
**Information technology — Data interchange
on 120 mm optical disk cartridges using
phase change PD format — Capacity:
650 Mbytes per cartridge**

*Technologies de l'information — Échange de données sur cartouches de
disque optique de 120 mm de diamètre utilisant un format PD de
changement de phase — Capacité: 650 Mbytes par cartouche*



Contents

Section 1 - General	1
1 Scope	1
2 Conformance	1
2.1 Optical disk cartridge	1
2.2 Generating system	1
2.3 Receiving system	1
2.4 Compatibility statement	1
3 Normative reference	1
4 Definitions	2
4.1 addressable track	2
4.2 band	2
4.3 case	2
4.4 Channel bit	2
4.5 Clamping Zone	2
4.6 control track	2
4.7 Cyclic Redundancy Check (CRC)	2
4.8 defect management	2
4.9 disk reference plane	2
4.10 embossed mark	2
4.11 entrance surface	2
4.12 Error Correction Code (ECC)	2
4.13 field	2
4.14 format	2
4.15 interleaving	2
4.16 land and groove	2
4.17 mark	2
4.18 one-beam overwrite	2
4.19 optical disk	2
4.20 optical disk cartridge (ODC)	2
4.21 phase change (PC)	2
4.22 physical track	2
4.23 pitch	2
4.24 polarization	2
4.25 read power	3
4.26 recording layer	3
4.27 Reed-Solomon code	3
4.28 rewritable disk	3
4.29 sector	3

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4.30 spindle	3
4.31 substrate	3
4.32 write once disk	3
4.33 ZCAV	3
4.34 zone	3
5 Conventions and notations	3
5.1 Representation of numbers	3
5.2 Names	3
6 List of acronyms	4
7 General description of the optical disk cartridge	4
8 General requirements	4
8.1 Environments	4
8.1.1 Test environment	4
8.1.2 Operating environment	5
8.1.3 Storage environment	5
8.1.4 Transportation	5
8.2 Temperature shock	5
8.3 Safety requirements	5
8.4 Flammability	5
9 Reference Drive	5
9.1 Optical system	5
9.2 Optical beam	6
9.3 Read channel	6
9.4 Tracking	7
9.5 Rotation of the disk	7
Section 2 - Mechanical and physical characteristics	7
10 Dimensional and physical characteristics of the case	7
10.1 General description of the case	7
10.2 Reference planes of the case	7
10.3 Dimensions of the case	7
10.3.1 Overall dimensions	7
10.3.2 Location hole	8
10.3.3 Alignment hole	8
10.3.4 Reference surfaces	9
10.3.5 Detents	9
10.3.6 Write inhibit hole	10
10.3.7 Media sensor area	10
10.3.8 Spindle and head windows	11
10.3.9 Shutter and shutter opener	11
10.3.10 Mis-insertion protection	12
10.3.11 Gripper slots	13
10.3.12 Label area	13
10.4 Mechanical characteristics	13
10.4.1 Material	14
10.4.2 Mass	14
10.4.3 Edge distortion	14
10.4.4 Compliance	14

10.4.5 Shutter opening force	14
11 Dimensional, mechanical and physical characteristics of the disk	14
11.1 General description of the disk	14
11.2 Reference axis and plane of the disk	14
11.3 Dimensions of the disk	14
11.3.1 Clamping Zone	14
11.3.2 Clamping force	15
11.4 Mechanical characteristics	15
11.4.1 Material	15
11.4.2 Mass	15
11.4.3 Moment of inertia	15
11.4.4 Imbalance	15
11.4.5 Axial deflection	15
11.4.6 Axial acceleration	15
11.4.7 Radial runout	15
11.4.8 Radial acceleration	15
11.4.9 Tilt	16
11.5 Optical characteristics	16
11.5.1 Index of refraction	16
11.5.2 Thickness of the substrate	16
11.5.3 Birefringence	16
11.5.4 Reflectance	16
12 Interface between cartridge and drive	16
12.1 Capture cylinder	16
12.2 Disk position in operating condition	17
Section 3 - Format of information	32
13 Geometry of physical tracks	32
13.1 Physical track shape	32
13.2 Direction of rotation	32
13.3 Physical track pitch	32
13.4 Addressable track number	32
14 Format of the Information Zone	32
14.1 General description of the Information Zone	32
14.2 Division of the Information Zone	32
14.2.1 Initial Zone	33
14.2.2 Test Zones for drives and manufacturers	33
14.2.3 Test Zones for servo	34
14.2.4 Control Zone	34
14.2.5 Data Zone	34
15 Addressable track format	34
15.1 Addressable track layout	34
15.2 Clock frequencies and periods	34
15.3 Radial alignment	35
15.4 Sector number	35
16 Sector format	35
16.1 Sector layout	35

16.2	Sector Mark (SM)	36
16.3	VFO fields	36
16.4	Address Mark (AM)	37
16.5	ID fields	37
16.6	Postamble 1 (PA1)	37
16.7	Offset Detection Field (ODF)	37
16.8	Gap	37
16.9	Sync	37
16.10	Data field	37
16.10.1	User data bytes	38
16.10.2	CRC and ECC bytes	38
16.10.3	Resync bytes	38
16.10.4	Postamble 2 (PA2)	38
16.11	Buffer field	38
17	Recording code	38
18	Format of the Data Zone	40
18.1	Buffer tracks in the Data Zone	44
18.2	Defect Management Areas (DMAs)	44
18.3	Disk Definition Structure (DDS)	44
18.4	Defect Management Sector (DMS)	45
18.5	Working Defect List (WDL)	46
18.6	Partitioning	46
19	Defect management	46
19.1	Initialization of the disk	46
19.2	Certification	47
19.2.1	Slipping Algorithm	47
19.2.2	Linear Replacement Algorithm	47
19.3	Disks not certified	47
19.4	Write procedure	47
19.4.1	Rewritable disk	47
19.4.2	Write once disk	48
19.5	Primary Defect List (PDL)	48
19.6	Secondary Defect List (SDL) and Working Defect List (WDL)	48
19.6.1	Rewritable disk	48
19.6.2	Write once disk	50
Section 4	- Characteristics of embossed information	52
20	Method of testing	52
20.1	Environment	52
20.2	Reference Drive	52
20.2.1	Optics and mechanics	52
20.2.2	Read power	52
20.2.3	Read channels	53
20.2.4	Tracking	53
20.3	Definition of signals	53
21	Signals from grooves	55
21.1	Push-pull signal	55

