
**Information technology — Data interchange
on 90 mm optical disk cartridges —
HS-1 format — Capacity: 650 Mbytes per
cartridge**

*Technologies de l'information — Échange de données sur cartouches de
disque optique de diamètre 90 mm — Format HS-1 — Capacité:
650 Mbytes par cartouche*



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Printed in Switzerland

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 15498 was prepared by ECMA (as ECMA-239) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annexes A to N form an integral part of this International Standard. Annexes P to W are for information only.

Introduction

This International Standard specifies the characteristics of 90 mm Optical Disk Cartridges (ODC) with a capacity of 650 Mbytes per cartridge.

The format for the information on the disk is known as HS-1 (“Hyper Storage”).

Information technology — Data interchange on 90 mm optical disk cartridges — HS-1 format — Capacity: 650 Mbytes per cartridge

Section 1 - General

1 Scope

This International Standard specifies the characteristics of 90 mm Optical Disk Cartridges (ODC) with a capacity of 650 Mbytes per Cartridge. The Standard specifies three related, but different implementations of such cartridges, viz.

Type R/W	Provides for data to be written and read many times over the recording surface of the disk using the thermo-magnetic and magneto-optical effects.
Type P-ROM	Provides for a part of the recording surface of the disk to be embossed by stamping or other means. This part of the disk is read without recourse to the magneto-optical effect. The part which is not embossed provides for data to meet the requirements of Type R/W.
Type O-ROM	Provides for the recording surface of the disk to be embossed and reproduced by stamping or other means. This type of disk is read without recourse to the magneto-optical effect.

Type R/W, Type P-ROM and Type O-ROM are also referred to as “fully rewritable”, “partially embossed” and “fully embossed”, respectively.

This International Standard specifies

- the conditions for conformance testing and the Reference Drive;
- the environments in which the cartridges are to be operated and stored;
- the mechanical and physical characteristics of the cartridge, so as to provide mechanical interchangeability between data processing systems;
- the format of the information on the disk, called HS-1 (HS stands for “Hyper-Storage”), including the physical disposition of the tracks and sectors, the error correction codes, and the recording method used;
- the characteristics of the embossed information on the disk;
- the magneto-optical characteristics of the disk, enabling processing systems to write data onto the disk;
- the minimum quality of user-written data on the disk, enabling data processing systems to read data from the disk.

This International Standard provides for interchange between optical disk drives. Together with a standard for volume and file structure, it provides for full data interchange between data processing systems.

2 Conformance

2.1 Optical disk cartridge (ODC)

A claim of conformance with this International Standard shall specify its Type. An ODC shall be in conformance if it meets all mandatory requirements specified herein for that Type.

2.2 Generating system

A claim of conformance with this International Standard shall specify which Type(s) is (are) supported. A system generating an ODC for interchange shall be in conformance with this International Standard if the ODC meets the mandatory requirements of this International Standard for the Type(s) specified.

2.3 Receiving system

A claim of conformance with this International Standard shall specify which Type(s) is (are) supported. A system receiving an ODC for interchange shall be in conformance with this International Standard if it is able to process any recording made on the cartridge in accordance with 2.1 for the Type(s) specified.

2.4 Compatibility statement

A claim of conformance by a Generating or Receiving system with this International Standard shall include a statement listing any other International Standards supported. This statement shall specify the number of the standard(s), the ODC type(s) supported (where appropriate) and whether support includes reading only or both reading and writing.

3 Normative reference

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

IEC 950:1991, *Safety of information technology equipment*.

4 Definitions

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

- 4.1 band:** A part of the Data Zone comprising a fixed number of consecutive physical tracks.
- 4.2 case:** The housing for an optical disk, that protects the disk and facilitates disk interchange.
- 4.3 Channel bit:** The smallest element for the representation of data on a disk. It is recorded as either a space or a mark.
- 4.4 clamping zone:** The annular part of the disk within which the clamping force is applied by the clamping device.
- 4.5 control zone:** A zone containing the information on media parameters and format necessary for writing and reading the remaining tracks of the optical disk.
- 4.6 Cyclic Redundancy Check (CRC):** A method for detecting errors in data.
- 4.7 data clock:** A clock for data detection and data recording, generated by a PLL synchronized to servo marks.
- 4.8 defect management:** A method for handling the defective areas on the disk.
- 4.9 disk reference plane:** A plane defined by the perfectly flat annular surface of an ideal spindle onto which the clamping zone of the disk is clamped, and which is normal to the axis of rotation.
- 4.10 embossed mark:** A mark so formed as to be unalterable by magneto-optical means.
- 4.11 entrance surface:** The surface of the disk onto which the optical beam first impinges.
- 4.12 Error Correction Code (ECC):** An error-detecting code designed to correct certain kinds of errors in data.
- 4.13 field:** A subdivision of a segment.
NOTE - Subdivisions of a sector which are named 'field' are not fields in the sense of this definition.
- 4.14 format:** The arrangement of information on the disk.
- 4.15 frame:** The smallest addressable part of a track in the Information Zone of a disk that can be accessed independently of other parts of the zone.
- 4.16 flyable zone:** A part of the protective coating area over which the slider with a magnetic head can fly.
- 4.17 groove:** See 4.24.
- 4.18 Gray code Encoded Part (GEP):** Tracks containing a portion of control information for a drive which can be detected without tracking servo.
- 4.19 hub:** The central feature on the disk which interacts with the spindle of the disk drive to provide radial centring.
- 4.20 interleaving:** The process of allocating the physical sequence of units of data so as to render the data more immune to burst errors.
- 4.21 Kerr rotation:** The rotation of the plane of polarization of an optical beam upon reflection from the recording layer, as caused by the magneto-optical effect.

4.22 land and groove: A trench-like feature of the disk, applied before the recording of any information, and used to define the track location. The groove is located nearer to the entrance surface than the land with which it is paired to form a track.

4.23 magnetic field modulation: A technique for recording encoded information on the disk by switching a recording magnetic field between two opposite directions.

4.24 mark: A feature of the recording layer which may take the form of a magnetic domain, a pit, or any other type or form that can be sensed by the optical system. The pattern of marks represents the data on the disk.

NOTE - Subdivisions of a segment which are named 'mark' are not marks in the sense of this definition.

4.25 optical disk: A disk that will accept and retain information in the form of marks in a recording layer, that can be read with an optical beam.

4.26 optical disk cartridge (ODC): A device consisting of a case containing an optical disk.

4.27 polarization: The direction of polarization of an optical beam is the direction of the electric vector of the beam.

NOTE - The plane of polarization is the plane containing the electric vector and the direction of propagation of the beam. The polarization is right-handed when to an observer looking in the direction of propagation of the beam, the endpoint of the electric vector would appear to describe an ellipse in the clockwise sense

4.28 protective coating: A layer coated on top of the recording layer to protect from environmental influences and emergency landing of magnetic head.

4.29 read power: The optical power, incident at the entrance surface of the disk, used when reading.

4.30 recording magnetic field: The magnetic field that switches between two opposite directions (both perpendicular to the disk surface) according to the encoded information. When the focus spot of a laser beam heats the disk sufficiently, this magnetic field causes a permanent magnetic domain in the magneto-optical layer on the disk.

4.31 recording layer: A layer of the disk on, or in, which data is written during manufacture and/or use.

4.32 Reed-Solomon code: An error detection and/or correction code which is particularly suited for the correction of errors which occur in bursts or are strongly correlated.

4.33 servo clock: A clock generated with embossed wobble pits in servo field on disk.

4.34 sector: The smallest unit of a track in the Information Zone of a disk for reading and writing that comprises a number of segments.

4.35 segment: A subdivision of a frame.

4.36 spindle: The part of the disk drive which contacts with the disk and/or hub.

4.37 substrate: A transparent layer of the disk, provided for mechanical support of the recording layer, through which the optical beam accesses the recording layer.

4.38 track: The path which is followed by the focus of the optical beam during one revolution of the disk.

4.39 track pitch: The distance between adjacent track centre lines, measured in a radial direction.

4.40 zone: An annular area of the disk.

5 Conventions and notations

5.1 Representation of numbers

A measured value is rounded off to the least significant digit of the corresponding specified value. It implies that a specified value of 1,26 with a positive tolerance of + 0,01, and a negative tolerance of - 0,02 allows a range of measured values from 1,235 to 1,275.

- Letters and digits in parentheses represent numbers in hexadecimal notation.
- The setting of a bit is denoted by ZERO or ONE.
- Numbers in binary notation and bit combinations are represented by strings of 0 and 1.

- Numbers in binary notation and bit combinations are shown with the most significant bit to the left.
- Negative values of numbers in binary notation are given in TWO's complement.
- In each field the data is recorded so that the most significant byte (byte 0) is recorded first. Within each byte the least significant bit is numbered 0 and is recorded first, the most significant bit (numbered 7 in an 8-bit byte) is recorded last. This order of recording applies also to the data input of the Error Detection and Correction circuits and to their output.

5.2 Names

The names of entities, e.g. specific tracks, fields etc., have a capital initial.

6 List of acronyms

ALPC	Auto Laser Power Control
CAV	Constant Angular Velocity
CRC	Cyclic Redundancy Check
DCB	Data Channel Bit
DDS	Disk Definition Structure
DMA	Defect Management Area
ECC	Error Correction Code
FA1	Functional Area 1
FA2	Functional Area 2
GEP	Gray code Encoded Part of the Control Zone
ID	Identifier
LSB	Least Significant Byte
MO	Magneto-Optical
MSB	Most Significant Byte
NRZI	Non Return to Zero Inverted
ODC	Optical Disk Cartridge
O-ROM	Optical Read Only Memory
PDL	Primary Defect List
P-ROM	Partial Read Only Memory
R/W	Rewritable
R-S	Reed-Solomon(code)
R-S/LDC	Reed-Solomon Long Distance Code
SCB	Servo Channel Bit
SDL	Secondary Defect List
SFP	Standard Formatted Part of the Control Zone
SIP	Sector Interleave Parity (2nd ECC for embossed user data)
UD	User-Defined bytes
ZCAV	Zoned Constant Angular Velocity

7 General description of the optical disk cartridge

The optical disk cartridge which is the subject of this International Standard consists of a case containing an optical disk.

The case is a protective enclosure for the disk. It has access windows covered by a shutter. The windows are automatically uncovered by the drive when the cartridge is inserted into it.

The optical disk is recordable on one side. Data can be written onto the disk as marks in the form of magnetic domains in the recording layer and can be overwritten with new data with a focused optical beam, using the thermo-magnetic effect. The data can be read with a focused optical beam, using the magneto-optical effect. The beam accesses the recording layer through the transparent substrate of the disk.

Part of the disk or the entire disk may contain read-only data in the form of pits embossed by the manufacturer. This data can be read using the diffraction of the optical beam by the embossed pits.

