
**Information technology — Data interchange
on 90 mm overwritable and read only
optical disk cartridges using phase
change — Capacity: 1,3 Gbytes per
cartridge**

*Technologies de l'information — Échange de données sur cartouches de
disque optique de recouvrement et de lecture seule, de 90 mm de
diamètre, utilisant un changement de phase — Capacité: 1,3 Gbytes 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 14760 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 23, *Optical disk cartridges for information interchange*.

Annexes A to J form an integral part of this International Standard. Annexes K to S are for information only.

Introduction

The International Standards for optical disk cartridges issued up to now by ISO/IEC JTC 1 are based on a technology known as *magneto-optical (MO)*, this International Standard is the first based on a different technology known as *phase change (PC)*.

Information technology - Data interchange on 90 mm overwritable and read only optical disk cartridges using phase change - Capacity: 1,3 Gbytes per cartridge

Section 1 - General

1 Scope

This International Standard specifies the characteristics of 90 mm Optical Disk Cartridges (ODCs) using the phase change technology, with a capacity of 1,3 Gbytes per cartridge. It specifies three related Types of such cartridges.

Type R/W Provides for data to be written or overwritten and read many times over the recording surface of the disk using the phase change overwritable effect.

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

Type O-ROM Provides for the whole of the recording surfaces of the disk to be embossed and reproduced by stamping or other means. This type of disk is read without recourse to the phase change overwritable effect.

For each Type, this International Standard provides for 512-byte and 2 048-byte sectors. All sectors of a given cartridge have the same size.

Type R/W, Type P-ROM and Type O-ROM are also referred to as "fully overwritable", "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, stored and transported;
- 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 phase change overwritable characteristics of the disk, enabling processing systems to overwrite 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 implemented. An ODC shall be in conformance with this International Standard 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 to this International Standard if it is able to process any recording made on the cartridge in accordance with 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 other International Standards supported, if any. 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 overwriting.

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 subjected 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*.

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 elements by which the binary values ZERO and ONE are represented on the disk by either a space or a mark.

NOTE - In this International Standard each input bit is represented by two Channel bits. Their sequence depends on that of the 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 overwriting and reading 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 data.
- 4.8 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.
- 4.9 embossed mark:** A mark so formed as to be unalterable by phase change optical means.
- 4.10 entrance surface:** The surface of the disk onto which the optical beam first impinges.
- 4.11 Error Correction Code (ECC):** An error-detecting code designed to correct certain kinds of errors in data.
- 4.12 field:** A subdivision of a sector.
- 4.13 format:** The arrangement or layout of information on the disk.
- 4.14 fully embossed disk:** An optical disk in which all data fields in the Data Zone are embossed.
- 4.15 fully overwritable disk:** An optical disk in which the data in specified areas can be written using one-beam overwrite (see 4.22).
- 4.16 groove:** See 4.19.
- 4.17 hub:** The central feature on the disk which interacts with the spindle of the disk drive to provide radial centring and the clamping force.
- 4.18 interleaving:** The process of allocating the physical sequence of units of data so as to render the data more immune to burst errors.

4.19 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 with which the land is to be paired to form a track is located nearer to the entrance surface than the land and the data is recorded in the grooves.

4.20 logical track: Either 16 contiguous sectors for 512-byte sector disks or 4 contiguous sectors for disks with 2048-byte sector disks in less than one complete revolution of the disk. Sector number 0 is assigned to the first sector of each logical track.

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

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

4.22 one-beam overwrite: A method by which the information is written by overwriting without prior erasing using a laser beam.

4.23 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.

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

4.25 partially embossed disk: An optical disk which contains both overwritable and embossed data fields in the Data Zone.

4.26 phase change (PC): A physical effect in which the laser beam irradiated area of a recording film is heated so as to reversibly change from an amorphous state to a crystalline state, and vice versa.

4.27 physical track: The path followed by the focus of the optical beam during one revolution of the disk.

4.28 physical track group: A fixed number of consecutive physical tracks in the Data Zone.

4.29 pitch: The distance between adjacent physical track centrelines, measured in a radial direction.

4.30 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 circularly 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 circle in the clockwise sense.

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

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

4.33 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.

4.34 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.

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

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

4.37 ZCAV: A disk format requiring Zoned Constant Angular Velocity operation, all tracks in the Data Zone being logical tracks.

4.38 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 + 0,01, and a negative tolerance - 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 number 0 and is recorded last, the most significant bit (numbered 7 in a 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, a group of decimal digits of the form **xx...x/yy...y** indicates that the value **xx...x** is a byte, sector, or track number of a disk with 512-byte sectors and **yy...y** of a disk with 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
ECC	Error Correction Code
EDAC	Error Detection and Correction Code
FA1	Functional Area 1
FA2	Functional Area 2
ID	Identifier
LBA	Logical Block Address
LSB	Least Significant Byte
MSB	Most Significant Byte
ODC	Optical Disk Cartridge
O-ROM	Optical Read Only Memory
PA	Postamble
PC	Phase change
PDL	Primary Defect List
PLL	Phase-Lock Loop Circuit
P-ROM	Partial Read Only Memory
RLL(2,7)	Run Length Limited (code)
R-S	Reed-Solomon (code)
R/W	Read/Write
SDL	Secondary Defect List
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.

A disk consists of two sides assembled together with the recording layers inside.

The optical disk is recordable on both sides. Data is written onto the disk as marks in the form of an amorphous spot in the recording layer and can be overwritten by new data with a focused optical beam, using the phase change effect between amorphous and crystalline states. The data is read with a focused optical beam, using phase change effect as the reflective difference between amorphous and crystalline states. 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 is 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 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 G)

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 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

The 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 Q)

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 L).

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 60 °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 Q)

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 P.

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 overwrite 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 overwrite 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.

The optical beam emitted from a laser diode A shall be collimated by a collimator lens B, and the ellipticity of the collimated beam shall be corrected by the optical shaping prism C.

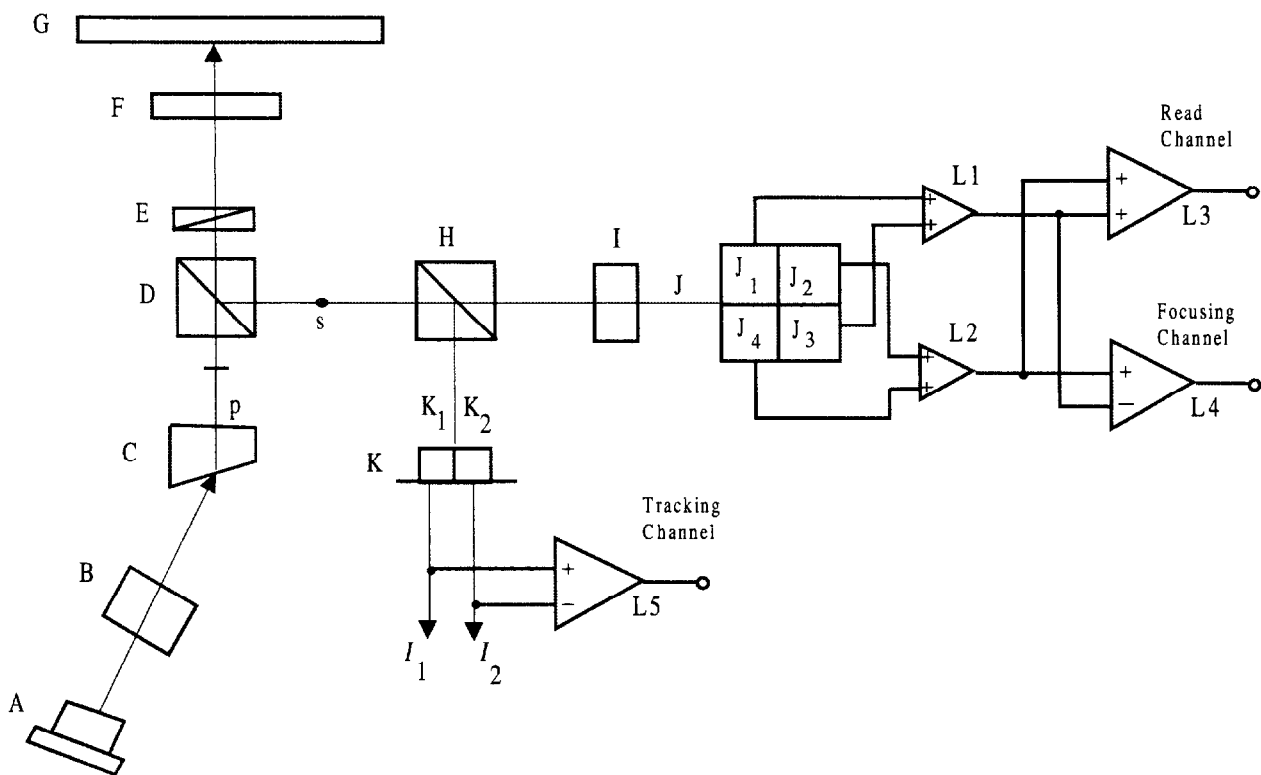
After passing through the polarizing beam splitter D and the quarter-wave plate E, the p-polarized beam becomes a right-handed circularly polarized light. After being converted to circularly light, the light which is focused on the data recording surface of the optical disk G by the objective lens F.

