ecma INTERNATIONAL

Standard ECMA-406

1st Edition / December 2013

Disk Cassette for 5 Disks with 120 mm Diameter

Standard

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Introduction

Optical disks have been used widely. And the optical disks have advantage for long-term digital data preservation usage.

However, single-optical-disk based system has weaknesses for the data capacity and transfer rate compared to other devices. To meet the emerging demands for the long-term preservation of digital data, this proposal solves the issues by introducing multiple-disk based system. The system deals multiple disks as a set and writes/reads the set of disks in parallel.

Developing an industry standard is strongly needed for promoting the optical disk in the enterprise usage.

The new project for developing two standards, disk cassette & parallel write/read disk format for 5 disks, was proposed at the 95th meeting of TC31. These two draft standards were discussed at the 96th and 97th meetings of TC31. And then, TC31 agreed to bring these two draft standards to final draft standards.

This Ecma Standard has been adopted by the General Assembly of December 2013.

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Disk Cassette for 5 Disks with 120 mm Diameter

1 Scope

This Ecma Standard specifies the mechanical and physical characteristics of a disk cassette. The disk cassette employs five disks of the same type with 120 mm diameter and almost 1,2 mm thickness.

2 Conformance

A claim of conformance with this Ecma Standard shall specify the type of disk implemented. A cassette shall be in conformance with this Ecma Standard if it meets the mandatory requirements specified herein for its type of disk.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ECMA-129 *Information Technology Equipment - Safety* (1994)

ECMA-279 *80 mm (1,23 Gbytes per side) and 120 mm (3,95 Gbytes per side) DVD-Recordable Disk (DVD-R) (December 1998)*

ECMA-287 *Safety of electronic equipment, 2nd edition* (December 2002)

ECMA-337 *Data Interchange on 120 mm and 80 mm - Optical Disk using +RW Format - Capacity: 4,7 and 1,46 Gbytes per side (Recording speed up to 4X), 4th edition (June 2008)*

ECMA-349 *Data Interchange on 120 mm and 80 mm Optical Disk using +R Format - Capacity: 4,7 and 1,46 Gbytes per Side (Recording speed up to 16X), 4th edition (June 2008)*

ECMA-364 *Data interchange on 120 mm and 80 mm Optical Disk using +R DL Format - Capacity: 8,55 and 2,66 Gbytes per Side (Recording speed up to 16X), 3rd edition (December 2007)*

ECMA-371 *Data Interchange on 120 mm and 80 mm Optical Disk using +RW HS Format - Capacity: 4,7 and 1,46 Gbytes per Side (Recording speed 8X), 2nd edition (June 2008)*

ECMA-382 *120 mm (8,54 Gbytes per side) and 80 mm (2,66 Gbytes per side) DVD Recordable Disk for Dual Layer (DVD-R for DL), 2nd edition (June 2010)*

ISO/IEC 15693-1:2010, *Identification cards*

ISO/IEC 30190:2013, *Information technology — Digitally recorded media for information interchange and storage — 120 mm Single Layer (25,0 Gbytes per disk) and Dual Layer (50,0 Gbytes per disk) BD Recordable disk*

NOTE In this Ecma standard, the recording mode is not limited to Sequential-Recording mode.

ISO/IEC 30191:2013, *Information technology — Digitally recorded media for information interchange and storage — 120 mm Triple Layer (100,0 Gbytes per disk) and Quadruple Layer (128,0 Gbytes per disk) BD Recordable disk*

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NOTE In this Ecma standard, the recording mode is not limited to Sequential-Recording mode.

ISO/IEC 30192:2013, *Information technology — Digitally recorded media for information interchange and storage — 120 mm Single Layer (25,0 Gbytes per disk) and Dual Layer (50,0 Gbytes per disk) BD Rewritable disk*

ISO/IEC 30193:2013, *Information technology — Digitally recorded media for information interchange and storage — 120 mm Triple Layer (100,0 Gbytes per disk) BD Rewritable disk*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
cassette
housing for five optical disks of 120 mm in diameter; the housing has a shutter mechanism

4.2
disk cassette
device consisting of a cassette containing five optical disks

4.3
optical disk
disk that accepts and retains information in the form of marks in a recording layer, which can be read with an optical beam

4.4
Radio-frequency identification tag
RFID tag
element for transmitting information by wireless communications over a short distance of approximately several centimeters; the cassette ID and the media ID of the cassette are recorded on the RFID tag

4.5
ring tray
round saucer that loads an optical disk into the cassette

4.6
shutter
mechanism by which the disk is loaded into the cassette and by which the disk is removed from the cassette

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. For instance, 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.

6 General description of the cassette

The cassette is a hard protective housing in a shape that combines a rectangle and a semicircle. The cassette has an upper shell and an under shell, and five disks can be stored in it.

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Composition of cassette

The cassette has an insertion slot, a fixing hole, gripper slots, a positioning hole for a guide rail, a shutter, shutter open/close bay, a shutter lock mechanism, a ring tray, an RFID tag for managing the cassette and disks, a label area, feet, and shutter center mark. A disk is inserted such that the recording side faces downward on the ring tray. The five disks, starting from the bottom disk (nearest the under shell), are sequentially named disk 1, disk 2, disk 3, disk 4, and disk 5. When the cassette is put into the changer system, the shutter is unlocked. The shutter can be opened by engaging a gear with the shutter open/close bay and rotating the gear. Then the disk is removed from the cassette. When the cassette is removed from the changer system, the shutter is locked.

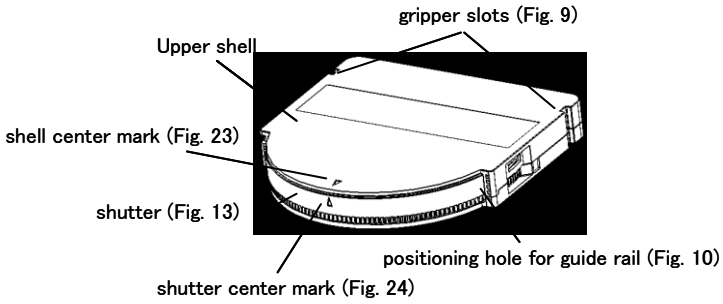

Figure 1 – Appearance of the cassette with the shutter closed (viewed diagonally from above)

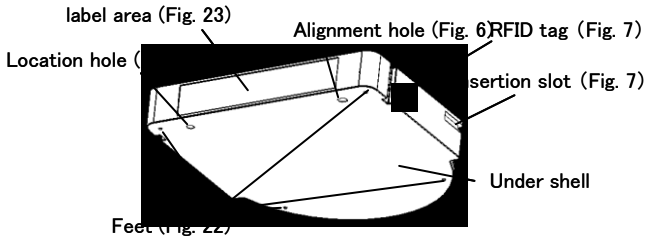

Figure 2 – Appearance of the cassette with the shutter closed (viewed diagonally from below)

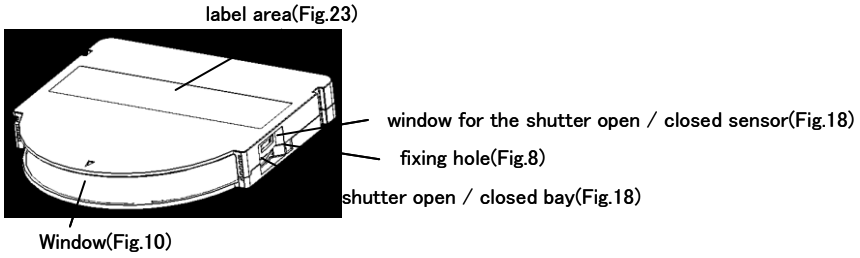

Figure 3 – Appearance of the cassette with the shutter open (viewed diagonally from above)

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7 General requirements

7.1 Environments

7.1.1 Test environment

The test environment is an environment where the air immediately surrounding the cassette 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 B)

No condensation on or in the cassette shall occur. Before testing, the cassette shall be conditioned in this environment for at least 48 h. Unless otherwise stated, all tests and measurements shall be conducted in this test environment.

