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Information technology — Data interchange on 90 mm optical disk cartridges — Capacity: 640 Mbytes per cartridge

*Technologies de l'information — Échange de données sur cartouches de
disque optique de 90 mm — Capacité: 640 Mbytes par cartouche*



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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 15041 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 23, *Optical disk cartridges for information interchange*.

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

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Information technology — Data interchange on 90 mm optical disk cartridges — Capacity: 640 Mbytes per cartridge

Section 1 - General

1 Scope

This International Standard defines the characteristics of 90 mm Optical Disk Cartridges (ODC) with a capacity of 640 Mbytes per Cartridge. The Standard specifies five related, but different implementations of such cartridges, viz.

Type R/W Provides for data to be written, read and erased many times over the whole recording surface of the disk using the thermo-magnetic and magneto-optical effects.

Type DOW Provides for data to be written and read many times over the whole recording surface of the disk, using the direct overwrite thermo-magnetic and magneto-optical effects requiring a single external magnetic field.

Type P-ROM Provides for a part of the disk surface to be embossed by stamping or other means. This part of the disk is read without recourse to the magneto-optical effect. All parts which are not embossed provide for data to meet the requirements of Type R/W.

Type P-DOW Provides for a part of the disk surface to be embossed by stamping or other means. This part of the disk is read without recourse to the magneto-optical effect. All parts which are not embossed provide for data to meet the requirements of Type DOW.

Type O-ROM Provides for the whole of the disk surface 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 and Type DOW are also referred to as "fully rewritable", Type P-ROM and Type P-DOW as "partially embossed" and Type O-ROM as "fully embossed".

For each Type, this International Standard provides for 512-byte and 2 048-byte sectors. All sectors on a disk are of the same size.

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, both embossed and user-written; including the physical disposition of the tracks and sectors, the error correction codes, and the modulation 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 the Type of the ODC. It 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 it 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 on the Type(s) specified.

2.4 Compatibility statement: A claim of conformance with this International Standard shall include a statement listing any other International Standard supported by the system for which conformance is claimed. This statement shall specify the number of the Standard(s), the ODC type(s) supported (where appropriate) and whether support includes reading 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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

4 Definitions

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

4.1 band: 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. Twelve channel bits are used to represent eight input bits.

4.4 clamping zone: The annular part of the disk within which the clamping force is applied by the clamping device.

4.5 control track: A track containing the information on media parameters and format necessary for writing, reading and erasing the remaining tracks on the optical disk.

4.6 Cyclic Redundancy Check (CRC): A method for detecting errors in data.

4.7 defect management: A method for handling the defective areas on the disk.

4.8 DOW disk: A Magneto-Optical disk in which the new data can be written directly over old data by modulating the laser-intensity without reversing the magnetic field direction.

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 on to 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 sector.

4.14 format: The arrangement or layout of information on the disk.

- 4.15 fully embossed disk:** An optical disk in which all data fields in the Data Zone are embossed.
- 4.16 fully rewritable disk:** An optical disk in which the data in specified areas can be rewritten by an optical beam.
- 4.17 groove:** See 4.21.
- 4.18 hub:** The central feature on the disk which interacts with the spindle of the disk drive to provide radial centring and the clamping force.
- 4.19 interleaving:** The process of allocating the physical sequence of units of data so as to render the data more immune to burst errors.
- 4.20 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.
- 4.21 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.
- 4.22 logical track:** Either 25 consecutive sectors for disks with 512-byte sectors or 17 consecutive sectors for disks with 2 048-byte sectors in one or more physical tracks. The first sector of each logical track is assigned sector number 0.
- 4.23 logical ZCAV:** A disk format requiring Zoned Constant Angular Velocity operation and with tracks *n* in the Data Zone all being logical tracks.
- 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 1 - Subdivisions of a sector 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 partially embossed disk:** An optical disk which contains both rewritable and embossed data fields in the Data Zone.
- 4.28 physical track:** The path which is followed by the focus of the optical beam during one revolution of the disk.
- 4.29 physical track group:** A fixed number of consecutive physical tracks in the Data Zone.
- 4.30 pitch:** The distance between adjacent physical track centrelines, measured in a radial direction.
- 4.31 polarization:** The direction of polarization of an optical beam is the direction of the electric vector of the beam.
- Note 2 - 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 end-point of the electric vector would appear to describe an ellipse in the clockwise sense.
- 4.32 read power:** The optical power, incident at the entrance surface of the disk, used when reading.
- Note 3 - It is specified as a maximum power that may be used without damage to the written data. Lower power may be used provided that the signal-to-noise ratio and other requirements of this International Standard are met.
- 4.33 recording layer:** A layer of the disk on, or in, which data is written during manufacture and/or use.
- 4.34 Reed-Solomon code:** An error detection and/or correction code which is particularly suited to the correction of errors which occur in bursts or are strongly correlated.
- 4.35 sector:** The smallest addressable part of a track in the Information Zone of a disk that can be accessed independently of other addressable parts of the zone.
- 4.36 space:** The area between marks along the track.

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

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

4.39 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 digits 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 last, the most significant bit (numbered 7 in an 8-bit byte) is recorded first. This order of recording applies also to the data input of the Error Detection and Correction circuits and to their output.
- Unless otherwise stated, all track numbers refer to logical tracks.
- Unless otherwise stated, a group of decimal digits of the form xx.x/yy.y indicates that the value xx.x applies to 512-byte sectors and that the value yy.y applies to 2 048-byte sectors.

5.2 Names

The names of entities, e.g. specific tracks, fields, etc., are given with a capital initial.

6 List of acronyms

AM	Address Mark
CRC	Cyclic Redundancy Check
DDS	Disk Definition Structure
DMA	Defect Management Area
DOW	Direct OverWrite
ECC	Error Correction Code
FA1	Functional Area 1
FA2	Functional Area 2
ID	Identifier
LSB	Least Significant Byte
MO	Magneto-Optical
MSB	Most Significant Byte
ODC	Optical Disk Cartridge
O-ROM	Optical Read Only Memory
PA	Postamble
PDL	Primary Defect List
P-DOW	Partial ROM Direct OverWrite
P-ROM	Partial Read Only Memory
RLL(1,7)	Run Length Limited (code)
R/W	Rewritable

SDL	Secondary Defect List
SM	Sector Mark
TIA	Time Interval Analyser
VFO	Variable Frequency Oscillator
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 erased from it with a focused optical beam, using the thermo-magnetic effect. Data may be directly written over existing data by modulating the intensity of the optical beam. 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 Testing environment

The test environment is the environment where the air immediately surrounding the optical disk cartridge has the 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 K)

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 also T.1)
magnetic field strength at the recording layer for any condition under which a beam is in focus	: 32 000 A/m max. (see also T.2)

magnetic field strength at the recording layer during : 48 000 A/m max.
any other condition

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 R)

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 defined as an 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 also T.1)
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 S.

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 IEC 950, 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 IEC 950.

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, read and erase 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, read and erase 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.