21.2 Divided push-pull signal	55
21.3 On-track signal	56
21.4 Phase depth	56
21.5 Track location	56
22 Signals from Headers	56
22.1 Sector Mark	56
22.2 VFO ₁ and VFO ₂	56
22.3 Address Mark, ID field and Postamble	56
23 Signals from embossed Recording fields	57
Section 5 - Characteristics of the recording layer	57
24 Method of testing	57
24.1 Environment	57
24.2 Reference Drive	57
24.2.1 Optics and mechanics	57
24.2.2 Read power	57
24.2.3 Read channel	57
24.2.4 Tracking	57
24.3 Write conditions	57
24.3.1 Write pulse	58
24.3.2 Write power and pulse width	58
24.4 Definition of signals	58
25 Write characteristics	58
25.1 Resolution and modulation depth	58
25.2 Narrow-band signal-to-noise ratio	58
25.3 Cross-talk	59
26 Overwrite erasability	59
Section 6 - Characteristics of user data	60
27 Method of testing	60
27.1 Environment	60
27.2 Reference Drive	60
27.2.1 Optics and mechanics	60
27.2.2 Read power	60
27.2.3 Read amplifiers	60
27.2.4 Analog-to-binary converters	60
27.2.5 Error correction	60
27.2.6 Tracking	60
28 Minimum quality of a sector	60
28.1 Headers	60
28.1.1 Sector Mark	60
28.1.2 ID fields	60
28.2 User-written data	61
28.3 Embossed data	61
29 Data interchange requirements	61
29.1 Tracking	61

29.2	User-written data	61
29.3	Quality of disk	61
Annexes		
A	Edge distortion test	62
B	Compliance test	63
C	CRC for ID fields	65
D	Format of the Data field of a sector	66
E	Contents of the Control Zone	69
F	Definition of the overwrite pulse	72
G	Air cleanliness class 100 000	73
H	Position of the cartridge relative to the reference planes	74
J	Relaxation by zones of the requirements for signals	75
K	Track deviation measurement	76
L	Guidelines for sector replacement	80
M	Derivation of the operating climatic environment	81
N	Transportation	86
P	Office environment	87
Q	Measurement of birefringence	88

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 15485 was prepared by ECMA (as ECMA-240) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

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

Introduction

This International Standard specifies the characteristics of 120 mm Optical Disk Cartridges (ODCs) with a capacity of 650 Mbytes using phase change technology. The format for the information on the disk is known as the PD format.

The 120 mm ODC has a large degree of commonality with CD-ROM so as to allow drive manufacturers to develop drives which can offer read compatibility with CD-ROM as defined in ISO/IEC 10149.

This International Standard specifies two types of ODCs (Type R/W and Type WORM) both of which are intended for use in dual-function optical disk drives with the capability to handle both the 120 mm ODCs and CD-ROM disks such as those conforming to ISO/IEC 10149.

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Information technology — Data interchange on 120 mm optical disk cartridges using phase change PD format — Capacity: 650 Mbytes per cartridge

Section 1 - General

1 Scope

This International Standard specifies the characteristics of 120 mm Optical Disk Cartridges (ODCs) with a capacity of 650 Mbytes using Phase Change PD format. This present International Standard specifies two related, but different implementations of such cartridges, viz.

Type R/W Provides for data to be written, read and overwritten many times over the whole recording surface of the disk using the phase change recording and read-out method .

Type WORM Provides for data to be written once and read many times over the whole recording surface of the disk using the phase change recording and read-out method.

Type R/W and Type WORM are also referred to as “rewritable” and “write-once” respectively.

This International Standard specifies

- the conditions for conformance testing and the Reference Drive;
- the environments in which the cartridges are to be operated and stored;
- the mechanical and physical characteristics of the cartridge, so as to provide mechanical interchangeability between data processing systems;
- the format of the information on the disk known as the PD format; 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 recording characteristics of the disk, enabling data 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

An optical disk cartridge shall be in conformance with this International Standard if it meets the mandatory requirements specified herein for its Type.

2.2 Generating system

A generating system shall be in conformance with this International Standard if the ODC it generates is in accordance with 2.1.

2.3 Receiving system

A receiving system shall be in conformance with this International Standard if it is able to handle an ODC according to 2.1.

2.4 Compatibility statement

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

3 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are 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 listed below. Members of IEC and ISO maintain registers of currently valid International Standard.

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

4 Definitions

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

- 4.1 addressable track:** A continuous group of 64 sectors in which each sector can be addressed in a linear manner beginning with sector number 0.
- 4.2 band:** A part of the Data Zone comprising a fixed number of consecutive physical tracks.
- 4.3 case:** The housing for an optical disk, that protects the disk and facilitates disk interchange.
- 4.4 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.

- 4.5 Clamping Zone:** The annular part of the disk within which the clamping force is applied by the clamping device.
- 4.6 control track:** A track containing the information on media parameters and format necessary for writing and reading the remaining tracks of the optical disk.
- 4.7 Cyclic Redundancy Check (CRC):** A method for detecting errors in data.
- 4.8 defect management:** A method for handling the defective areas on the disk.
- 4.9 disk reference plane:** A plane defined by the perfectly flat annular surface of an ideal spindle onto which the clamping zone of the disk is clamped, and which is normal to the axis of rotation.
- 4.10 embossed mark:** A mark so formed as to be unalterable by optical means.
- 4.11 entrance surface:** The surface of the disk onto which the optical beam first impinges.
- 4.12 Error Correction Code (ECC):** An error-detecting code designed to correct certain kinds of errors in data.
- 4.13 field:** A subdivision of a sector.
- 4.14 format:** The arrangement of information on the disk.
- 4.15 interleaving:** The process of allocating the physical sequence of units of data so as to render the data more immune to burst errors.
- 4.16 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.
- 4.17 mark:** A feature of the recording layer that may take the form of an amorphous spot, crystalline spot, a pit, or other form that can be sensed by the optical system. The pattern of marks represents the data on the disk.

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

- 4.25 read power:** The optical power, incident at the entrance surface of the disk, used when reading.
- 4.26 recording layer:** A layer of the disk on, or in, which data is written during manufacture and/or use.
- 4.27 Reed-Solomon code:** An error detection and/or correction code for the correction of errors that occur in bursts or are strongly correlated.
- 4.28 rewritable disk:** An optical disk in which the data in specified areas can be rewritten by an optical beam.
- 4.29 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.
- 4.30 spindle:** The part of the disk drive which contacts the disk.
- 4.31 substrate:** A transparent layer of the disk, provided for mechanical support of the recording layer, through which the optical beam accesses the recording layer.
- 4.32 write once disk:** An optical disk in which the data in specified areas is irreversibly written and read many times by an optical beam.
- 4.33 ZCAV:** A disk format requiring Zoned Constant Angular Velocity operations.
- 4.34 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. [i.e. (F0) etc.]
- 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 addressable tracks.

5.2 Names

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

6 List of acronyms

AM	Address Mark
CRC	Cyclic Redundancy Check
DC	Direct Current (d.c.)
DDS	Disk Definition Structure
DMA	Defect Management Area
DMS	Defect Management Sector
ECC	Error Correction Code
ID	Identifier
LSB	Least Significant Byte
MSB	Most Significant Byte
ODC	Optical Disk Cartridge
ODF	Offset Detection Field
PA	Postamble
PC	Phase Change

PDL	Primary Defect List
RLL(2,7)	Run Length Limited (code)
R/W	rewritable
SDL	Secondary Defect List
SM	Sector Mark
VFO	Variable Frequency Oscillator
WDL	Working Defect List
WORM	Write Once Read Many
ZCAV	Zoned Constant Angular Velocity

7 General description of the optical disk cartridge

The optical disk cartridge that 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. In the rewritable disk, data can be written onto the disk as marks in the form of amorphous spots in the crystalline recording layer and can be overwritten on it with a focused optical beam, using the phase change effect between amorphous and crystalline states. In the write once disk, data can be irreversibly written onto the disk as marks in the form of crystalline spots in the amorphous recording layer, using phase change effect. The data can be 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 contains read-only data for the drive in the form of pits embossed by the manufacturer. This data can be read using the diffraction of the optical beam by the embossed pits.

