pm 1.5$ mm extending above height $h_5 = 6.3 \pm 0.8$ mm.

7.3 Location. The height h_6 of the hub above the reference line shall be 21 ± 0.5 mm.

7.4 Bore taper. The taper of the hub bore shall be $(1 \pm 0.0002):2$.

7.5 Bore finish. The finish of the bore shall be 1.6 μ m to 0.8 μ m arithmetic mean deviation.

8 Spindle lock (see Figure 3 and Figure 4)

8.1 Thread specification. The thread of the spindle lock shall be a two-start thread of type 16 UNC-2A (BS 1580-1 & BS 1580-2). The nominal diameter d_2 of the spindle lockshaft shall be 9.52 mm.

8.2 Thread length. The length h_7 of full thread shall be 7.4 mm minimum.

8.3 Chamfer. The lower end of the spindle lock shall be chamfered, having a minor diameter $d_3 = 7.3 \pm 0.3$ mm and an angle $\gamma = 30 \pm 2^\circ$.

8.4 Shoulder. The height h_8 of the shoulder of the spindle lock from the reference line shall be 59.05 ± 0.56 mm. The diameter d_4 of the spindle above the shoulder shall be $12.7 + 0.8, - 0.0$ mm.

¹⁾ Also known as full indicated movement, FIM (see BS 308).

8.5 Length. The length h_9 of the lower part of the spindle lock from the shoulder shall be 19.65 ± 0.15 mm.

8.6 Diameter over safety balls

8.6.1 The diameter d_5 of the lowest part of the spindle lock with the safety balls expanded shall be $10.97 + 0.00 - 0.25$ mm.

The safety balls shall not extend before the lockshaft pin is at a distance from the shoulder of the spindle lock $h_{10} = 18.5$ mm maximum.

The safety balls shall cease to extend when the lockshaft pin is at a distance from the shoulder of the spindle lock $h_{11} = 14.3$ mm minimum.

8.6.2 The diameter d_6 with relaxed balls shall be 9.65 mm maximum.

8.7 Location of safety balls. The height h_{12} of the centres of the safety balls from the shoulder of the spindle lock shall be 8.66 ± 0.24 mm.

8.8 Hole for lockshaft pin. The diameter d_7 of the hole for the penetration of the drive spindle lockshaft pin into the spindle lock shall be $3.18 + 0.00, - 0.13$ mm.

8.9 Clearance for lockshaft pin. The clearance for the penetration of the drive spindle lockshaft pin into the spindle lock shall extend to a maximum height from the shoulder $h_{13} = 12.5$ mm maximum.

8.10 Removal of top cover. The top cover shall be removable when the lockshaft has penetrated into the spindle lock to a height from the shoulder $h_{14} = 13.8 \pm 0.5$ mm

9 Index disk (see Figure 5)

9.1 Diameter. The diameter d_8 of the index disk shall be 362.74 ± 0.25 mm.

9.2 Thickness. The thickness e_1 of the index disk shall be 1.30 ± 0.08 mm.

9.3 Notch. The index disk shall have at its circumference a single rectangular notch.

9.4 Depth of notch. The radial depth of the notch shall be limited by the radius $r_1 = 177.8 \pm 0.02$ mm.

9.5 Width of notch. The width e_2 of the notch shall be 1.90 ± 0.13 mm.

9.6 Edge relief. All edges and corners of the index disk may be relieved to a radius $r_2 = 0.5$ mm maximum.

10 Disk support (see Figure 6)

The radius r_3 of the disk supports shall be 95.3 mm maximum.

11 Recording disk (see Figure 6)

11.1 Diameter. The diameter d_9 of each recording disk shall be 356.25 ± 0.15 mm.

11.2 Thickness. The thickness e_3 of each recording disk shall be 1.27 ± 0.03 mm.

11.3 Edge relief. For a distance $e_4 = 1.3$ mm maximum from the outside edge of each recording disk, the disk contour may be relieved.

12 Location of disks (see Figure 6)

The disks shall be located from the reference line as follows.

12.1 Index disk. Height of the lower surface of the index disk below the reference line $h_{15} = 12.22 + 0.51, - 0.64$ mm.

12.2 First recording disk. Height of the upper surface of the first recording disk below the reference line $h_{16} = 9.65 \pm 0.41$ mm.

12.3 Second recording disk. Height of the lower surface of the second recording disk below the reference line $h_{17} = 0.76 \pm 0.41$ mm.

12.4 Third to eleventh recording disks. Height of the lower surface above the reference line

$$h_{18} = 9.40 \pm 0.41 \text{ mm} \quad h_{23} = 60.20 \pm 0.41 \text{ mm}$$

$$h_{19} = 19.56 \pm 0.41 \text{ mm} \quad h_{24} = 70.36 \pm 0.41 \text{ mm}$$

$$h_{20} = 29.72 \pm 0.41 \text{ mm} \quad h_{25} = 80.52 \pm 0.41 \text{ mm}$$

$$h_{21} = 39.88 \pm 0.41 \text{ mm} \quad h_{26} = 90.68 \pm 0.41 \text{ mm}$$

$$h_{22} = 50.04 \pm 0.41 \text{ mm}$$

12.5 Top cover disk. Height of the upper surface of the top cover disk above the reference line $h_{27} = 93.22 \pm 0.48$ mm.

