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**Information technology — Data  
interchange on 130 mm optical disk  
cartridges — Capacity: 1 gigabyte per  
cartridge**

*Technologies de l'information — Échange de données sur cartouches de  
disque optique de diamètre 130 mm — Capacité: 1 gigabyte 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 13481 was prepared by the European Computer Manufacturers Association (as Standard ECMA-183) 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, B, D, E, F, K, L and N form an integral part of this International Standard. Annexes C, G, H, J, M and P are for information only.

## Patents

During the preparation of the ECMA standard, information was gathered on patents upon which application of the standard might depend. Relevant patents were identified as belonging to the MAXOPTIX Corporation. However, neither ECMA nor ISO/IEC can give authoritative or comprehensive information about evidence, validity or scope of patent and like rights. The patent holders have stated that licences will be granted under reasonable and non-discriminatory terms. Communications on this subject should be addressed to

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2520 Junction Avenue  
SAN JOSE – CA 95 134  
USA

## Introduction

This International Standard specifies the characteristics of 130 mm Optical Disk Cartridges (ODC) with a capacity of 1 Gbyte per cartridge. This International Standard specifies two related but different implementations of such cartridges, viz.

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

**Type WO** Provides write once, read multiple functionality on the whole of both disk surfaces using the thermo-magnetic and magneto-optical effects.

## Information technology - Data interchange on 130 mm optical disk cartridges - Capacity: 1 gigabyte per cartridge

### Section 1 - General

#### 1 Scope

This International Standard specifies the characteristics of 130 mm optical disk cartridges (ODCs) with a capacity of 1 Gigabyte per cartridge. It specifies two related, but different implementations of such cartridges:

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

**Type WO** Provides write once, read multiple functionality on both disk surfaces using the thermo-magnetic and magneto-optical effects.

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, physical and dimensional characteristics of the case and of the cartridge, so as to provide mechanical interchangeability between data processing systems;
- the format of the information on the disk, both embossed and user-written, including the physical disposition of the tracks and sectors, the error correction codes, and the modulation method used;
- the characteristics of the embossed information on the disk;
- the magneto-optical characteristics of the disk, enabling processing systems to write data onto the disk;
- the minimum quality of user-written data on the disk, enabling data processing systems to read data from the disk.

It also 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. Interchange involves the ability to write, read and erase data without introducing any error.

#### 2 Conformance

##### 2.1 Optical disk cartridges

An ODC claiming conformance with this International Standard shall specify its Type. It shall conform to 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 entitled to claim conformance with this Standard if it meets all mandatory requirements of this 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 entitled to claim conformance with this International Standard if it is able to handle any recording made on the cartridge according to 2.1 on the Type(s) specified.

### 3 Normative references

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

ISO 683-13:1986, *Heat treatable steels, alloy steels and free-cutting steels - Part 13: Wrought stainless steels*.

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

### 4 Definitions

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

**4.1 case:** The housing for an optical disk, that protects the disk and facilitates disk interchange.

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

**4.3 embossed mark:** A mark so formed as to be unalterable by magneto-optical means.

**4.4 entrance surface:** The surface of the disk on to which the optical beam first impinges.

**4.5 Error Correction Code (ECC):** An error-detecting code designed to correct certain kinds of errors in data.

**4.6 field:** A subdivision of a sector.

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

**4.8 groove:** See 4.11.

**4.9 interleaving:** The process of allocating the physical sequence of units of data so as to render the data more immune to burst errors.

**4.10 Kerr rotation:** The rotation of the plane of polarization of an optical beam upon reflection from the recording layer, as caused by the magneto-optical effect.

**4.11 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.

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

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

**4.13 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.

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

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

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

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

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

**4.18 rewritable optical disk:** An optical disk in which the data in specified areas can be written, erased and rewritten by an optical beam.

**4.19 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.

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

**4.21 track:** The path which is to be followed by the focus of the optical beam during one revolution of the disk.

**4.22 write-once functionality:** A disk with write-once functionality can be initialized and written once in specified areas and read many times by an optical beam. Erasing of data in these specified areas is not permitted.

**4.23 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 the 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 ZEROs and ONES.
- Numbers in binary notation and bit combinations are shown with the most significant bit to the left.
- Bit combinations are shown with the most significant bit to the left.
- Negative values of numbers in binary notation are expressed in TWO's complement notation.
- 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.

### 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                                  |
| CCS      | Continuous Composite Servo (tracking method)  |
| CRC      | Cyclic Redundancy Code                        |
| DDS      | Disk Definition Structure                     |
| DMA      | Defect Management Area                        |
| DMP      | Defect Management Pointers                    |
| ECC      | Error Correction Code                         |
| ID       | Identifier                                    |
| LBA      | Logical Block Address                         |
| LDC      | Long Distance Code                            |
| LSB      | Least Significant Byte                        |
| MSB      | Most Significant Byte                         |
| ODC      | Optical Disk Cartridge                        |
| ODF      | Offset Detection Flag                         |
| PA       | Postamble                                     |
| PDL      | Primary Defect List                           |
| PEP      | Phase Encoded Part of the Control Tracks      |
| RLL(2,7) | Run Length Limited (code)                     |
| R-S      | Reed-Solomon                                  |
| SCSI     | Small Computer Systems Interface              |
| SDL      | Secondary Defect List                         |
| SFP      | Standard Formatted Part of the Control Tracks |
| SM       | Sector Mark                                   |
| VFO      | Variable Frequency Oscillator                 |
| ZCAV     | Zoned Constant Angular Velocity               |

## ZST      Zone Structure Table

**7      General description of the optical disk cartridge**

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

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

The optical disk is recordable on both sides. Data can be written onto the disk as mark in the form of magnetic domains in the recording layer and can be erased from it with a focussed optical beam, using the thermo-magnetic effect. The data can be read with a focussed optical beam, using the magneto-optical Kerr effect. The beam accesses the recording layer through the transparent substrate of the disk.

The disk is intended for use in a drive with optical access from one side only. To gain access to the second side of a disk, the cartridge must be reversed before insertion into the drive.

**8      General requirements****8.1      Environments****8.1.1      Testing environment**

The test environment is the environment where the air immediately surrounding the optical disk cartridge shall have the following properties

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

No condensation on or in the ODC shall occur. Before testing, the optical disc cartridge shall be conditioned in this environment for 48h min. 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 testing 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 shall have the following properties

|                                                                                                    |                                             |
|----------------------------------------------------------------------------------------------------|---------------------------------------------|
| temperature                                                                                        | : 5 °C to 55 °C                             |
| relative humidity                                                                                  | : 3 % to 85 %                               |
| absolute humidity                                                                                  | : 1 g/m <sup>3</sup> to 30 g/m <sup>3</sup> |
| atmospheric pressure                                                                               | : 60 kPa to 106 kPa                         |
| temperature gradient                                                                               | : 0 °C /h max.                              |
| relative humidity gradient                                                                         | : 10 % /h max.                              |
| air cleanliness                                                                                    | : Office environment (see annex H)          |
| magnetic field strength at the recording layer<br>for any condition under which a beam is in focus | : 32 000 A/m max.                           |
| magnetic field strength at the recording layer<br>during any other condition.                      | : 48 000 A/m max.                           |

No condensation on or in the optical disk cartridge shall be allowed to 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 shall have the following properties

|                                                |                                             |
|------------------------------------------------|---------------------------------------------|
| temperature                                    | : -10 °C to 55 °C                           |
| relative humidity                              | : 3 % to 90 %                               |
| absolute humidity                              | : 1 g/m <sup>3</sup> to 30 g/m <sup>3</sup> |
| 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 H)          |
| magnetic field strength at the recording layer | : 48 000 A/m max.                           |

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

### 8.1.4 Transportation

This International Standard does not specify requirements for transportation; guidance is given in annex 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 its intended manner or in any foreseeable use in an information processing system.