8 General requirements

8.1 Environments

8.1.1 Test environment

The test environment is the environment where the air immediately surrounding the optical disk cartridge has 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 shall be cleaned according to the instructions of the manufacturer of the disk.

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

8.1.2 Operating environment

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

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

temperature	: 5 °C to 55 °C
relative humidity	: 3 % to 85 %
absolute humidity	: 1 g/m ³ to 30 g/m ³
atmospheric pressure	: 60 kPa to 106 kPa
temperature gradient	: 10 °C/h max.
relative humidity gradient	: 10 %/h max.
air cleanliness	: Office environment (see annex P)

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 M.)

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 annex P)

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 N.

8.2 Temperature shock

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

8.3 Safety requirements

The cartridge shall satisfy the safety requirements of Standard 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 Standard IEC 950.

9 Reference Drive

The Reference Drive is a drive of which several critical components have well defined properties and which is used to test write, read and overwrite 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 are 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.

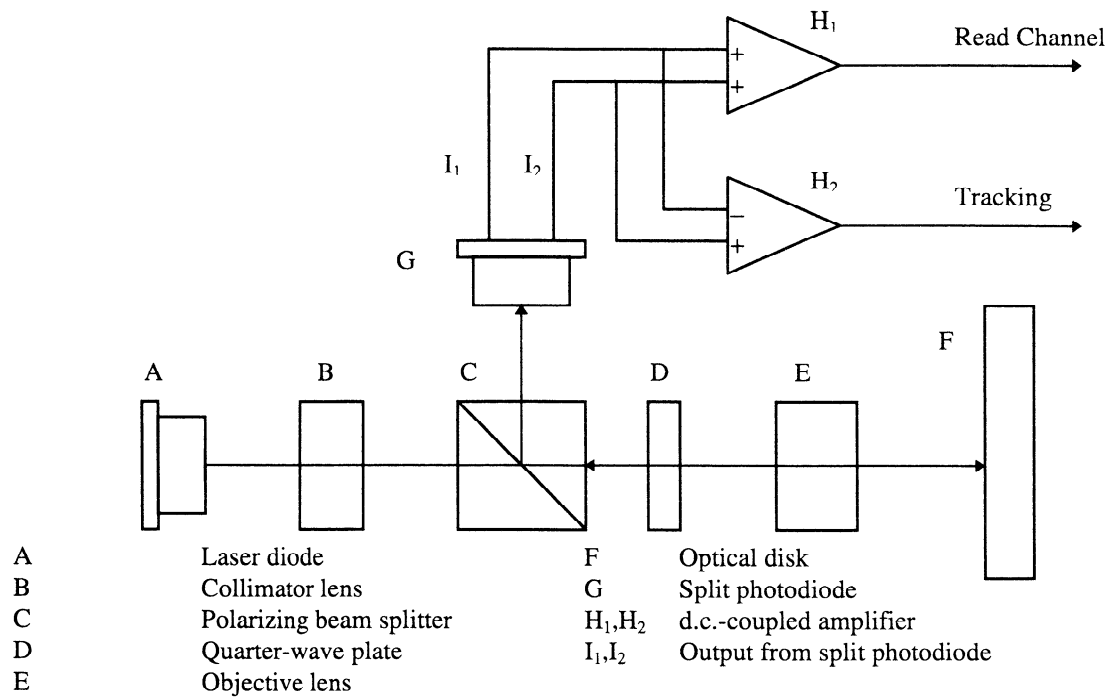


Figure 1 - Optical system of the Reference Drive

The combination of polarizing beam splitter C and a quarter-wave plate D shall separate the entrance optical beam from a laser diode A and the reflected optical beam from an optical disk F. The beam splitter C shall have a p-s intensity reflectance ratio of at least 100.

9.2 Optical beam

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

- a) Wavelength (λ)
780 nm
+ 20 nm
- 10 nm
- b) Wavelength (λ) divided by the numerical aperture of the objective lens (NA)
 $\lambda / NA = 1,565 \mu m \pm 0,030 \mu m$
- c) Filling D/W of the aperture of the objective lens
radial 0,75 < D/W < 1,20
tangential D/W < 0,65
- d) Variance of the wavefront of the objective lens near the recording layer after passing through an ideal substrate
0 to $\lambda^2 / 180$
- e) Polarization
Circular
- f) Read power
see 20.2.2, 24.2.2 and 27.2.2
- g) Write 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

One Read channel shall be provided to generate signals from the marks in the recording layer. This Read channel shall be used for reading the embossed marks, using the diffraction of the optical beam by the marks, and be used for reading the user-written marks, using the change of reflected intensity of the optical beam due to the phase change effect of the marks. The read amplifiers after the photo-detectors in the Read channel shall have a flat response within 1 dB from d.c. to 17,7 MHz.

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 in the tracking channel. The division of the diode runs parallel to the image of the physical 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 12.2. It shall rotate the disk at $33,8 \text{ Hz} \pm 0,3 \text{ Hz}$. 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 2a and 2b)

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. 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 clamping means. 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, gripper slots for an autochanger, and detents for autoloading, and for vertical use of the cartridge.

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 four reference surfaces S1 to S4 on Side A of the case shall lie in plane Z when measuring those dimensions of the case in 10.3 which are referenced to this plane. The intersection of the three planes defines the centre of the location hole. The centre of the alignment hole shall lie at the intersection of the X and Z planes (see annex H). 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

$$L_1 = 135,0 \text{ mm} \pm 0,3 \text{ mm}$$

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

$$L_2 = 113,0 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$L_3 = 22,0 \text{ mm} \pm 0,1 \text{ mm}$$

The total width of the case shall be

$$L_4 = 124,0 \text{ mm} \begin{matrix} + 0,0 \text{ mm} \\ - 0,3 \text{ mm} \end{matrix}$$

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

$$L_5 = 113,0 \text{ mm} \begin{matrix} + 0,0 \text{ mm} \\ - 0,2 \text{ mm} \end{matrix}$$

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

$$L_6 = 11,0 \text{ mm} \begin{matrix} + 0,0 \text{ mm} \\ - 0,1 \text{ mm} \end{matrix}$$

A corner at the top shall be rounded with a radius

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

and the two corners at the bottom with a radius

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

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

$$L_7 = 7,8 \text{ mm} \begin{matrix} + 0,2 \text{ mm} \\ - 0,1 \text{ mm} \end{matrix}$$

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

$$R_3 = 0,5 \text{ mm} \pm 0,1 \text{ mm}$$

10.3.2 Location hole (see figure 3)

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

$$D_1 = 4,00 \text{ mm} \begin{matrix} + 0,05 \text{ mm} \\ - 0,00 \text{ mm} \end{matrix}$$

held to a depth

$$L_8 = 1,5 \text{ mm min.}$$

The location hole shall extend below plane Z by

$$L_9 = 5,0 \text{ mm min.}$$

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 chamfered and rounded off with a chamfer C_1 and a radius R_4 for the inner edge.

$$C_1 = 0,5 \text{ mm} \pm 0,1 \text{ mm}$$

$$R_4 = 0,2 \text{ mm} \begin{matrix} + 0,1 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

10.3.3 Alignment hole (see figure 3)

The centre of the alignment hole shall lie at the intersection of planes X and Z at a distance

$$L_{10} = 102,0 \text{ mm} \pm 0,2 \text{ mm}$$

from reference plane Y.