7.1.2 Operating environment

According to this Ecma Standard, a disk cassette meeting all of the requirements of this Standard in the specified test environment is required to provide data interchange over the specified ranges of environmental parameters in the operating environment. A disk cassette consists of the cassette, as specified in this Standard, and the disks contained therein of the same type with 120 mm diameter and almost 1.2 mm thickness. This disk cassette shall meet the requirements of this clause and provides for data interchange. The operating environment is an environment where the air immediately surrounding the disk cassette or cassette 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 H)

No condensation on or in the disk cassette shall occur. If a disk cassette 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.

7.1.3 Storage environment

The storage environment is defined as an environment where the air immediately surrounding the disk cassette has the following properties.

Temperature: -10 °C to 55 °C

Relative humidity: 3% to 85 %

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Absolute humidity: 1 g/m^3 to 30 g/m^3

Atmospheric pressure: 75 kPa to 106 kPa

Temperature gradient: 10 °C/h max.

Relative humidity gradient: 10%/h max.

Air cleanliness: Office environment (see also Annex H)

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

7.1.4 Transportation

This standard does not specify requirements for transportation; guidance is given in Annex I.

7.2 Temperature shock

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

7.3 Safety requirements

The disk cassette shall satisfy the safety requirements of Standard ECMA-287, when used in the intended manner or in any foreseeable manner in an information processing system.

7.4 Flammability

The cassette shall be made from materials that comply with the flammability class for HB materials, or better, as specified in Standard ECMA-287.

8 Dimensional characteristics

The dimensions of the cassette shall be referenced to three orthogonal reference planes: X, Y, and Z. The cassette shall be constrained such that four reference surfaces S1 to S4 on the under shell of the cassette lie in reference plane Z. The intersection of the three planes defines the center of the location hole. The center of the alignment hole shall lie on the intersection of reference planes X and Z. Refer to Annex A. A dimension of a feature referenced to one of the planes is the shortest distance from the feature to the plane. As explained below, the upper shell of the cassette is defined as the front surface and the semicircle part is defined as the top of the cassette. For example, the insertion slot is located in the right-hand side of the cassette.

8.1 Overall dimensions (Figure 4)

The total length of the cassette shall be

L101 = 137,5 mm ± 0,4 mm.

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

L102 = 126,8 mm $^{+0,3}_{-0,2}$ mm.

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

L103 = 10,7 mm ± 0,2 mm.

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The distance from the shoulder of the cassette to reference plane X shall be

L104 = 80,6 mm ± 0,2 mm.

The total width of the cassette shall be

L105 = 138,0 mm $^{+0,0}_{-0,5}$ mm.

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

L106 = 115,0 mm $^{+0,2}_{-0,4}$ mm.

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

L107 = 23,0 mm $^{+0,1}_{-0,3}$ mm.

The corners of the top shall be rounded with a radius

R101 = 65,60 mm ± 0,15 mm.

The center of the round shutter shall be located

L108 = 46,0 mm ± 0,2 mm

from reference plane X and

L109 = 61,6 mm ± 0,2 mm

from reference plane Y.

The total thickness of the cassette shall be

L110 = 21,0 mm $^{+0,0}_{-0,2}$ mm.

The total thickness includes the feet for leveling installed on the bottom surface.

The height of each foot shall be 0,3 mm.

The two corners of the shoulder of the cassette shall be rounded with a radius

R102 = 2,0 mm ± 0,2 mm

R103 = 2,0 mm ± 0,2 mm.

The two corners of the bottom of the cassette shall be rounded with a radius

R104 = 7,0 mm ± 0,2 mm.

The long edges of the cassette shall be rounded with a radius

R105 = 0,3 mm ± 0,2 mm.

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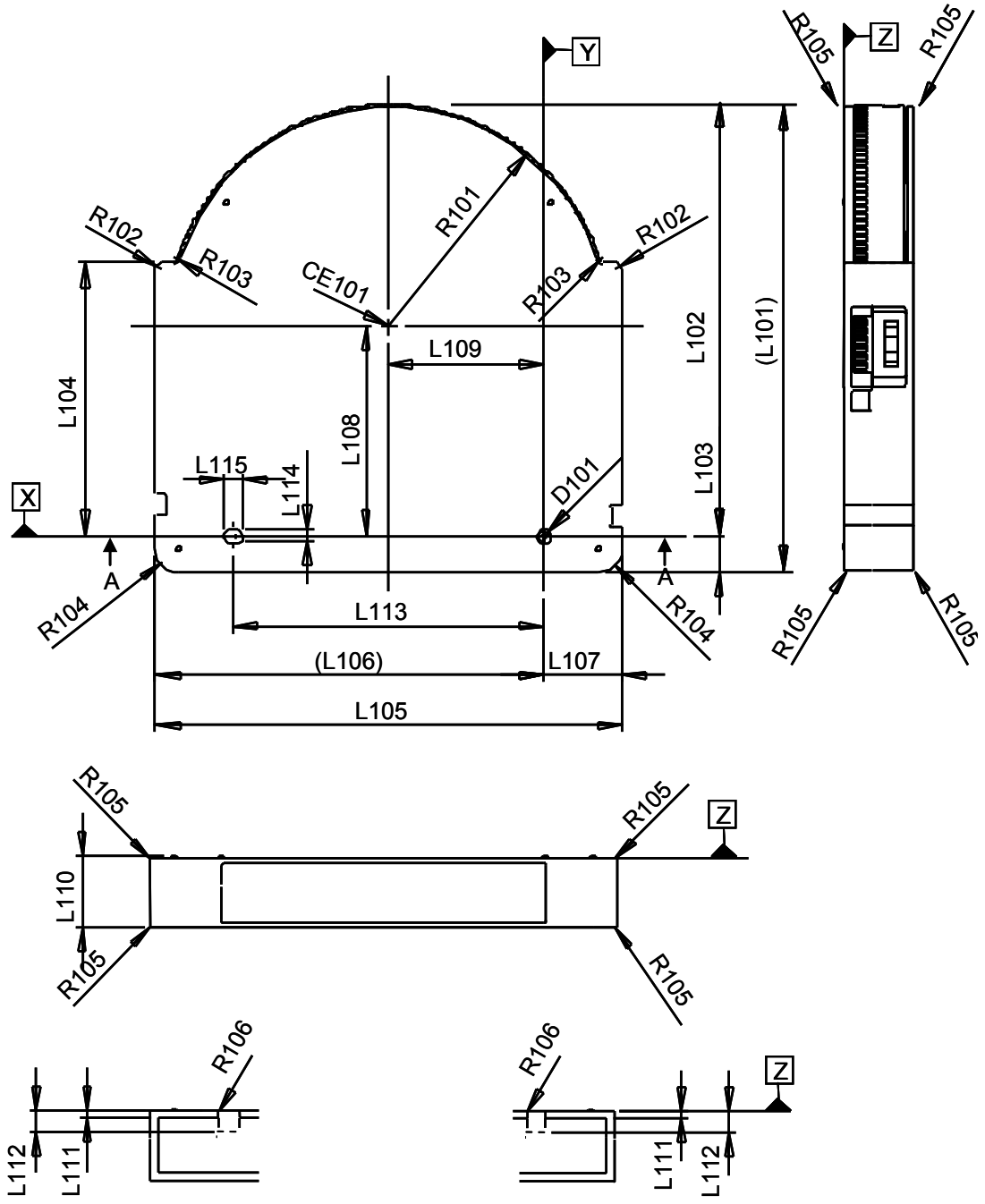