The circularly polarized light reflected back from the optical disk G, which is polarized to the left-handed, is converted to a s-polarized light through the quarter-wave plate E, and all of the s-polarized light shall be reflected to the direction of the beam splitter H by the polarizing beam splitter D. One-half of the light intensity is then reflected by the beam splitter H, while the other half is transmitted.

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

The output of Tracking Channel is the difference between currents I_1 and I_2 of a split photo diode K (K_1 and K_2) and is used for the radial tracking of the optical beam.

J is a quadrant photo diode. The output of Read Channel is the sum of the currents through photo diodes J_1 , J_2 , J_3 , and J_4 , and is used for reading embossed marks and user-written marks with the reflective change. The output of the Focusing Channel is the difference between the sum of currents through photo diodes J_2 and J_4 and the sum of current thorough photo diodes J_1 and J_3 , and shall be used for the focusing.



95-0120-A

A	Laser diode	G	Optical disk
B	Collimator lens	H	Beam splitter
C	Optional shaping prism	I	Cylindrical/spherical lens
D	Polarizing beam splitter	J	Quadrant-split photo diode for Read Channel and Focusing Channel
E	Quarter-wave plate	K	Split photo diode for Tracking Channel
F	Objective lens	L1,2,3,4,5	d.c.-coupled amplifiers

Figure 1 - Optical system of the Reference Drive

9.2 Optical beam

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

- a) Wavelength (λ) 685 nm $\pm$ 10 nm
- b) The numerical aperture of the objective lens (NA) 0,60
- c) Wavelength (λ) divided by NA $\lambda/NA = 1,14 \mu\text{m} \pm 0,02 \mu\text{m}$
- d) Filling D/W of the aperture of the objective lens 0,8 max.
- e) Variance of the wavefront of the optical beam near the surface of the recording layer 0 to $\lambda^2/400$
- f) Polarization circular
- g) Extinction ratio 0,01 max.
- h) Read power see 20.2.2
- i) Overwrite power and pulse width see 24.3.2

D is the diameter of the lens aperture and W is the beam diameter of the Gaussian beam where the intensity is 1/e² of the maximum intensity.

9.3 Read Channel

The Read Channel shall be provided to generate signals from the marks in the recording layer. It shall be used for reading the embossed marks, using the diffraction of the optical beam by the marks, and for reading the user-written marks, using the intensity change of the reflected light due to the phase change effect of the marks.

The read amplifier after the photo-detectors in Read Channel shall have a flat response within 1 dB from d.c. to 25 MHz.

9.4 Focusing and tracking

The Tracking Channel of the Reference Drive provides the tracking error signal to control the servos for the radial tracking of the optical beam. The Focusing Channel of the Reference Drive provides the focusing error signal to control the servo for the axial tracking of the optical beam. The requirements for the accuracy with which the optical beam shall follow the tracks are 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 $50,00 \text{ Hz} \pm 0,05 \text{ Hz}$. 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 head and spindle windows on Sides A and B to allow the spindle of the drive to clamp the disk by its hub and the optical head(s) of the drive to access Sides A and B. 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, to inhibit writing, sensor holes, detents 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 (see annex H). The case shall be constrained such that eight reference surfaces S1 to S8 on Side A of the case lie in plane Z. The intersection of the three planes defines the centre of the location hole. The centre of the alignment hole shall lie on the intersection of planes X and Z. On Side B, some dimensions are referred to reference plane X and two planes Y' and Z', where

- Y' is a plane parallel to reference plane Y at a nominal distance of 80,0 mm,
- Z' is a plane parallel to reference plane Z at a nominal distance of 5,0 mm.

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 overall dimensions specified below are identical for Side A and Side B.

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

$$L_5 = 85,0 \text{ mm} \begin{array}{l} + 0,1 \text{ mm} \\ - 0,3 \text{ mm} \end{array}$$

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 each corner shall be rounded with a radius

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

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

$$L_8 = 5,0 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

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

$$R_2 = 0,3 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

10.3.2 Location hole (see figure 3)

On Side A, the centre of the location hole shall coincide with the intersection of reference planes X, Y and Z. The diameter D_1 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

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

after which a cavity extends through to the alignment hole on the opposite side of the case.

The lead-in edges shall be rounded with a radius

$$R_3 = 0,5 \text{ mm max.}$$

On Side B, the centre of the location hole shall coincide with the intersection of reference plane X and planes Y' and Z'. The dimensions of the location hole are the same as on Side A.

10.3.3 Alignment hole (see figure 3)

On Side A, the centre of the alignment hole shall lie on the intersection of planes X and Z at a distance

$$L_{10} = 80,0 \text{ mm} \pm 0,2 \text{ mm}$$

from the reference plane Y.

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

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

$$L_{12} = 4,4 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

held to a depth L_9 , after which a cavity extends through to the location hole on the opposite side of the case.

The lead-in edges shall be rounded with a radius R_3 .

On Side B, the centre of the alignment hole shall lie on the intersection of reference plane X and plane Z' at a distance L_{10} from plane Y'. The dimensions of this hole are the same on Side A.

10.3.4 Reference surfaces (see figure 4)

The dimensions of the reference surfaces specified below are the same on Side A and Side B.

There shall be eight reference surfaces S1, S2, S3, S4, S5, S6, S7 and S8 on Side A of the case.

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

$$L_{13} = 54,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{14} = 1,0 \text{ mm} \pm 0,2 \text{ mm}$$

and

$$L_{15} = 81,0 \text{ mm} \pm 0,2 \text{ mm.}$$

Surfaces S5, S6, S7 and S8 shall be semicircular with a radius

$$R_4 = 2,5 \text{ mm min.}$$

with their centres located at

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

$$L_{17} = 65,5 \text{ mm} \pm 0,2 \text{ mm}$$

on the edge of the case.

No portion of the case or of the shutter mechanism (see 10.3.10) shall protrude more than

$$L_{18} = 0,15 \text{ mm max.}$$

beyond the reference plane Z for Side A, or plane Z' for Side B.

10.3.5 Detents (see figure 5)

The case shall have two symmetrical detents. The detent shall have a depth

$$L_{19} = 2,0 \text{ mm} \begin{array}{l} +0,3 \text{ mm} \\ - 0,1 \text{ mm} \end{array}$$

measured from the edge of the case. The width of the detent shall be

$$L_{20} = 3,0 \text{ mm} \begin{array}{l} +0,3 \text{ mm} \\ - 0,1 \text{ mm} \end{array}$$

The upper edge of the detent shall be at a distance

$$L_{21} = 40,0 \text{ mm} \pm 0,2 \text{ mm}$$

from reference plane X. The part of the bottom of the detent that is parallel to reference plane Y shall extend below the upper edge of the detent by

$$L_{22} = 1,5 \text{ mm min.}$$

The lower edge of the detent shall be parallel to the upper edge over a distance

$$L_{23} = 1,0 \text{ mm min.}$$

The corners of the detents shall be rounded with a radius R_5

$$R_5 = 0,3 \text{ mm} \pm 0,1 \text{ mm}$$

10.3.6 Functional Areas (see figure 6)

The case shall have two rectangular through openings, called Functional Areas FA1 and FA2, respectively, as shown in figure 6 for Side A.