8 General requirements

8.1 Environments

8.1.1 Test environment

The test environment is the environment where the air immediately surrounding the optical disk cartridge has following properties:

temperature	: 23 °C ± 2 °C
relative humidity	: 45 % to 55 %
atmospheric pressure	: 60 kPa to 106 kPa
air cleanliness	: Class 100 000 (see annex J)

No condensation on or in the optical disk cartridge shall occur. Before testing, the optical disk cartridge shall be conditioned in this environment for 48 h minimum. It is recommended that, before testing, the entrance surface of the optical disk shall be cleaned according to the instructions of the manufacturer of the disk.

Unless otherwise stated, all tests and measurements shall be made in this test environment.

8.1.2 Operating environment

This International Standard requires that an optical disk cartridge which meets all requirements of this International Standard in the specified test environment provides data interchange over the specified ranges of environmental parameters in the operating environment.

The operating environment is the environment where the air immediately surrounding the optical disk cartridge has the following properties:

temperature	: 5 °C to 55 °C
relative humidity	: 3 % to 85 %
absolute humidity	: 1 g/m ³ to 30 g/m ³
atmospheric pressure	: 60 kPa to 106 kPa
temperature gradient	: 10 °C/h max.
relative humidity gradient	: 10 %/h max.
air cleanliness	: Office environment (see annex U)
magnetic field strength at the recording layer for any condition under which a beam is in focus	: 24 000 A/m max.
magnetic field strength at the recording layer during any other condition	: 48 000 A/m max.

No condensation on or in the optical disk cartridge shall occur. If an optical disk cartridge has been exposed to conditions outside those specified in this clause, it shall be acclimatized in an allowed operating environment for at least 2 h before use (See also annex S).

8.1.3 Storage environment

The optical disk cartridge without any protective enclosure shall not be stored in an environment outside the range allowed for storage. The storage environment is the environment where the air immediately surrounding the optical disk cartridge has the following properties:

temperature	: -10 °C to 55 °C
relative humidity	: 3 % to 90 %
absolute humidity	: 1 g/m ³ to 30 g/m ³
atmospheric pressure	: 60 kPa to 106 kPa
temperature gradient	: 15 °C/h max.
relative humidity gradient	: 10 %/h max.
air cleanliness	: Office environment (see annex U)
magnetic field strength at the recording layer	: 48 000 A/m max.

No condensation on or in the optical disk cartridge shall occur.

8.1.4 Transportation

This International Standard does not specify requirements for transportation; guidance is given in annex T.

8.2 Temperature shock

The optical disk cartridge shall withstand a temperature shock of up to 20°C when inserted into, or removed from, the drive.

8.3 Safety requirements

The cartridge shall satisfy the safety requirements of Standard ECMA-129, when used in the intended manner or in any foreseeable use in an information processing system.

8.4 Flammability

The cartridge and its components shall be made from materials that comply with the flammability class for HB materials, or better, as specified in Standard ECMA-129.

9 Reference Drive

The Reference Drive is a drive several critical components of which have well defined properties and which is used to test write and read parameters of the disk for conformance to this International Standard. The critical components vary from test to test. This clause gives an outline of all components; components critical for tests in specific clauses only are specified in these clauses.

9.1 Optical system

The basic set-up of the optical system of the Reference Drive used for measuring the write and read parameters is shown in figure 1. Different components and locations of components are permitted, provided that the performance remains the same as that of the set-up in figure 1. The optical system shall be such that the detected light reflected from the entrance surface of the disk is minimized so as not to influence the accuracy of the measurements.

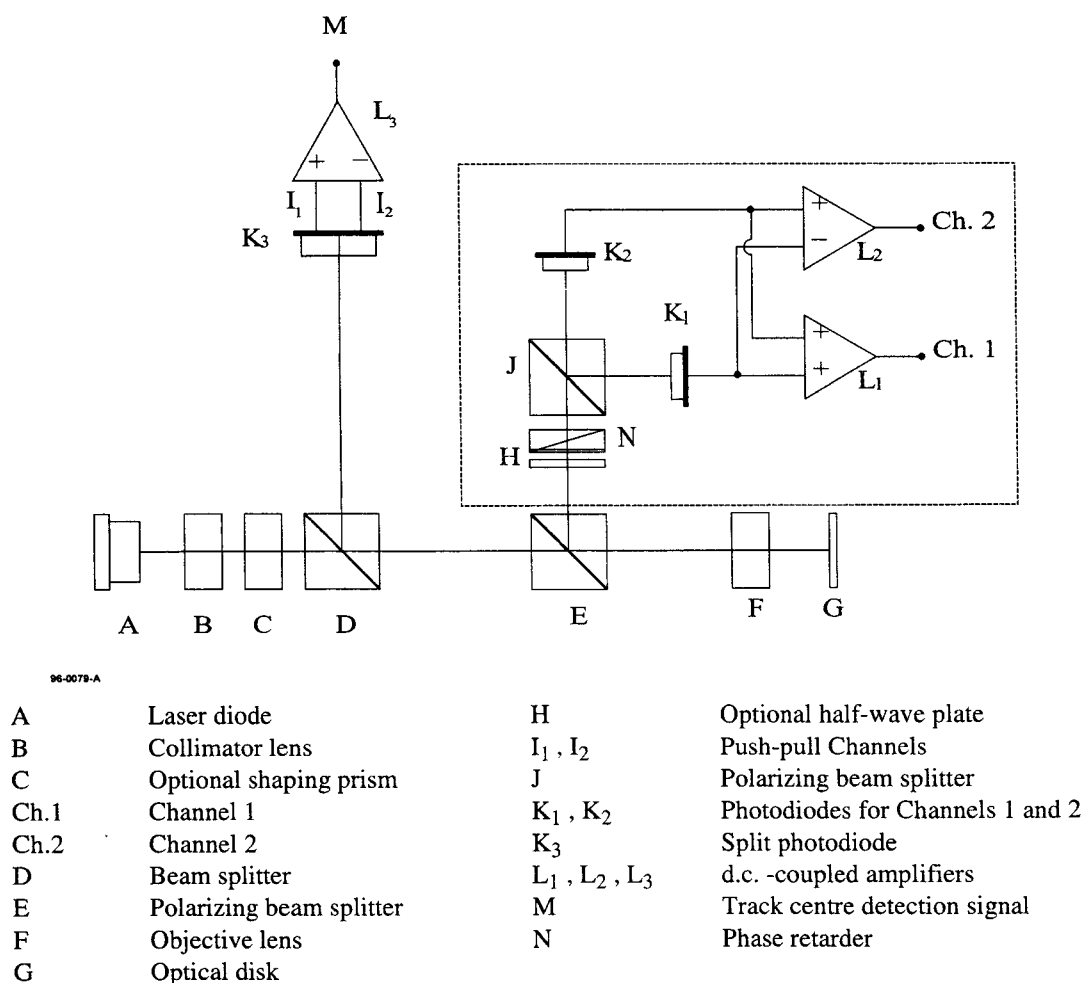


Figure 1 - Optical system of the Reference Drive

In the absence of polarization changes in the disk, the polarizing beam splitter J shall be aligned to make the signal of detector K_1 equal to that of detector K_2 . The direction of polarization in this case is called the neutral direction. The phase retarder N shall be adjusted such that the optical system does not have more than $2,5^\circ$ phase retardation between the neutral polarization and the polarization perpendicular to it. This position of the retarder is called the neutral position.

The phase retarder can be used for the measurement of the Overwrite characteristics (see clause 28).

The beam splitter J shall have a p-s intensity reflectance ratio of at least 100.

The beam splitter E shall have an intensity reflectance R_p from F to H of nominally 0,30 for the neutral polarization direction. The reflectance R_s for the polarization perpendicular to the neutral direction shall be nominally 0,95. The actual value of R_s shall not be smaller than 0,90.

The imbalance of the magneto-optical signal is specified for a beam splitter with nominal reflectance. If the measurement is made on a drive with reflectances R_p' and R_s' for beam splitter E, then the measured imbalance shall be multiplied by

$$\sqrt{\frac{R_s \cdot R_p'}{R_p \cdot R_s'}}$$

to make it correspond to the nominal beam splitter E.

The output of Channel 1 is the sum of the currents through photodiodes K_1 and K_2 , and is used for reading embossed marks. The output of Channel 2 is the difference between photodiode currents, and is used for reading user-written marks with the magneto-optical effect.

9.2 Optical beam

The focused optical beam used for writing and reading data shall have the following properties:

- a) Wavelength (λ)

	+ 10 nm
685 nm	
	- 10 nm
- b) Wavelength (λ) divided by the numerical aperture of the objective lens (NA)

$\lambda/NA = 1,245 \mu\text{m} \pm 0,018 \mu\text{m}$
--
- c) Filling D/W of the aperture of the objective lens

radial	$1,30 \pm 0,03$
tangential	$0,64 \pm 0,03$
- d) Variance of the wavefront of the optical beam near the recording layer, after passing through an ideal substrate

0 to $\lambda^2 / 180$

- e) Polarization

Perpendicular to the track

- f) Extinction ratio

0,01 max.

- g) The optical power for writing and reading, and the magnetic field shall be as specified in 21.2.2, 26.2.2, 26.3 and 29.2.2.

D is the diameter of the lens aperture and W is the beam diameter of the Gaussian beam where the intensity is $1/e^2$ of the maximum intensity.

The extinction ratio is the ratio of the minimum over the maximum power observed behind a linear polarizer in the optical beam, which is rotated over at least 180° .

9.3 Read channels

Two read channels shall be provided to generate signals from the marks in the recording layer. Channel 1 shall be used for reading the embossed marks, using the diffraction of the optical beam by the marks. Channel 2 shall be used for reading the user-written marks, using the rotation of the polarization of the optical beam due to the magneto-optical effect of the marks. The read amplifiers after the photo-detectors in Channel 1 and Channel 2 shall have a flat response within 1 dB from d.c. to 13 MHz.

9.4 Tracking

Channel 1 shall be used for generating the tracking error signals to control the servos for the axial and radial tracking of the optical beam. The method of generating the axial tracking error is not specified for the Reference Drive. The radial tracking error is the difference between the signal levels obtained from the centres of two Wobble Marks.

The requirements for the accuracy with which the focus of the optical beam must follow the tracks is specified in 21.2.4.

9.5 Rotation of the disk

The spindle shall position the disk as specified in 12.4. It shall rotate the disk at $40,00 \text{ Hz} \pm 0,08 \text{ Hz}$.

The direction of rotation shall be counter-clockwise when viewed from the objective lens.

Section 2 - Mechanical and physical characteristics

10 Dimensional and physical characteristics of the case

10.1 General description of the case (see figure 2)

The case is a rigid protective container of rectangular shape. It has a spindle window on Side A to allow the spindle of the drive to clamp the disk by its hub. Both Side A and Side B of the case have a head window, the one on Side A for the optical head of the drive, the other one on Side B for the slider with a magnetic head providing the necessary magnetic fields. A shutter uncovers the windows upon insertion into the drive, and automatically covers them upon removal from the drive. The case has features that enable a drive to reject a mis-inserted cartridge, and write-inhibit and reflectance detection features.