Section A-A
(Larger scale)

Figure 4 – Overall dimensions

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8.2 Location hole (Figure 5)

The center of the location hole shall coincide with the intersection of reference planes X, Y and Z.

The diameter of the hole shall be

D101 = 4,00 mm $^{+0,05}_{-0,00}$ mm

and its depth shall be

L111 = 1,2 mm min.

The room below the location hole shall be free up to

L112 = 5,0 mm min.

below reference plane Z.

The diameter of the free room shall be equal to at least D101.

The lead-in edges shall be rounded with a radius

R106 = 0,5 mm ± 0,1 mm.

8.3 Alignment hole (Figure 5)

The center of the alignment hole shall lie on the intersection of reference planes X and Z at a distance

L113 = 92,0 mm ± 0,2 mm

from reference plane Y.

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

L114 = 4,00 mm $^{+0,05}_{-0,00}$ mm

L115 = 5,6 mm $^{+0,2}_{-0,0}$ mm

and its depth shall be equal to L111.

The room below the alignment hole shall be free up to at least L111.

The dimensions of the free room shall be at least L114 and L115.

The lead-in edges shall be rounded with a radius R106.

8.4 Reference surfaces (Figure 5)

There shall be four reference surfaces S1, S2, S3, and S4 on the under shell of the cassette

Surfaces S1 and S2 shall be circular with a diameter

D102 = 7,0 mm min.

Surface S1 shall be centered on the location hole, and surface S2 shall be centered on the alignment hole.

Surface S3 shall be rectangular with dimensions

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L116 = 79,0 mm max.

L117 = 92,0 mm max.

from reference plane Y and

L118 = 1,0 mm max.

L119 = 11,0 mm max.

from reference plane X, except in the areas of the detents.

Surface S4 shall be in a symmetrical position with respect to the central axis cassette, and shall be located

L120 = 93,0 mm max.

L121 = 103,0 mm max.

from reference plane Y.

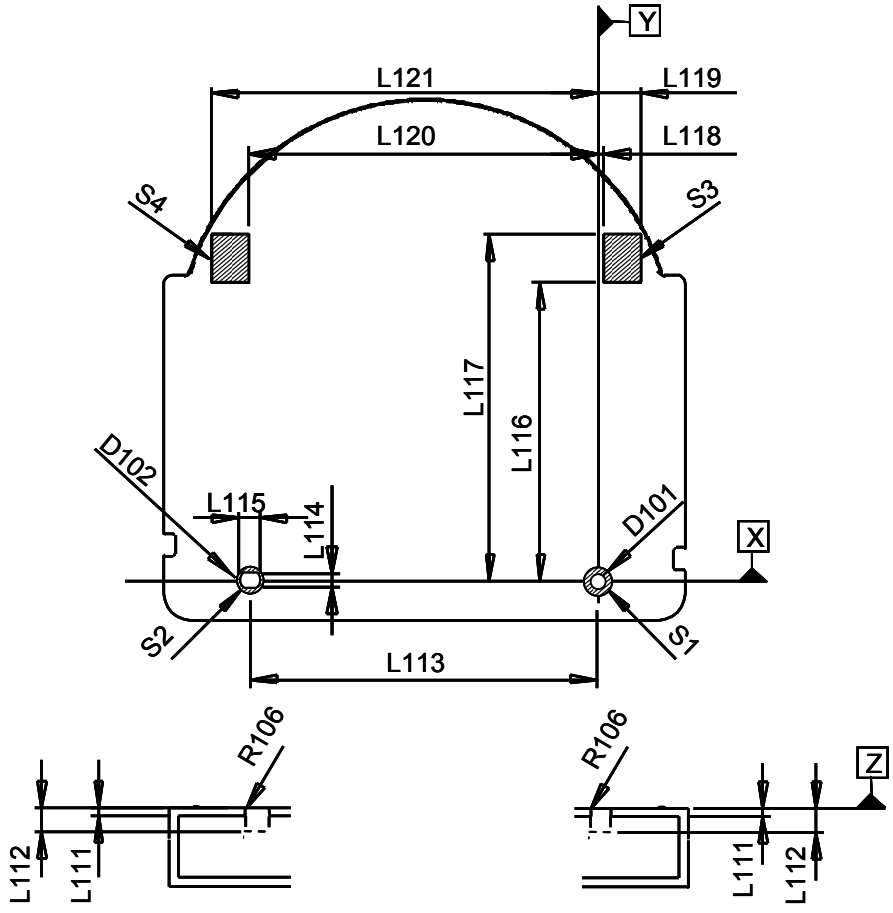

Figure 5 – Location hole, Alignment hole , Reference surface

8.5 Insertion slot (Figure 6)

The cassette shall have an insertion slot in the plane of the right side

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The bottom of the slot shall be at a distance

L122 = 61,6 mm ± 0,3 mm

from reference plane X.

The depth measured from the edge of the cassette shall be

L123 = 2,5 mm ± 0,2 mm.

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

L124 = 13,6 mm ± 0,2 mm

from reference plane Z.

The width of the insertion slots shall be

L125 = 4,8 mm ± 0,1 mm.

The corner of the insertion slot shall be rounded with a radius

R107 = 0,5 mm ± 0,1 mm.