Their dimensions shall be

$$L_{24} = 4,4 \text{ mm min.}$$

$$L_{25} = 3,6 \text{ mm min.}$$

The centre of FA1 is defined by a line parallel to reference plane Y at a distance L_{10} from this reference plane Y, and a line parallel to reference plane X at a distance

$$L_{26} = 12,8 \text{ mm} \pm 0,2 \text{ mm}$$

from this reference plane X. The centre of FA2 is defined by the intersection of reference plane Y and said parallel to reference plane X at the distance L_{26} .

The cartridge shall have devices capable of

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

The two Functional Areas shall indicate 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

Functional Areas	Writing
FA1: Closed	Permitted on Side A
FA1: Open	Inhibited on Side A
FA2: Closed	Permitted on Side B
FA2: Open	Inhibited on Side B

The surface of the device shall be located below reference plane Z for Side A or plane Z' for Side B at a distance

$$L_{27} = 0,3 \text{ mm max.}$$

On Side B, FA1 designates the opening on the right-hand side and FA2 designates the opening on the left-hand side.

10.3.7 Media sensor holes (see figure 7)

The case shall have four media sensor holes A_1 , A_2 , A_3 and A_4 in side A with a diameter D_4 .

$$D_4 = 3,0 \text{ mm min.}$$

The centre of each hole shall be at a distance L_{28} , L_{29} , L_{30} and L_{31} , respectively, from reference plane Y, and at a distance L_{32} from reference plane X.

$$L_{28} = 5,5 \text{ mm} \pm 0,2 \text{ mm}$$
$$L_{29} = 11,0 \text{ mm} \pm 0,2 \text{ mm}$$
$$L_{30} = 69,0 \text{ mm} \pm 0,2 \text{ mm}$$
$$L_{31} = 74,5 \text{ mm} \pm 0,2 \text{ mm}$$
$$L_{32} = 12,8 \text{ mm} \pm 0,2 \text{ mm}.$$

Side B shall have four corresponding media sensor holes B₁ , B₂ , B₃ and B₄ with the diameter D₄. Dimensions L₂₈ to L₃₁ are related to a plane Y'.

The media sensor holes shall indicate attributes of the cartridge, as specified in the table 2.

Table 2 - Use of the Media sensor holes

Media sensor hole	Attribute	Type of Cartridge
A ₁ : Closed	Low reflectance	R/W or P-ROM (see table 1)
A ₁ : Open	High reflectance	O-ROM The utilized disk side is not valid, if Functional Areas FA1 is closed.
A ₂ : Closed	---	Reserved
A ₃ : Closed	---	Reserved
A ₄ : Closed	---	Reserved

If the media sensor holes are obturated by a plug, the surface of the plug shall not be recessed from reference plane Z for Side A or plane Z' for Side B by more than

$$L_{33} = 0,2 \text{ mm}$$

If a media sensor hole is open, the room below it shall be free over at least

$$L_{34} = 3,0 \text{ mm}$$

10.3.8 Spindle and head windows (see figure 8)

Sides A and B of the case shall have an identical window enabling 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

$$L_{35} = 40,0 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$L_{36} = 11,0 \text{ mm} \begin{matrix} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

and

$$L_{37} = 11,0 \text{ mm} \begin{matrix} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

The top of the window shall be curved by radius

$$R_6 = 43,7 \text{ mm min.}$$

originating from the intersection of L₃₅ and

$$L_{38} = 27,0 \text{ mm} \pm 0,2 \text{ mm}$$

The area bounded by R_6 and the top of the case shall be recessed from reference plane Z by

$$L_{39} = 1,6 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

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 the intersection of L_{35} and L_{38} .

10.3.9 Insertion slots (see figure 9)

On Side A, the left and right edges of the case shall present each an insertion slot into which the shutter opener can move. The bottom of the right-hand side (as seen from Side A) insertion slot shall be at a distance

$$L_{40} = 43,8 \text{ mm} \pm 0,3 \text{ mm}$$

from reference plane X. The bottom of the left-hand side insertion slot shall be at a distance

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

from reference plane X. The depth of these slots, measured from the edge of the case shall be

$$L_{42} = 2,5 \text{ mm} \pm 0,2 \text{ mm}$$

The side of the insertion slots parallel to reference plane Z shall be at a distance

$$L_{43} = 1,25 \text{ mm} \pm 0,10 \text{ mm}$$

from this reference plane Z. The width of the insertion slots shall be

$$L_{44} = 2,5 \text{ mm} \pm 0,1 \text{ mm}.$$

The lead-in edge at the right-hand side insertion slot shall have a ramp defined by L_{42} and

$$L_{45} = 72,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$A_1 = 10^\circ \pm 1^\circ.$$

On Side B, these dimensions are referred to reference plane X and to plane Z'.

10.3.10 Shutter (see figure 10)

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.

The shutter shall be free to slide in a recessed area of the case. The overall thickness of the case and shutter shall not exceed L_8 by more than L_{18} (see 10.3.4).

The shutter opener tab shall be provided in the right-hand side insertion slot (seen from Side A) which the shutter opener of the drive can push to open the shutter.

The dimensions of the shutter opener tab in the insertion slot shall be

$$L_{46} = 0,5 \text{ mm max.}$$

$$L_{47} = 2,0 \text{ mm min.}$$

$$L_{48} = 1,6 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{49} = 1,8 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

When the shutter is closed, the position of the tab above reference plane X shall be

$$L_{50} = 68,0 \text{ mm} \begin{array}{l} + 0,5 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

A movement of the tab to

$$L_{51} = 45,5 \text{ mm min.}$$

shall be sufficient to open the windows.

It shall be possible to move the tab further up to

$$L_{52} = 43,8 \text{ mm max.}$$

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

10.3.11 Gripper slots (see figure 11)

The case shall have two symmetrical gripper slots on the bottom of the case. The hole of the slots shall have a width

$$L_{53} = 5,0 \text{ mm} \begin{array}{l} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{array}$$

Their height shall be

$$L_{54} = 2,6 \text{ mm} \pm 0,1 \text{ mm}$$

Their depth, i.e. the wall thickness of the case on this edge, shall be

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

The centres of these holes shall be located at a distance

$$L_{56} = 18,5 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{57} = 61,5 \text{ mm} \pm 0,2 \text{ mm}$$

respectively, from reference plane Y and at a distance

$$L_{58} = 2,5 \text{ mm} \pm 0,1 \text{ mm}$$

from reference plane Z.

The dimensions of the free space inside the case, behind these holes shall be L_{54} and

$$L_{59} = 7,5 \text{ mm min.}$$

$$L_{60} = 3,5 \text{ mm min.}$$

10.3.12 Label area (see figure 12)

The case shall have label areas on Side A and Side B, with dimensions shown below. Dimensions L_{61} and L_{62} are related to a plane Y'.

$$L_{61} = 4,5 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{62} = 25,5 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{63} = 12,5 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{64} = 65,5 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{65} = 55,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{66} = 75,5 \text{ mm} \pm 0,3 \text{ mm.}$$

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

$$R_7 = 2,0 \text{ mm max.}$$

The areas on each side shall be recessed by

$$L_{67} = 0,2 \text{ mm min.}$$

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 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 ensures 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.

11 Dimensional, mechanical and physical characteristics of the disk

11.1 General description of the disk

The disk consists of two circular substrates attached by an adhesive layer with a hub on each side of the disk (see figure 13). A recording layer shall be coated on the inner surface of the substrate. The Information Zone of the substrate is transparent to allow an optical beam to focus on the recording layer through the substrate.

The Information and Clamping Zones are on different planes.

When the disk is mounted on the spindle, the hub in the clamping side interacts with the spindle, and provides the radial centring of the disk and the clamping force.

Surfaces A and B of the disk are identical, thus the following description refers to one side only, unless otherwise specified.

11.2 Reference axis and plane of the disk

The reference plane P is the plane including the clamping zone of surface A of the disk.

Some dimensions of the hub are referred to a reference plane P, that 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 the rotation of this spindle.

The reference axis A passes through the centre of the centre hole of the hub, and is normal to plane P (see figure 13).