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

$$L_{11} = 4,00 \text{ mm} \begin{matrix} + 0,05 \text{ mm} \\ - 0,00 \text{ mm} \end{matrix}$$

$$L_{12} = 5,6 \text{ mm} \begin{matrix} + 0,2 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

held to a depth L_8 .

The alignment hole shall extend below plane Z by L_9 .

The alignment hole shall not extend through Side B.

The lead-in edges shall be chamfered and rounded with a chamfer C_1 and radius R_4 .

10.3.4 Reference surfaces (see figure 4)

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

Surface S1 shall be circular with a diameter

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

and S2 shall be oval-shaped having centres at the points specified by L_{13} with dimensions

$$R_5 = 3,5 \text{ mm min.}$$

$$L_{13} = 1,6 \text{ mm min.}$$

$$L_{14} = 7,0 \text{ mm min.}$$

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

Surfaces S3 and S4 shall be rectangular and shall be surrounded by the boundaries located at distances L_{15} , L_{16} , L_{17} and L_{18} from plane Y

$$L_{15} = 10,3 \text{ mm min.}$$

$$L_{16} = 5,0 \text{ mm max.}$$

$$L_{17} = 112,2 \text{ mm min.}$$

$$L_{18} = 107,5 \text{ mm max.}$$

and shall be surrounded by the boundaries located at distances L_{19} and L_{20} from plane X.

$$L_{19} = 105,0 \text{ mm min.}$$

$$L_{20} = 101,3 \text{ mm max.}$$

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

$$L_{21} = 0,15 \text{ mm max.}$$

beyond the reference plane Z and the surface of the other side of the case.

10.3.5 Detents (see figure 5)

The case shall have two symmetrical side detents and two symmetrical bottom detents.

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

$$L_{22} = 6,90 \text{ mm} \begin{matrix} + 0,20 \text{ mm} \\ - 0,05 \text{ mm} \end{matrix}$$

and shall not extend through Side B.

Each side detent is defined and positioned by the dimensions

$$R_6 = 1,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{23} = 100,5 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{24} = 98,1 \text{ mm} \pm 0,4 \text{ mm}$$

$$L_{25} = 92,9 \text{ mm} \pm 0,4 \text{ mm}$$

$$L_{26} = 3,0 \text{ mm} \pm 0,2 \text{ mm}$$

The outside edges of the side detents toward the top side of the cartridge shall be rounded off by a radius

$$R_7 = 0,5 \text{ mm} \pm 0,2 \text{ mm}$$

The two symmetrical bottom detents are intended for clamping the cartridge in case of vertical use. The cartridge can be clamped by the bottom detents and prevented from falling during vertical loading or unloading. Each bottom detent is defined by the dimensions

$$L_{27} = 3,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{28} = 3,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{29} = 1,0 \text{ mm} \pm 0,1 \text{ mm}$$

with their centres located at distances L_{30} and L_{31} from plane Y and at a distance L_{32} from plane Z.

$$L_{30} = 108,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{31} = 6,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{32} = 3,9 \text{ mm} \pm 0,1 \text{ mm}$$

10.3.6 Write inhibit hole (see figure 6)

The case shall have a Write inhibit hole W in Side A. The diameter of the Write inhibit hole shall be

$$D_3 = 3,0 \text{ mm min.}$$

Its centre line shall be in the reference plane Z, and parallel to the reference plane X at a distance

$$L_{33} = 18,5 \text{ mm} \pm 0,1 \text{ mm}$$

and at a distance

$$L_{34} = 9,0 \text{ mm} \pm 0,1 \text{ mm}$$

from plane Y.

When writing of the disk is not allowed, the Write inhibit hole W shall be extended from side A to side B.

The cartridge shall have a device capable of closing the Write inhibit hole.

When writing of the disk is allowed, the device is moved to close the Write inhibit hole W at the position L_{34} .

The Write inhibit hole W shall indicate whether or not writing on the disk is permitted as specified in table 1.

Table 1 - Use of the Write inhibit hole

W	Writing
Open	Inhibited
Closed	Permitted

The recess of the device surface shall be

$$L_{35} = 0,05 \text{ mm max.}$$

from plane Z.

The device surface shall not protrude from plane Z.

10.3.7 Media sensor area (see figure 6)

The case shall have a reserved media sensor area A_1 with a diameter

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

The centre of the area shall be at a distance

$$L_{36} = 14,5 \text{ mm} \pm 0,1 \text{ mm}$$

from the reference plane Y, and at a distance L_{33} from the reference plane X. The reserved media sensor area shall be closed according to this International Standard.

The recess of the reserved area shall not be more than

$$L_{35} = 0,05 \text{ mm max.}$$

The reserved media sensor area shall not protrude from plane Z.

The reserved media sensor area shall be reserved for future use.

10.3.8 Spindle and head windows (see figure 7a and 7b)

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

$$L_{37} = 51,0 \text{ mm} \pm 0,1 \text{ mm}$$

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

$$L_{38} = 16,5 \text{ mm} \begin{matrix} + 0,1 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

and

$$L_{39} = 16,5 \text{ mm} \begin{matrix} + 0,1 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

The top of the window shall be given by radius

$$R_8 = 64,0 \text{ mm} \pm 0,4 \text{ mm}$$

originating from L_{37} and

$$L_{40} = 40,0 \text{ mm} \pm 0,1 \text{ mm}$$

The bottom of the window shall be the arc of the semi-circle which joins the sides of the window. The centre of the semi-circle shall be defined by L_{37} and L_{40} and the radius shall be defined by R_9 .

$$R_9 = 18,0 \text{ mm} \begin{matrix} + 0,1 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

The diameter of the semi-circle opening is set larger than the width of the window for the purpose to secure the clamping zone.

Side B of the case shall have a window that enables clamping of the disk. The dimensions of the window are referenced to a centreline, located at a distance L_{37} from plane Y. The width of the window shall be given by L_{38} and L_{39} .

The top and bottom of the window shall be the arc and semi-circle with radii R_8 and R_9 .

The area bounded by R_8 and top of the case on side A shall be recessed from plane Z by

$$L_{41} = 2,90 \text{ mm} \begin{matrix} + 0,10 \text{ mm} \\ - 0,05 \text{ mm} \end{matrix}$$

over the width of the window.