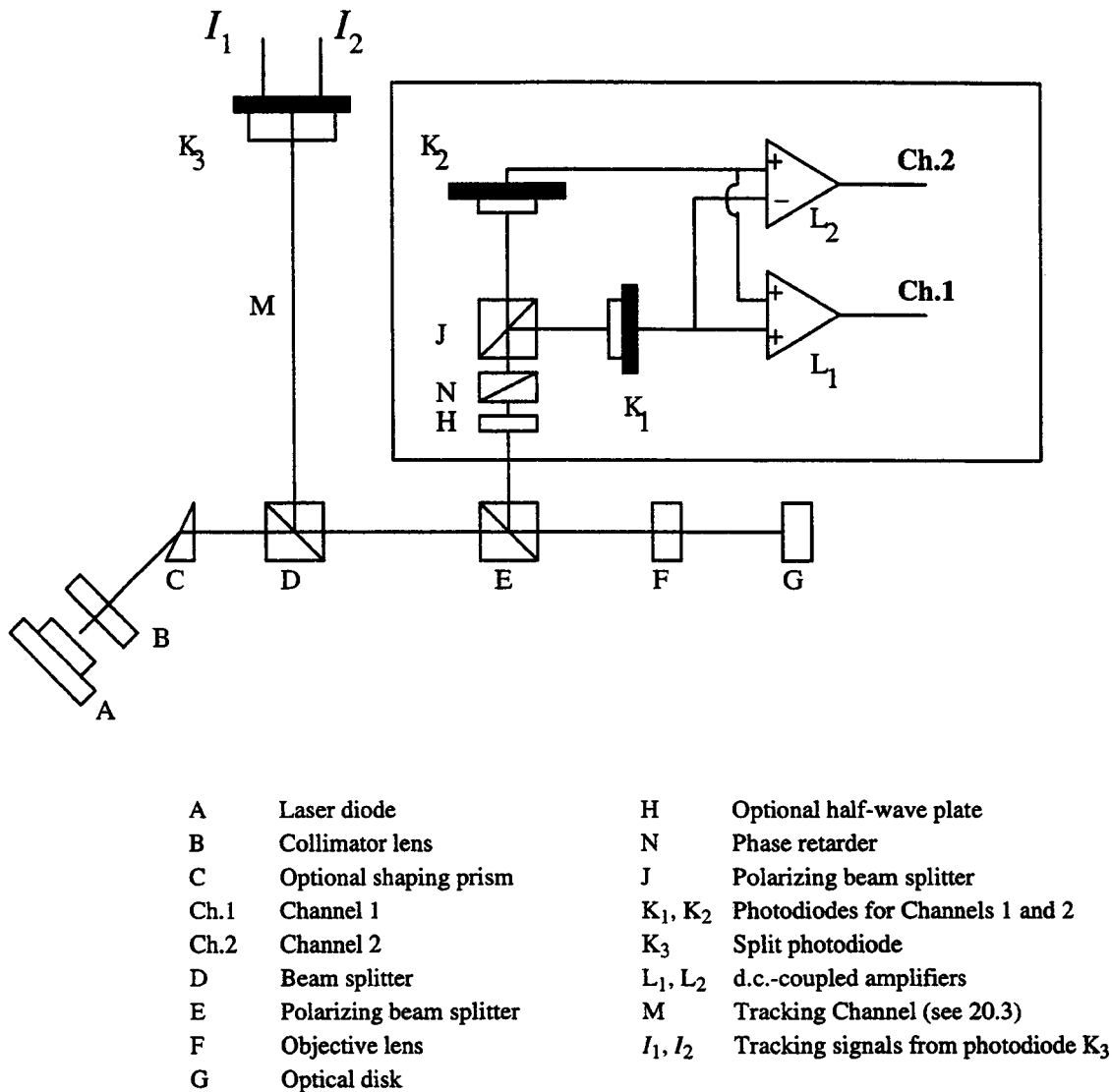


Figure 1 - Optical system of the Reference Drive

In the absence of polarization changes in the disk, the polarizing beam splitter J shall be aligned to make the signal of detector K₁ equal to that of detector K₂. 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° 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 narrow-band signal-to-noise ratio (see 26.2).

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 reflectance's R_p' and R_s' for beam splitter E, then the measured imbalance shall be multiplied by

$$\sqrt{\frac{R_s R'_p}{R_p R'_s}}$$

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 photo-diode 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, reading and erasing data shall have the following properties:

- | | | |
|----|--|---|
| a) | Wavelength (λ) | 685 nm
+ 10 nm
- 10 nm |
| b) | Wavelength (λ) divided by the numerical aperture of the objective lens (NA) | $\lambda / \text{NA} = 1,245 \mu\text{m} \pm 0,018 \mu\text{m}$ |
| c) | Filling D/W of the aperture of the objective lens | $0,85 \pm 0,05$ |
| d) | Variance of the wavefront of the optical beam near the recording layer, after passing through an ideal substrate. | 0 to $\lambda^2/330$ |
| e) | Polarization | Linear, parallel or perpendicular to the groove where appropriate |
| f) | Extinction ratio | 0,01 max. |
| g) | The optical power and pulse width for writing, reading and erasing, and the magnetic field shall be as specified in 20.2.2, 24.2.2, 24.3, 24.4 and 28.2.2. | |

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. Unless otherwise stated, the signal of Channel 1 is not equalized before detection. 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 20 MHz. Unless otherwise stated, the signal of Channel 1 is not equalised before detection.

The signal from Channel 2 is not equalized before detection. The signal shall be filtered with a 3-pole Butterworth low-pass filter with a cut-off frequency of one half the Channel clock frequency.

9.4 Tracking

The Tracking channel of the drive provides 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 generated by a split photodiode detector K_3 in the tracking channel. The division of the diode runs parallel to the image of the tracks on the diode.

The requirements for the accuracy with which the focus of the optical beam must follow the tracks is specified in 20.2.4.

9.5 Rotation of the disk

The spindle shall position the disk as specified in 12.4. It shall rotate the disk at 50,0 Hz $\pm$ 0,5 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 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, write-inhibit and reflectance detection features, and gripper slots for an autochanger.

10.2 Reference planes of the case

The dimensions of the case shall be referred to three orthogonal reference planes X, Y and Z. 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 in the X plane (see annex L). 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

$$L_1 = 94,0 \text{ mm} \pm 0,3 \text{ mm}$$

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

$$L_2 = 76,0 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$L_3 = 18,0 \text{ mm} \pm 0,2 \text{ mm}$$

The total width of the case shall be

$$L_4 = 90,0 \text{ mm} \begin{array}{l} + 0,0 \text{ mm} \\ - 0,4 \text{ mm} \end{array}$$

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

$$L_5 = 85,0 \text{ mm} \pm 0,3 \text{ mm}$$

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

$$L_6 = 5,0 \text{ mm} \pm 0,1 \text{ mm}$$

The corner at the top shall be rounded with a radius

$$R_1 = 1,5 \text{ mm} \pm 0,2 \text{ mm}$$

and the two corners at the bottom with a radius

$$R_2 = 2,0 \text{ mm} \pm 0,2 \text{ mm}$$

In the zones extending

$$L_7 = 8,6 \text{ mm min.}$$

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

$$L_8 = 6,0 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$R_3 = 0,3 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

10.3.2 Location hole (see figure 3)

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

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

held to a depth

$$L_9 = 1,5 \text{ mm min.}$$

The location hole shall extend below plane Z by

$$L_{10} = 4,0 \text{ mm min.}$$

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

$$L_{11} = 80,0 \text{ mm} \pm 0,2 \text{ mm}$$

from reference plane Y.

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

$$L_{12} = 3,60 \text{ mm} \begin{array}{l} + 0,00 \text{ mm} \\ - 0,06 \text{ mm} \end{array}$$

$$L_{13} = 4,4 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

held to a depth L_9 , below which the alignment hole shall extend to L_{10} , with dimensions equal to, or greater than, L_{12} and L_{13} , respectively.

The alignment hole shall not extend through Side B.

The lead-in edges shall be rounded with 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.

Surfaces 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.

Surfaces S3 and S4 shall be circular with a diameter

$$D_3 = 6,0 \text{ mm min.}$$

with their centres located at

$$L_{14} = 54,0 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$L_{16} = 81,0 \text{ mm} \pm 0,2 \text{ mm}$$

No portion of the case or of the shutter mechanism (see 10.3.8) shall protrude more than

$$L_{17} = 0,15 \text{ mm max.}$$

beyond plane Z.

10.3.5 Detents (see figure 5)

The case shall have two symmetrical detents intended for autoloading. Each detent shall extend from plane Z up to

$$L_{18} = 5,0 \text{ mm min.}$$

and shall not extend through Side B.

Each detent is defined by a semi-circular section with a radius

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

which stretches out to the side of the case along two straight lines extending from the semi-circle. The radii of the two detents originate from

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

$$L_{20} = 4,0 \text{ mm max.}$$

$$L_{21} = 84,0 \text{ mm max.}$$

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

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

10.3.6 Functional Areas (see figure 6)

The case shall have an opening in Side A the length of which shall be

$$L_{22} = 8,2 \text{ mm min.}$$

Its width shall be at least equal to L_{23} , and its centreline shall be located on the intersection of planes Y and Z.

Functional Area FA1 shall have the dimensions

$$L_{23} = 4,4 \text{ mm min.}$$

$$L_{24} = 3,6 \text{ mm min.}$$

Its centreline shall be in plane Z, and parallel to plane X at a distance

$$L_{25} = 7,8 \text{ mm} \pm 0,2 \text{ mm}$$

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

Functional Area FA2 shall have the dimensions L_{23} , L_{24} and

$$L_{26} = 4,0 \text{ mm min.}$$

Its centreline shall be in plane Z, and parallel to plane X at a distance

$$L_{27} = 12,8 \text{ mm} \pm 0,2 \text{ mm}$$

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, DOW, P-ROM, P-DOW, O-ROM
Closed	Open	Permitted	Low	R/W, DOW, P-ROM, P-DOW
Closed	Closed	Inhibited	High	O-ROM
Open	Open	Not permitted by this International Standard		

The surface of the device shall be at a distance

$$L_{28} = 0,3 \text{ mm max.}$$

from plane Z.

10.3.7 Spindle and head windows (see figure 7)

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

The dimensions of the window are referenced to a centreline, located at a distance

$$L_{29} = 40,0 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$L_{30} = 11,0 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

and

$$L_{31} = 11,0 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

The top of the window shall be given by radius

$$R_7 = 43,7 \text{ mm min.}$$

originating from L_{29} and

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

The area bounded by R_7 and the top of the case shall be recessed from plane Z by

$$L_{33} = 2,0 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

over the width of the window.

The bottom of the window shall be the arc of the semi-circle which smoothly joins the sides of the window. The centre of the semi-circle shall be defined by L_{29} and L_{32} .

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_{29} from plane Y. The width of the window shall be given by L_{30} and L_{31} . The window shall extend from

$$L_{34} = 40,0 \text{ mm max.}$$

to the arc of R_7 , originating from L_{29} and L_{32} .

The area bounded by R_7 and the top of the case shall be, over the width of the window, at a distance

$$L_{35} = 4,2 \text{ mm} \quad \begin{array}{l} + 0,0 \text{ mm} \\ - 0,4 \text{ mm} \end{array}$$

from plane Z.

The two inside corners shall be rounded with a radius

$$R_8 = 2,0 \text{ mm max.}$$

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 semi-circle at the bottom of the window up to the top of the case, and from L_{30} to L_{31} ;

on Side B: from L_{34} up to the top of the case, and from L_{30} to L_{31} ;

on the top: from plane Z to L_{33} , from L_{30} to L_{31} , from L_{35} up to Side B, and from L_{30} to L_{31} .