10.2 Reference planes of the case

The dimensions of the case shall be referred to three orthogonal planes X, Y and Z (see annex K). The case shall be constrained such that four reference surfaces S1 to S4 on Side A of the case lie in plane Z when measuring those dimensions of the case in 10.3 which are referenced to this plane. The intersection of the three planes defines the centre of the location hole. The centre of the alignment hole shall lie at the intersection of planes X and Z (see annex K). A dimension of a feature referenced to one of the planes is the shortest distance from the feature to the plane.

10.3 Dimensions of the case

The dimensions of the case shall be measured in the test environment. The dimensions of the case in an operating environment can be estimated from the dimensions specified in this clause.

10.3.1 Overall dimensions (see figure 3)

The total length of the case shall be

$$L_1 = 97,0 \text{ mm} \pm 0,3 \text{ mm}$$

The distance from the top of the case to reference plane X shall be

$$L_2 = 78,0 \text{ mm} \pm 0,2 \text{ mm}$$

The total width of the case shall be

$$L_3 = 92,0 \text{ mm} \pm 0,2 \text{ mm}$$

The distance from the right hand side of the case to reference plane Y shall be

$$L_4 = 5,0 \text{ mm} \pm 0,2 \text{ mm}$$

The two corners at the top shall be rounded with a radius

$$R_1 = 6,0 \text{ mm} \pm 0,2 \text{ mm}$$

and the two corners at the bottom with a radius

$$R_2 = 6,0 \text{ mm} \pm 0,5 \text{ mm}$$

In the zones extending

$$L_5 = 9,6 \text{ mm min.}$$

from the left-hand and right-hand edges of the case, the thickness of the case shall

$$L_6 = 5,0 \text{ mm} \pm 0,2 \text{ mm}$$

The eight long edges of the case shall be rounded with a radius

$$R_3 = 0,5 \text{ mm} \pm 0,2 \text{ mm}$$

10.3.2 Location hole (see figure 3)

The centre of the location hole shall coincide with the interaction of the planes X, Y and Z. The diameter of the hole shall be

$$D_1 = 3,60 \text{ mm} \begin{matrix} + 0,00 \text{ mm} \\ - 0,06 \text{ mm} \end{matrix}$$

held to a depth

$$L_7 = 1,0 \text{ mm min.}$$

The location hole shall extend below plane Z by

$$L_8 = 3,5 \text{ mm min.}$$

with a diameter equal to, or greater than D_1 .

The location hole shall not extend through Side B.

The lead-in edges shall be rounded with a radius

$$R_4 = 0,5 \text{ mm max.}$$

10.3.3 Alignment hole (see figure 3)

The centre of the alignment hole shall lie in the X plane at a distance

$$L_9 = 82,0 \text{ mm} \pm 0,2 \text{ mm}$$

from reference plane Y.

The alignment hole shall have a substantially rectangular shape. Its dimensions shall be

$$\begin{array}{l} L_{10} = 3,60 \text{ mm} \quad + 0,00 \text{ mm} \\ \quad \quad \quad \quad \quad - 0,06 \text{ mm} \\ L_{11} = 4,4 \text{ mm} \quad + 0,2 \text{ mm} \\ \quad \quad \quad \quad \quad - 0,0 \text{ mm} \end{array}$$

held to a depth

$$L_{12} = 1,0 \text{ mm min.}$$

below which the alignment hole shall extend to

$$L_{13} = 3,5 \text{ mm min.}$$

with dimensions equal to, or greater than, L_{10} and L_{11} , respectively.

The alignment hole shall not extend through Side B.

The lead-in edges shall be rounded with a radius R_4 .

10.3.4 Reference surfaces (see figure 4)

Side A of the case shall contain four reference surfaces S1, S2, S3 and S4.

Surface S1 and S2 shall be circular with a diameter

$$D_2 = 7,0 \text{ mm min.}$$

S1 shall be centred on the location hole, and S2 shall be centred on the alignment hole.

Surface S3 and S4 shall be semi-circular with a diameter

$$D_3 = 7,0 \text{ mm min.}$$

The location of the centre of S4 is specified by

$$\begin{array}{l} L_{14} = 54,0 \text{ mm} \pm 0,2 \text{ mm} \\ L_{15} = 82,0 \text{ mm} \pm 0,2 \text{ mm} \end{array}$$

The centre of S3 shall be in plane Y at a distance L_{14} of plane X.

Surface finish and the height of S1, S2, S3 and S4 shall be the same as those of the surrounding area.

No portion of the case, including the warp, or of the shutter mechanism shall protrude more than

$$\begin{array}{l} L_{16} = 0,2 \text{ mm max.} \\ L_{17} = 5,4 \text{ mm max.} \end{array}$$

beyond plane Z.

10.3.5 Insertion slots and detent features (see figure 5)

The case shall have two sets of symmetrically placed insertion slots with detent features. The slots are intended to prevent mis-insertion of the cartridge into a drive. The detent features are intended for autoloading.

The slots are called inject notches, the detents mis-insert grooves.

Each detent shall extend from plane Z up to

$$L_{18} = 3,0 \text{ mm} \pm 0,2 \text{ mm}$$

and shall not extend through Side B.

Inject notches are defined by semi-circular sections with a radius

$$R_5 = 2,1 \text{ mm} \pm 0,1 \text{ mm}$$

which stretch out to the edge of the case along two straight lines extending from the semi-circle. The radii of the two inject notches originate from points located at

$$L_{19} = 65,5 \text{ mm} \pm 0,2 \text{ mm}$$

from plane X, and at

$$L_{20} = 1,5 \text{ mm} \pm 0,2 \text{ mm}$$

and

$$L_{21} = 83,5 \text{ mm} \pm 0,2 \text{ mm}$$

from plane Y.

The outside edges of the inject notches shall be rounded off by a radius

$$R_6 = 0,5 \text{ mm} \pm 0,2 \text{ mm}$$

Mis-insert grooves are defined by

$$L_{22} = 39,5 \text{ mm} \pm 0,2 \text{ mm}$$

from plane X, and have a depth of

$$L_{23} = 2,5 \text{ mm} \begin{array}{l} + 0,3 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

from the edges of the case.

The detents of the mis-insert grooves shall be rounded off by radii

$$R_7 = 1,0 \text{ mm max.}$$

$$R_8 = 0,5 \text{ mm} \pm 0,2 \text{ mm}$$

The lead-in edges of mis-insert grooves shall be ramps to the top of the case with an angle

$$A_1 = 15^\circ \pm 2^\circ$$

starting from the point defined by the intersection of L_{23} and

$$L_{24} = 8,0 \text{ mm} \pm 0,2 \text{ mm}$$

10.3.6 Functional Areas (see figure 6)

The case shall have an opening in Side A corresponding to the surfaces of Functional Areas FA1 and FA2.

Functional Area FA1 shall be circular with a diameter

$$D_4 = 2,5 \text{ mm min.}$$

with its centre located at a distance

$$L_{25} = 14,0 \text{ mm} \pm 0,2 \text{ mm}$$

from plane X, and a distance

$$L_{26} = 15,0 \text{ mm} \pm 0,2 \text{ mm}$$

from plane Y. Side B shall have an opening corresponding to the surface of Functional Area FA1.

Functional Area FA2 shall have the diameter D_4 and held to a depth

$$L_{27} = 3,5 \text{ mm min.}$$

from plane Z with its centre located at a distance L_{25} from plane X, and a distance

$$L_{28} = 10,0 \text{ mm} \pm 0,2 \text{ mm}$$

from plane Y.

There shall be no opening in Side B corresponding to Functional Area FA2.

The cartridge shall have a device capable of

- either closing FA1 or FA2,
- or closing both FA1 and FA2.

The two Functional Areas shall indicate the reflectance of the disk in the cartridge and whether or not writing on the disk is permitted, as specified in table 1 (see also figure 6) .

Table 1 - Use of the Functional Areas FA1 and FA2

FA1	FA2	Writing	Reflectance	Type of Cartridge
Open	Closed	Inhibited	Low	R/W, P-ROM
Closed	Open	Permitted	Low	R/W or P-ROM
Closed	Closed	Inhibited	High	O-ROM
Open	Open	Not permitted by this International Standard		

The surface of the device shall be at a depth

$$L_{29} = 0,3 \text{ mm max.}$$

from plane Z.

10.3.7 Spindle and head windows (see figure 7)

Side A of the case shall have two windows to enable the spindle and the optical head of the drive to access the disk.

The dimensions of the top window for the optical head are referenced to a centreline, located at a distance

$$L_{30} = 41,0 \text{ mm} \pm 0,2 \text{ mm}$$

from plane Y. The width of the window shall be given by

$$L_{31} = 9,75 \text{ mm} \begin{matrix} + 0,25 \text{ mm} \\ - 0,00 \text{ mm} \end{matrix}$$

The top of the window shall be defined by the radius

$$R_9 = 44,6 \text{ mm min.}$$

originating from L_{30} and

$$L_{32} = 27,0 \text{ mm} \pm 0,2 \text{ mm}$$

The window for the optical head shall extend from

$$L_{33} = 39,0 \text{ mm max.}$$

to the arc of R_9 , originating from L_{30} and L_{32} .

The area bounded by R_9 and the top of the case shall be recessed from plane Z by

$$L_{34} = 1,6 \text{ mm min.}$$

over the width of the window.

The window for the spindle shall be circular with a diameter

$$D_5 = 19,5 \text{ mm} \begin{array}{l} + 0,5 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

originating from L_{30} and L_{32} .

The two inside corners shall be rounded with radii

$$R_{10} = 2,0 \text{ mm max.}$$

Side B of the case shall have a window to enable the magnetic head of the drive to access the disk.

The dimensions of the window are referenced to a centreline, located at a distance L_{30} from plane Y.

The width of the window shall be given by

$$L_{35} = 8,00 \text{ mm} \begin{array}{l} + 0,25 \text{ mm} \\ - 0,00 \text{ mm} \end{array}$$

The window for the magnetic head shall extend from

$$L_{36} = 39,0 \text{ mm max.}$$

to the arc of R_9 , originating from L_{30} and L_{32} .

The area bounded by R_9 and the top of the case shall be, over the width of the window, at a distance

$$L_{37} = 3,5 \text{ mm max.}$$

from plane Z.

The two inside corners shall be rounded with a radius

$$R_{11} = 2,0 \text{ mm max.}$$

10.3.8 Shutter (see figure 8)

The case shall have a spring-loaded shutter designed to completely cover the spindle and head windows when closed. When open, the shutter shall expose the windows up to at least the minimum size allowed by the following dimensions, given in 10.3.7:

on Side A: from the circle defined by D_5 up to the top of the case, and from L_{33} up to the top of the case, and from L_{31} ;

on Side B: from L_{36} up to the top of the case, and from L_{35} .

on the top: from plane Z to L_{34} , from L_{31} , from L_{37} up to Side B, from L_{35} .