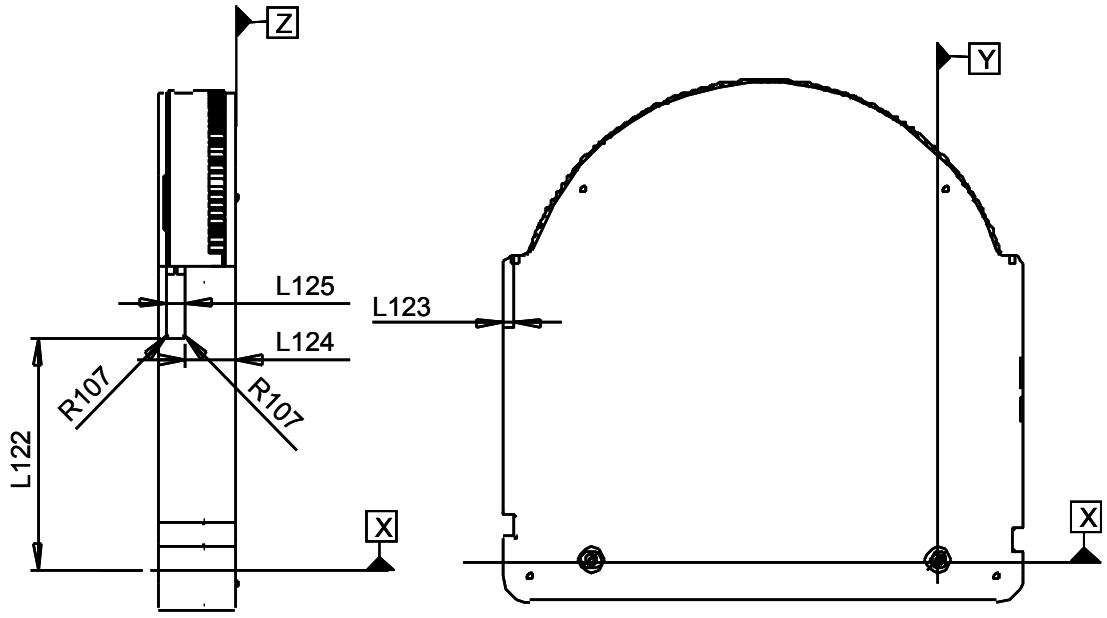

Figure 6 – Insertion slot

8.6 Fixing hole (Figure 7)

The cassette shall have a fixing hole on the left side.

The edge of the fixing hole shall be at a distance

L126 = 36,6 mm ± 0,25 mm

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L127 = 42,6 mm ± 0,25 mm

from reference plane X.

The depth measured from the edge of the cassette shall be

L128 = 1,2 mm ± 0,1 mm.

The side of the fixing hole parallel to reference plane Z shall be at a distance

L129 = 2,1 mm ± 0,1 mm.

The width of the fixing hole shall be

L130 = 6,1 mm ± 0,1 mm.

The corner of the fixing hole shall be rounded with a radius

R108 = 0,5 mm ± 0,1 mm.

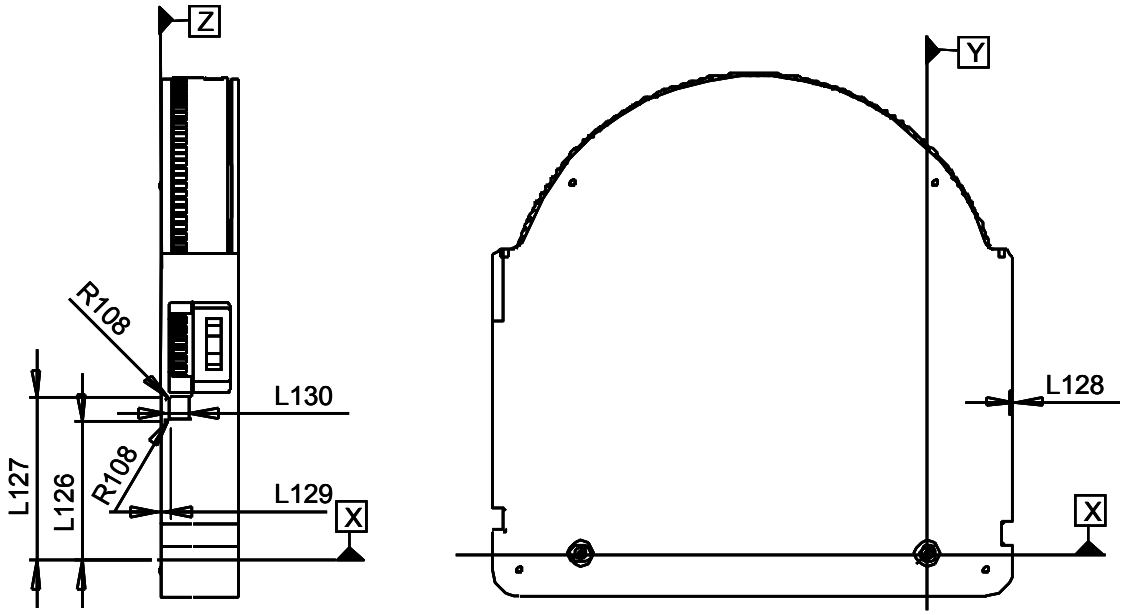

Figure 7 – Fixing hole

8.7 Gripper slots (Figure 8)

The cassette shall have two asymmetrical gripper slots.

The slots shall be through upper shell and under shell.

Each slot shall have a depth of

L131 = 3,0 mm $^{+0,3}_{-0,0}$ mm

L132 = 3,0 mm $^{+0,3}_{-0,0}$ mm

from the edge of the cassette and shall have width of

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L133 = 6,0 mm ± 0,2 mm

L134 = 6,0 mm ± 0,2 mm.

The lower edge of the left slot shall be at

L135 = 2,6 mm ± 0,1 mm

from reference plane X.

The lower edge of the right slot shall be at

L136 = 6,3 mm ± 0,1 mm

from reference plane X.

The corners of the slot shall be rounded with a radius

R109 = 0,2 mm ± 0,2 mm

R110 = 0,2 mm ± 0,2 mm

R111 = 0,8 mm ± 0,2 mm

R112 = 0,8 mm ± 0,2 mm

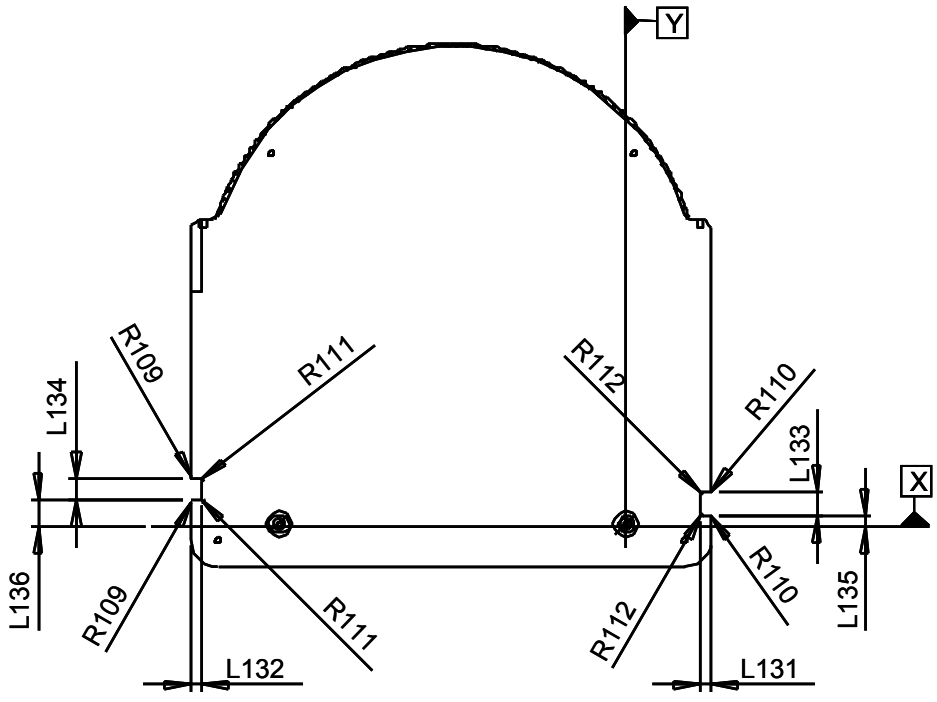

Figure 8 – Gripper slots

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8.8 Positioning hole for guide rail (Figure 9)

When the ring tray is removed from the cassette, the guide rails installed in the changer are set in the cassette.