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_8 by more than 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

$$L_{36} = 79,0 \text{ mm} \quad \begin{array}{l} + 0,0 \text{ mm} \\ - 0,3 \text{ mm} \end{array}$$

from plane Y. A movement of the edge to

$$L_{37} = 55,5 \text{ mm min.}$$

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

$$L_{38} = 54,7 \text{ mm max.}$$

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 figure 9)

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

The path shall run from

$$L_{39} = 81,0 \text{ mm} \pm 0,3 \text{ mm}$$

to

$$L_{40} = 57,5 \text{ mm} \quad \begin{array}{l} + 0,3 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

at a distance

$$L_{41} = 74,0 \text{ mm} \pm 0,3 \text{ mm}$$

from plane X.

The lead-in edge at L_{39} shall be a ramp to the top of the case with an angle

$$A_1 = 45^\circ \pm 5^\circ$$

The path shall end in a notch with a width at the bottom from L_{40} to

$$L_{42} = 54,7 \text{ mm max.}$$

and a depth

$$L_{43} = 3,3 \text{ mm} \pm 0,2 \text{ mm}$$

below L_{41} . The lead-in edge at the right-hand side of the notch shall be rounded with a radius

$$R_9 = 1,2 \text{ mm} \pm 0,2 \text{ mm}$$

When the shutter edge is moved to L_{37} , a length of at least ($L_{40} - L_{37}$) of the notch shall be exposed. This enables a drive to confirm that the shutter is fully open.

10.3.10 Mis-insert protections (see figure 10)

The profile on the top of the case shall have two features to prevent the case from being inserted in the drive upside-down.

The first feature is a notch intended to capture and block the shutter opener of the drive if the case is loaded upside-down. It shall have a width from

$$L_{44} = 4,6 \text{ mm} \pm 0,2 \text{ mm}$$

to

$$L_{45} = 1,0 \text{ mm} \pm 0,2 \text{ mm}$$

and a depth

$$L_{46} = 3,1 \text{ mm} \pm 0,2 \text{ mm}$$

below the top of the case.

The right-hand edge of the notch shall be

$$L_{47} = 75,4 \text{ mm} \pm 0,2 \text{ mm}$$

above plane X.

The corners of this notch shall be rounded off by radii

$$R_{10} = 0,3 \text{ mm max.}$$

$$R_{11} = 0,5 \text{ mm} \pm 0,3 \text{ mm}$$

The second feature is a chamfer and a tooth. If the case is correctly loaded, the chamfer pushes aside a possible pawl in the side of the sledge of the drive. If the case is loaded upside-down, the pawl catches the tooth and prevents further insertion of the case. The tooth is formed by the ramp specified in 10.3.10. The chamfer shall have an angle

$$A_2 = 45^\circ \pm 2^\circ$$

and a height

$$L_{48} = 5,0 \text{ mm} \pm 0,3 \text{ mm}$$

10.3.11 Gripper slots (see figure 11)

The case shall have two symmetrical gripper slots. Each slot shall have a depth of

$$L_{49} = 2,5 \text{ mm} \begin{array}{l} + 0,3 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

from the edge of the case and a width of

$$L_{50} = 4,0 \text{ mm} \begin{array}{l} + 0,3 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

The lower edge of a slot shall be

$$L_{51} = 23,0 \text{ mm} \begin{array}{l} + 0,0 \text{ mm} \\ - 0,3 \text{ mm} \end{array}$$

above the bottom of the case.

The corners of the gripper slots shall be rounded off by radii

$$R_{12} = 0,4 \text{ mm} \pm 0,2 \text{ mm}$$

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

10.3.12 Label area (see figure 12)

The case shall have one connected label area on Side A, the bottom and Side B, with dimensions

$$L_{52} = 4,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{53} = 76,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{54} = 30,0 \text{ mm} \pm 0,2 \text{ mm}$$

and

$$L_{55} = 1,2 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$L_{56} = 0,2 \text{ mm min. on all three sides.}$$

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 50 g.

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 guarantees 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 open the shutter does not exceed 1,5 N.

It shall be sufficiently strong to close a free-sliding shutter, irrespective of the orientation of the case.