The shutter shall be free to slide in a recessed area of the case in such a way as to ensure that the overall thickness of the case and shutter does not exceed L_{14} by more than L_{16} and L_{17} .

The shutter shall have one edge against which the shutter opener of the drive can push to open the shutter. When the shutter is closed, this edge shall be

$$L_{38} = 76,0 \text{ mm} \begin{array}{l} + 0,0 \text{ mm} \\ - 0,4 \text{ mm} \end{array}$$

from plane Y. A movement of the edge to

$$L_{39} = 54,6 \text{ mm min.}$$

shall be sufficient to open the windows to the minimum size specified in 10.3.8. It shall be possible to move the edge to

$$L_{40} = 54,0 \text{ mm max.}$$

without exceeding the shutter opening force as specified in 10.4.5, while leaving the minimum size window open.

10.3.9 Path for shutter opener and shutter sensor notch (see figures 9 and 10)

The profile on the top of the case provides a path over which the shutter opener of the drive can move.

The path shall run from

$$L_{41} = 78,0 \text{ mm} \pm 0,3 \text{ mm}$$

to

$$L_{42} = 57,0 \text{ mm} \begin{array}{l} + 0,4 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

at a distance

$$L_{43} = 75,5 \text{ mm} \pm 0,3 \text{ mm}$$

from plane X.

The lead-in edge at L_{41} shall be a ramp to the top of the case at a distance

$$L_{44} = 79,5 \text{ mm} \pm 0,3 \text{ mm}$$

from plane Y.

The path shall end in a notch with a width at the bottom extending from L_{42} to

$$L_{45} = 54,0 \text{ mm max.}$$

and a depth

$$L_{46} = 2,0 \text{ mm} \begin{array}{l} + 0,3 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

below L_{43} . The lead-in edge at the left-hand side of the notch shall be rounded with a radius

$$R_{12} = 0,5 \text{ mm max.}$$

and the bottom of the same side of the notch shall be rounded with a radius

$$R_{13} = 0,5 \text{ mm} \pm 0,2 \text{ mm}$$

When the shutter edge is moved to L_{39} , a length of at least $(L_{42} - L_{39})$ of the notch shall be exposed.

This enables a drive to confirm that the shutter is fully open.

The top of the slider shall be given by

$$L_{47} = 77,7 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{48} = 0,7 \text{ mm min.}$$

10.3.10 Label area (see figure 11)

The case shall have a label area on Side B with dimensions

$$L_{49} = 10,0 \pm 0,2 \text{ mm}$$

$$L_{50} = 72,0 \pm 0,3 \text{ mm}$$

$$L_{51} = 10,0 \pm 0,2 \text{ mm}$$

and

$$L_{52} = 42,0 \pm 0,3 \text{ mm.}$$

The four corners of the area shall be rounded with a radius

$$R_{14} = 2,0 \text{ mm max.}$$

When there is no label, the area shall be recessed by

$$L_{53} = 0,12 \text{ mm min.}$$

10.4 Mechanical characteristics

All requirements of this clause shall be met in the operating environment.

10.4.1 Material

The case shall be constructed from any suitable materials such that it meets the requirements of this International Standard.

10.4.2 Mass

The mass of the case without the optical disk shall not exceed 50g.

10.4.3 Edge distortion

The cartridge shall meet the requirement of the edge distortion test defined in annex A.

10.4.4 Compliance

The cartridge shall meet the requirement of the compliance (flexibility) test defined in annex B. The requirement assures that a cartridge can be constrained in the proper plane of operation within the drive.

10.4.5 Shutter opening force

The spring force on the shutter shall be such that the force required to fully open the shutter does not exceed 1,0 N. It shall be sufficiently strong to fully close a free-sliding shutter, irrespective of the orientation of the case.

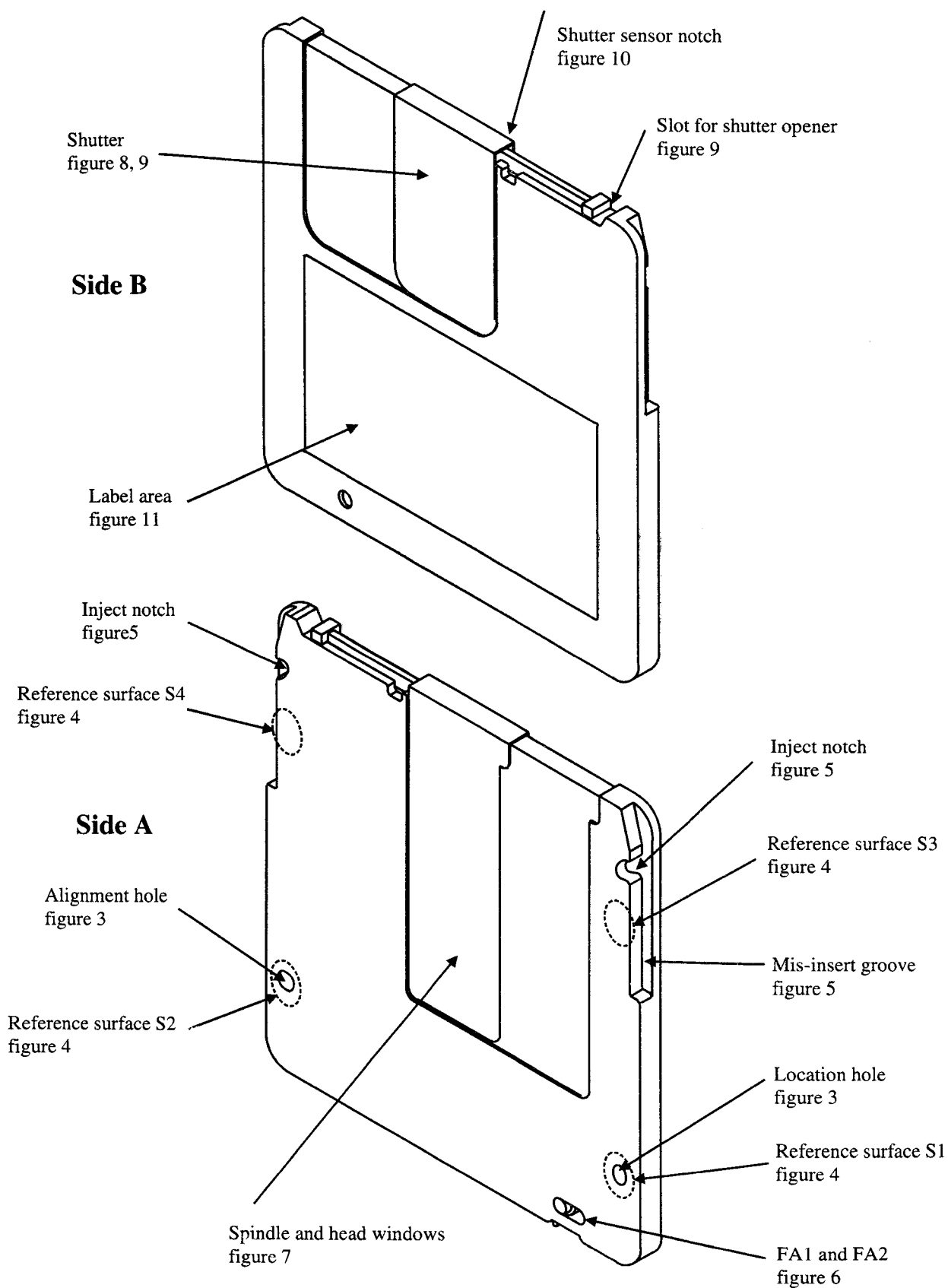
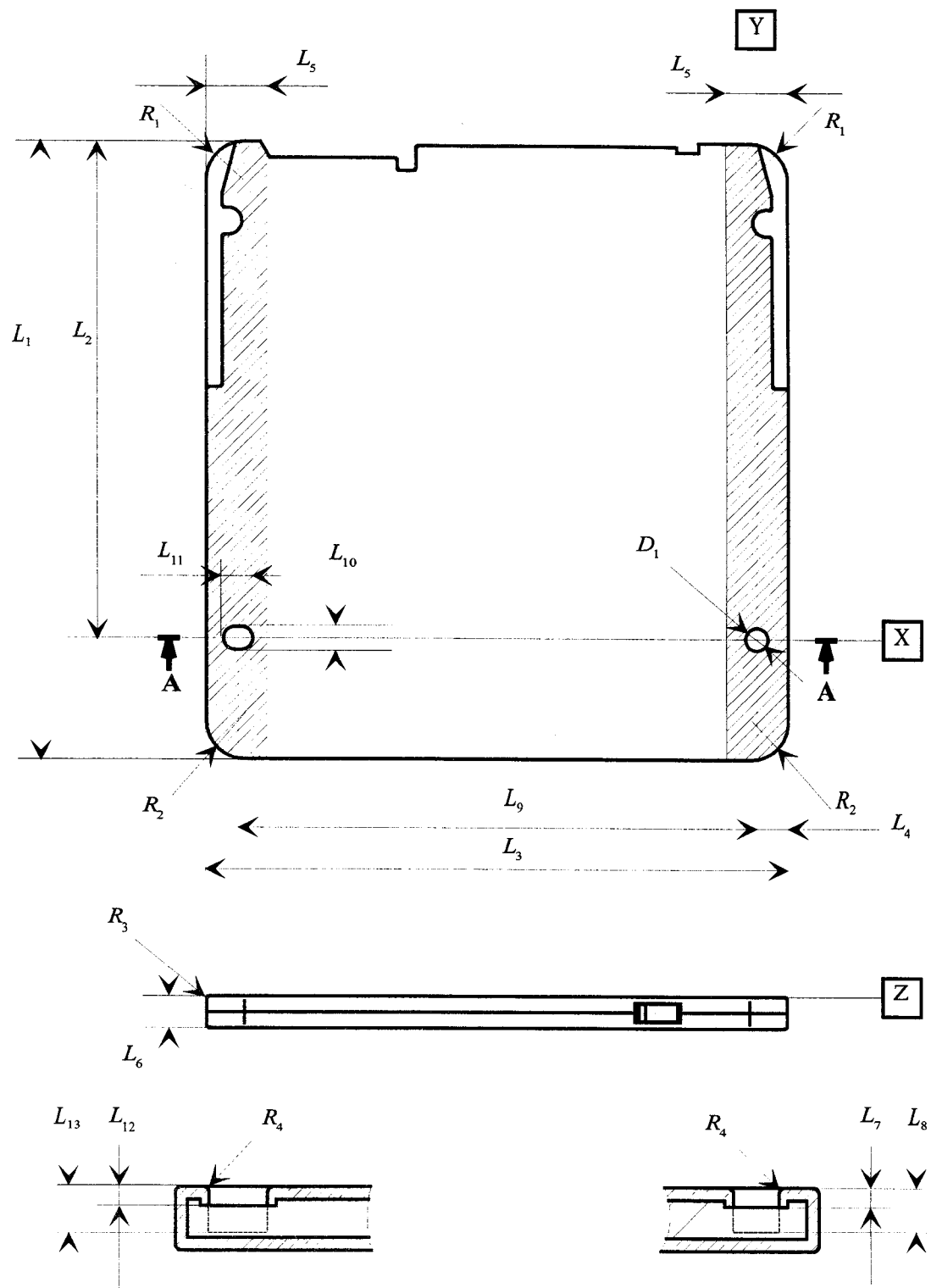