## 8.4 Flammability

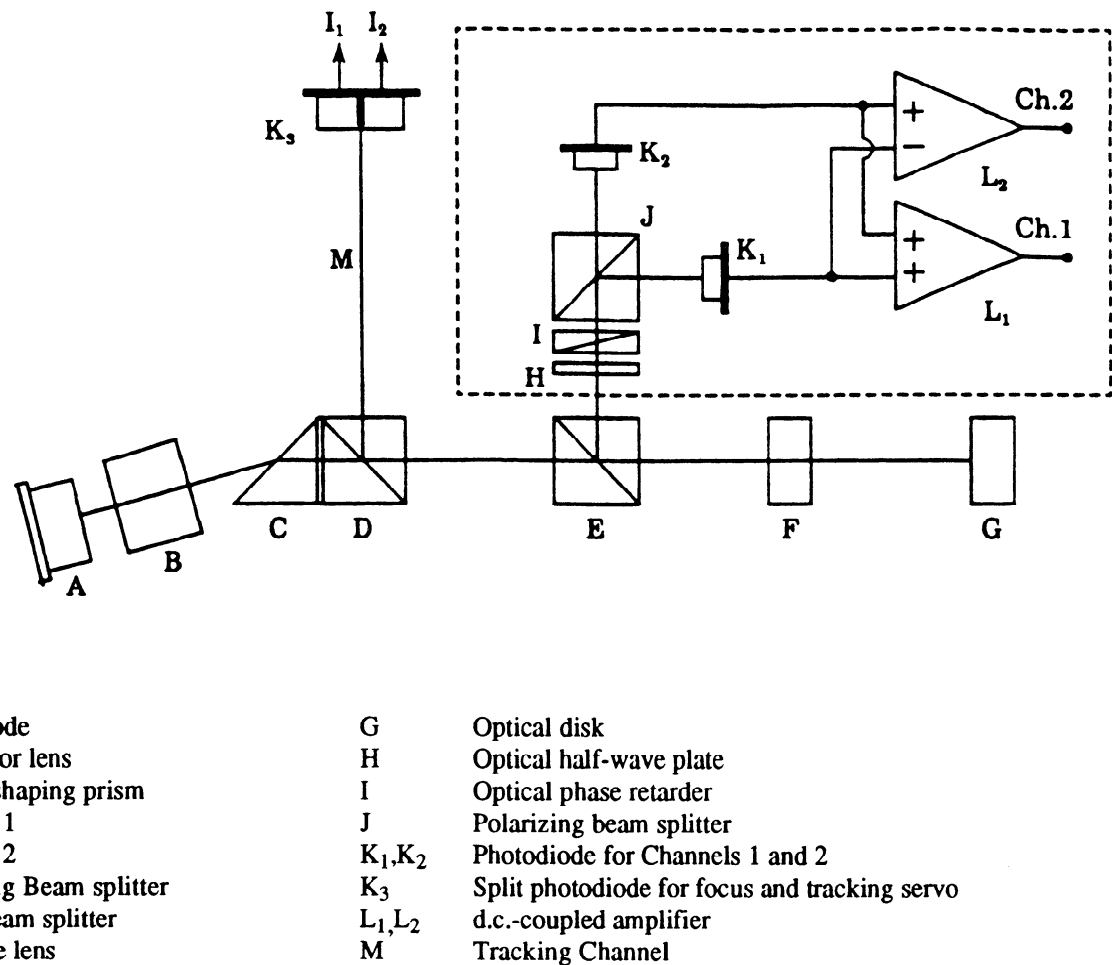
The cartridge and its components shall be made from materials that comply with the flammability class for HB materials, or as specified in IEC 950.

# 9 Reference Drive

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

## 9.1 Optical system

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



|      |                          |                                |                                               |
|------|--------------------------|--------------------------------|-----------------------------------------------|
| A    | Laser diode              | G                              | Optical disk                                  |
| B    | Collimator lens          | H                              | Optical half-wave plate                       |
| C    | Optical shaping prism    | I                              | Optical phase retarder                        |
| Ch.1 | Channel 1                | J                              | Polarizing beam splitter                      |
| Ch.2 | Channel 2                | K <sub>1</sub> ,K <sub>2</sub> | Photodiode for Channels 1 and 2               |
| D    | Polarizing Beam splitter | K <sub>3</sub>                 | Split photodiode for focus and tracking servo |
| E    | Leaky beam splitter      | L <sub>1</sub> ,L <sub>2</sub> | d.c.-coupled amplifier                        |
| F    | Objective lens           | M                              | Tracking Channel                              |

Figure 1 - Optical system of the Reference Drive

In the absence of polarization changes in the disk, the polarizing beam splitter J shall be aligned to make the signal of detector K<sub>1</sub> equal to that of detector K<sub>2</sub>. The direction of polarization in this case is called the neutral direction. The phase retarder I shall be adjusted such that the optical system does not have more than 2,5° phase retardation between the neutral polarization and the polarization perpendicular to it. This position of the retarder is called the neutral position.

The phase retarder can be used for the measurement of the narrow-band signal-to-noise ratio.

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

The intensity reflectance R<sub>p</sub> of the beam splitter E from F to H for the neutral polarization direction shall be nominally 0,10. The reflectance R<sub>s</sub> for the polarization perpendicular to the neutral direction shall be nominally 0,99. The actual value of R<sub>s</sub> shall not be smaller than 0,95.

The imbalance of the magneto-optical signal is specified for the beam splitter with nominal reflectances. If the measurement is made on a drive with reflectances R<sub>p</sub>' and R<sub>s</sub>' for the beam splitter E, then the measured imbalance shall be multiplied by

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

to make it correspond to the nominal beam splitter E.

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

## 9.2 Optical beam

The focussed optical beam used for writing, reading and erasing data shall have the following properties

|                                                                                                                                         |                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Environment                                                                                                                             | : Test environment                                                                |
| Wavelength ( $\lambda$ )                                                                                                                | : $780 \text{ nm} \begin{smallmatrix} + 15 \\ - 10 \end{smallmatrix} \text{ nm}$  |
| Wavelength ( $\lambda$ ) divided by the numerical aperture (NA) of the objective lens                                                   | : $\lambda/\text{NA} = 1,423 \text{ } \mu\text{m} \pm 0,023 \text{ } \mu\text{m}$ |
| Filling of the lens aperture (D/W) where D is the diameter of the lens aperture and W is the $1/e^2$ beam diameter of the Gaussian beam | : 1,0 max.                                                                        |
| Variance of the wave front of the optical beam at the recording layer                                                                   | : $\lambda^2/180$ max.                                                            |
| Polarization                                                                                                                            | : Parallel to the track                                                           |

## 9.3 Read Channels

Two read Channels shall be provided to generate signals from the marks in the recording layer. Channel 1 shall be used for reading the embossed marks, using the diffraction of the optical beam by the marks. Channel 2 shall be used for reading the user-written marks, using the rotation of the polarization of the optical beam due to the magneto-optical effect of the marks. The read amplifiers after the photo-detectors in Channel 1 and Channel 2 shall have a flat response within  $\pm 1$  dB from 100 kHz to 11,6 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 photo-diode detector in the Tracking Channel. The division of the diode runs parallel to the image of the tracks on the diode.