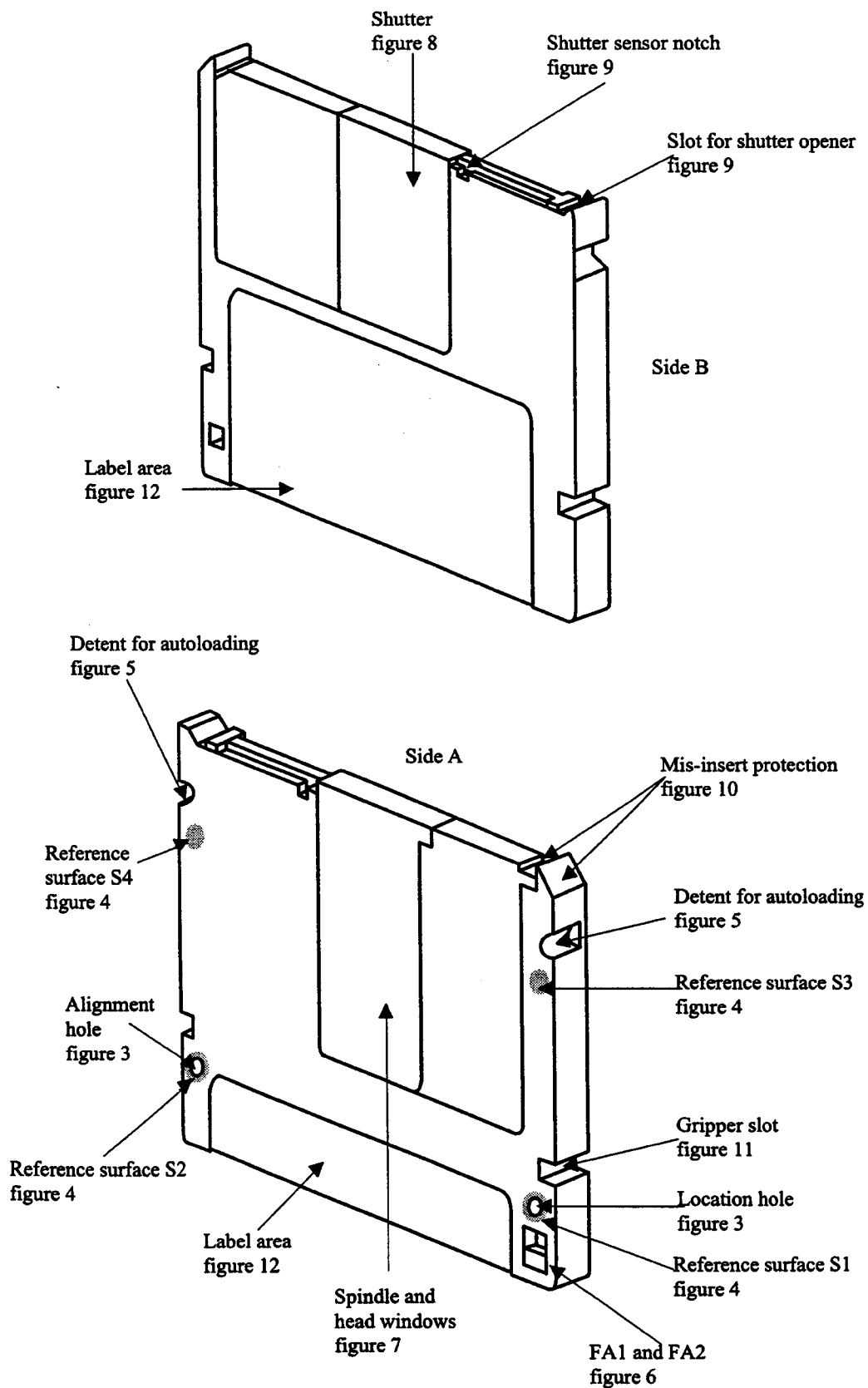
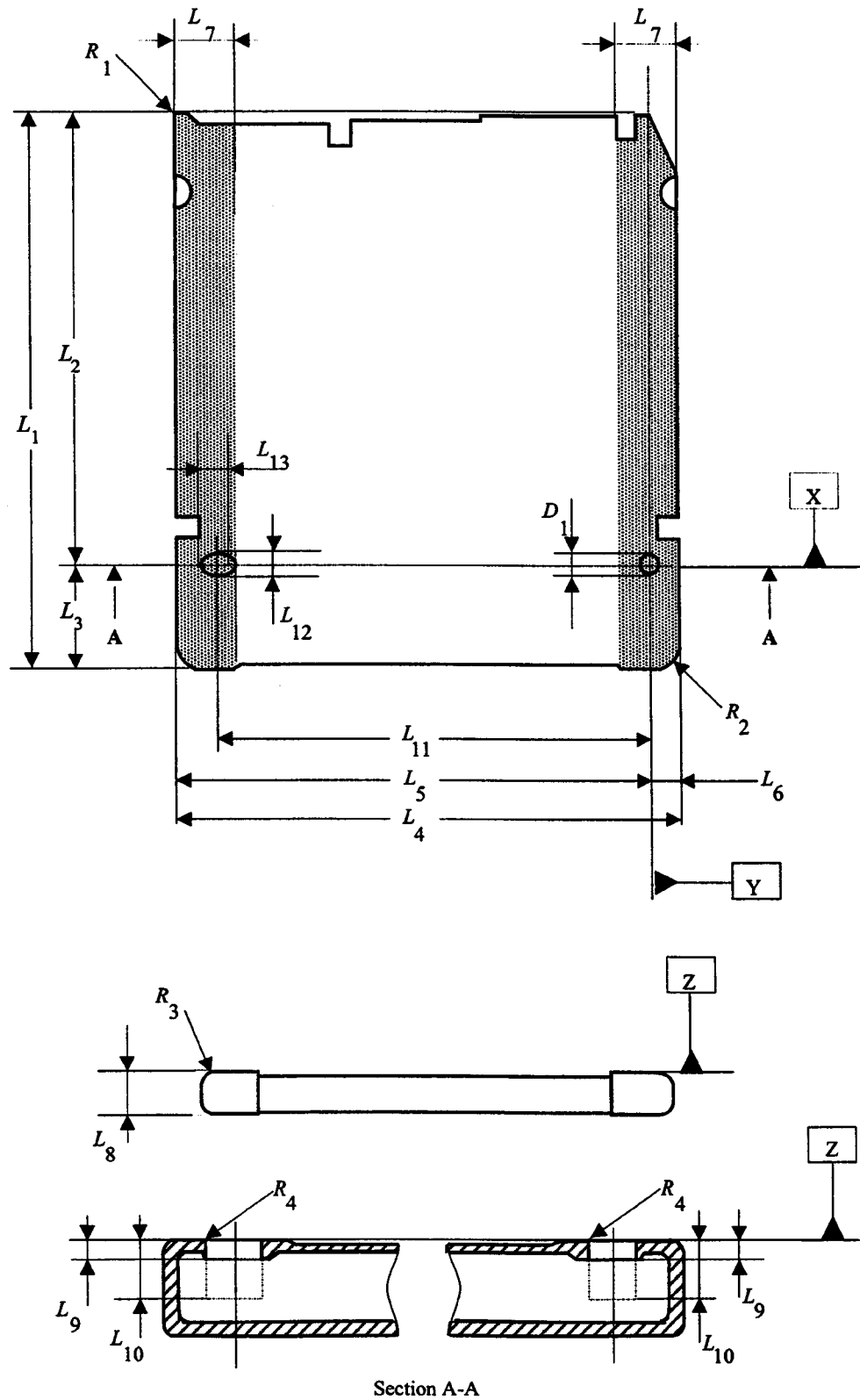
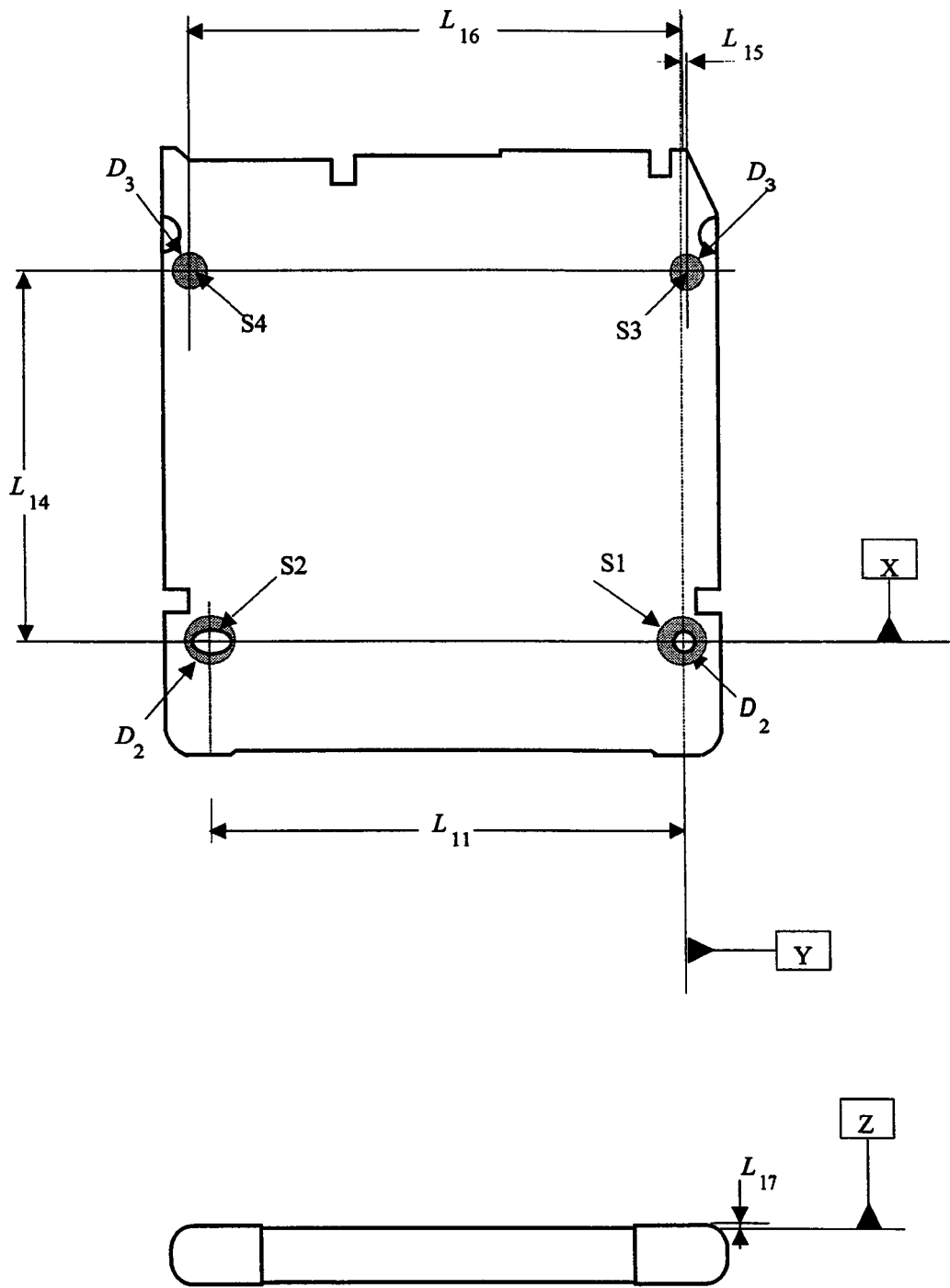