13 Minimum clearance of lowest element (see Figure 6)

Within an area of radius $r_4 = 90$ mm maximum, the height h_{28} of the lowest element of the disk pack below the reference line shall be 18.42 mm maximum.

Within an area between radii $r_5 = 32.5$ mm and $r_6 = 40.4$ mm the height h_{29} of the lowest element of the disk pack above the reference line shall be 24.9 mm minimum.

In the remaining areas within a radius $r_7 = 42.2$ mm the height h_{30} of the lowest element of the disk pack above the reference line shall be 20.1 mm minimum.

14 Overall height

14.1 Height with covers (see Figure 2). The overall height h_1 of the disk pack with top and bottom covers shall be 167 mm maximum.

14.2 Height without covers (see Figure 3 and Figure 6). The overall height h_{31} of the disk pack, without covers, above the reference line shall be 115.2 mm maximum.

15 Hub/disks relationship

15.1 Axial position limits of disk surfaces. At any speed within the range 2 352 rev/min to 2 448 rev/min, the axial run-out of the recording disks and of the index disk shall remain within the axial position limits defined for each surface by the tolerances around the height dimensions from the reference line specified in clause 12 as h_{15} to h_{27} inclusive. This requirement shall apply to the area of each disk surface between radii of 177.4 mm minimum and 104.9 mm maximum.

A suggested test method is given in C.1.1.

15.2 Axial run-out of disks. At any speed within the range 2 352 rev/min to 2 448 rev/min, the axial run-out of each recording disk shall not exceed 0.30 mm total indicator reading. This requirement shall apply to the area of each disk surface between radii of 177.4 mm minimum and 104.9 mm maximum.

At a speed of less than 10 rev/min, the axial run-out of the index disk shall not exceed 0.51 mm total indicator reading, between radii of 177.4 mm minimum and 104.9 mm maximum.

A suggested test method is given in C.1.2.

15.3 Acceleration of axial run-out. At any speed within the range 2 352 rev/min to 2 448 rev/min, the acceleration of axial run-out of each recording disk surface shall not exceed 140 m/s^2 from the base line. The measurement shall be made using a high frequency cut-off defined by the flat response/high frequency asymptote intercept of 1 500 Hz and a high frequency fall-off of 18 dB per octave. This requirement shall apply to the area of each disk surface between radii of 177.4 mm minimum and 104.9 mm maximum.

A suggested test method is given in C.1.3.

15.4 Radial run-out of disks. The radial run-out referenced to the centre line of the disk pack hub shall not exceed 0.25 mm total indicator reading for the index disk and the bottom two recording disks and shall not exceed 0.51 mm for the other disks.

15.5 Angular displacement. Up to a positive or negative acceleration of $3\,000 \text{ rad/s}^2$ there shall be no angular displacement between any disk and the hub when measured with a device capable of detecting a shift of three seconds of arc.

16 Location of magnetic surface

The area of the magnetic surface of the recording disks shall extend from a minor diameter of 209.8 mm maximum to a major diameter of 354.8 mm minimum.

Section 3. Mechanical characteristics

17 Environment

17.1 Operating conditions. The operating temperature shall lie within the range from 15 °C to 50 °C at a relative humidity of 8 % to 80 %; the wet bulb reading shall not exceed 26 °C. Before a disk pack is put 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. The ambient stray magnetic field intensity shall not exceed 4 000 A/m.

17.2 Storage conditions

17.2.1 Unrecorded. The storage temperature shall lie within the range – 40 °C to + 65 °C, the wet bulb reading not exceeding 30 °C. For wet bulb temperatures between 0.5 °C and 30 °C the disk pack shall be able to withstand a relative humidity of 8 % to 80 %.

17.2.2 Recorded. The storage temperature shall lie within the range – 40 °C to + 65 °C, the wet bulb reading not exceeding 30 °C. For wet bulb temperatures between 0.5 °C and 30 °C the disk pack shall be able to withstand a relative humidity of 8 % to 80 %. The stray magnetic field intensity shall not exceed 4 000 A/m. A recommended accelerated storage life test is included in appendix A.

17.3 Conditions for mechanical tests. Unless otherwise stated, measurements shall be carried out at 23 ± 3 °C, 40 % r.h. to 60 % r.h. after 24 h of acclimatization. Tests shall be carried out with the disk pack in the upright position, unless otherwise stated.

18 General

18.1 Shock and vibration. The disk pack shall withstand exposure to shock and/or vibration and still meet all dimensional and functional specifications of this standard.

Recommended test procedures are described in appendix B. Any damage to the cover shall not be a failure criterion.

18.2 Materials. Unless otherwise stated, the disk pack may be constructed from any suitable materials so long as the dimensional, inertial and other functional requirements of this standard are maintained. Material for hub, disk support, disk substrate and index disk shall have the thermal coefficient of expansion of $(24 \pm 2) \times 10^{-6}$ per °C which is the same as that for aluminium alloy.