## 9.5 Rotation of the disk

The spindle shall position the disk as specified in 13.6. It shall rotate the disk at  $30,0 \text{ Hz} \pm 0,3 \text{ Hz}$ . The direction shall be counter-clockwise when viewed from the objective lens.

## Section 2 - Mechanical and physical characteristics

### 10 Dimensions and mechanical characteristics of the case

#### 10.1 General

The case shall be a rigid, protective enclosure of rectangular shape and include a shutter which uncovers access windows upon insertion into the drive, and automatically covers them upon removal from the drive. The case shall have means for positioning and identifying the cartridge, and write-inhibit holes.

The dimensions of the inside of the case are not specified in this International Standard, but are determined by the movement of the disk inside the case allowed by 13.5 and 13.6.

#### 10.2 Case drawings

The case is represented schematically by the following drawings.

- Figure 2 shows the hub dimensions.
- Figure 3 shows a composite drawing of Side A of the case in isometric form, with the major features identified from Side A.
- Figure 4 shows the envelope of the case with respect to a location hole at the intersection of the X and Y axes and reference plane P.
- Figure 5 a) shows the surfaces  $S_1$ ,  $S_2$ ,  $S_3$  and  $S_4$  which establish the reference plane P.
- Figure 5 b) shows the details of surface  $S_3$ .
- Figure 6 shows the details of the insertion slot and detent.
- Figure 7 shows the gripper slots, used for automatic handling.
- Figure 8 shows the write-inhibit holes.
- Figure 9 shows the media ID sensor holes.
- Figure 10 shows the shutter sensor notch.
- Figure 11 shows the head and motor window.
- Figure 12 shows the shutter opening features.
- Figure 13 shows the capture cylinder.
- Figure 14 shows the user label areas.

#### 10.3 Sides, reference axes and reference planes

##### 10.3.1 Relationship of Sides A and B

The features essential for physical interchangeability are represented in figure 5. When Side A of the cartridge faces upwards, Side A of the disk faces downwards. Sides A and B of the case are identical as far as the features given here are concerned. The description is given for one side only. References to Sides A and B can be changed to B or A respectively.

Only the shutter and the slot for the shutter opener, described in 10.14 and 10.15 are not identical for both sides of the case.

##### 10.3.2 Reference axes and case reference planes

There is a reference plane P for each side of the case. Each reference plane P contains two orthogonal axes X and Y to which the dimensions of the case are referred. The intersection of the X and Y axes defines the centre of the location hole. The X axis extends through the centre of the alignment hole.

#### 10.4 Materials

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

### 10.5 Mass

The mass of the case without the optical disk shall not exceed 150 g.

### 10.6 Overall dimensions

See figure 4.

The total length of the case shall be

$$L_1 = 153,0 \text{ mm} \pm 0,4 \text{ mm}$$

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

$$L_2 = 127,0 \text{ mm} \pm 0,3 \text{ mm}$$

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

$$L_3 = 26,0 \text{ mm} \pm 0,3 \text{ mm}$$

The total width of the case shall be

$$L_4 = 135,0 \text{ mm} \begin{matrix} + 0,0 \\ - 0,6 \end{matrix} \text{ mm}$$

The distance from the left-hand side of the cartridge to the reference axis Y shall be

$$L_5 = 128,5 \text{ mm} \begin{matrix} + 0,0 \\ - 0,5 \end{matrix} \text{ mm}$$

The distance from the right-hand side of the cartridge to the reference axis Y shall be

$$L_6 = 6,5 \text{ mm} \pm 0,2 \text{ mm}$$

The width shall be reduced on the top by the radius

$$R_1 = L_4$$

originating from a point defined by  $L_5$  and

$$L_7 = 101,0 \text{ mm} \pm 0,3 \text{ mm}$$

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

$$R_2 = 1,5 \text{ mm} \pm 0,5 \text{ mm}$$

and the two corners at the bottom with a radius

$$R_3 = 3,0 \text{ mm} \pm 1,0 \text{ mm}$$

The thickness of the case shall be

$$L_8 = 11,00 \text{ mm} \pm 0,30 \text{ mm}$$

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

$$R_4 = 1,0 \text{ mm max.}$$

### 10.7 Location hole

See figure 4.

The centre of the location hole shall coincide with the intersection of the reference axes X and Y. It shall have a square form with a side length of

$$L_9 = 4,10 \text{ mm} \begin{matrix} + 0,00 \\ - 0,06 \end{matrix} \text{ mm}$$

held to a depth of

$$L_{10} = 1,5 \text{ mm (i.e. typical wall thickness)}$$

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

$$R_5 = 0,5 \text{ mm max.}$$

### 10.8 Alignment hole

See figure 4.

The centre of the alignment hole shall lie on reference axis X at a distance of

$$L_{11} = 122,0 \text{ mm} \pm 0,2 \text{ mm}$$

from the reference axis Y.

The dimensions of the hole shall be

$$L_{12} = 4,10 \text{ mm} \begin{matrix} + 0,00 \\ - 0,06 \end{matrix} \text{ mm}$$

and

$$L_{13} = 5,0 \text{ mm} \begin{matrix} + 0,2 \\ - 0,0 \end{matrix} \text{ mm}$$

held to a depth of  $L_{10}$ , 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 radius  $R_5$ .

### 10.9 Surfaces on reference planes P

See figures 5 a) and 5 b).

The reference plane P for a side of the case shall contain four surfaces ( $S_1$ ,  $S_2$ ,  $S_3$  and  $S_4$ ) on that side of the case, specified as follows:

- Two circular surfaces  $S_1$  and  $S_2$ .

Surface  $S_1$  shall be a circular area centred around the square location hole and have a diameter of

$$D_1 = 9,0 \text{ mm min.}$$

Surface  $S_2$  shall be a circular area centred around the rectangular alignment hole and have a diameter of

$$D_2 = 9,0 \text{ mm min.}$$

- Two elongated surfaces  $S_3$  and  $S_4$ , that follow the contour of the cartridge and shutter edges.

Surfaces  $S_3$  and  $S_4$  are shaped symmetrically.

Surface  $S_3$  shall be defined by two circular sections with radii

$$R_6 = 1,5 \text{ mm} \pm 0,1 \text{ mm}$$

with an origin given by

$$L_{14} = 4,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{15} = 86,0 \text{ mm} \pm 0,3 \text{ mm}$$

and

$$R_7 = 1,5 \text{ mm} \pm 0,1 \text{ mm}$$

with an origin given by

$$L_{16} = 1,9 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{17} = 124,5 \text{ mm} \pm 0,3 \text{ mm}$$

The arc with radius  $R_7$  shall continue on the right hand side with radius

$$R_8 = 134,0 \text{ mm} \begin{matrix} + 0,2 \\ - 0,7 \end{matrix} \text{ mm}$$

which is a dimension resulting from  $L_5 + L_{14} + R_6$  with an origin given by  $L_5$  and  $L_7$ . A straight, vertical line shall smoothly join the arc of  $R_6$  to the arc of  $R_8$ .