Figure 2 - General view of the case



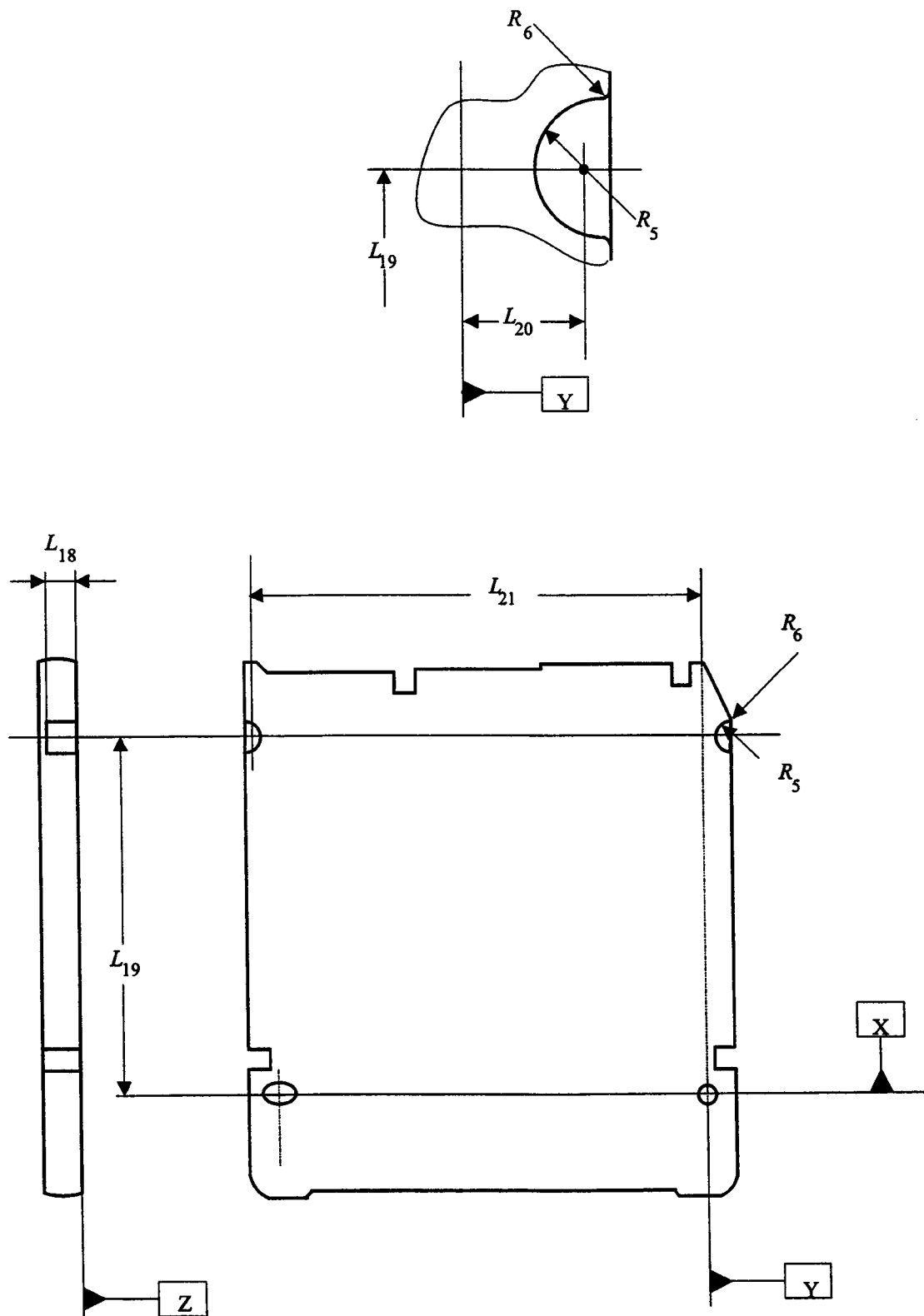
06-0148A

Figure 3 - Overall dimensions, viewed on Side A



95-0147A

Figure 4 - Reference surfaces on Side A



95-0148A

Figure 5 - Detents, seen on Side A

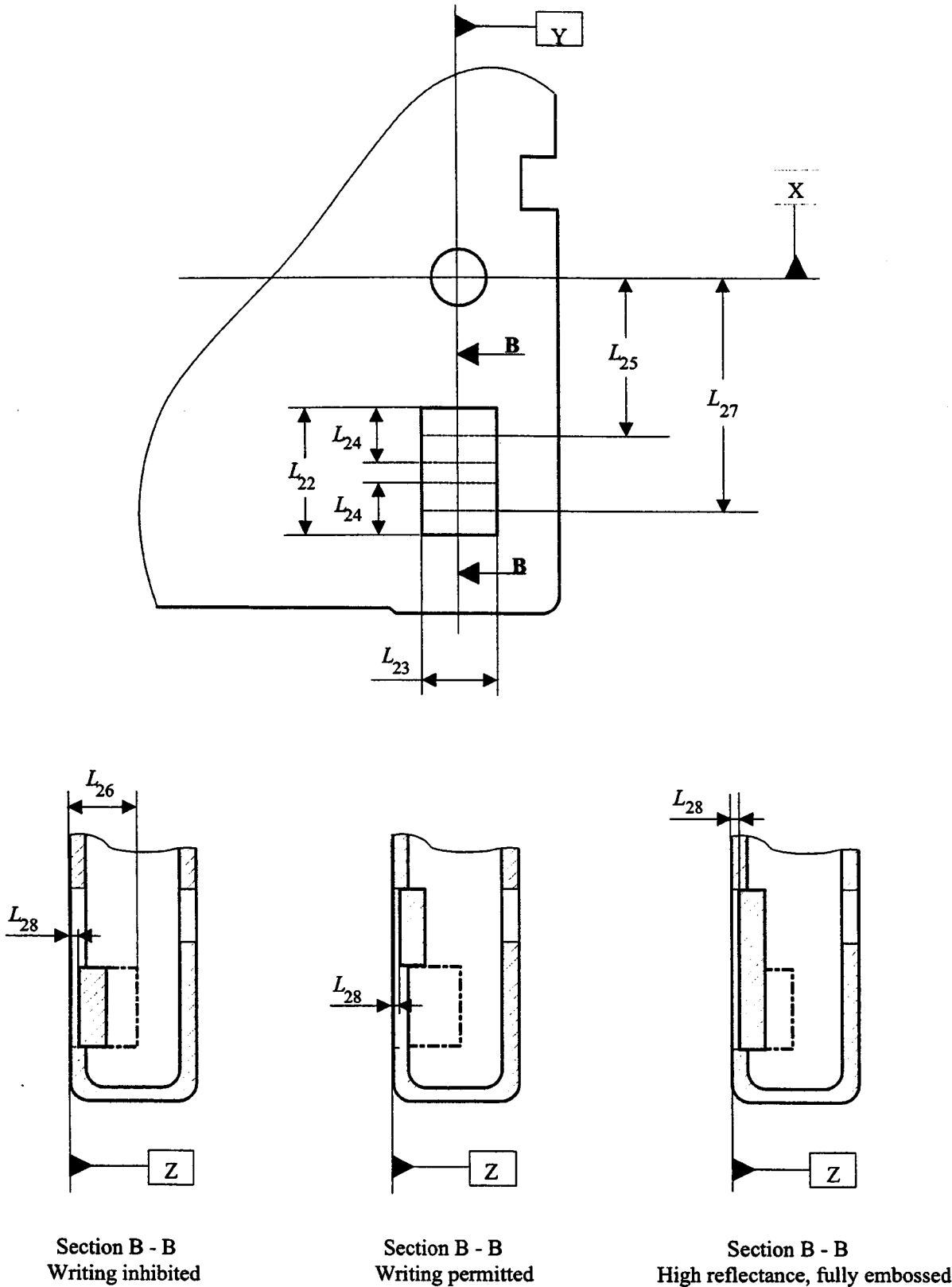
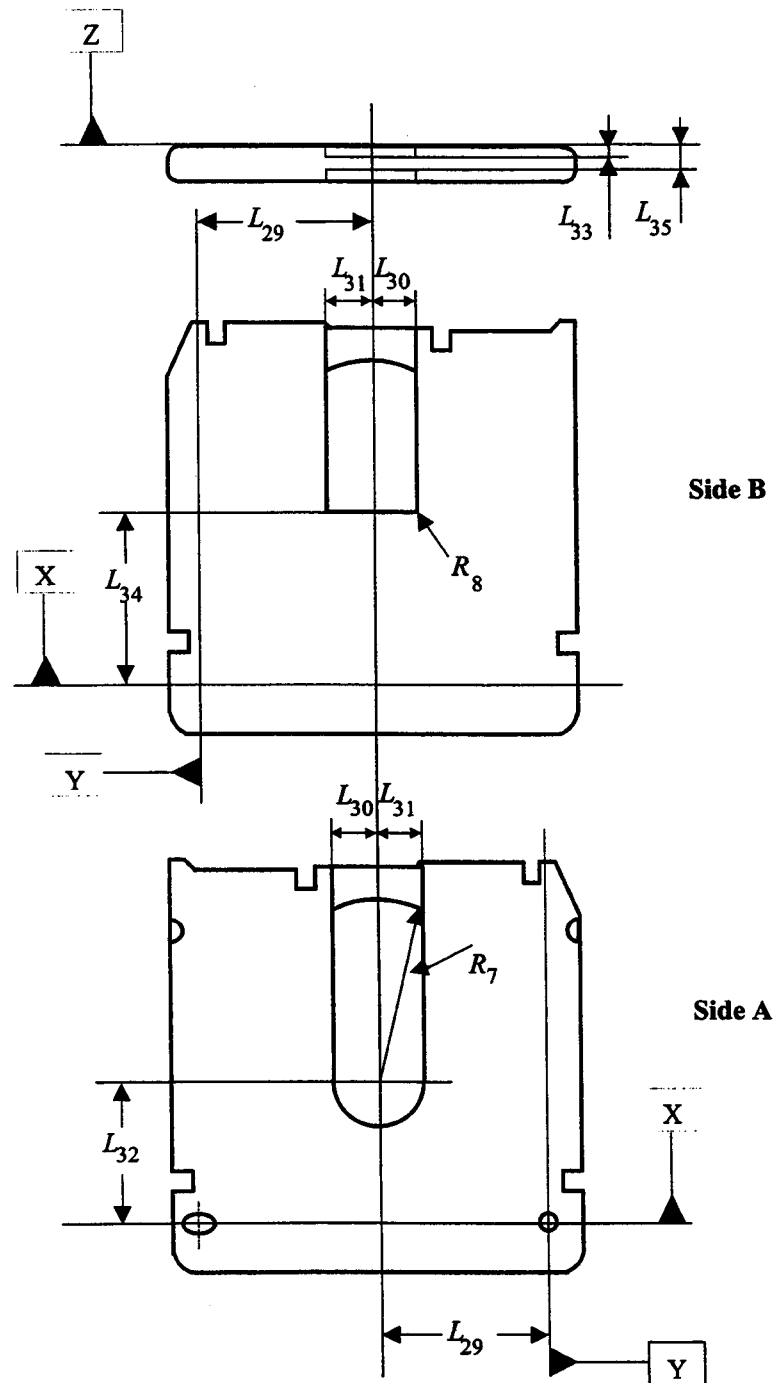