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 D_5 of the disk, shall be

$$D_5 = 86,0 \text{ mm} \begin{matrix} + 0,0 \text{ mm} \\ - 0,5 \text{ mm} \end{matrix}$$

The diameter D_6 of the centre hole of the disk without the hub shall be

$$D_6 = 6,0 \text{ mm min.}$$

The height L_{68} from plane P and the total thickness L_{69} of the disk between diameters D_5 and

$$D_7 = 27,0 \text{ mm max.}$$

shall be

$$L_{68} = 0,45 \text{ mm} \begin{array}{l} + 0,05 \text{ mm} \\ - 0,00 \text{ mm} \end{array}$$

and

$$L_{69} = 1,25 \text{ mm} \pm 0,06 \text{ mm, excluding axial deflection.}$$

The zone from the diameter D_6 to D_7 outside the clamping zone shall not protrude from plane P.

11.3.1 Hub dimensions (see figure 13)

The diameter of the centre hole of the hub shall be

$$D_8 = 4,004 \text{ mm} \begin{array}{l} + 0,012 \text{ mm} \\ - 0,000 \text{ mm} \end{array}$$

The outer diameter of the hub shall be

$$D_9 = 15,0 \text{ mm} \begin{array}{l} + 0,3 \text{ mm} \\ - 0,5 \text{ mm.} \end{array}$$

The height of the hub shall be

$$h_1 = 0,25 \text{ mm} \begin{array}{l} + 0,00 \text{ mm} \\ - 0,10 \text{ mm} \end{array}$$

The position of the top of the magnetizable surface shall be

$$h_2 = 0,25 \text{ mm} \begin{array}{l} + 0,00 \text{ mm} \\ - 0,10 \text{ mm} \end{array}$$

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

$$h_3 = 0,05 \text{ mm max.}$$

The centring length at a diameter D_8 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 a radius

$$R_8 = 0,2 \text{ mm} \pm 0,1 \text{ mm.}$$

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 a radius

$$R_9 = 0,4 \text{ mm} \pm 0,1 \text{ mm.}$$

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

$$D_{10} = 13,0 \text{ mm min.}$$

$$D_{11} = 6,0 \text{ mm max.}$$

and its adsorbent force measured by the test device specified in annex F 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

$$D_{12} = 21,0 \text{ mm min.}$$

The inner diameter of the clamping zone shall be

$$D_{13} = 16,0 \text{ mm max.}$$

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).

11.4.2 Mass

The mass of the disk shall not exceed 12,0 g.

11.4.3 Moment of inertia

The moment of inertia of the disk relative to axis A shall not exceed 0,011 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 $\pm 0,2$ mm for rotational frequencies of the disk up to 50 Hz.

11.4.6 Axial acceleration

The maximum allowed tracking error $e_{\max}$ (see annex K) shall not exceed $\pm 0,6$ μm , measured using the Reference Servo for axial tracking of the recording layer. The rotational frequency of the disk shall be 50,00 Hz $\pm$ 0,05 Hz. 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

$$\omega = 2\pi f$$

$$\omega_0/2\pi = 1\,880 \text{ Hz}$$

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

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 27,8 m/s² 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-uniformity 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 μm at a rotational frequency of the disk of 50,00 Hz $\pm$ 0,05 Hz.

11.4.8 Radial acceleration

The maximum allowed tracking error $e_{\max}$ (see annex K) shall not exceed $\pm 0,05$ μm , measured using the Reference Servo for radial tracking of the tracks. The rotational frequency of the disk shall be 50,00 Hz $\pm$ 0,05 Hz. 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

$$\omega = 2\pi f$$

$$\omega_0/2\pi = 2\,980 \text{ Hz}$$

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

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 $5,8 \text{ m/s}^2$ 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 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 1,40 to 1,60.

11.5.2 Thickness of the substrate

The nominal thickness of the substrate, from the entrance surface to the recording layer, in the Information Zone shall be $0,60 \text{ mm} \pm 0,02 \text{ mm}$ when the index of refraction of the substrate is equal to 1,58.

If the index of refraction is not equal to 1,58, the thickness of the substrate, from the entrance surface to the recording layer, in the Information Zone shall be

$$t(n) = 0,254 \, 6 \left(\frac{n^3}{n^2 - 1} \right) \left(\frac{n^2 - 0,264 \, 9}{n^2 - 0,000 \, 8} \right)$$

with a tolerance of $\pm 0,02 \text{ mm}$, where n is the index of refraction.

11.5.3 Birefringence

The birefringence of the substrate shall not exceed 70 nm in the Information Zone under the test environment, when measured by the round trip optical path described in annex S.

11.5.4 Reflectance

The reflectance of the recording layer is the value of the Mirror Zone specified in 17.2.1, 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 19 of the Control Zones (see annex D).

The value of R shall lie within the range from 0,14 to 0,28 for partially embossed and fully overwritable disks. The value of R shall lie within the range from 0,50 to 0,90 for high reflectance fully embossed disks (see annex J).

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 F) and the magnets in the spindle. The radial positioning of the disk is provided by the centring 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

$$L_{70} = 0,7 \text{ mm min.}$$

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

$$L_{71} = 2,3 \text{ mm max.}$$

above plane Z. The radius of the cylinder shall be

$$R_{10} = 1,4 \text{ mm max.}$$

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

$$L_{72} = 1,45 \text{ mm} \pm 0,10 \text{ mm}$$

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

$$R_{11} = 0,1 \text{ mm max.}$$

and a centre given by the nominal values of L_{35} and L_{38} .

The torque to be exerted on the disk in the operating condition in order to maintain a rotational frequency of 50 Hz shall not exceed 0,01 N•m.