The area bounded by R_8 and the top of the case shall be, over the window, at a distance

$$L_{42} = 5,70 \text{ mm} \begin{matrix} + 0,10 \text{ mm} \\ - 0,15 \text{ mm} \end{matrix}$$

10.3.9 Shutter and shutter opener (see figures 7a, 7b, 8 and 9)

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 10.3.8:

- on Side A: from the semi-circle at the bottom of the window up to the top of the case, and from L_{38} to L_{39} ;
- on Side B: from the semi-circle at the bottom of the window up to the top of the case, and from L_{38} to L_{39} ;
- on the top: from plane Z to L_{41} , from L_{38} to L_{39} , from L_{42} up to Side B, and from L_{38} to L_{39} .

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

The shutter of the cartridge shall have a slot with an edge, against which the shutter opener of the drive can push to open the shutter.

The path shall run from

$$L_{43} = 31,5 \text{ mm} \pm 0,3 \text{ mm}$$

to the position of just open

$$L_{44} = 67,8 \text{ mm} \begin{matrix} + 0,3 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

at a distance L_{45} which is from plane X to the bottom of the slot for shutter opener.

$$L_{45} = 109,9 \text{ mm} \pm 0,3 \text{ mm}$$

The lead-in edge of the slot for shutter opener shall have a ramp with an angle

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

The bottom of the slot for shutter opener shall have a width

$$L_{46} = 3,5 \text{ mm} \begin{matrix} + 0,2 \text{ mm} \\ - 0,1 \text{ mm} \end{matrix}$$

A movement of the edge to

$$L_{47} = 75,3 \text{ mm} \begin{matrix} + 0,3 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

shall be sufficient to open the windows to the minimum size specified in 10.3.8 without exceeding the shutter opening force as specified in 10.4.5, while leaving the minimum size window open.

It shall be possible to move the edge to

$$L_{48} = 76,0 \text{ mm max.}$$

10.3.10 Mis-insertion protection (see figure 10)

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

The first feature consists in mis-insertion protection notches which block the loading of a case if it is inserted upside-down.

It shall have the dimensions

$$L_{49} = 8,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{50} = 2,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{51} = 110,0 \text{ mm} \begin{matrix} + 0,1 \text{ mm} \\ - 0,3 \text{ mm} \end{matrix}$$

$$L_{52} = 8,0 \text{ mm} \begin{matrix} + 0,1 \text{ mm} \\ - 0,3 \text{ mm} \end{matrix}$$

The depth of the mis-insertion protection notches shall be L_{53} and shall not be extended to side B.

$$L_{53} = 5,9 \text{ mm} \pm 0,1 \text{ mm}$$

The corners of mis-insertion protection notches are rounded by

$$R_{10} = 0,3 \text{ mm} \pm 0,1 \text{ mm}$$

$$R_{11} = 1,0 \text{ mm} \pm 0,2 \text{ mm}$$

The second feature is a chamfer and a case corner. The profile on the top of the case shall have a feature to prevent the case from being inserted in the drive upside-down.

If the case is correctly loaded, the chamfer pushes aside a possible pawl in the drive. If the case is inserted upside-down, the case corner pushes against the pawl and the case is prevented from further insertion of the case. The chamfer shall have an angle

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

and a height

$$L_{54} = 3,7 \text{ mm} \begin{matrix} +0,3 \text{ mm} \\ -0,1 \text{ mm} \end{matrix}$$

10.3.11 Gripper slots (see figure 11)

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

$$L_{55} = 6,0 \text{ mm} \begin{matrix} +0,3 \text{ mm} \\ -0,0 \text{ mm} \end{matrix}$$

from the edge of the case and a width of

$$L_{56} = 6,0 \text{ mm} \begin{matrix} +0,3 \text{ mm} \\ -0,0 \text{ mm} \end{matrix}$$

The upper edge of a slot shall be

$$L_{57} = 5,0 \text{ mm} \begin{matrix} +0,0 \text{ mm} \\ -0,3 \text{ mm} \end{matrix}$$

below reference plane X.

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

$$R_{12} = 1,0 \text{ mm} \pm 0,2 \text{ mm}$$

10.3.12 Label area (see figure 12)

The case shall have two label areas located on Side B and the bottom, with dimensions

SideB:

$$L_{58} = 5,3 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{59} = 29,2 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{60} = 44,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{61} = 89,0 \text{ mm} \pm 0,2 \text{ mm}$$

The four corners of the area shall be rounded with a radius $R_{13} = 1,5 \text{ mm max.}$

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

$$L_{62} = 0,3 \text{ mm min.}$$

Bottom:

$$L_{63} = 1,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{64} = 103,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{65} = 6,0 \text{ mm} \pm 0,2 \text{ mm}$$

with centre line located at a distance L_{66} from plane Z.

$$L_{66} = 3,9 \text{ mm} \pm 0,2 \text{ mm}$$

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

$$R_{14} = 1,0 \text{ mm max.}$$

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

$$L_{67} = 0,3 \text{ mm min.}$$

10.4 Mechanical characteristics

The requirements of 10.4.1 to 10.4.4 shall all 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 75 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 fully open the shutter does not exceed 1,6 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 shall consist of a circular substrate with a recording layer coated on one side. The recording layer can be protected from environmental influences by a protective layer. The Information Zone of the substrate is transparent so as to allow an optical beam to focus on the recording layer through the substrate. The disk has a centre hole which provides the radial centring of the disk.

11.2 Reference axis and plane of the disk (see figure 13)

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 which passes through the centre of the centre hole of the disk, 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 below. The outer diameter of the disk shall be

$$D_5 = 120,0 \text{ mm} \begin{matrix} + 0,2 \text{ mm} \\ - 0,2 \text{ mm} \end{matrix}$$

Excluding axial deflection (see 11.4.5), the total thickness of the disk shall not exceed 1,4 mm with the exception of the annular region between concentric circles of diameter 40,0 mm and 42,5 mm. Within this annular region of the disk, a projection of not more than 0,24 mm in height below the reference plane of the disk is permitted.

The diameter of the centre hole of the disk shall be

$$D_6 = 15,0 \text{ mm} \begin{matrix} + 0,1 \text{ mm} \\ - 0,0 \text{ mm} \end{matrix}$$

11.3.1 Clamping Zone (see figure 13)

The outer diameter of the Clamping Zone shall be

$$D_7 = 33,0 \text{ mm min.}$$

The inner diameter of the Clamping Zone shall be

$$D_8 = 26,0 \text{ mm max.}$$

The lead-in edge of the centre hole shall have a chamfer C_2 of 45° by 0,1 mm max. or shall be rounded off by a radius

$$R_{15} = 0,1 \text{ mm max.}$$

Burrs opposite the entrance surface of the centre hole are permitted. The height of such burrs shall be less than 0,2 mm.

11.3.2 Clamping force

The clamping force on the Clamping Zone of a disk shall not exceed 10 N.

11.4 Mechanical characteristics

The requirements of 11.4.1 to 11.4.4 shall all 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 optical properties of the substrate in the Information Zone (see 11.5).

11.4.2 Mass

The mass of the disk shall not exceed 20,0 g.