Five positioning holes for guide rails shall be set on each side of the window.

The lower edge of the positioning hole shall be located

L137 = 4,6 mm $^{+0,1}_{-0,0}$ mm

L138 = 7,6 mm $^{+0,1}_{-0,0}$ mm

L139 = 10,6 mm $^{+0,1}_{-0,0}$ mm

L140 = 13,6 mm $^{+0,1}_{-0,0}$ mm

L141 = 16,6 mm $^{+0,1}_{-0,0}$ mm

form reference plane Z.

The inner edge of the positioning hole shall be located

L142 = 111,0 mm $^{+0,2}_{-0,0}$ mm

L143 = 19,1 mm $^{+0,2}_{-0,0}$ mm

from reference plane Y.

The size of the positioning hole shall be

L144 = 2,0 mm $^{+0,2}_{-0,0}$ mm

L145 = 1,8 mm $^{+0,2}_{-0,0}$ mm.

The depth of the positioning hole shall be

L146 = 2,1 mm $^{+0,2}_{-0,0}$ mm.

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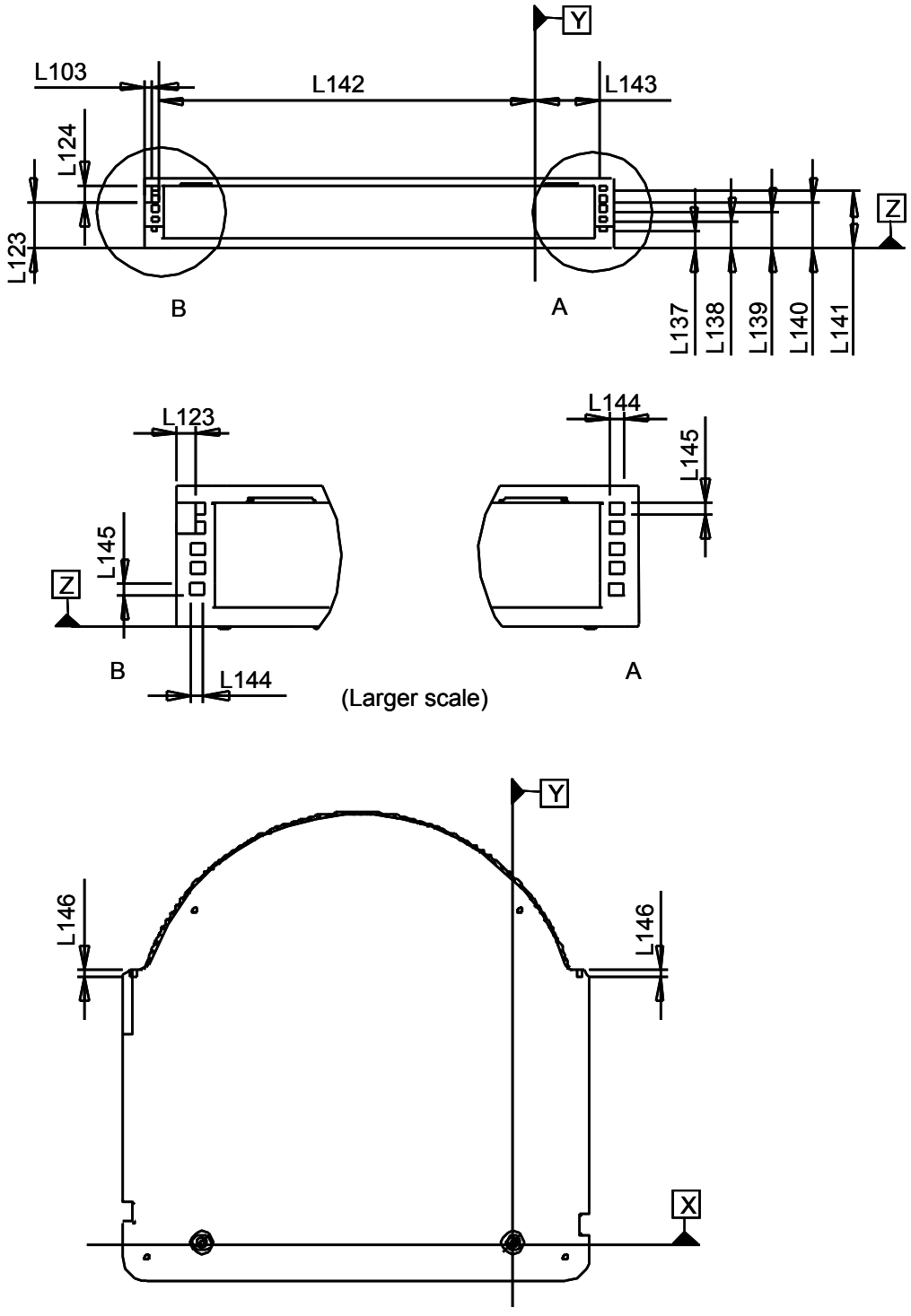

Figure 9 - Positioning hole for guide rail

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8.9 Shutter (Figure 10, Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16)

When the cassette is not set in the changer system, the shutter of the cassette shall cover the window of the cassette.

The shutter shall overlap with the upper shell and under shell.

The overlap of the shutter and the window of the upper shell shall be

L147 = 0,2 mm min.

The shutter shall cover the window of the under shell so that dust may not enter.

The overlap of the shutter and the window of the under shell shall be

L148 = 1,1 mm min.

The shutter shall rotate around CE101 in the region that is formed in the cassette.

When the cassette is set in the changer, the shutter shall open.

The round groove inside the upper shell shall be at

R113 = 62,80 mm ± 0,25 mm

R114 = 58,00 mm ± 0,25 mm

with its center of CE101.

The round groove inside the under shell shall be at

R115 = 63,60 mm ± 0,25 mm

R116 = 56,00 mm ± 0,25 mm

with the center of CE101.

The cassette shall have a stopper that prevents the shutter from moving into an irregular position

The height of the window shall be

L149 = 2,8 mm max.

L150 = 18,4 mm min.

from reference plane Z.

The window shall be at a distance

L151 = 17,4 mm min.

L152 = 109,4 mm min.

from reference plane Y.

The corner of the window shall be rounded with a radius

R117 = 0,5 mm ± 0,1 mm.

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The edge of the upper of the window shall be cut with a distance

C101= 0,5 mm ± 0,1 mm.