Figure 6 - Functional Areas FA1 and FA2, seen on Side A and in cross-section



95-0150A

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

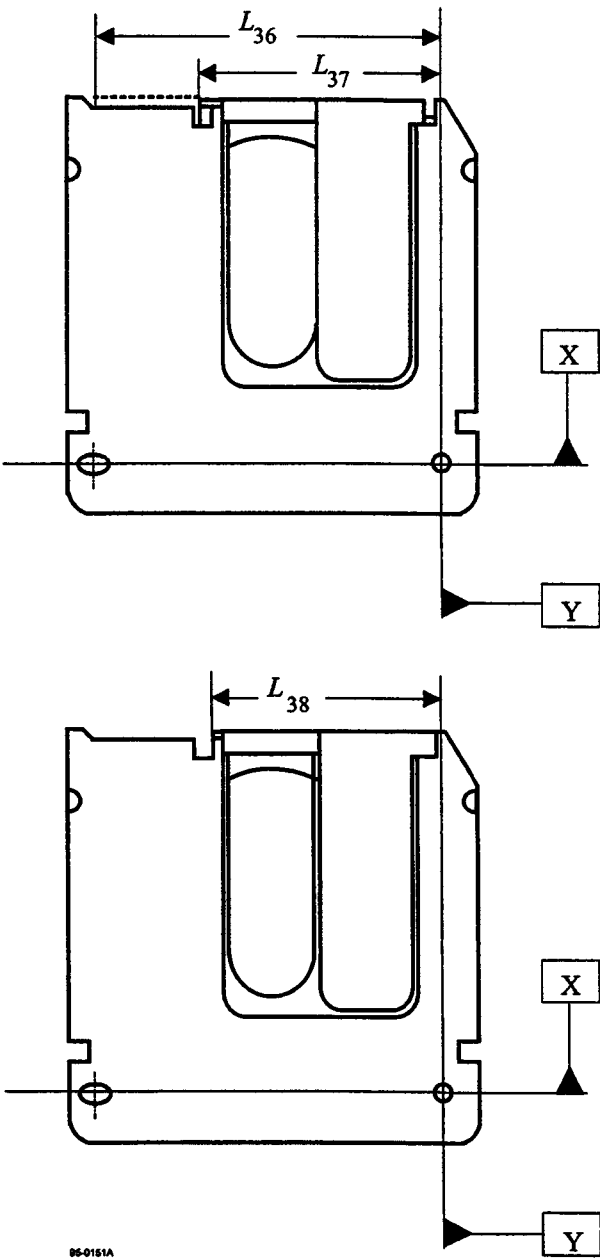
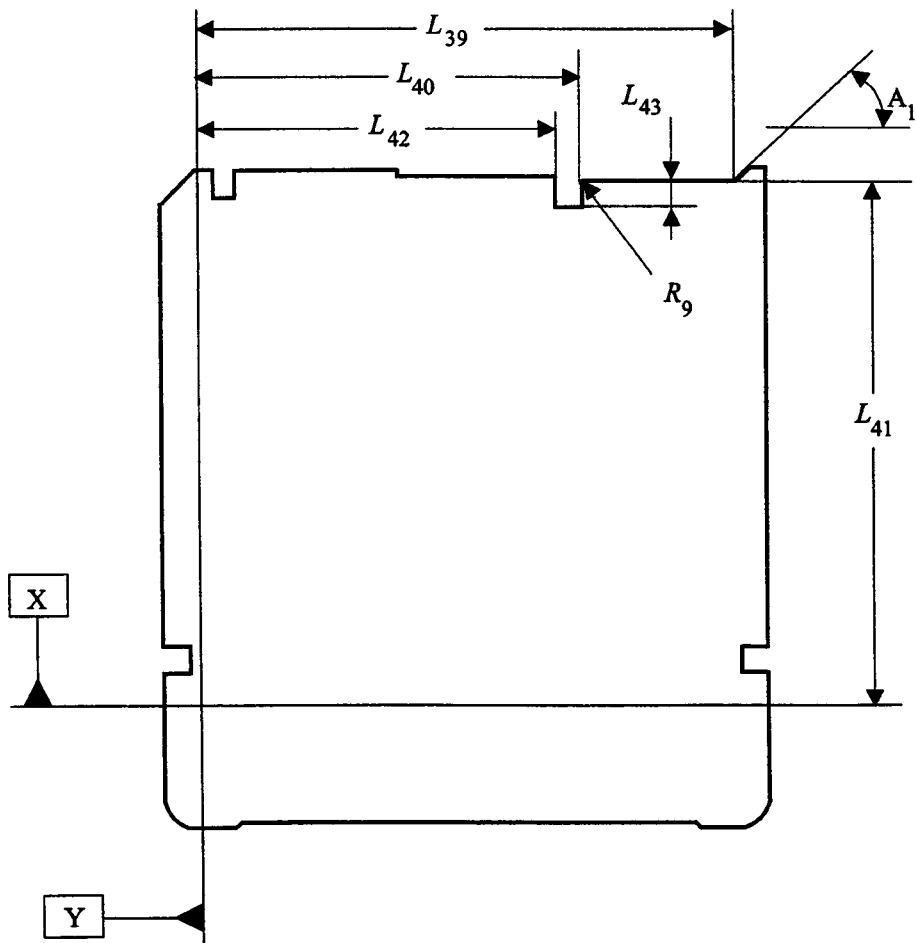
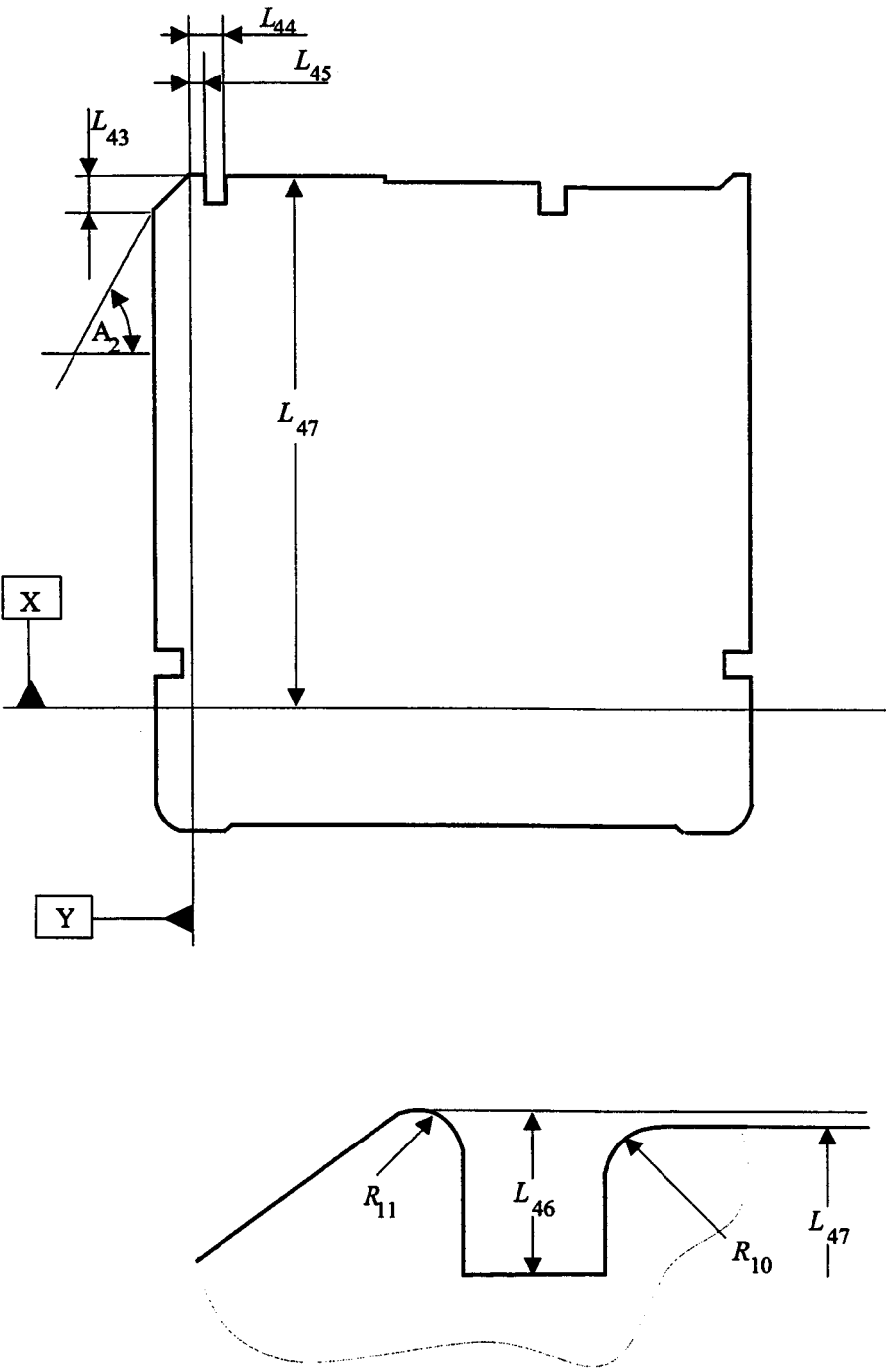


Figure 8 - Shutter in just open position (top) and maximum open position (bottom)
The dashed line indicates the position of the shutter edge when the shutter is closed