11.4.3 Moment of inertia

The moment of inertia of the disk relative to axis A shall not exceed 0,040 g•m².

11.4.4 Imbalance

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

11.4.5 Axial deflection

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

The deflection of any point of the recording layer in the Information Zone from its nominal position, in a direction normal to plane P, shall not exceed 0,35 mm for rotational frequencies of the disk up to 33,8 Hz.

11.4.6 Axial acceleration

The maximum allowed axial error $e_{\max}$ (see annex K) shall not exceed $\pm 1,0 \mu\text{m}$, measured using the Reference Servo for axial tracking of the recording layer. The rotational frequency of the disk shall be 33,8 Hz $\pm 0,3$ 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

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

where

$$\begin{aligned}\omega &= 2\pi f \\ \omega_0 / 2\pi &= 1\,085 \text{ Hz} \\ i &= \sqrt{-1}\end{aligned}$$

or any other servo with $|1+H|$ within 20% of $|1+H_s|$ in the bandwidth of 33,8 Hz to 100 kHz. Thus, the disk shall not require an axial acceleration of more than 15,5 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-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 70 μm at a rotational frequency of the disk of 33,8 Hz $\pm 0,3$ Hz.

11.4.8 Radial acceleration

The maximum allowed tracking error $e_{\max}$ (see annex K) shall not exceed $\pm 0,15 \mu\text{m}$, measured using the Reference Servo for radial tracking of the tracks. The rotational frequency of the disk shall be 33,8 Hz $\pm 0,3$ 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

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

where

$$\begin{aligned}\omega &= 2\pi f \\ \omega_0 / 2\pi &= 1\,425 \text{ Hz} \\ i &= \sqrt{-1}\end{aligned}$$

or any other servo with $|1+H|$ within 20% of $|1+H_s|$ in the bandwidth of 33,8 Hz to 100 kHz. Thus, the disk shall not require a radial acceleration of more than 4 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 7 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

$$t(n) = 0,509 \times \frac{n^3}{n^2 - 1} \times \frac{n^2 + 0,265}{n^2 + 0,593} \text{ mm}$$

with a tolerance of $\pm 0,05 \text{ mm}$ 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 Channels 1 and 2 of the set-up for measurement in annex Q. The imbalance can be measured by the optical beam on a double passage through a substrate when measured as described in annex Q. It shall not exceed

0,10 in the Data zone

0,15 in the Lead-In and Lead-Out Zones.

11.5.4 Reflectance

The double-pass optical transmission of the substrate and the reflectance of the recording layer are measured together as the reflectance R of the disk. The value of R shall lie within the range from 0,19 to 0,38 for Type R/W disks. The value of R shall lie within the range from 0,24 to 0,48 for Type WORM disks.

The actual value R_m shall be measured with the focused beam and wavelength of the Reference Drive. It shall be measured in unrecorded, ungrooved areas, e.g. the ODF of a sector (see 16.7).

The value R_m shall equal $R(1 \pm 0,12)$.

12 Interface between cartridge and drive

12.1 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 disk to be, just prior to capture, and with the cartridge constrained as in 10.4.4. 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 disk.

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

$$L_{68} = 2,25 \text{ mm min.}$$

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

$$L_{69} = 4,7 \text{ mm max.}$$

above plane Z. The diameter of the cylinder shall be

$$D_9 = 2,1 \text{ mm max.}$$

and its centre shall be given by the nominal values of L_{37} and L_{40} in the drive.

12.2 Disk position in operating condition (see figure 15)

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

$$L_{70} = 3,3 \text{ mm} \pm 0,1 \text{ mm}$$

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

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

and a centre given by the nominal values of L_{37} and L_{40} .