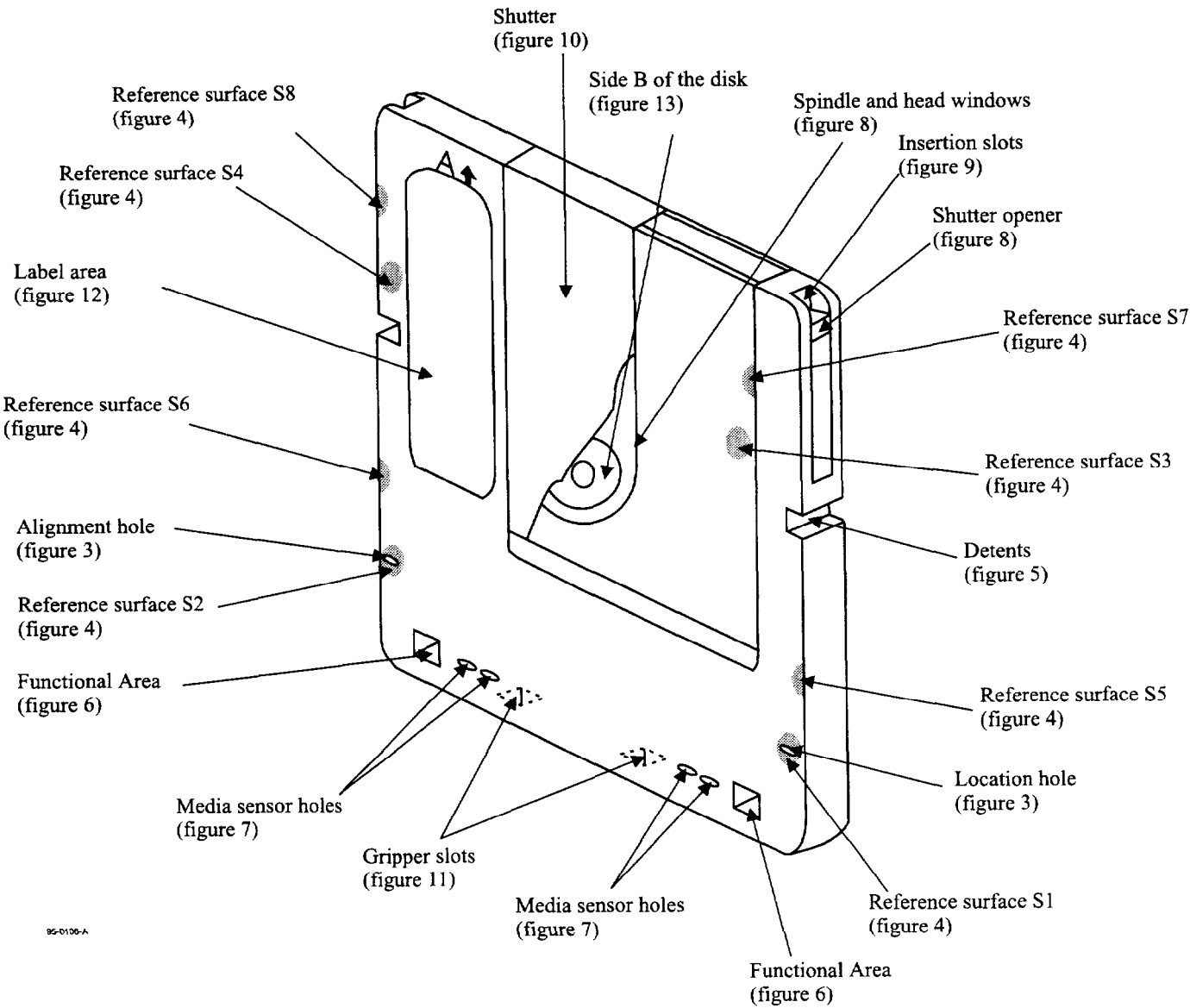
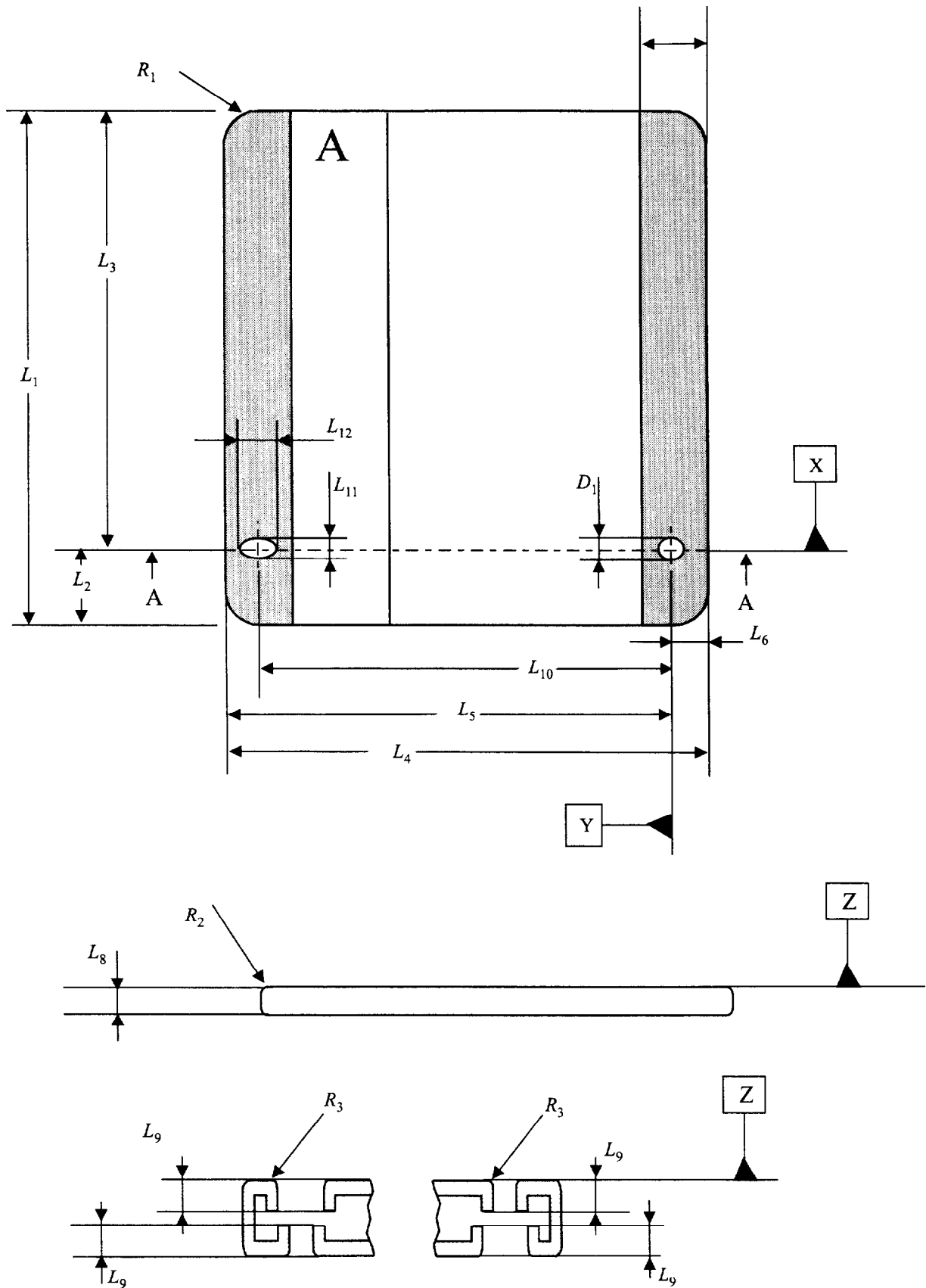
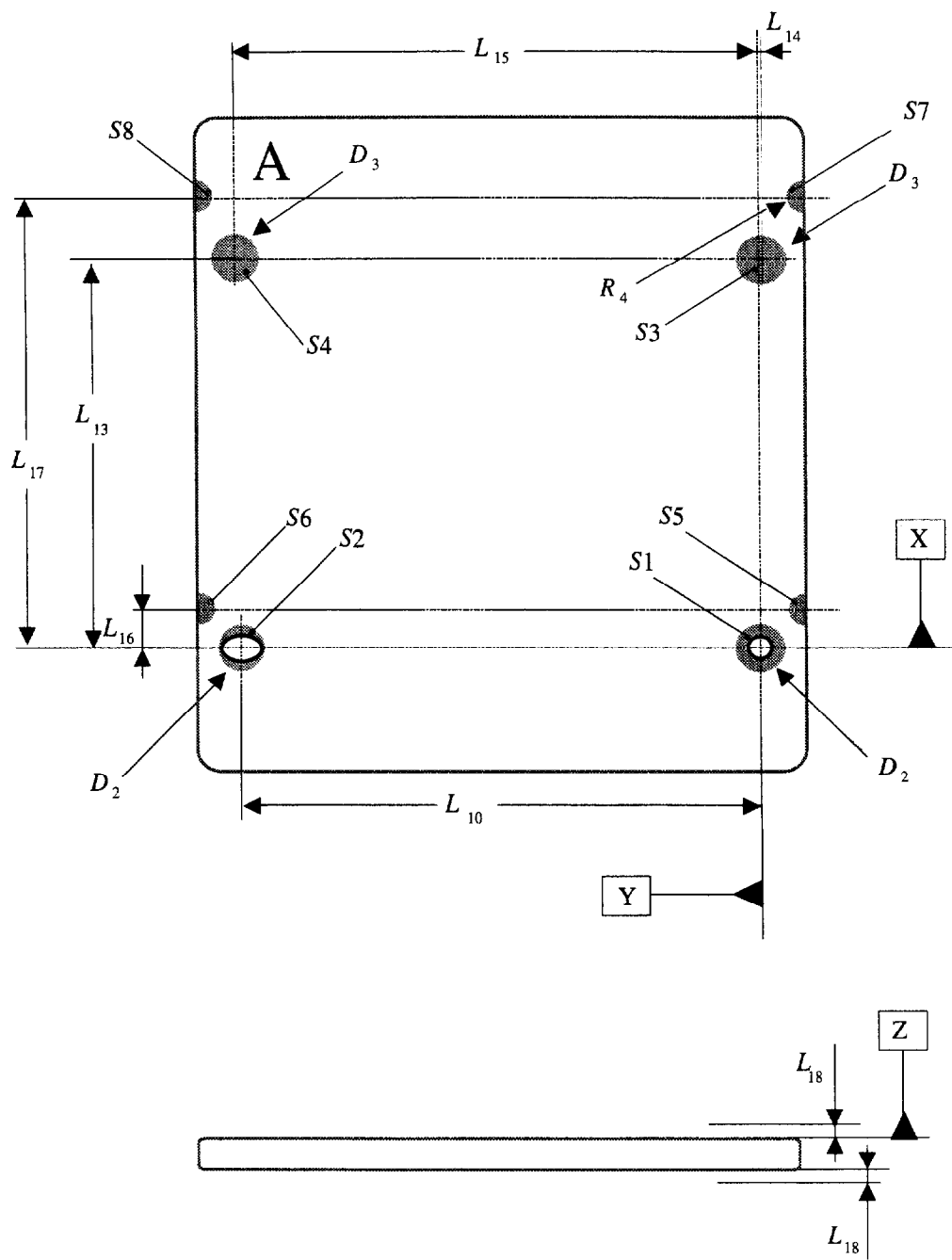