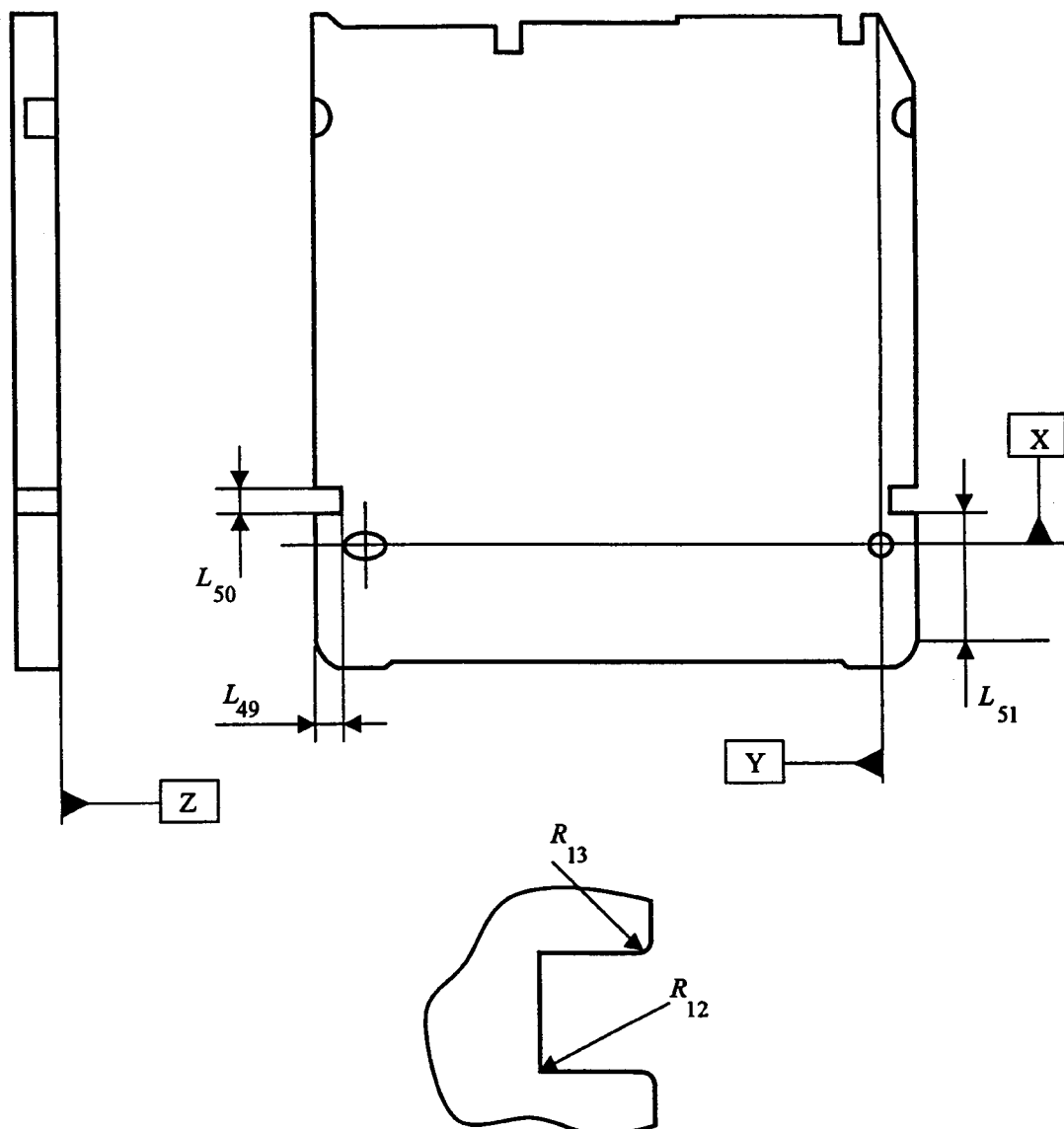
95-0152A

Figure 9 - Path for the shutter opener, seen from Side B without shutter



95-0153A

Figure 10 - Mis-insert protections, seen from Side B of the case without shutter



95-0154A

Figure 11 - Gripper slots seen from Side B of the case without shutter

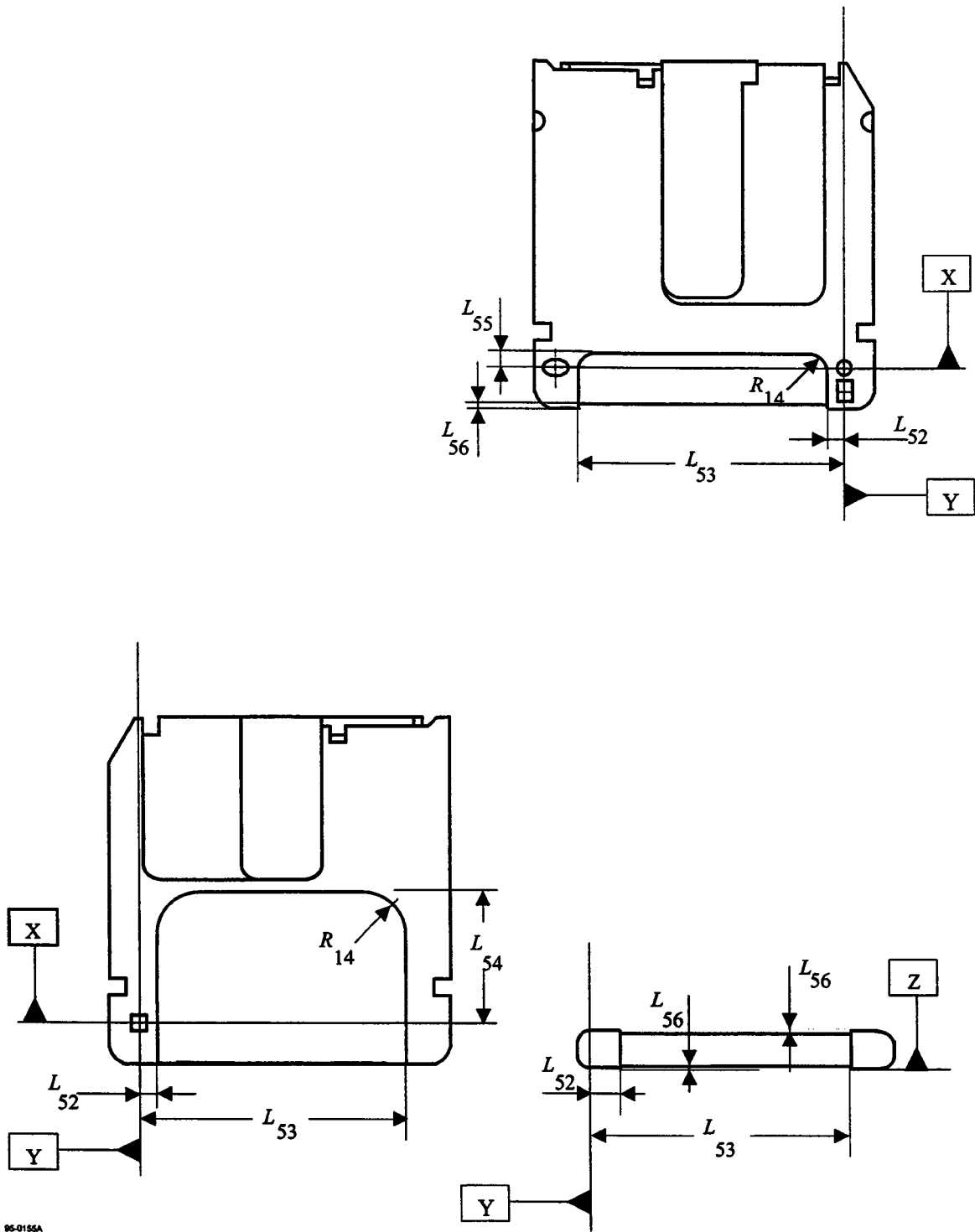


Figure 12 - Label area

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 can be protected from environmental influences 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 opposite to the recording layer. The hub interacts with the spindle of the drive 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 disk 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 13)

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 in this clause. The outer diameter of the disk shall be

$$86,0 \text{ mm} \begin{array}{l} + 0,0 \text{ mm} \\ - 0,5 \text{ mm} \end{array}$$

Excluding axial deflection (see 11.4.5), the total thickness of the disk without the hub shall not exceed 1,4 mm.

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

$$D_4 = 6,0 \text{ mm min.}$$

11.3.1 Hub dimensions (see figure 13)

The diameter of the centre hole of the hub shall be

$$D_5 = 4,004 \text{ mm} \begin{array}{l} + 0,012 \text{ mm} \\ - 0,000 \text{ mm} \end{array}$$

The outer diameter of the hub shall be

$$D_6 = 15,0 \text{ mm} \begin{array}{l} + 0,0 \text{ mm} \\ - 0,2 \text{ mm} \end{array}$$

The height of the hub shall be

$$h_1 = 1,2 \text{ mm} \begin{array}{l} + 0,0 \text{ mm} \\ - 0,2 \text{ mm} \end{array}$$

The position of the top of the magnetizable surface shall be

$$h_2 = 1,20 \text{ mm} \begin{array}{l} + 0,00 \text{ mm} \\ - 0,15 \text{ mm} \end{array}$$

The height of the centring hole above reference plane P shall be

$$h_3 = 0,8 \text{ mm min.}$$

The centring length at a diameter D_5 shall be

$$h_4 = 0,15 \text{ mm min.}$$

The lead-in edge of the centre hole shall have chamfer c_1 of 45° by $0,2 \text{ mm} \pm 0,1 \text{ mm}$ or shall be rounded off by radius

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

The outer edge of the centre hole shall have a chamfer c_2 of 45° by $0,4 \text{ mm} \pm 0,1 \text{ mm}$ or shall be rounded off by radius

$$R_{16} = 0,4 \text{ mm} \pm 0,1 \text{ mm}$$

The hub shall have any suitable magnetizable material for clamping the disk. Its dimensions shall be

$$D_9 = 13,0 \text{ mm min.}$$

$$D_{10} = 6,0 \text{ mm max.}$$

and its adsorbent force measured by the test device specified in annex N shall be in the range of 3,0 N to 4,5 N.

11.3.2 Clamping zone (see figure 13)

The outer diameter of the clamping zone shall be

$$D_7 = 21,0 \text{ mm min.}$$

The inner diameter of the clamping zone shall be

$$D_8 = 16,0 \text{ mm max.}$$

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).