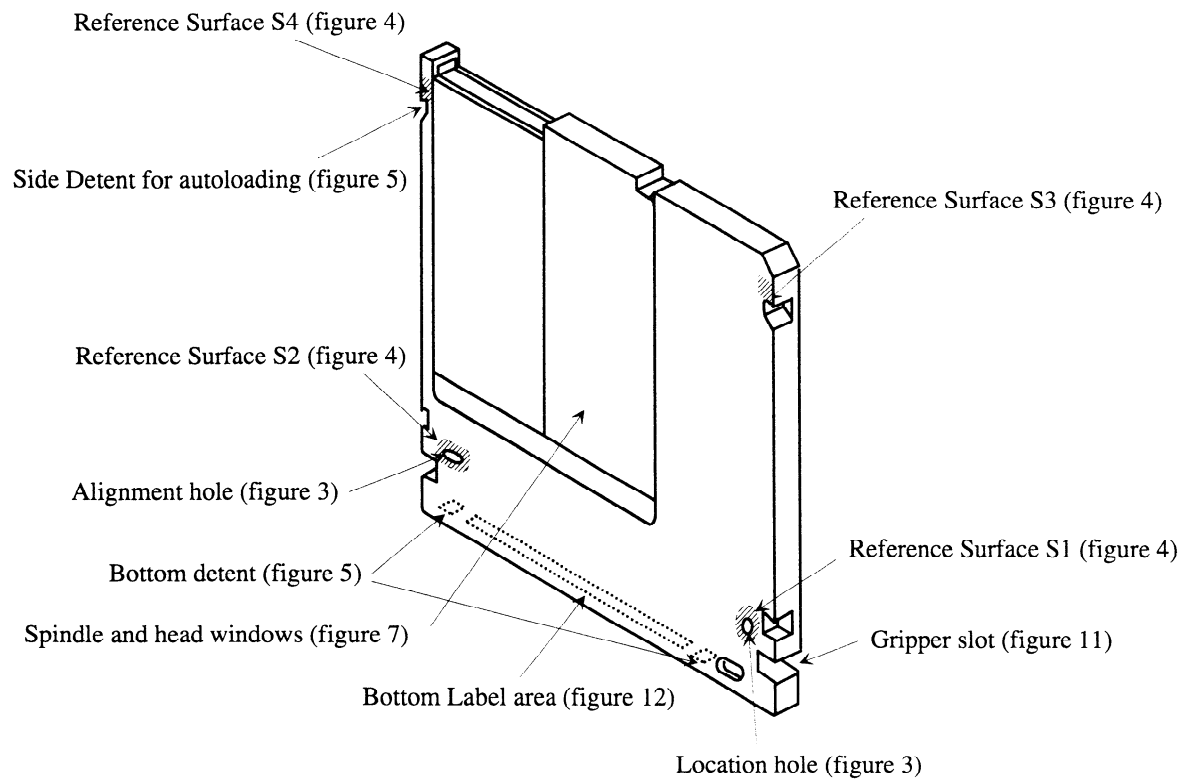


Figure 2a - General view of the case side A

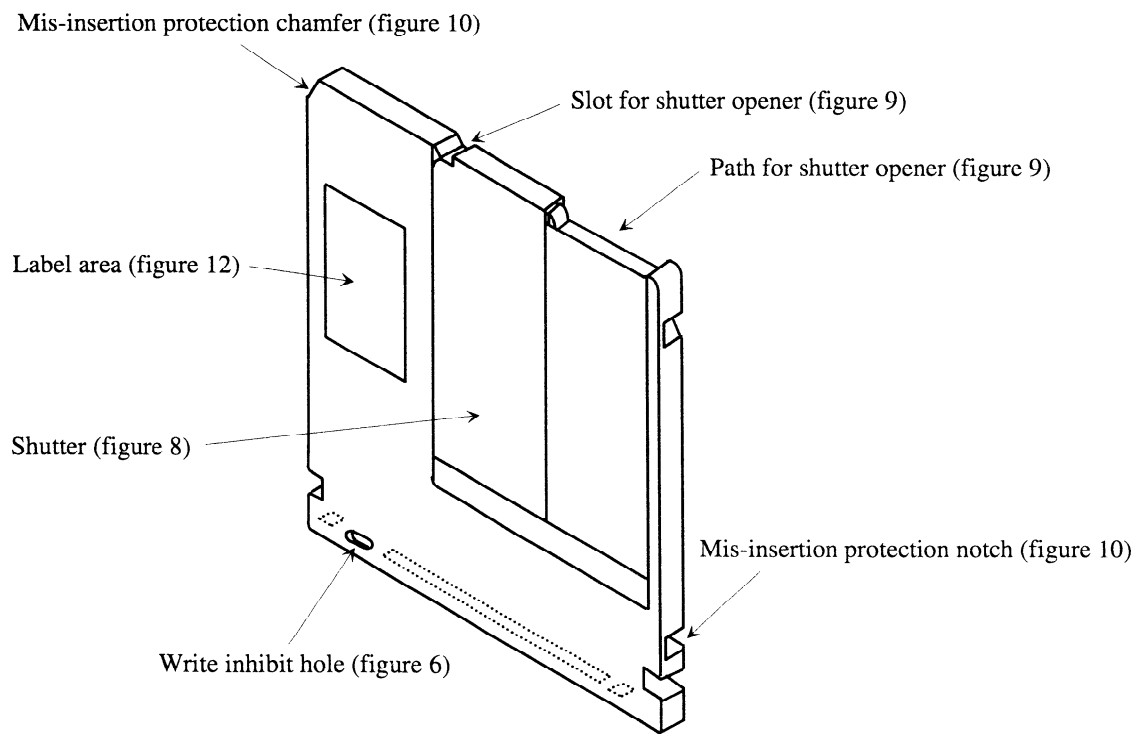


Figure 2b - General view of the case side B

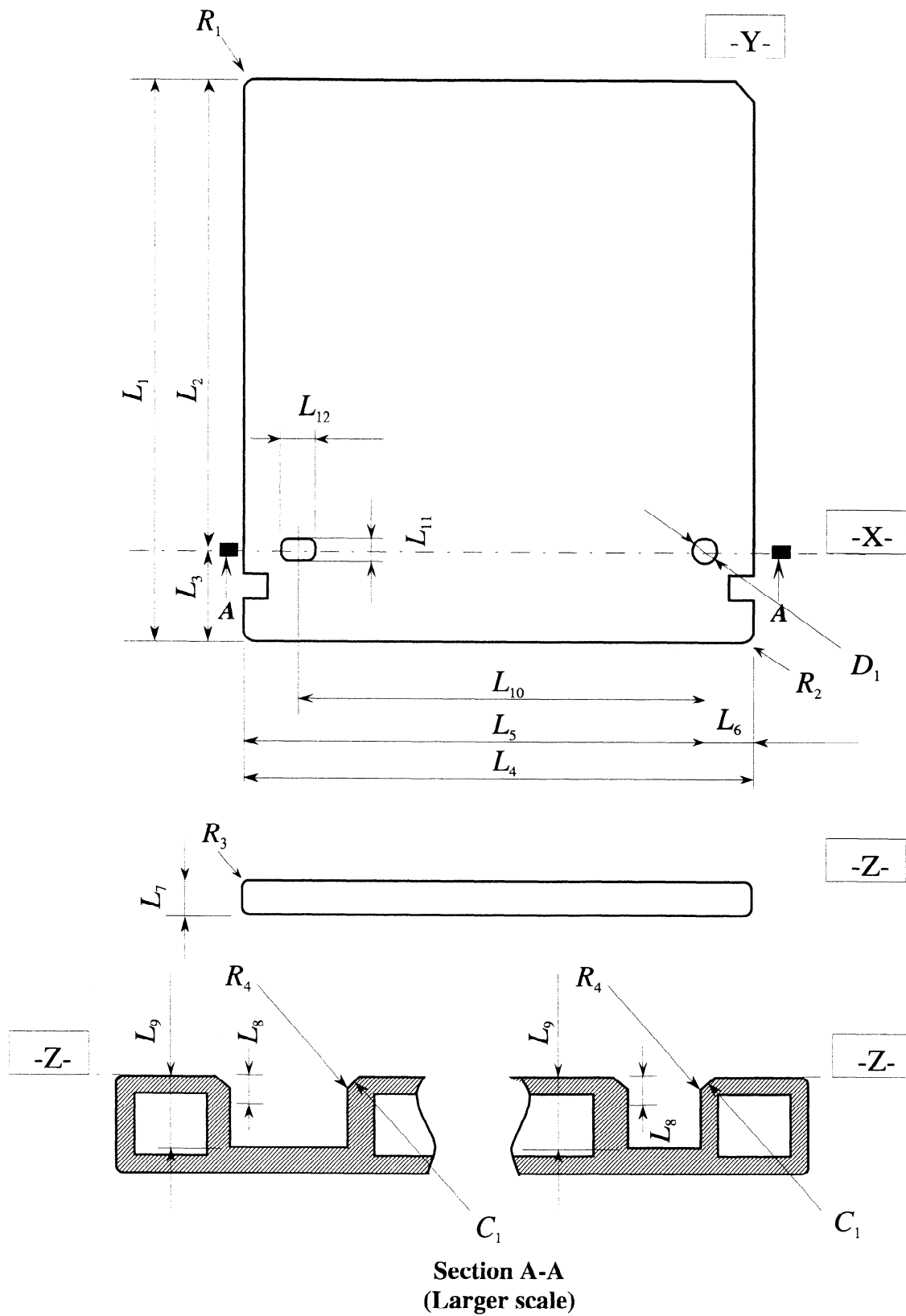