Figure 2 - General view of Side A of the case



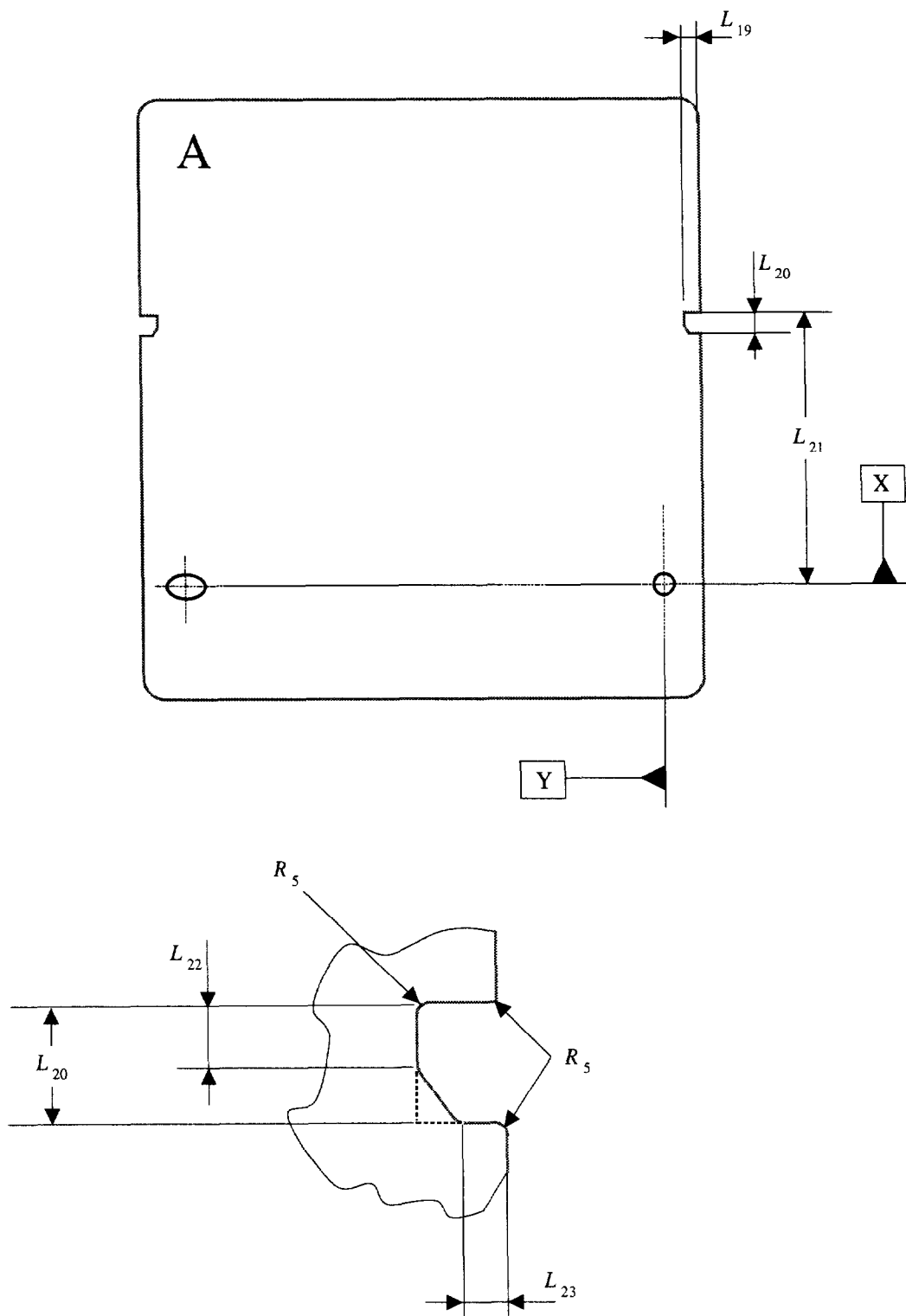
95 0107-A

Figure 3 - Overall dimensions, viewed on Side A of the case



95-0108-A

Figure 4 - Reference surfaces on Side A of the case



95-0109-A