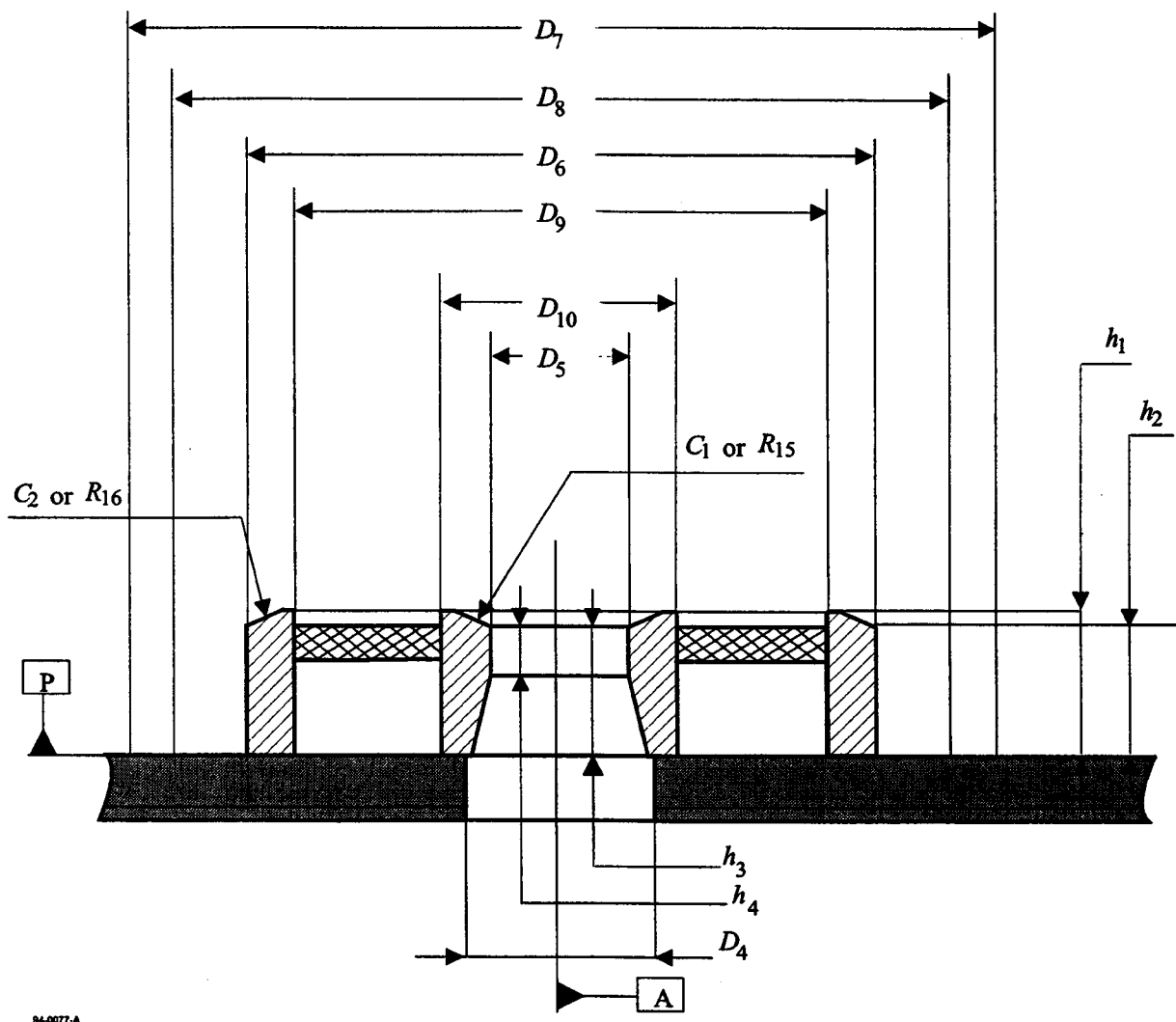


Figure 13 - Hub dimensions and clamping zone

11.4.2 Mass

The mass of the disk shall not exceed 24,0 g.

11.4.3 Moment of inertia

The moment of inertia of the disk relative to axis A shall not exceed 0,020 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 $\pm 0,15$ mm for rotational frequencies of the disk as specified in 9.5.

11.4.6 Axial acceleration

The maximum allowed tracking error $e_{\max}$ (see annex Q) shall not exceed $\pm 0,8 \mu\text{m}$, 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

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

where

$$\omega = 2\pi f$$

$$\omega_0/2\pi = 1\,450 \text{ Hz}$$

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

or any other servo with $|1+H|$ within 20 % of $|1+H_s|$ in the bandwidth of 50 Hz to 170 kHz. Thus, the disk shall not require an axial acceleration of more than 22 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 minimum distance of the centre of any track from the axis of rotation, measured along a fixed radial line over one revolution of the disk, shall not exceed $50 \mu\text{m}$ at a rotational frequency of the disk as specified in 9.5.

11.4.8 Radial acceleration

The maximum allowed tracking error $e_{\max}$ (see annex Q) shall not exceed $\pm 0,09 \mu\text{m}$, 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

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

where

$$\omega = 2\pi f$$

$$\omega_0/2\pi = 2\,430 \text{ Hz}$$

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

or any other servo with $|1+H|$ within 20 % of $|1+H_s|$ in the bandwidth of 50 Hz to 170 kHz. Thus, the disk shall not require a radial acceleration of more than $7,0 \text{ m/s}^2$ 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 $3,2 \text{ mrad}$ 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

$$0,5093 \times \frac{n^3}{n^2 - 1} \times \frac{n^2 + 0,2650}{n^2 + 0,5929} \text{ mm} \pm 0,05 \text{ mm}$$

where n is the index of refraction.

11.5.3 Birefringence

The effect of the birefringence of the substrate is included in the measurement of the imbalance of the signals in Channel 2 of the Reference Drive (see 25.2).

11.5.4 Vertical Birefringence

The principal vertical birefringence value shall be contained as follows:

$$0 \leq |N_p - N_z| \leq 500 \times 10^{-6}$$

where N_p is the index of refraction along any direction in the plane of the disk and N_z is the index of refraction normal to the plane of the disk (see annex V).

11.5.5 Reflectance

11.5.5.1 General

The reflectance R is the value of the reflectance on-land of an unrecorded, grooved 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 3 and byte 9 of the Control Tracks (see annex E).

11.5.5.2 Measured Value

The measured value R_m of the reflectance shall be measured under the conditions a) to f) of 9.2 and those of 20.2.2 using the split photo detector $(I_1 + I_2)_{OL}$.

Measurements shall be made in the Data Zone in any track without embossed data fields.

11.5.5.3 Requirement

The value of R at the standard wavelength specified in 9.2 shall lie within the range of 0,12 to 0,25 for partially embossed or fully rewritable disks and for low reflectance fully embossed disks. The value of R shall be larger than 0,35 for high reflectance fully embossed disks (see annex M).

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

This requirement specifies the acceptable range for R_m for all disks with the same value of R .

Additionally, the variation of R_m shall meet the requirement

$$\frac{R_{m_{\max}} - R_{m_{\min}}}{R_{m_{\max}} + R_{m_{\min}}} \leq 0,12$$

Where $R_{m_{\max}}$ is the maximum value of measured reflectance in the Data Zone
 $R_{m_{\min}}$ is the minimum value of measured reflectance in the Data Zone.

12 Interface between cartridge and drive

12.1 Clamping method

When the cartridge is inserted into the drive, the shutter of the case is opened and the drive spindle engages the disk. The disk is held against the spindle by an axial clamping force, provided by the magnetizable material in the hub (see annex N) and the magnets in the spindle. The radial positioning of the disk is provided by the centering of the axis of the spindle in the centre hole of the hub. A cup-shaped turntable of the spindle shall support the disk in its clamping zone, determining the axial position of the disk in the case.

12.2 Clamping force

The clamping force exerted by the spindle on the hub shall not exceed 5 N.

12.3 Capture cylinder (see figure 14)

The capture cylinder is defined as the volume in which the spindle can expect the centre of the hole in the hub to be, just prior to capture, and with the cartridge constrained as in 10.4.4. The centre of the hole is defined as the point on axis A at a distance h_1 below plane P (see 11.3.1 and figure 13).

The size of the cylinder defines the permissible play of the disk inside its cavity in the case. The cylinder is referred to perfectly located and perfectly sized alignment and location pins in the drive; it includes the tolerances of those dimensions of the case and the disk which are between the two pins mentioned and the centre of the hub.

The bottom of the cylinder is parallel to plane Z, and shall be located a distance

$$L_{57} = 0,7 \text{ mm min.}$$

above plane Z. The top of the cylinder is located a distance

$$L_{58} = 2,3 \text{ mm max.}$$

above plane Z. The radius of the cylinder shall be

$$R_{17} = 1,4 \text{ mm max.}$$

and its centre shall be given by the nominal values of L_{29} and L_{32} in the drive.

12.4 Disk position in operating condition (see figure 14)

When the disk is in the operating condition within the drive, the position of plane P of the disk shall be

$$L_{59} = 2,4 \text{ mm} \pm 0,1 \text{ mm}$$

above plane Z of the case, and the axis of rotation shall be within a circle with a radius

$$R_{18} = 0,1 \text{ mm max.}$$

and a centre given by the nominal values of L_{29} and L_{32} .

The torque to be exerted on the disk in the operating condition in order to maintain the rotational frequency specified in 9.5 shall not exceed 0,01 N·m.