Figure 2 - General view of the case



Section AA

96-0081-A

Figure 3 - Overall dimensions, viewed on Side A

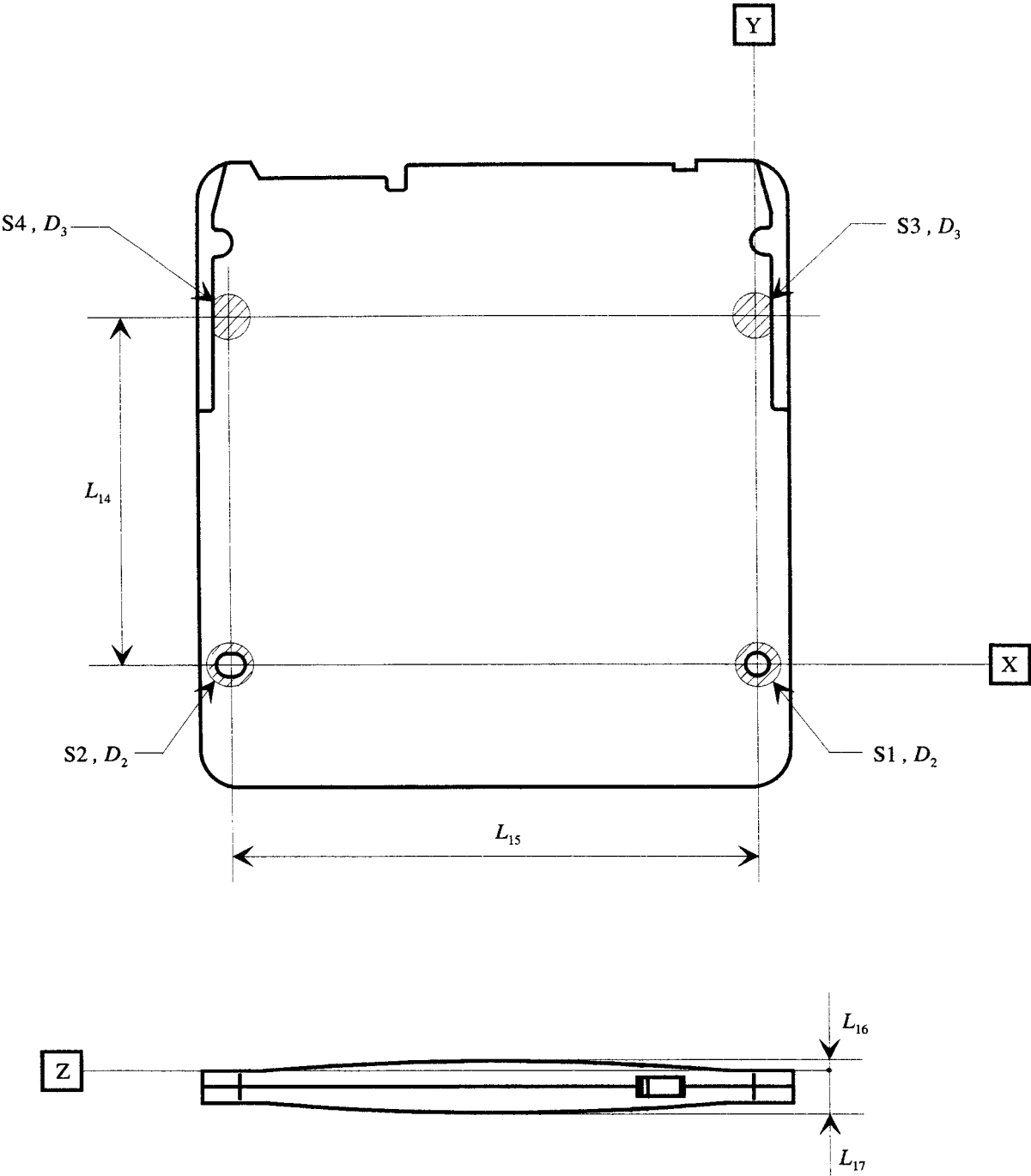


Figure 4 -Reference surfaces on Side A

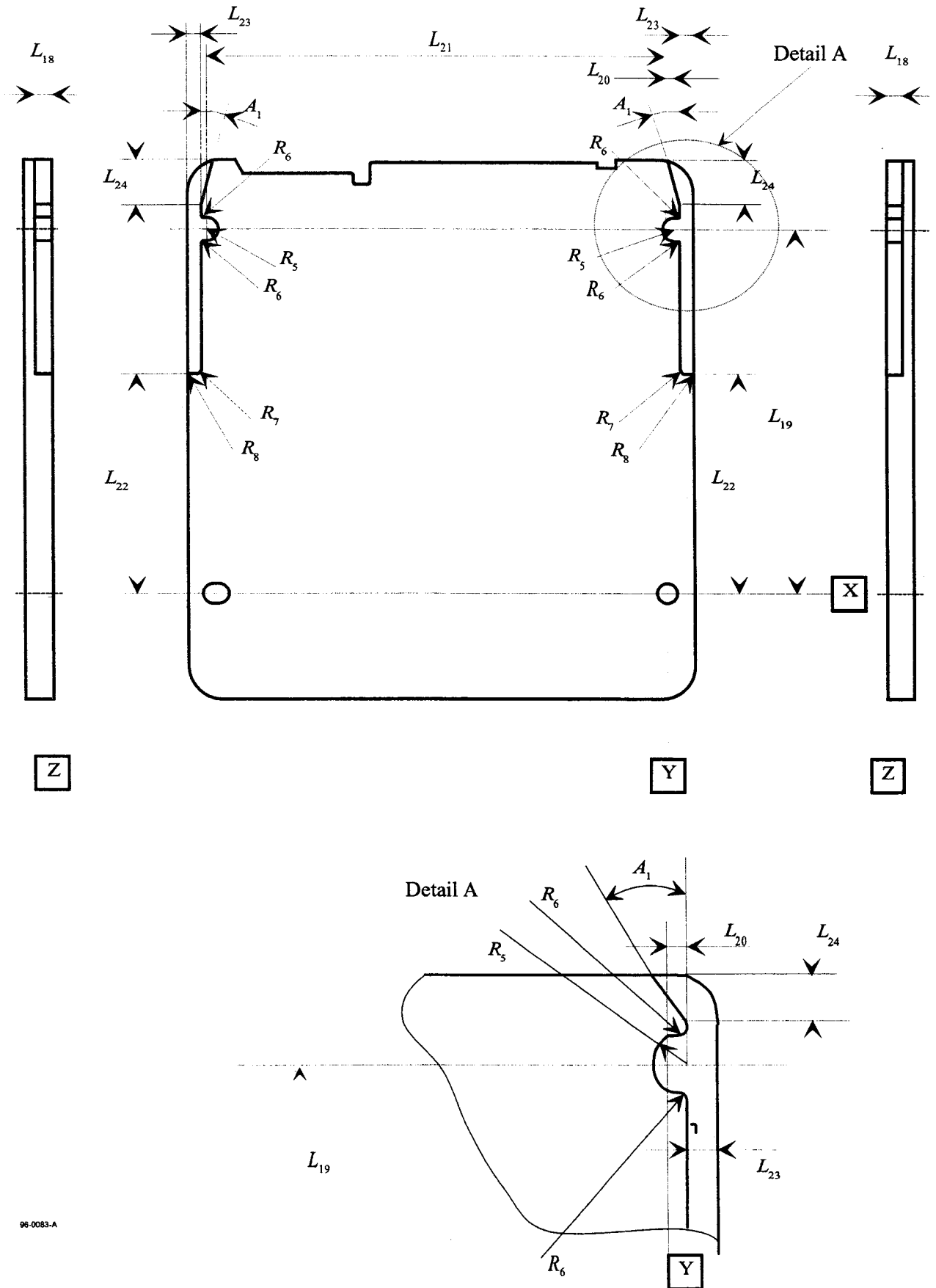


Figure 5 - Detent feature, seen on Side A

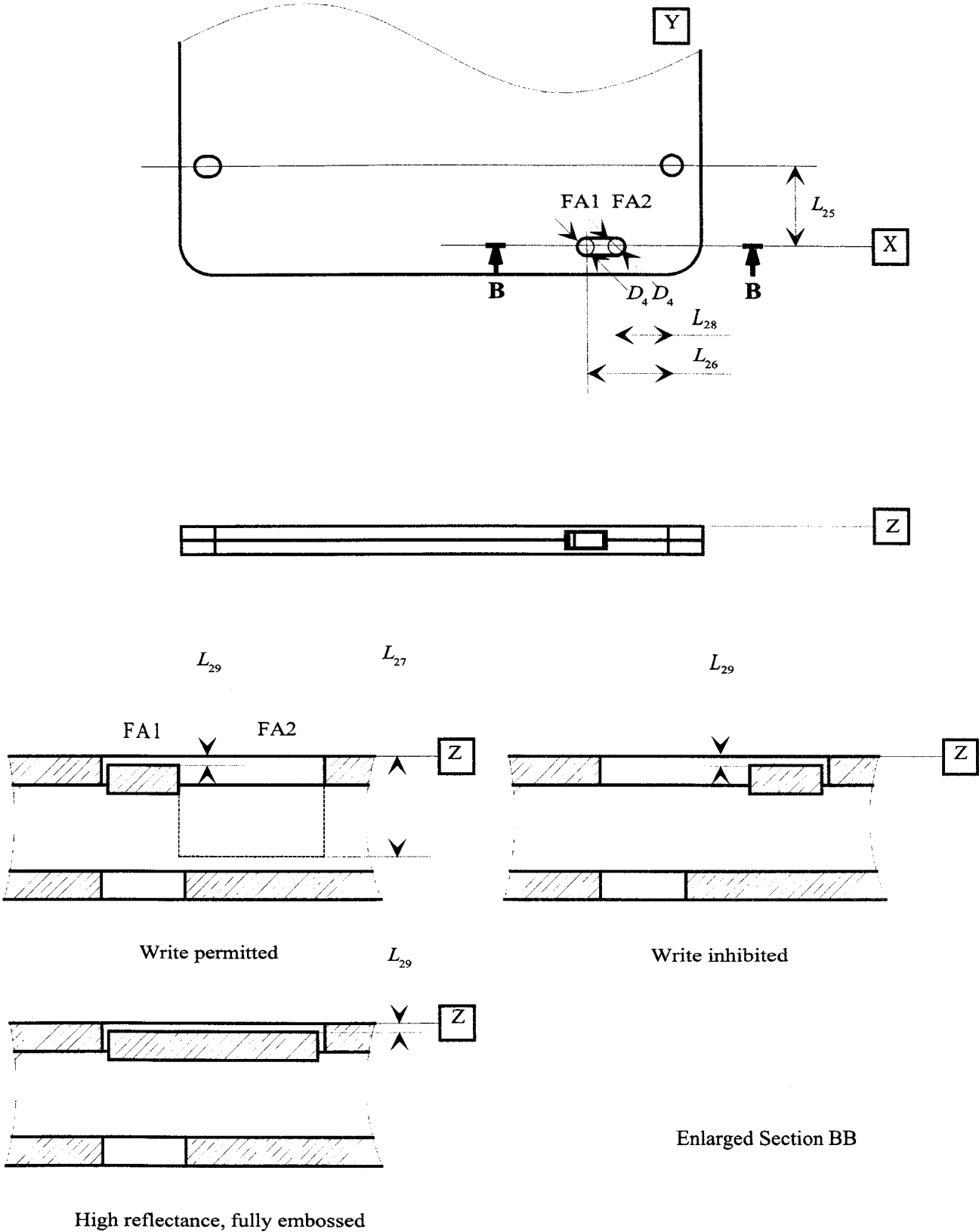