The index disk shall be constructed from aluminium alloy. The material and surface finish of the index disk shall permit detection of the notch by eddy current and optical transducers.

The materials and design of the disk pack should be based on an intended minimum life time of five years.

18.3 Moment of inertia. The moment of inertia of the disk pack without covers shall not exceed 850×10^{-4} kg m².

A suggested test method is given in C.2.

18.4 Balance. The disk pack shall be dynamically balanced within 100 g mm when measured at 2 400 rev/min, in each of two planes parallel to the disk surfaces at 6.6 ± 0.2 mm below the top disk surface and above the bottom disk surface respectively.

18.5 Maximum speed. The disk pack shall be capable of withstanding the effects of stress at a speed of 2 500 rev/min counter-clockwise as seen from the top.

18.6 Locking pull. The disk pack shall be held to the disk drive spindle by a force of 925 ± 145 N, exerted by the downward pull of the disk drive lockshaft on the disk pack spindle lock.

18.7 Air feed openings. At least 12 openings having a minimum total area of 710 mm² shall be equally distributed around the disk support between each pair of recording disks.

18.8 Air filter

18.8.1 Filter media. The filter media shall be of a screen type construction having a maximum spacing between strands of 44 µm. The material shall not contain tendrils or loose particles which may separate from the filter and enter the filtered system.

18.8.2 Air flow and pressure drop. The pressure drop across a clean air filter shall not exceed 1.05 mbar²⁾ while passing 1.6 ± 0.1 m³ of air (in standard condition) per minute.

18.9 Thermal time constant. The thermal time constant is defined as the time required to reduce an initial temperature difference between the pack and the drive by two thirds. The thermal time constant of the disk pack shall not exceed 1 min, when measured with the disk pack rotating at $2\,400 \pm 48$ rev/min and within the specified operating environment and conditions.

18.10 Operational earthing. The disk pack shall provide a discharge path from the disks, including the magnetic surfaces, to the drive spindle through the hub mechanism.

19 Physical characteristics of magnetic surfaces

19.1 Surface roughness. (See BS 1134.) The surface roughness of the finished magnetic surface shall not exceed $0.09\text{ }\mu\text{m}$, arithmetic average, with a maximum deviation in height of $0.76\text{ }\mu\text{m}$ from the average when measured with a 0.0025 mm stylus and a 0.75 mm cut-off range.

19.2 Head gliding requirements. In the band having a minor diameter of 209.8 mm and a major diameter of 354.8 mm (see clause 16), there shall be no head-to-disk contacts with heads flying at a height from $1.25\text{ }\mu\text{m}$ at the minor diameter increasing linearly to $1.65\text{ }\mu\text{m}$ at the major diameter.

19.3 Durability of magnetic surface

19.3.1 Resistance to chemical cleaning fluid. The magnetic surface 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.

19.3.2 Coating adhesion. The nature of the coating shall be such as to assure maintenance of adhesion under operating conditions. Suggested tests for assuring the durability of the coating are given in Appendix D.

19.3.3 Abrasive wear resistance. The coating shall be capable of withstanding wear due to head loading operations. A possible criterion and test method is described in Appendix D.

Section 4. Magnetic characteristics

20 Track and recording information

20.1 Surface geometry. The twenty magnetic recording surfaces with the associated head orientations shall be as shown in Figure 7.

20.2 Track geometry

20.2.1 Number of tracks. There shall be 203 discrete concentric tracks per disk surface.

20.2.2 Width of tracks. The recording track width on the disk surfaces after straddle erase shall be $0.175 + 0.000, - 0.025\text{ mm}$.

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

20.3 Track locations

20.3.1 Nominal locations. The nominal centreline locations of the tracks shall be as shown in Table 1. The dimensional constants for deriving the track centreline radii in accordance with the head-disk geometry of Figure 8, defined at $23.0\text{ }^{\circ}\text{C}$ are:

incremental head movement (spacing) $S = 0.2567\text{ mm}$ ($0.010\,106\text{ in}$);

magnetic gap offset distances $F_{\text{ar}} = 12.126\text{ mm}$ (0.4774 in), $F_{\text{br}} = 10.988\text{ mm}$ (0.4326 in);

centreline radius of track 73, $R_{73} = 148.0566\text{ mm}$; head offset angle $\theta = 4^{\circ} 54'$.

20.3.2 Track location tolerance. The centrelines of the recorded tracks measured at $23.0\text{ }^{\circ}\text{C}$ shall be within $\pm 0.025\text{ mm}$ of the nominal positions.

NOTE 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 $\pm 0.0075\text{ mm}$ of the nominal position.

NOTE 2 At other temperatures (within those specified in this standard) the nominal track centreline can be calculated using a linear coefficient of thermal expansion of $24 \times 10^{-6}/^{\circ}\text{C}$.

20.3.3 Recording offset angle. At the instant of writing or reading, a magnetic transition shall make an angle of $4^{\circ} 54' \pm 30'$ with the appropriate line of access of the heads as defined in Figure 8.

²⁾ $1\text{ mbar} = 10^2\text{ N/m}^2 = 100\text{ Pa}$.