Figure 3 - Overall dimensions, viewed on side A

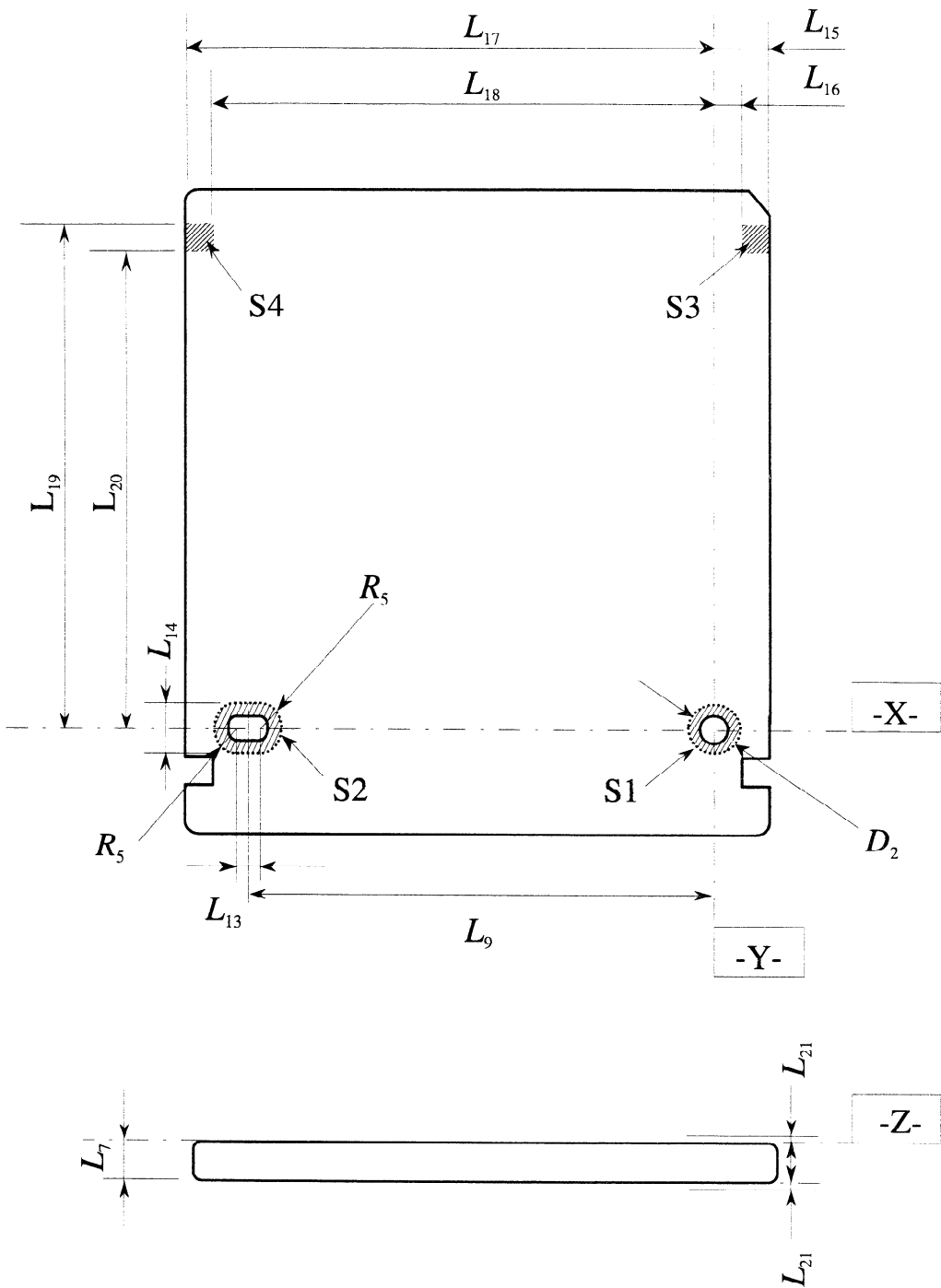


Figure 4 - Reference surface on side A

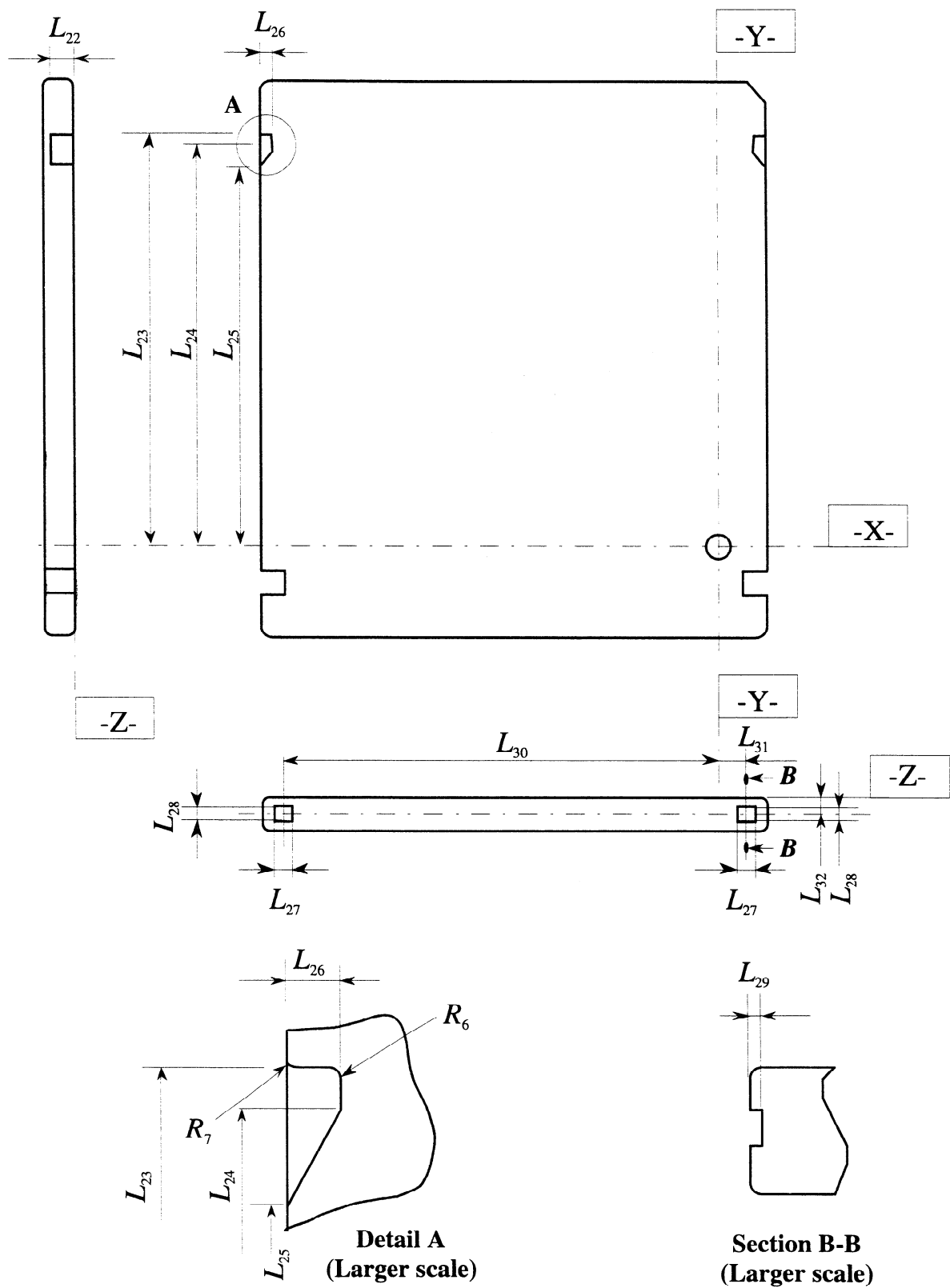


Figure 5 - Detents on side A and bottom