The left-hand side of  $S_3$  shall be bounded by radius

$$R_9 = 4,5 \text{ mm} \pm 0,3 \text{ mm}$$

which is a dimension resulting from  $L_{18} + L_{14} - R_6$  with an origin given by

$$L_{18} = 2,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{19} = 115,5 \text{ mm} \pm 0,3 \text{ mm}$$

The left-hand side of the boundary shall be closed by two straight lines. The first one shall smoothly join the arc of  $R_6$  to the arc of  $R_9$ . The second one shall run from the left hand tangent of  $R_7$  to its intersection with  $R_9$ . Along the left hand side of surface  $S_3$  there shall be a zone to protect  $S_3$  from being damaged by the shutter. In order to keep this zone at a minimum practical width

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

This radius originates from the same point as  $R_9$ .

#### 10.10 Insertion slots and detent features

See figure 6.

The case shall have two symmetrical insertion slots with embedded detent features. The slots shall have a length of

$$L_{20} = 26,0 \text{ mm} \pm 0,3 \text{ mm}$$

a width of

$$L_{21} = 6,0 \text{ mm} \begin{matrix} + 0,3 \\ - 0,0 \end{matrix} \text{ mm}$$

and a depth of

$$L_{22} = 3,0 \text{ mm} \pm 0,1 \text{ mm}$$

located

$$L_{23} = 2,5 \text{ mm} \pm 0,2 \text{ mm}$$

from reference plane P.

The slots shall have a lead-in chamfer given by

$$L_{24} = 0,5 \text{ mm max.}$$

$$L_{25} = 5,0 \text{ mm max.}$$

The detent notch shall be a semi-circle of radius

$$R_{11} = 3,0 \text{ mm} \pm 0,2 \text{ mm}$$

with the origin given by

$$L_{26} = 13,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{27} = 2,0 \text{ mm} \pm 0,1 \text{ mm}$$

$$L_{73} = 140,0 \text{ mm} \pm 0,3 \text{ mm}$$

The dimensions of  $L_2$ ,  $L_{26}$  and  $L_{73}$  are interrelated, their values shall be such that they are all three within specification.

#### 10.11 Gripper slots

See figure 7.

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

$$L_{28} = 5,0 \text{ mm} \pm 0,3 \text{ mm}$$

from the edge of the case and a width of

$$L_{29} = 6,0 \text{ mm} \pm 0,3 \text{ mm}$$

The upper edge of a slot shall be

$$L_{30} = 12,0 \text{ mm} \pm 0,3 \text{ mm}$$

above the bottom of the case.

## 10.12 Write-inhibit holes

See figure 8.

Sides A and B shall each have a write-inhibit hole. The case shall include a device for opening and closing each hole. The hole at the left-hand side of Side A of the case, is the write-inhibit hole for Side A of the disk. The protected side of the disk shall be made clear by inscriptions on the case or by the fact that the device for Side A of the disk can only be operated from Side A of the case.

When writing and erasing on Side A of the disk are not allowed, the write-inhibit hole shall be open all through the case. It shall have a diameter

$$D_3 = 4,0 \text{ mm min.}$$

Its centre shall be specified by

$$L_{31} = 8,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{32} = 111,0 \text{ mm} \pm 0,3 \text{ mm}$$

on Side A of the case.

When writing and erasing are allowed on Side A of the disk, the write-inhibit hole shall be closed on Side A of the case, at a depth of typically  $L_{10}$ , i.e. the wall thickness of the case. In this state, the opposite side of the same hole, at Side B of the case, shall be closed and not recessed from the reference plane P of Side B of the case by more than

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

The opposite side of the write-inhibit hole for protecting Side B of the disk shall have a diameter  $D_3$ . Its centre shall be specified by  $L_{31}$  and

$$L_{34} = 11,0 \text{ mm} \pm 0,2 \text{ mm}$$

on Side A of the case.

## 10.13 Media sensor holes

See figure 9.

There shall be two sets of four media sensor holes. The set of holes at the lower left hand corner of Side A of the case pertains to Side A of the disk. The holes shall extend through the case, and have a diameter of

$$D_4 = 4,0 \text{ mm} \begin{matrix} + 0,3 \\ - 0,0 \end{matrix} \text{ mm}$$

the positions of their centres shall be specified by  $L_{32}$ ,  $L_{34}$  and

$$L_{35} = 19,5 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{36} = 17,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{37} = 23,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{38} = 29,0 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{39} = 93,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{40} = 99,0 \text{ mm} \pm 0,3 \text{ mm}$$

$$L_{41} = 105,0 \text{ mm} \pm 0,3 \text{ mm}$$

A hole is deemed to be open when there is no obstruction in this hole over a diameter  $D_4$  all through the case.

A hole for Side A of the disk is deemed to be closed, when the hole is closed on both Side A and Side B of the case. The closure shall be recessed from reference plane P by

$$L_{42} = 0,1 \text{ mm max.}$$

The holes are numbered consecutively from 1 to 4. Hole No. 1 is the hole closest to the left hand edge of the case. The optical disk cartridge according to this International Standard does not use any holes. All four holes shall be in the closed state.

#### 10.14 Head and motor window

See figure 11.

The case shall have a window on each side to enable the optical head and the motor to access the disk. The dimensions are referenced to a centreline, located at a distance of

$$L_{46} = 61,0 \text{ mm} \pm 0,2 \text{ mm}$$

to the left of reference axis Y.

The width of the head access shall be

$$L_{47} = 20,00 \text{ mm min.}$$

$$L_{48} = 20,00 \text{ mm min.}$$

and its height shall extend from

$$L_{49} = 118,2 \text{ mm min. to}$$

$$L_{50} = 57,0 \text{ mm max.}$$

The four inside corners shall be rounded with a radius of

$$R_{12} = 3,0 \text{ mm max.}$$

The motor access has a diameter of

$$D_5 = 35,0 \text{ mm min.}$$

and its centre shall be defined by  $L_{46}$  and

$$L_{51} = 43,0 \text{ mm} \pm 0,2 \text{ mm}$$

#### 10.15 Shutter

See figure 12.

The case shall have a spring-loaded, unidirectional shutter with an optional latch, designed to completely cover the head and motor windows when closed. A shutter movement of 41,5 mm min. shall be sufficient to ensure that the head and motor window is opened to the minimum size specified in 10.14. The shutter shall be free to slide in a recessed area of the case in such a way as to ensure that the overall thickness shall not exceed  $L_8$ . The spring shall be sufficiently strong to close a free-sliding shutter, irrespective of the orientation of the cartridge.

The shutter opening force shall be 3 N max.

The right-hand side of the top of the shutter shall have a lead-in ramp with an angle

$$A_2 = 25^\circ \text{ max.}$$

The distance from the reference planes P to the nearest side of the ramp shall be

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

#### 10.16 Slot for shutter opener

See figure 12.

The shutter shall have only one slot in which the shutter opener of the drive can engage to open the shutter. The slot shall be dimensioned as follows: When the shutter is closed, the vertical edge used to push the shutter open shall be located at a distance of

$$L_{53} = 34,5 \text{ mm} \pm 0,5 \text{ mm}$$

from reference axis Y on Side B of the case.