Figure 6 - Functional Areas FA1 and FA2, seen on Side A and in cross-section

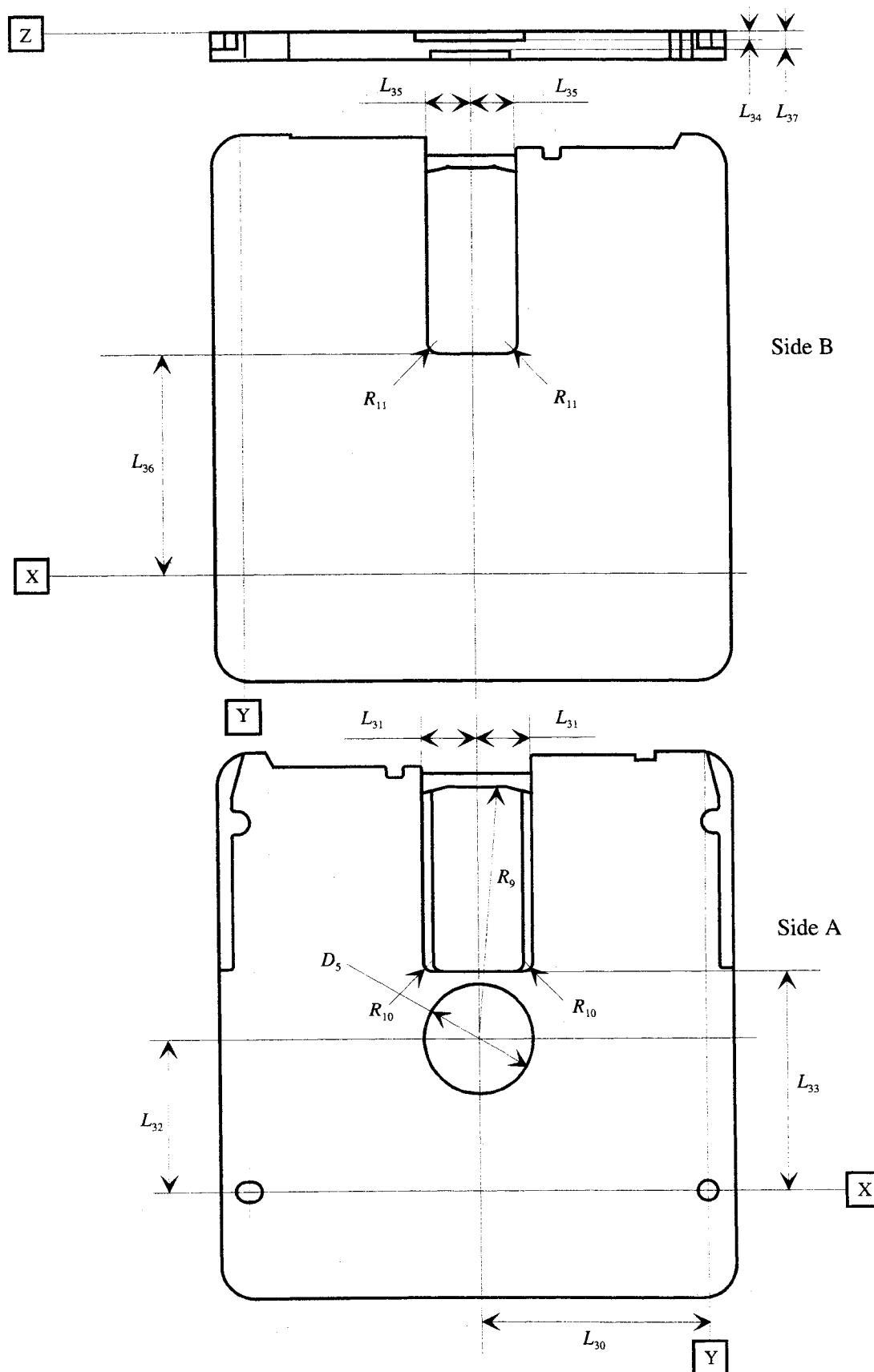


Figure 7 - Spindle and head windows on Side A and B of the case without shutter

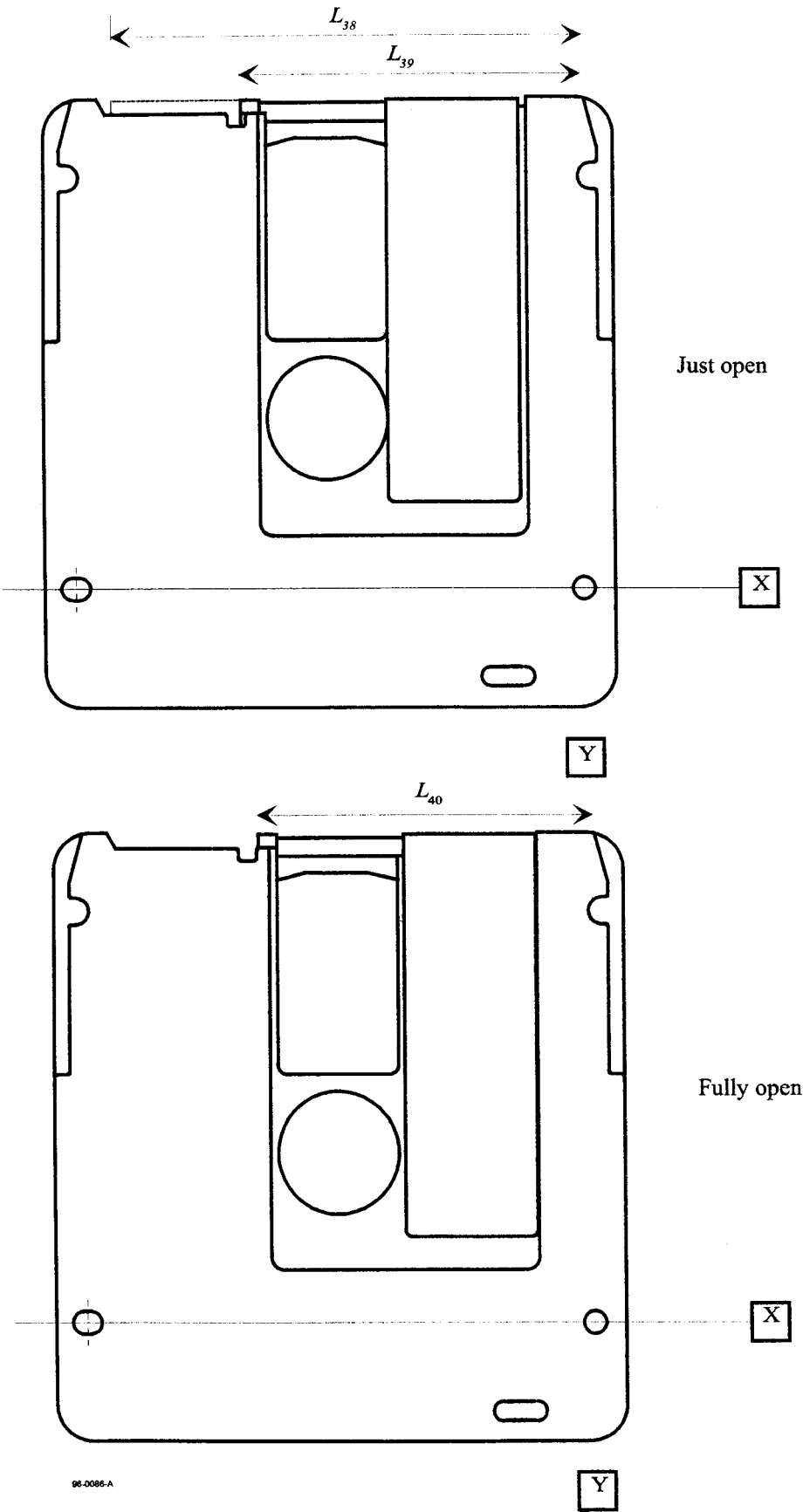


Figure 8 - Shutter in just open position and fully open position.
The dashed line indicates the position of the shutter edge when the shutter is closed.