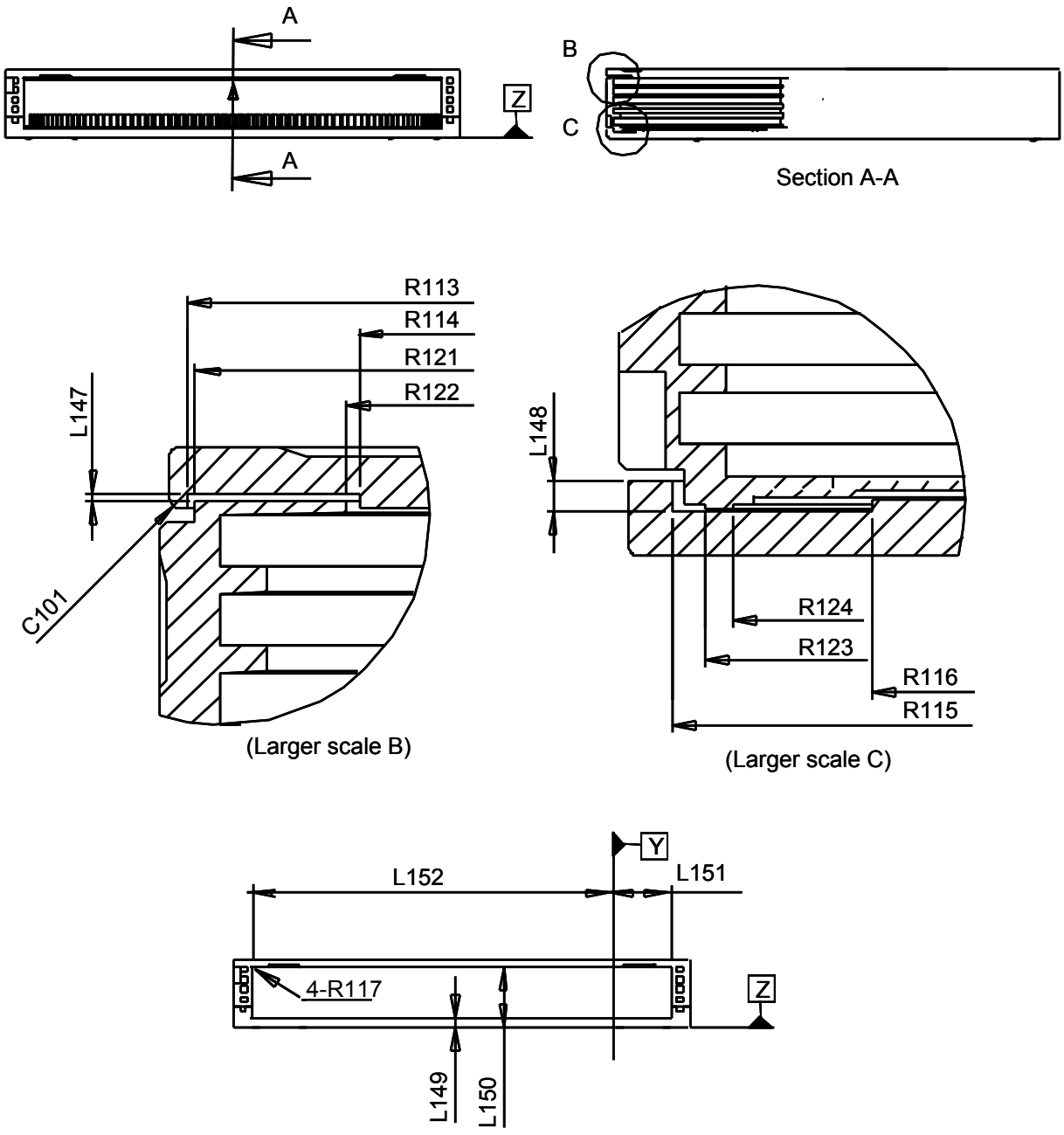

Figure 10 - window

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The upper part of the window shall have two hollows. The direction of the hollow from the center of the cassette shall be

α101= 33,5 ° ± 1,0 °

α102 = 33,5 ° ± 1,0 °.

The width of the hollow as viewed from the normal direction shall be

L153 = 17,0 mm $^{+0,2}_{-0,0}$ mm.

The height of the hollow shall be

L154 = 0,4 mm $^{+0,2}_{-0,0}$ mm.

The angle of the edge of the hollow shall be

α103 = 45 ° ± 5 °.

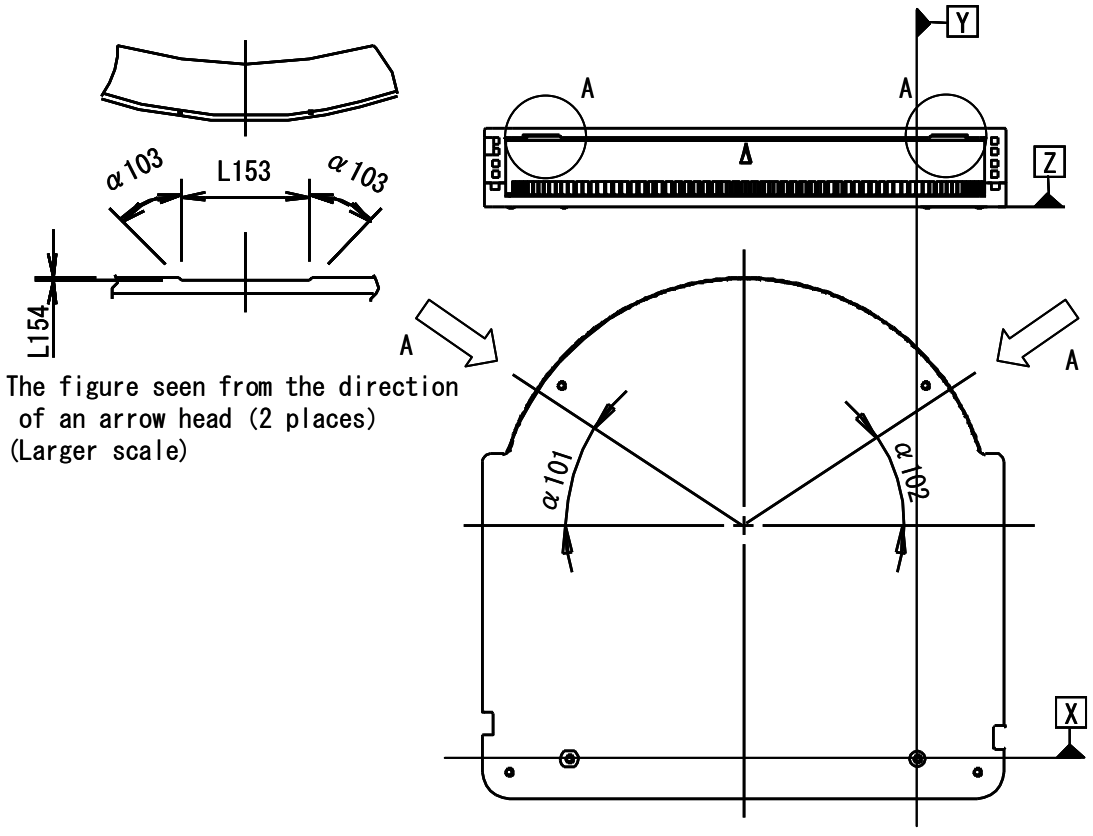

Figure 11 – Upper part of the window

The shutter shall consist of a disk-shaped plate and the outer wall of the semicircular part.

The outer wall of the semicircular part shall be fitted with a gear.

The radius of the outer wall including the gear shall be

R118 = 65,60 mm ± 0,25 mm.