The length of the slot shall be

$$L_{54} = 4,5 \text{ mm} \pm 0,1 \text{ mm}$$

and the angle of the lead-out ramp shall be

$$A_3 = 52,5^\circ \pm 7,5^\circ.$$

The depth of the slot shall be

$$L_{55} = 3,5 \text{ mm} \pm 0,1 \text{ mm}$$

The width of the slot from the reference plane P of Side B of the case shall be

$$L_{56} = 6,0 \text{ mm} \begin{array}{l} + 0,5 \\ - 0,0 \end{array} \text{ mm}$$

If a shutter latch is employed, the distance between the latch and reference plane P of Side B of the case shall be

$$L_{57} = 3,0 \text{ mm max.}$$

#### 10.17 Shutter sensor notch

See figure 10.

The shutter sensor notch is used to ensure that the shutter is fully open after insertion of the optical disk cartridge into the drive. Therefore, the notch shall be exposed only when the shutter is fully open.

The dimensions shall be

$$L_{43} = 3,5 \text{ mm} \pm 0,2 \text{ mm}$$

$$L_{44} = 71,0 \text{ mm} \pm 0,3 \text{ mm and}$$

$$L_{45} = 9,0 \text{ mm} \begin{array}{l} + 0,0 \\ - 2,0 \end{array} \text{ mm}$$

The notch shall have a lead-out ramp with an angle

$$A_1 = 45^\circ \pm 2^\circ$$

#### 10.18 User label areas

See figure 14.

The case shall have the following minimum areas for user labels:

- on Side A and Side B: 35,0 mm x 65,0 mm
- on the bottom side: 6,0 mm x 98,0 mm

These areas shall be recessed by 0,2 mm min. Their positions are specified by the following dimensions and relations between dimensions (see figure 14).

$$L_{61} = 4,5 \text{ mm min.}$$

$$L_{62} - L_{61} = 65,0 \text{ mm min.}$$

$$L_{64} - L_{63} = 35,0 \text{ mm min.}$$

$$L_{65} = 4,5 \text{ mm min.}$$

$$L_{66} - L_{65} = 65,0 \text{ mm min.}$$

$$L_{67} + L_{68} = 35,0 \text{ mm min.}$$

$$L_8 - L_{71} - L_{72} = 6,0 \text{ mm min.}$$

$$L_4 - L_{69} - L_{70} = 98,0 \text{ mm min.}$$

## 11 Dimensional and physical characteristics of the disk

### 11.1 Dimensions of the disk

#### 11.1.1 Outer diameter

The outer diameter of the disk shall be 130,0 mm nominal. The tolerance is determined by the movement of the disk inside the case allowed by 13.5 and 13.6.

#### 11.1.2 Thickness

The total thickness of the disk outside the hub area shall be 3,20 mm max.

#### 11.1.3 Clamping zone

See figure 2.

The outer diameter of the zone shall be

$$D_6 = 35,0 \text{ mm min.}$$

The inner diameter of the zone shall be

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

#### 11.1.4 Clearance zone

Within the zone defined by the outer diameter of the clamping zone ( $D_6$ ) and the inner diameter of the Reflective Zone (see 16.1) there shall be no projection from the disk reference plane in the direction of the optical system of more than 0,2 mm.

### 11.2 Mass

The mass of the disk shall not exceed 120 g.

### 11.3 Moment of inertia

The moment of inertia of the disk shall not exceed 0,22 g·m<sup>2</sup>.

### 11.4 Imbalance

The imbalance of the disk shall not exceed 0,01 g·m.

### 11.5 Axial deflection

The deviation of any point of the recording layer from its nominal position, in a direction normal to the disk reference plane, shall not exceed  $\pm 0,30$  mm for rotational frequencies of the disk up to 30 Hz. The deviation shall be measured by the optical system defined in 21.1.1 and 21.1.2.

The nominal position of the recording layer with respect to the disk reference plane is determined by the nominal thickness of the substrate and its index of refraction.

### 11.6 Axial acceleration

The acceleration of the recording layer along any fixed line normal to the disk reference plane shall not exceed 10 m/s<sup>2</sup> in a band width from 30 Hz to 1,5 kHz for a rotational frequency of the disk of 30,0 Hz  $\pm$  0,3 Hz. The acceleration shall be measured by the optical system defined in 15.1.1 and 15.1.2.

### 11.7 Dynamic radial runout

The difference between the maximum and the minimum distance of any track from the axis of rotation, measured along a fixed radial line over one revolution of the disk, shall not exceed 50  $\mu$ m, as measured by the optical system, for rotational frequencies of the disk up to 30 Hz.

### 11.8 Radial acceleration

The acceleration of any track along a fixed radial line shall not exceed  $3 \text{ m/s}^2$  in a band width from 30 Hz to 1,5 kHz, as measured by the optical system, at a rotational frequency of the disk of  $30,0 \text{ Hz} \pm 0,3 \text{ Hz}$ .

### 11.9 Tilt

The tilt angle, defined as the angle which the normal to the entrance surface, averaged over a circular area of 1 mm diameter, makes with the normal to the disk reference plane, shall not exceed 5 mrad in the operating environment.

## 12 Drop test

The optical disk cartridge shall withstand dropping on each surface and on each corner from a height of 760 mm on to a concrete floor covered with a vinyl layer 2 mm thick. The cartridge shall withstand all such impacts without any functional failure.

## 13 Interface between disk and drive

### 13.1 Clamping technique

Radial positioning of the optical disk shall be provided by the centring of the axle of the spindle in the centre hole of the hub.

The turntable of the drive spindle shall support the disk in the clamping zone, determining the axial position of the disk in the case.

A clamping force shall be provided by the attraction between magnets in the spindle and a magnetizable ring in the hub.

### 13.2 Dimensions of the hub

See figure 1.

#### 13.2.1 Outer diameter of the hub

This diameter shall be

$$D_8 = 25,0 \text{ mm} \begin{matrix} + 0,0 \\ - 0,2 \end{matrix} \text{ mm}$$

#### 13.2.2 Height of the hub

This height shall be

$$h_1 = 2,2 \text{ mm} \begin{matrix} + 0,0 \\ - 0,2 \end{matrix} \text{ mm}$$

#### 13.2.3 Diameter of the centre hole

The diameter of the centre hole shall be

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

#### 13.2.4 Height of the top of the centre hole at diameter $D_9$

The height of the top of the centre hole at diameter  $D_9$ , measured above the disk reference plane, shall be

$$h_2 = 2,0 \text{ mm min.}$$

#### 13.2.5 Centring length at diameter $D_9$

This length shall be

$$h_3 = 0,5 \text{ mm min.}$$

The hole shall have a diameter larger than, or equal to,  $D_9$  between the centring length and the disk reference plane. The hole shall extend through the substrate.

**13.2.6 Chamfer at diameter  $D_9$** 

The height of the outer chamfer of the centre hole of the hub shall be

$$h_4 = 0,2 \text{ mm max.}$$

The angle of the chamfer shall be  $45^\circ$ , or a corresponding full radius shall be used.

**13.2.7 Chamfer at diameter  $D_8$** 

The height of the chamfer at the rim of the hub shall be

$$h_5 = 0,2 \text{ mm} \begin{array}{l} + 0,2 \\ - 0,0 \end{array} \text{ mm}$$

The angle of the chamfer shall be  $45^\circ$ , or a corresponding full radius shall be used.