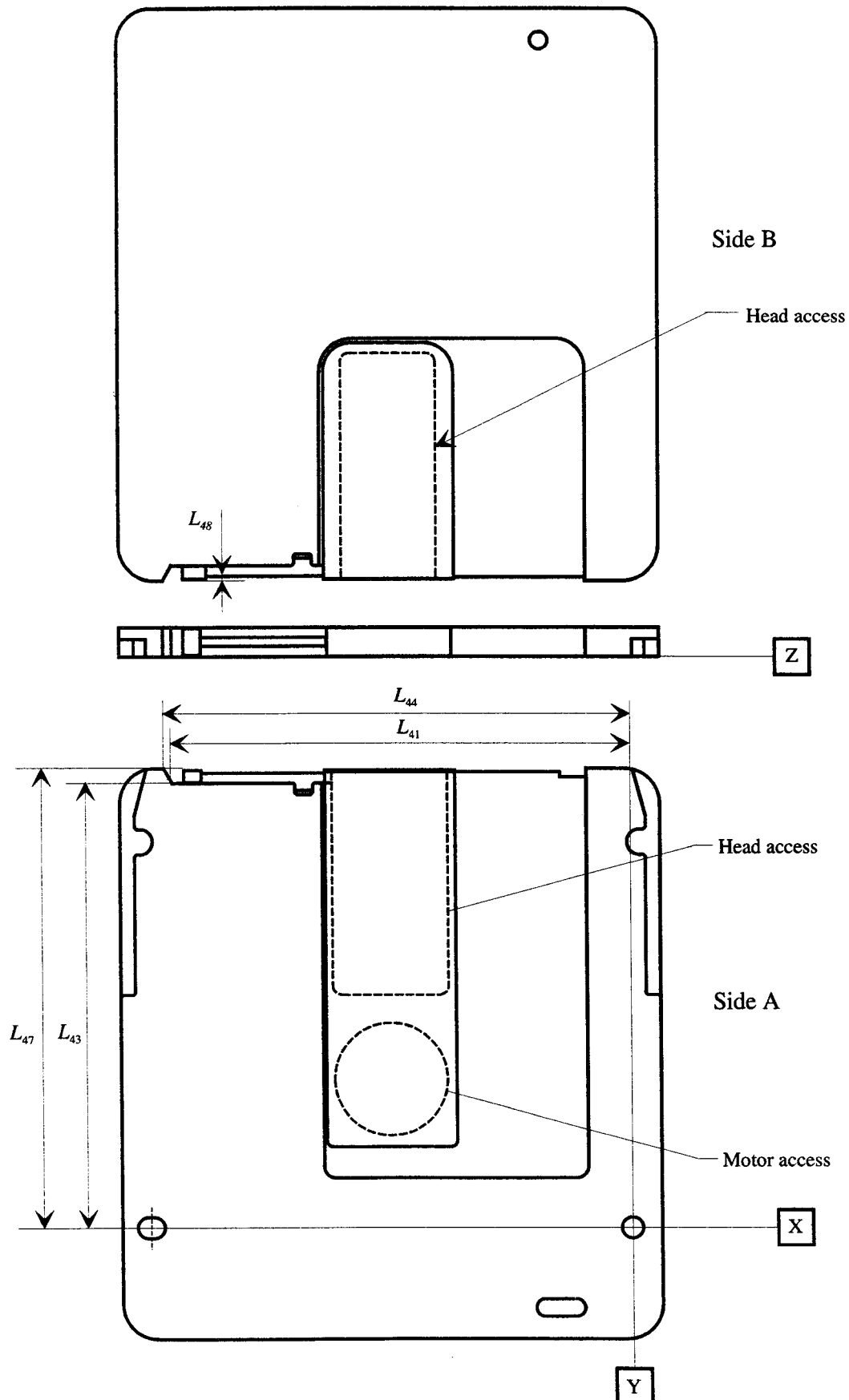


Figure 9 - Path for the shutter opener

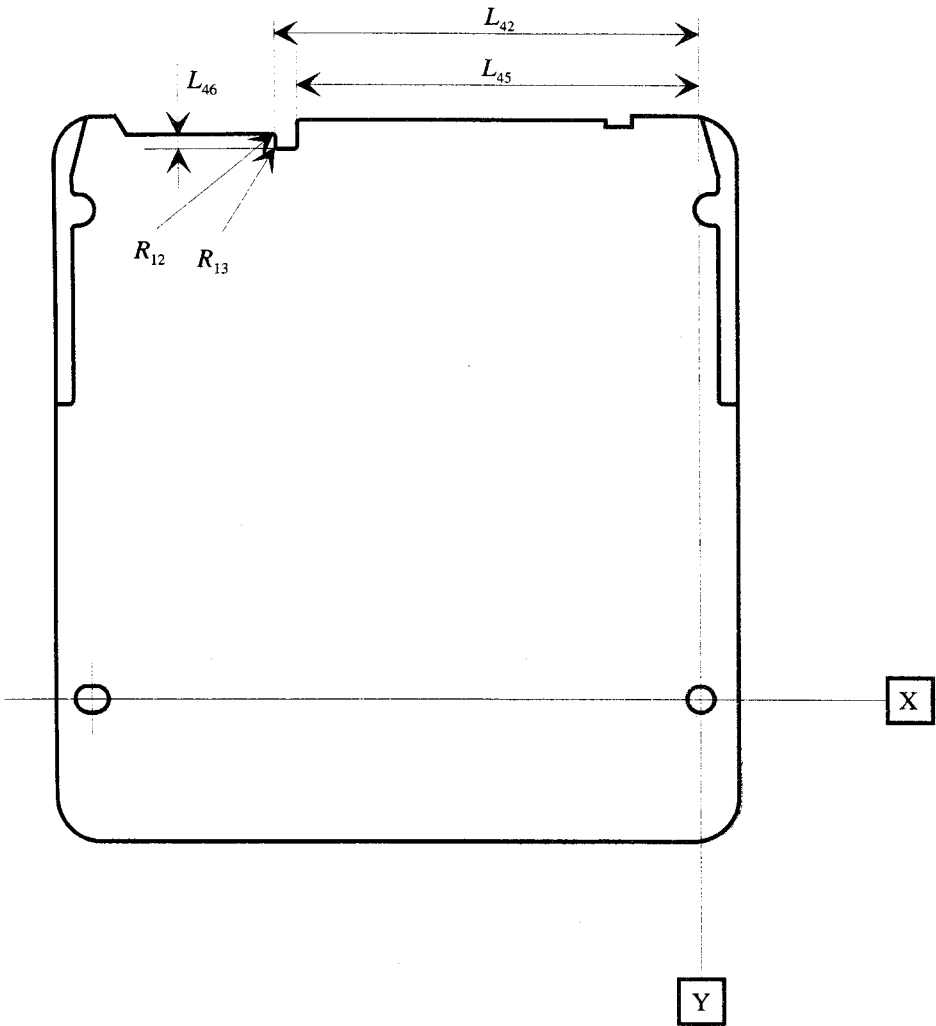


Figure 10 - Path for shutter opener and sensor notch, seen from Side A without shutter

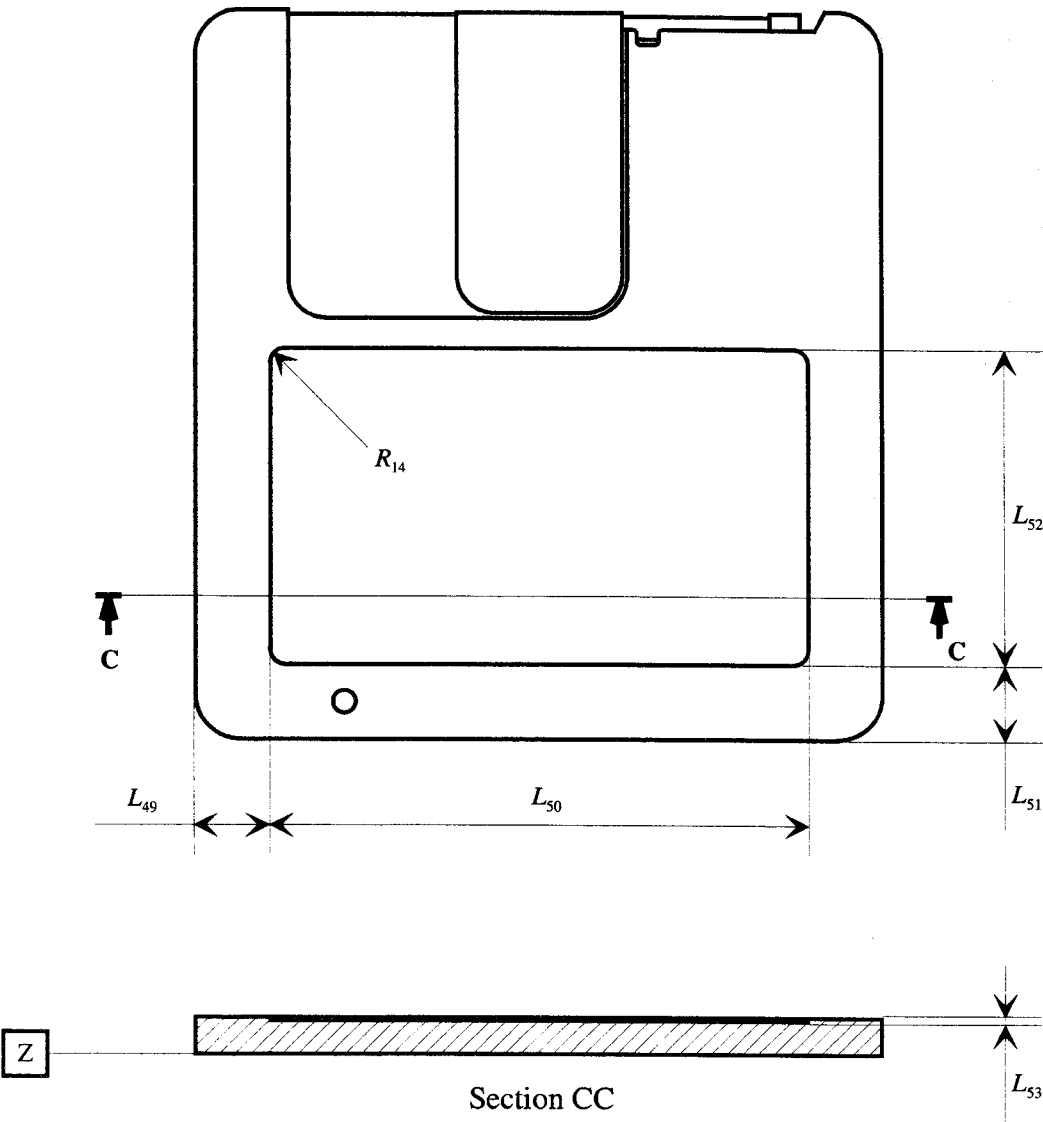


Figure 11 - Label area

11 Dimensional, mechanical and physical characteristics of the disk

11.1 General description of the disk

The disk shall consist of a circular substrate with a hub on one side and a recording layer coated on the other side. The recording layer shall be protected by a protective layer. The Information Zone of the substrate is transparent to allow an optical beam to focus on the recording layer through the substrate. The circular hub is in the centre of the disk on the side of the recording layer and provides the radial centring of the disk and the clamping force.

11.2 Reference axis and plane of the disk

Some dimensions of the hub are referred to a reference plane P. The disk reference plane P is defined by the perfectly flat annular surface of an ideal spindle onto which the clamping zone of the disk is clamped, and which is normal to the axis of rotation of this spindle. This axis A passes through the centre of the centre hole of the hub, and is normal to plane P.

11.3 Dimensions of the disk (see figure 12)

The dimensions of the disk shall be measured in the test environment. The dimensions of the disk in an operating environment can be estimated from the dimensions specified below.

The outer diameter of the disk shall be

$$D_6 = 88,0 \text{ mm} \begin{array}{l} + 0,4 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

The diameter of the centre hole of the disk without the hub shall be

$$D_8 = 11,0 \text{ mm} \begin{array}{l} + 0,1 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

Excluding axial deflection (see 11.4.5), the total thickness of the disk in the range of D_6 to D_7 shall not exceed 0,9 mm. D_7 shall not exceed 26,0 mm.