Figure 5 - Detents, seen on Side A of the case

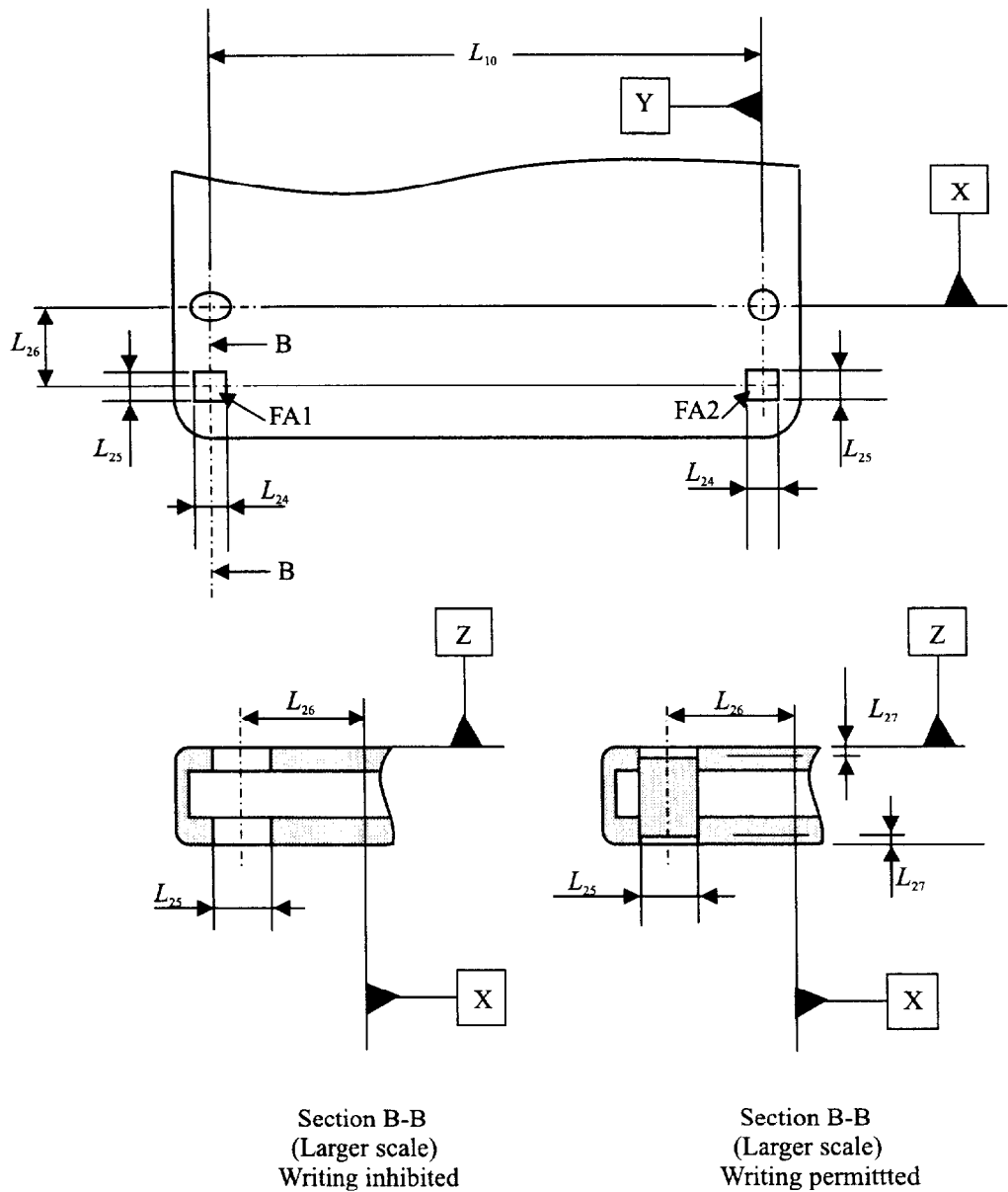


Figure 6 - Functional Areas FA1 and FA2, seen on Side A of the case

95-0110-A

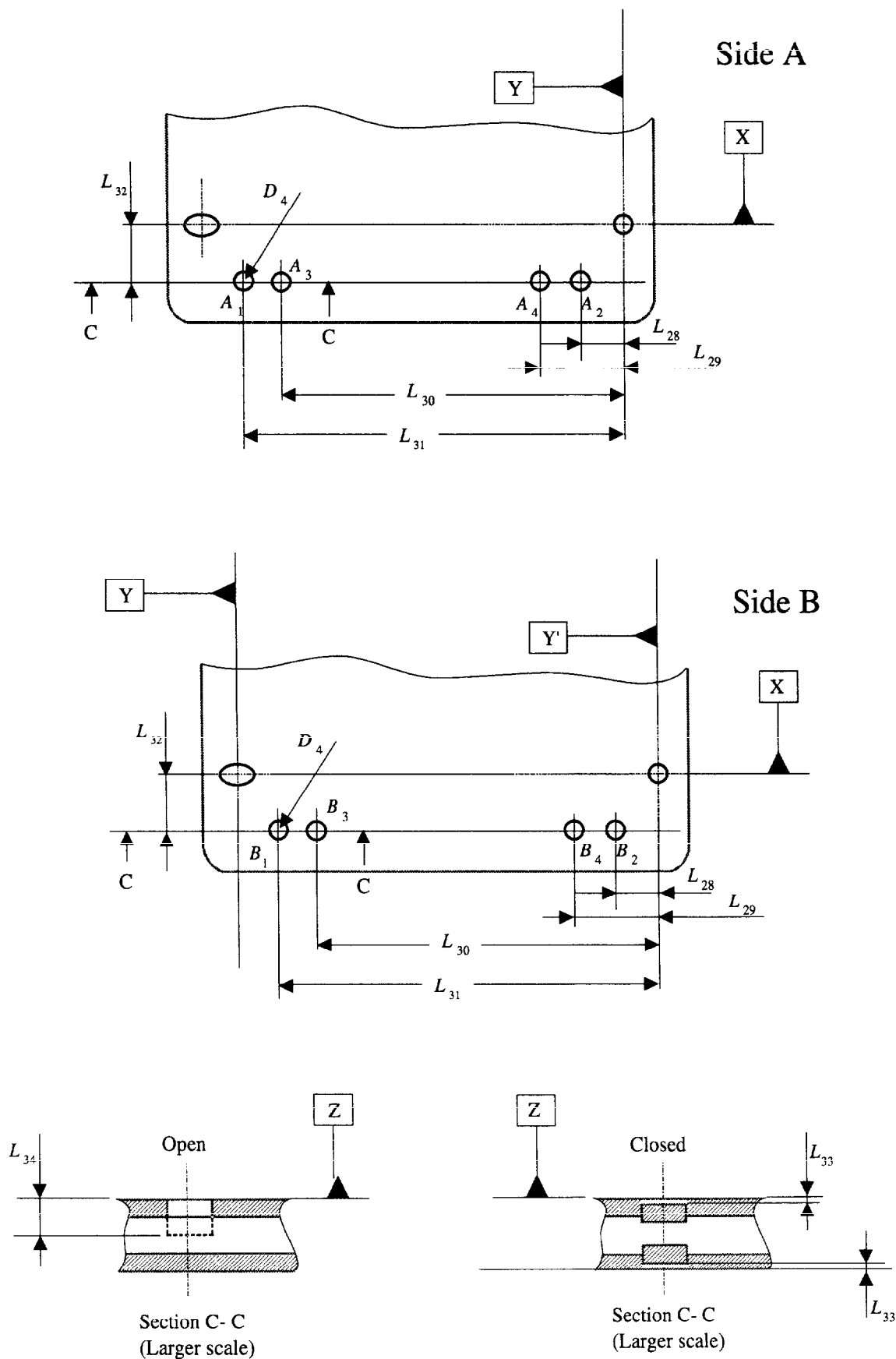
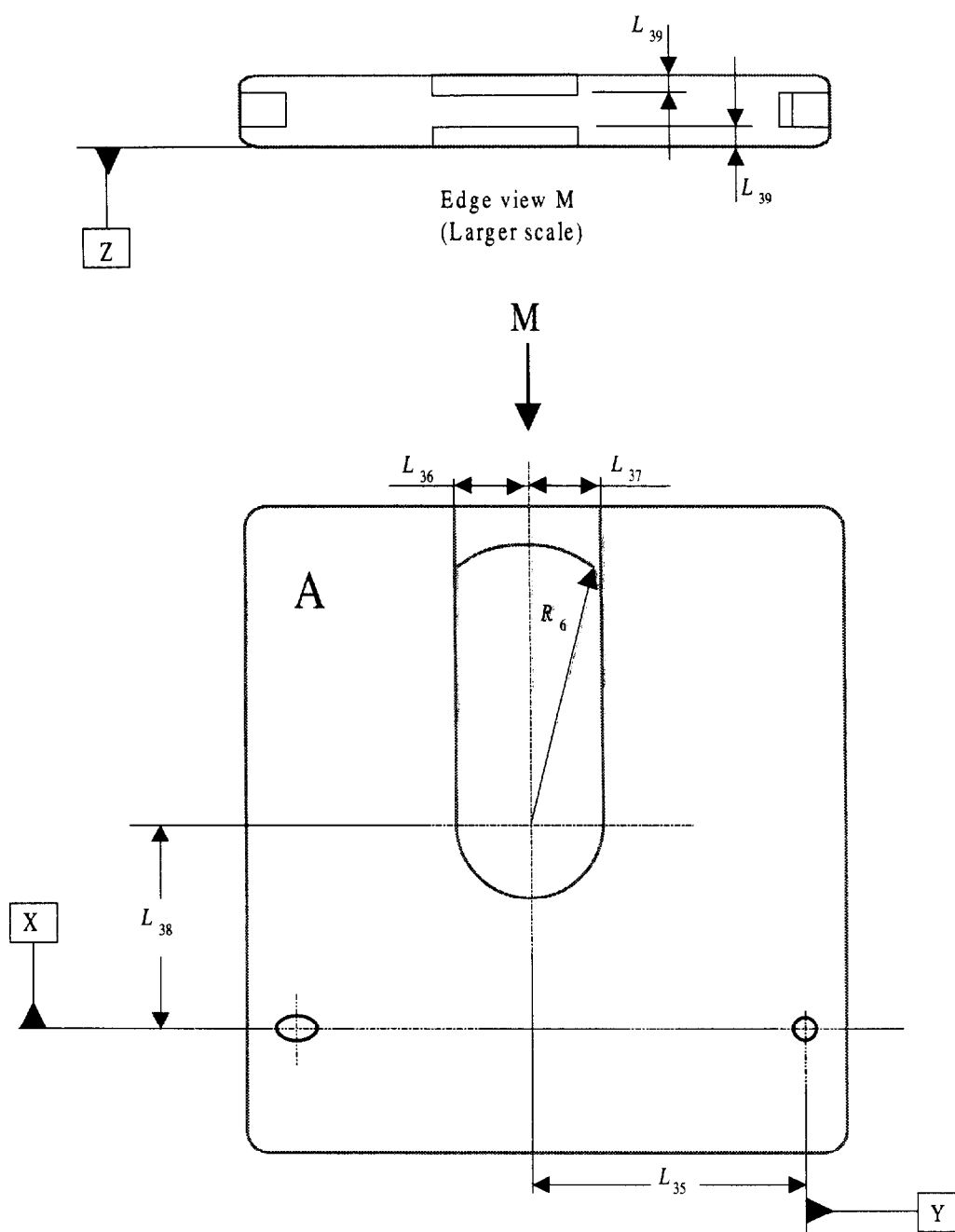