**13.2.8 Outer diameter of the magnetizable ring**

This diameter shall be

$$D_{10} = 19,0 \text{ mm min.}$$

**13.2.9 Inner diameter of the magnetizable ring**

This diameter shall be

$$D_{11} = 8,0 \text{ mm max.}$$

**13.2.10 Thickness of the magnetizable material**

This thickness shall be

$$h_6 = 0,5 \text{ mm min.}$$

**13.2.11 Position of the top of the magnetizable ring relative to the disk reference plane**

This position shall be

$$h_7 = 2,2 \text{ mm} \begin{array}{l} + 0,0 \\ - 0,1 \end{array} \text{ mm}$$

**13.3 Magnetizable material**

The magnetizable material shall be ferritic stainless steel (ISO 683-13, Type 8) or any suitable material with similar magnetic characteristics.

**13.4 Clamping force**

The clamping force exerted by the spindle shall be less than 14 N.

**13.5 Capture cylinder for the hub**

See figure 13.

The capture cylinder is defined as the volume in which the spindle can expect the centre of the hole of the hub to be at the maximum height of the hub, just prior to capture. The size of the cylinder limits the allowable play of the disk inside its cavity in the case. This cylinder is referred to perfectly located and perfectly sized alignment and location pins in the drive, and includes tolerances of dimensions of the case and the disk between the two pins mentioned and the centre of the hub. The bottom of the cylinder is parallel to the reference plane P, and shall be located at a distance of

$$L_{58} = 0,5 \text{ mm min.}$$

above the reference plane P of Side B of the case when Side A of the disk is to be used. The top of the cylinder shall be located at a distance of

$$L_{59} = 4,3 \text{ mm max.}$$

above the same reference plane. The diameter of the cylinder shall be

$$D_{12} = 3,0 \text{ mm max.}$$

Its centre shall be defined by the nominal values of  $L_{46}$  and  $L_{51}$ .

### 13.6 Disk position in the operating condition

See figure 13.

When the disk is in the operating condition within the drive, the position of the active recording layer shall be

$$L_{60} = 5,35 \text{ mm} \pm 0,15 \text{ mm}$$

above reference plane P of that side of the case that faces the optical system. Moreover, the torque to be exerted on the disk in order to maintain a rotational frequency of 30 Hz shall not exceed 0,01 N·m, when the axis of rotation is within a circle with a diameter of

$$D_{13} = 0,2 \text{ mm max.}$$

and a centre given by the nominal values of  $L_{46}$  and  $L_{51}$ .