The deviation of the periphery from an ideal circle shall be within 0,2 mm.

The inner radius of the shutter shall have a length

R119 = 58,50 mm ± 0,25 mm.

The radius of the bottom of the shutter shall be

R120 = 60,4 mm $^{+0,0}_{-0,2}$ mm.

The difference between the center of the cassette and the rotation center of the shutter shall be less than 0.1mm

The top of the shutter shall have a convex part at

R121 = 64,20 mm $^{+0,00}_{-0,15}$ mm

R122 = 63,30 mm ± 0,15 mm

in order to couple with the groove in the upper shell.

The bottom of the shutter shall have a convex part at

R123 = 62,30 mm ± 0,15 mm

R124 = 61,30 mm ± 0,15 mm

in order to couple with the groove in the upper shell.

Outside of the introduction part shall be a circular arc centered at CE101.

The inner side of the introduction part shall be able to insert the ring tray.

The width of the introduction part shall be

L156 = 126,6 mm ± 0,3 mm.

The height of the shutter shall be

L157 = 17,00 mm ± 0,15 mm.

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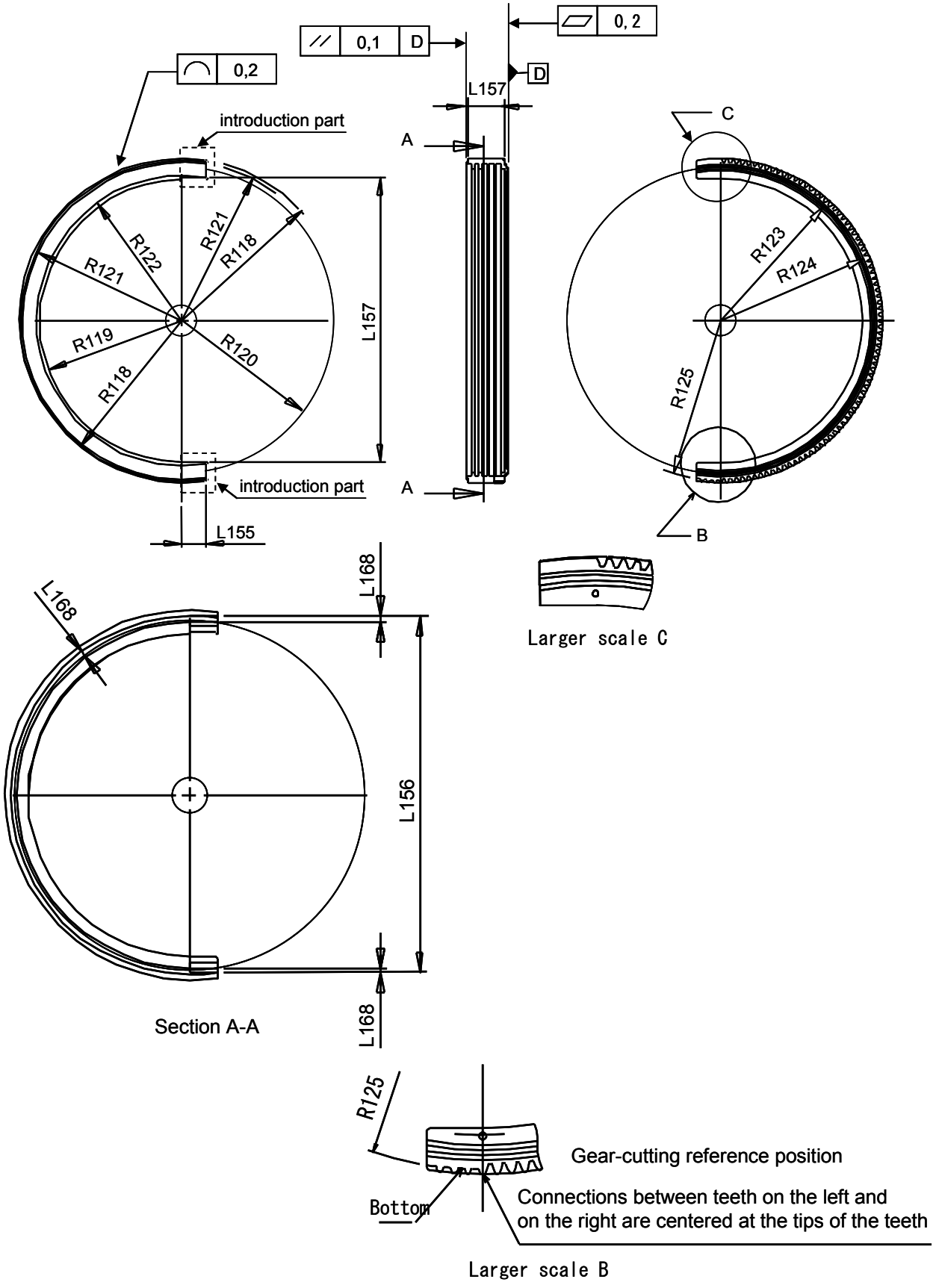

Figure 12 – Shutter

The height of the gear shall be

L158 = 6,65 mm ± 0,20 mm

from reference plane Z.

The width of the gear shall be

L159 = 3,8 mm $^{+0,2}_{-0,0}$ mm.

The shape of the gear shall be as follows;

Shape of the gear: standard

Module: 0,8

Pressure angle: 20

Number of teeth: 162(whole circumference)/84(actual)

Pitch diameter: 129.6 mm

Tooth profile accuracy: Grade 5 JIGMA

The bottom teeth of the introduction part of the gear of the shutter open/close bay shall be at a distance

R125 = 64.70 mm ± 0,25 mm.

The connections between teeth on the left and on the right are centered at the tips of the teeth.

The gear shall not be in the introduction part on the opposite side of the shutter open/close bay.

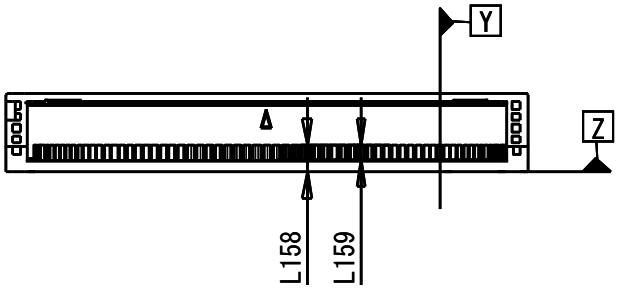

Figure 13 – Shutter gear

To sense opening and closing of the shutter, the outer wall of the shutter shall have two hollows.

While the shutter is open, the angle between one of the edges of the hollows and the line parallel to reference plane X passing through the center of the cassette shall be

α104 = 9,0 ° ± 1,0 °.

The other edge of the hollow shall be parallel to reference plane X.

The distance from the bottom of the hollow to the outer wall of the shutter shall be

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L160 = 1,5 mm $^{+0,2}_{-0,0}$ mm.

The angle between the left side edge of bottom and the line parallel to reference plane X passing through the center of the cassette shall be

α105 = 2,5 ° ± 1,0 °.

The angle between the right side edge of bottom and the line parallel to reference plane X passing through the center of the cassette shall be

α106 = 6,5 ° ± 1,0 °.