Figure 7 - Media sensor holes



95-0112-A

Figure 8 - Spindle and head windows on Side A of the case without shutter

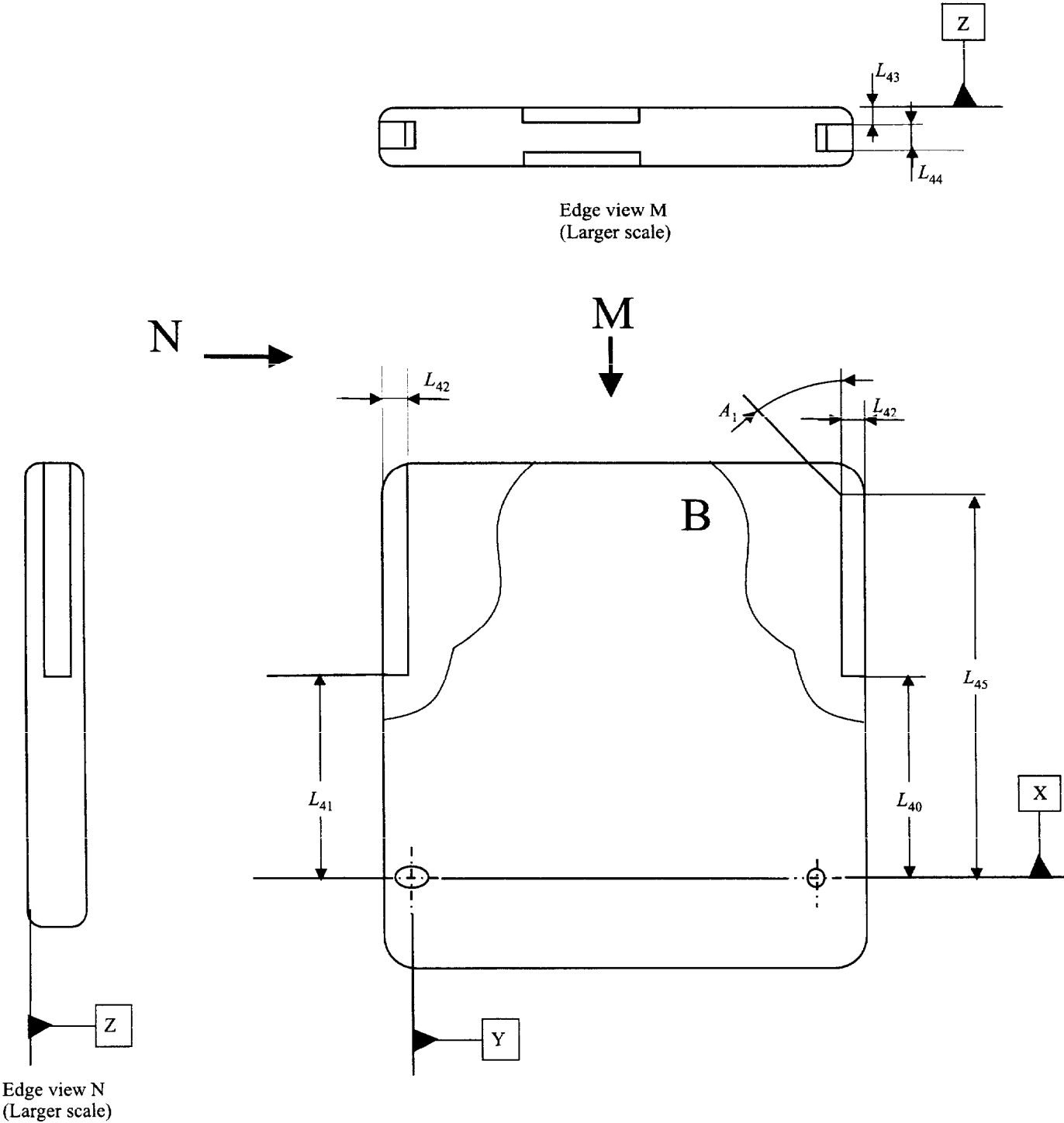


Figure 9 - Insertion slots, seen on Side B of the case

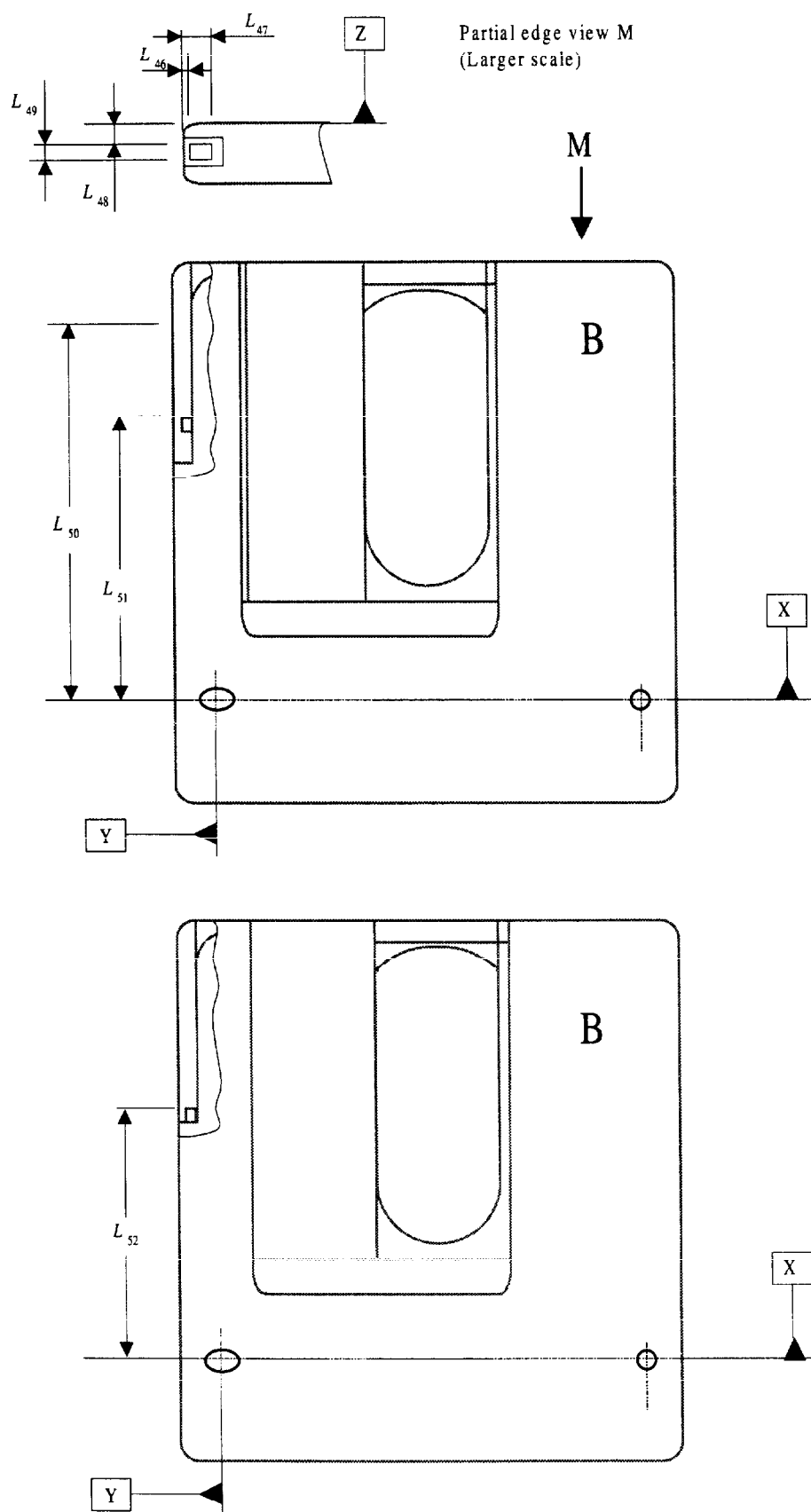


Figure 10 - Shutter in just open position (top) and completely open position (bottom), seen on Side B of the case