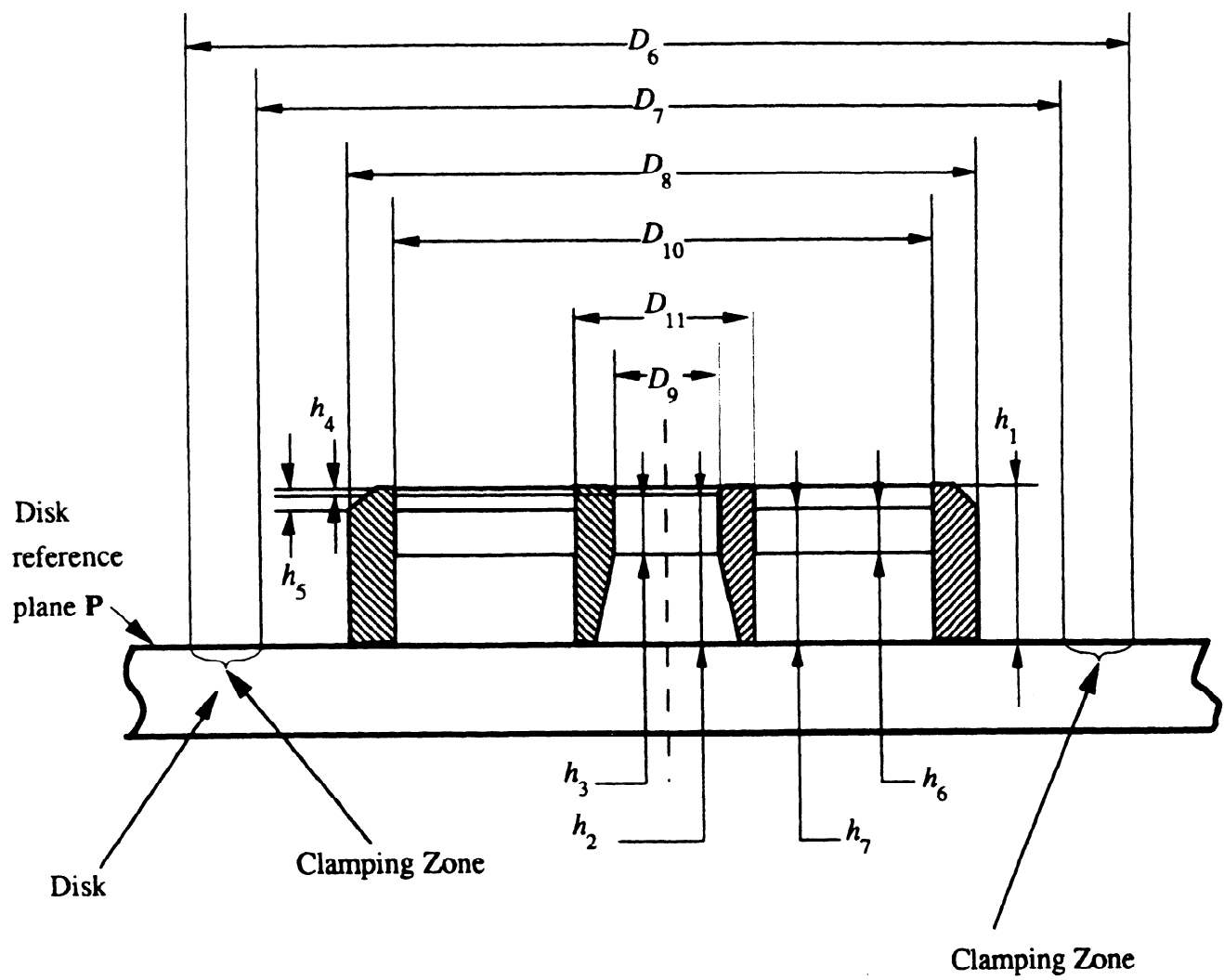


Figure 2- Hub dimensions

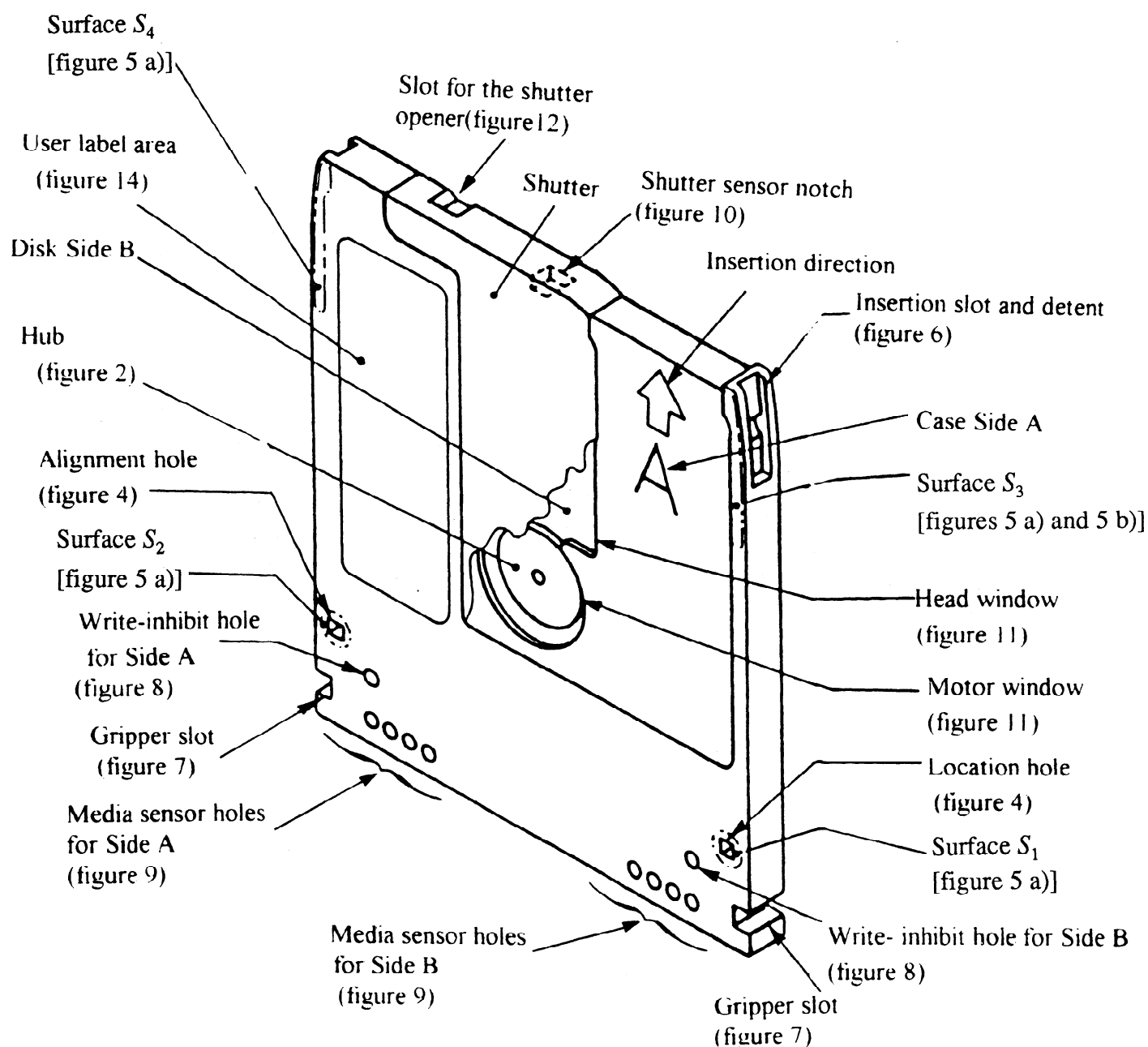


Figure 3 - Perspective view of the case

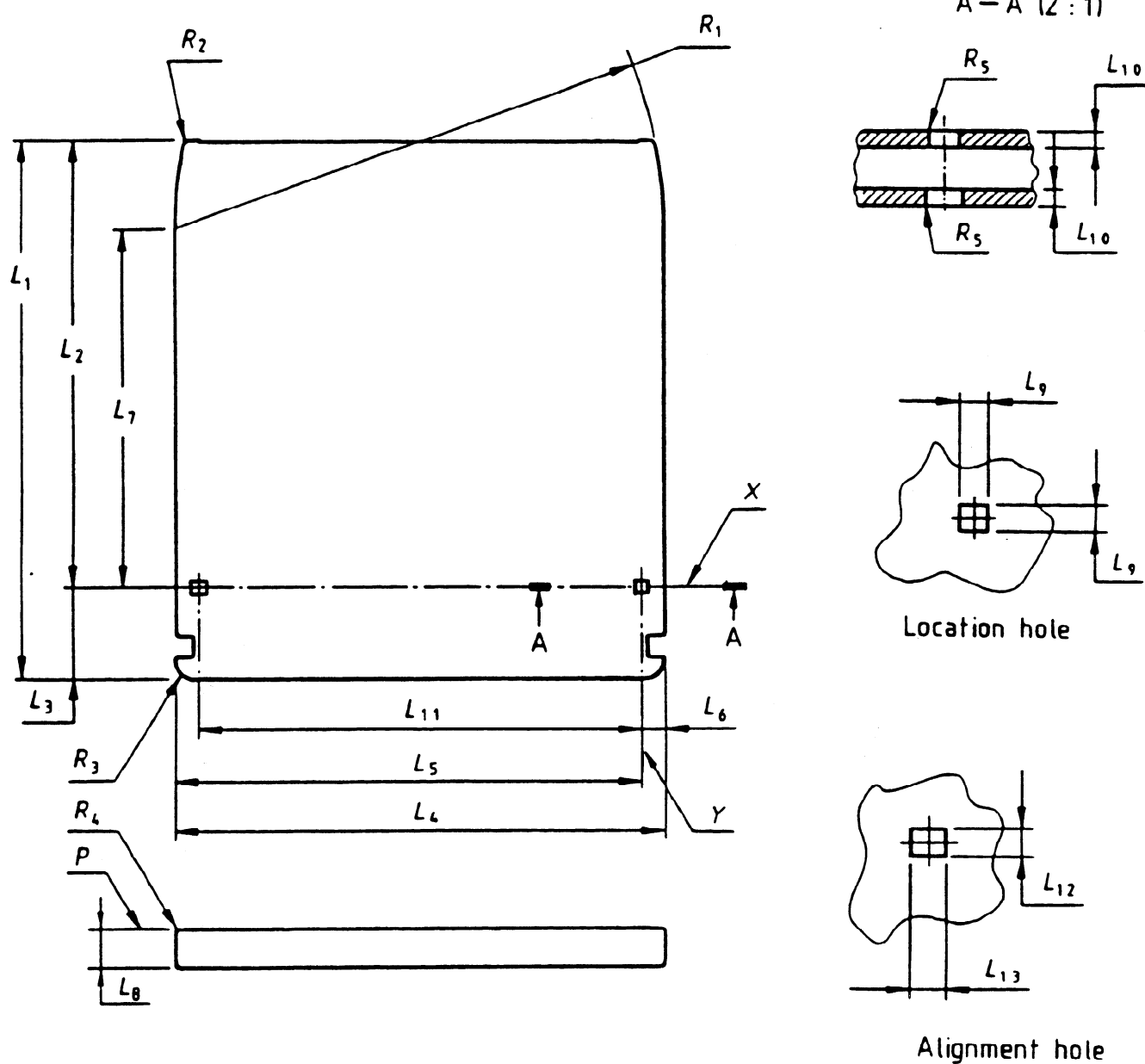


Figure 4 - Overall dimensions and reference axes