The total thickness of the disk in the range from D_7 to D_8 shall be $1,30 \text{ mm} \pm 0,05 \text{ mm}$. The disk thickness shall be the range between D_7 and D_6 is recessed below plane P.

11.3.1 Hub dimensions (see figure 12)

The diameter of the centre hole of the hub shall be

$$D_9 = 4,004 \text{ mm} \begin{array}{l} + 0,012 \text{ mm} \\ - 0,000 \text{ mm} \end{array}$$

The outer diameter of the hub shall be

$$D_{10} = 11,0 \text{ mm} \begin{array}{l} + 0,0 \text{ mm} \\ - 0,2 \text{ mm} \end{array}$$

The position of the top of the magnetizable surface shall be

$$h_1 = 0,5 \text{ mm} \begin{array}{l} + 0,00 \text{ mm} \\ - 0,15 \text{ mm} \end{array}$$

The centring length at a diameter D_9 shall be

$$h_2 = 0,15 \text{ mm min.}$$

The lead-in edge of the centre hole shall either have a chamfer C_1 of 45° by $0,2 \text{ mm} \pm 0,1 \text{ mm}$ or be rounded off by radius

$$R_{15} = 0,2 \text{ mm} \pm 0,1 \text{ mm}$$

The outer edge of the centre hole shall either have a chamfer C_2 of 45° by $0,2 \text{ mm} \pm 0,1 \text{ mm}$ or be rounded off by radius

$$R_{16} = 0,7 \text{ mm} \pm 0,2 \text{ mm}$$

11.3.2 Clamping zone (see figure 12)

The outer diameter of the clamping zone D_{11} shall be

$$18,0 \text{ mm} < D_{11} < D_7.$$

The inner diameter of the clamping zone D_{12} shall be

$$D_8 < D_{12} < 15,0 \text{ mm}.$$

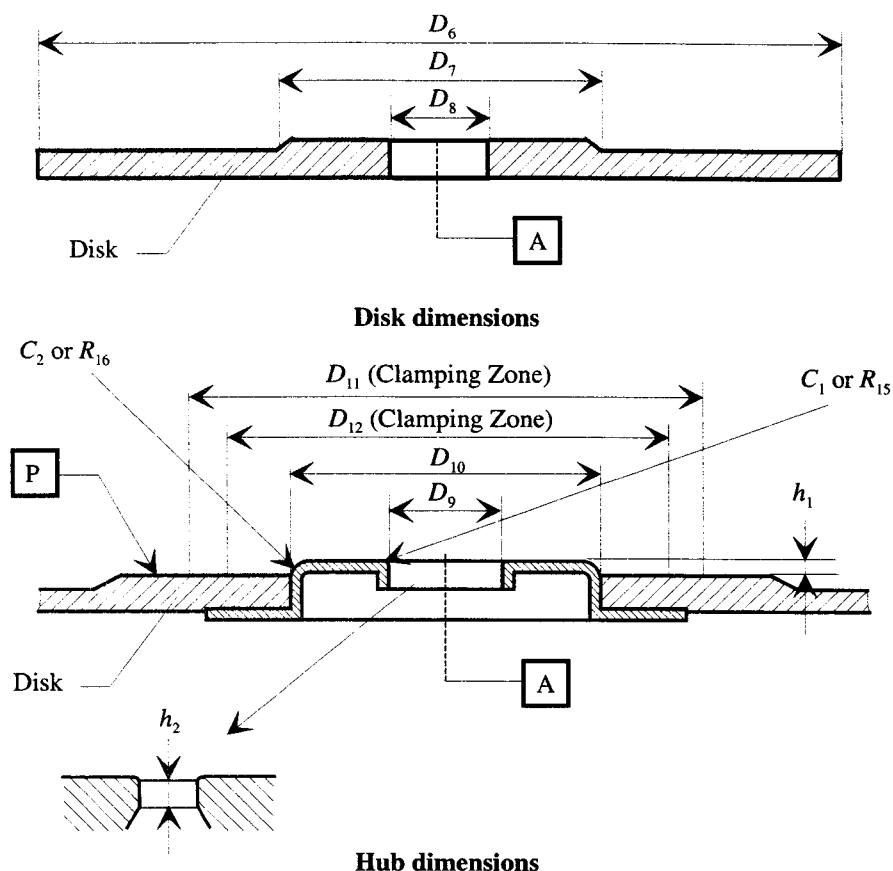


Figure 12 - Disk and hub dimensions

11.4 Mechanical characteristics

All requirements in this clause shall be met in the operating environment.

11.4.1 Material

The disk shall be made from any suitable materials such that it meets the requirements of this International Standard. The only material properties specified by this International Standard are the magnetic properties of the magnetizable zone in the hub (see 11.3.1) and the optical properties of the substrate in the Information Zone (see 11.5).

11.4.2 Mass

The mass of the disk shall not exceed 8 g.

11.4.3 Moment of inertia

The moment of inertia of the disk relative to axis A shall not exceed 0,010 g•m².

11.4.4 Imbalance

The imbalance of the disk relative to axis A shall not exceed 0,006 g•m.

11.4.5 Axial deflection

The axial deflection of the disk is measured as the axial deviation of the recording layer. Thus it comprises the tolerances on the thickness of the substrate, on its index of refraction and the deviation of the entrance surface from plane P. The nominal position of the recording layer with respect to reference plane P is determined by the nominal thickness of the substrate.

The deflection of any point of the recording layer in the Information Zone from its nominal position, in a direction normal to plane P, shall not exceed 0,2 mm for rotational frequencies of the disk up to 40 Hz.

11.4.6 Axial acceleration

The maximum allowed tracking error $e_{\max}$ (see annex R) shall not exceed 0,8 μm , measured using the Reference Servo for axial tracking of the recording layer. The rotational frequency of the disk shall be as specified in 9.5. The stationary part of the motor is assumed to be motionless (no external disturbances). The measurement shall be made using a servo with the transfer function

$$H_s(i\omega) = \frac{1}{3} \left(\frac{\omega_0}{i\omega} \right)^2 \frac{1 + \frac{3i\omega}{\omega_0}}{1 + \frac{i\omega}{3\omega_0}}$$

where

$$\omega = 2\pi f$$

$$\omega_0 / 2\pi = 1\,145 \text{ Hz}$$

$$i = \sqrt{-1}$$

or any other servo with $|1+H|$ within 20% of $|1+H_s|$ in the bandwidth of 40 Hz to 100 kHz. Thus, the disk shall not require an axial acceleration of more than 13,8 m/s^2 at low frequencies from the servo motor of the Reference Servo.

11.4.7 Radial runout

The radial runout of the tracks in the recording layer in the Information Zone is measured as seen by the optical head of the Reference Drive. Thus it includes the distance between the axis of rotation of the spindle and reference axis A, the tolerances on the dimensions between axis A and the location of the track, and effects of non-uniformities in the index of refraction.

The runout, defined as the difference between the maximum and the minimum distance of the centre of any track from the axis of rotation, measured along a fixed radial line over the one revolution of the disk, shall not exceed 60 μm (Type R/W, Type P-ROM), 100 μm (Type O-ROM) as measured by the optical system under conditions of a hub mounted on a perfect sized test fixture shaft, at a rotation frequency of the disk as specified in 9.5.

11.4.8 Radial acceleration

The maximum allowed tracking error $e_{\max}$ (see annex R) shall not exceed 0,12 μm , measured using the Reference Servo for radial tracking of the tracks. The rotational frequency of the disk shall be as specified in 9.5. The stationary part of the motor is assumed to be motionless (no external disturbances). The measurement shall be made using a servo with the transfer function.

$$H_s(i\omega) = \frac{1}{3} \left(\frac{\omega_0}{i\omega} \right)^2 \frac{1 + \frac{3i\omega}{\omega_0}}{1 + \frac{i\omega}{3\omega_0}}$$

where

$$\omega = 2\pi f$$

$$\omega_0 / 2\pi = 1\,725 \text{ Hz}$$

$$i = \sqrt{-1}$$

or any other servo with $|1+H|$ within 20% of $|1+H_s|$ in the bandwidth of 40 Hz to 100 kHz. Thus, the disk shall not require a radial acceleration of more than 4,7 m/s^2 at low frequencies from the servo motor of the Reference Servo.

11.4.9 Tilt

The tilt is the angle which the normal to the entrance surface, averaged over an area of 1 mm in diameter, makes with the normal to plane P. It shall not exceed 5 mrad in the Information Zone.

11.5 Optical characteristics

11.5.1 Index of refraction

The index of refraction of the substrate in the Information Zone shall be within the range from 1,46 to 1,60.

11.5.2 Thickness of the substrate

The thickness of the substrate, from the entrance surface to the recording layer, in the Information Zone shall be

$$1,20 < n \times d < 1,33$$

where n is the index of refraction and d is the thickness of the substrate.

11.5.3 Reflectance

11.5.3.1 General

The reflectance R is the value of the reflectance on an unrecorded, ungrooved area of the Data Zone of the disk, measured through the substrate and does not include the reflectance of the entrance surface.

The nominal value R of the reflectance shall be specified by the manufacturer in byte 21 of the SFP Zone (see annex D).

11.5.3.2 Measured Value

The measured value R_m of the reflectance shall be measured under the conditions a) to f) of 9.2. Measurements shall be made in the Data Zone in any track without embossed data fields.

R_a is defined as the mean value between the maximum value of R_m and the minimum value of R_m in the same disk.

11.5.3.3 Requirements

The value of R at the standard wavelength specified in 9.2 shall lie within the range from 0,15 to 0,25 for partially embossed or fully rewritable disks and for low reflectance fully embossed disks. The value of R shall lie within the range from 0,70 to 0,90 for high reflectance fully embossed disks (see annex L).

At any point of the Data Zone, the value R_a shall be equal to $(1 \pm 0,15)R$ and lie within the allowed range.

This requirement specifies the acceptable range for R_a for all disks with the same value of R . Additionally, the value R_m shall be equal to $(1 \pm 0,12)R_a$ and lie within the allowed range.

11.6 Protective coating

11.6.1 General description of protective coating

A protective coating shall cover the side of a disk which contains the recording layer to protect it from environmental influences and to fly the slider with magnetic head.

The slider with magnetic head usually does not touch the protective coating under the operating condition. But under the test condition specified in annex Q, the slider touches the protective coating at low rotation speed to test the characteristics of protective coating.

The protective coating shall not disturb the recording magnetic field.

11.6.2 General description of the flyable zone

The flyable zone is a part of the protective coating area. It is the area over which the slider with a magnetic head can fly.

11.6.3 Characteristics of the protective coating in the flyable zone (figure 13)

The dimensions and physical characteristics of the protective coating in the flyable zone shall meet the requirements specified in 11.6.3.1 to 11.6.3.5.

All requirements in this clause shall be met in the operating environment.

11.6.3.1 Dimensions of the protective coating in the flyable zone

The inner diameter of the flyable zone shall be