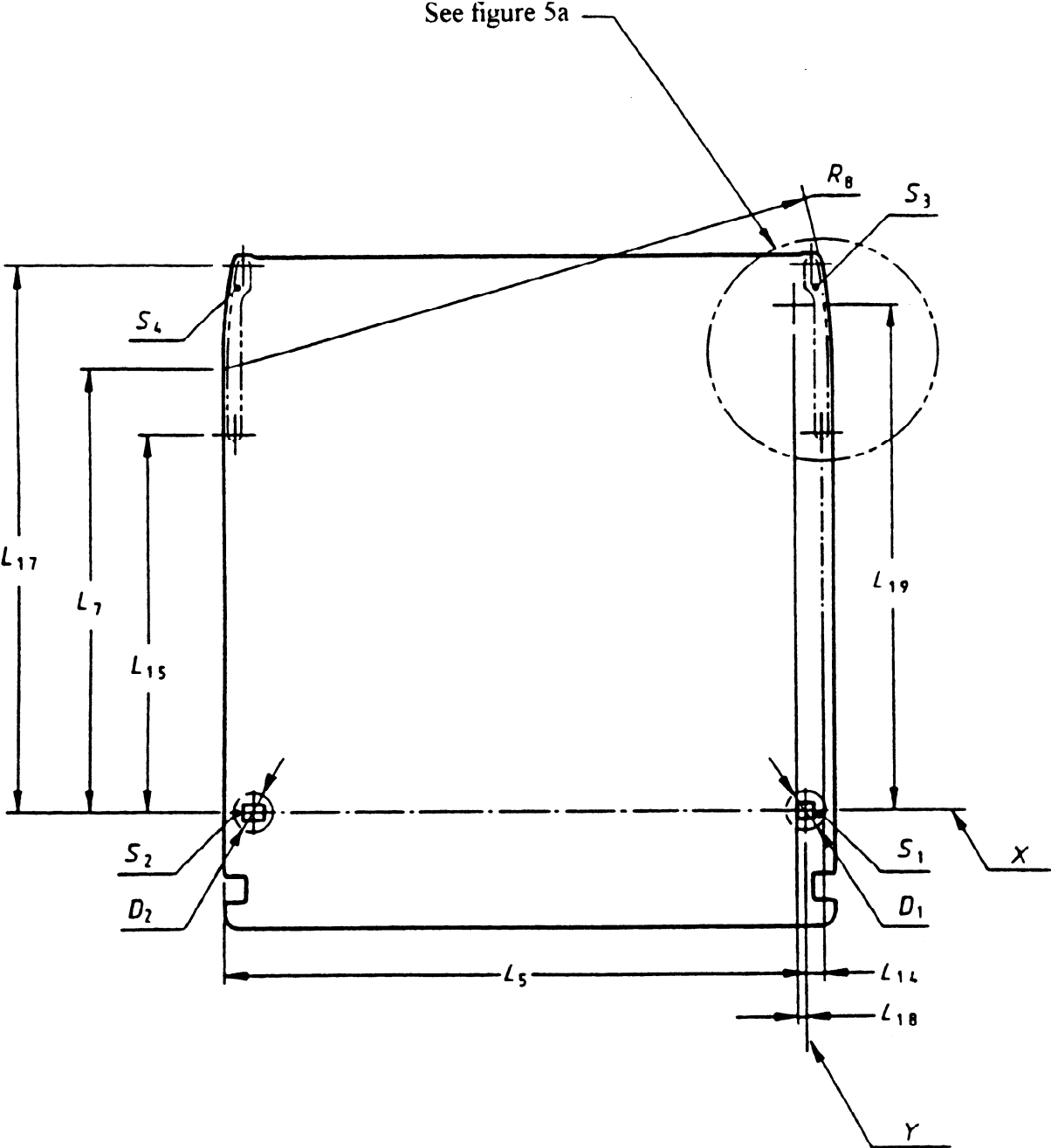
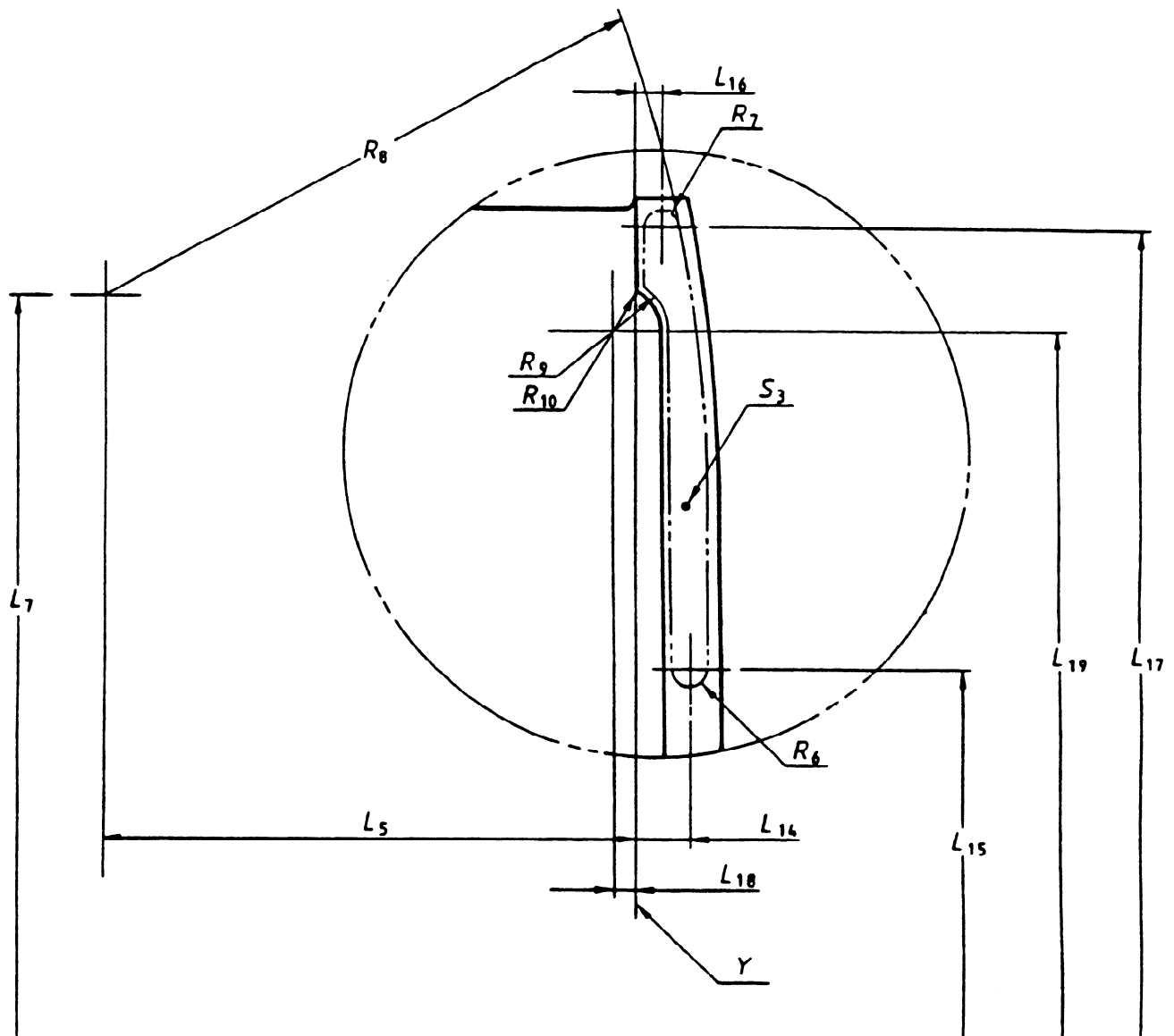


Figure 5 a) - Surfaces  $S_1$ ,  $S_2$ ,  $S_3$  and  $S_4$  of the reference plane  $P$

Figure 5 b) - Detail of surface  $S_3$