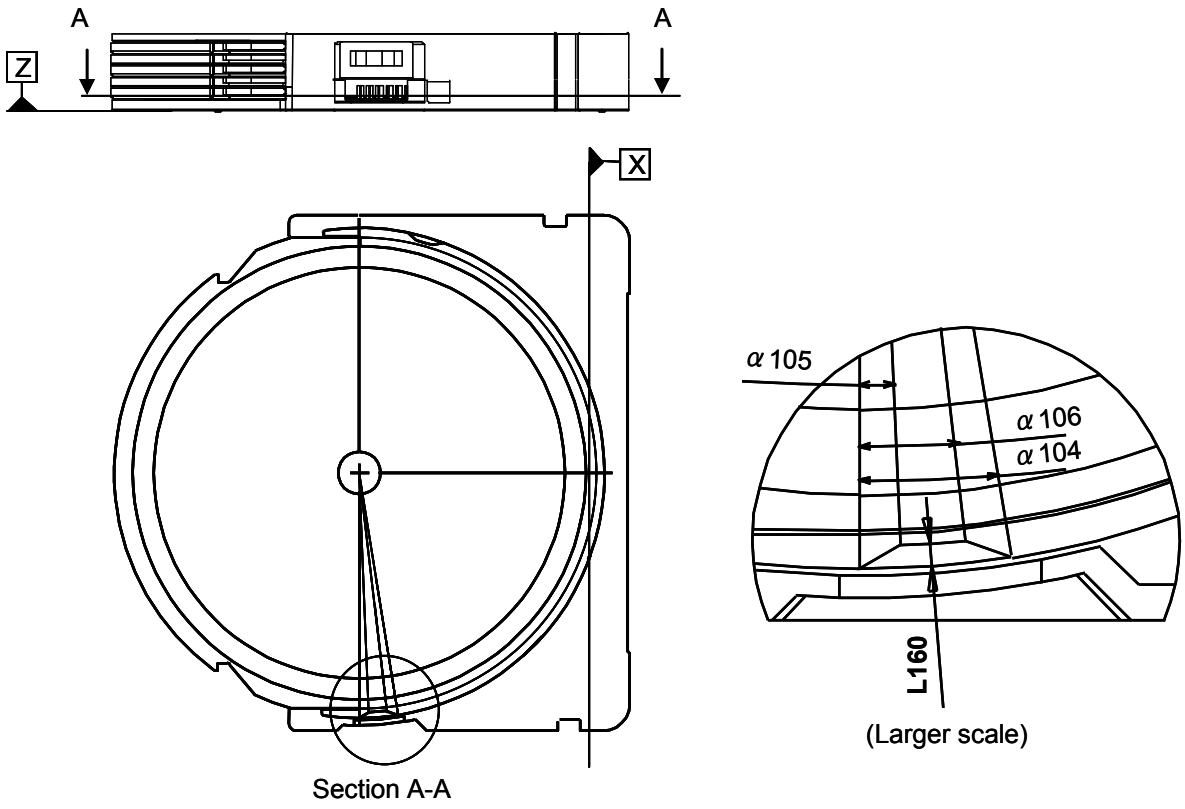

Figure 14 – Shutter open/closed sensor

While the shutter is closed, the angle between the right side of the hollow and the line parallel to reference plane X passing through the center of the cassette shall be

α107 = 9,0 ° ± 1,0 °

The edge of the left side of the hollow shall be parallel to reference plane X.

The distance from bottom of hollow to outer wall of the shutter shall be

L161 = 1,5 mm $^{+0,2}_{-0,0}$ mm.

The angle between the left side edge of bottom of the hollow and the line parallel to reference plane X passing through the center of the cassette shall be

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α108 = 2,5 ° ± 1,0 °.

The angle between the right side edge of the bottom of the hollow and the line parallel to reference plane X passing through the center of the cassette shall be

α109 = 6,5 ° ± 1,0 °.

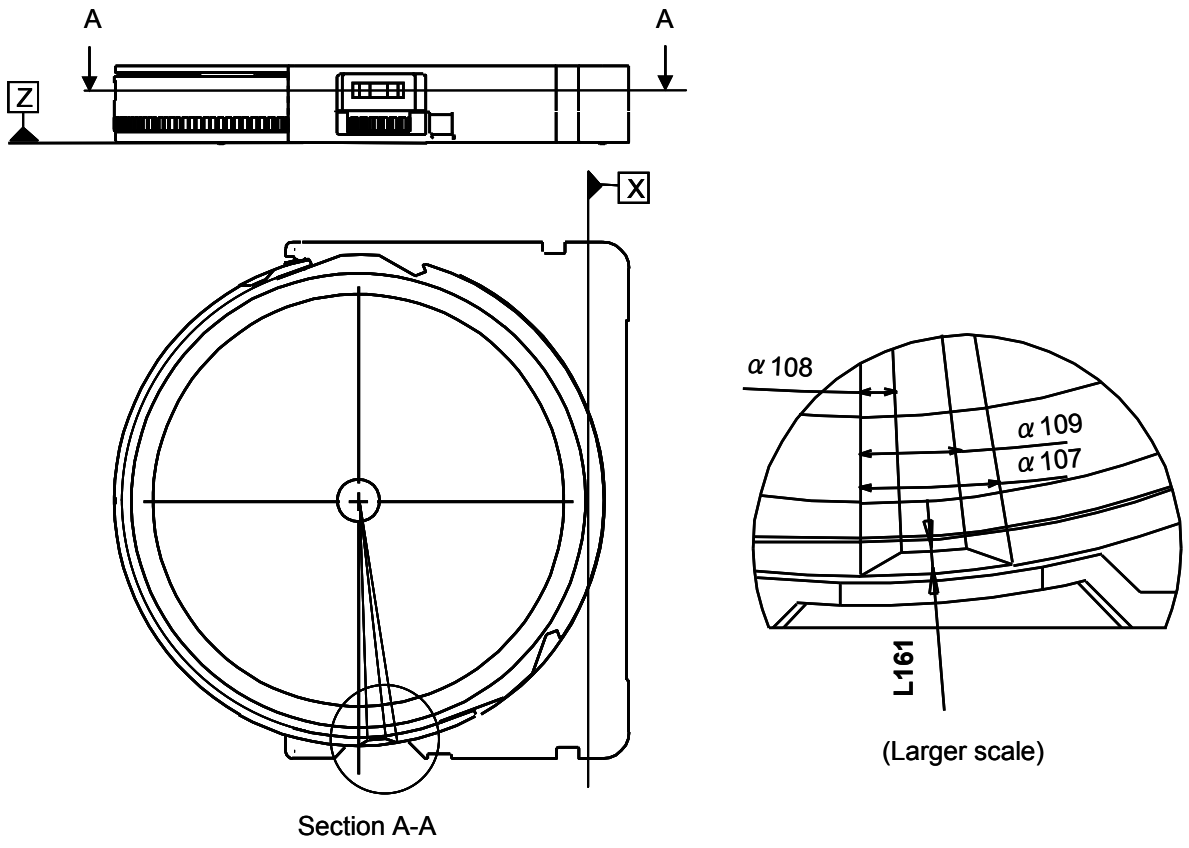

Figure 15 – Shutter open/closed sensor

The inside of the shutter shall have a structure with shelves support five ring trays.

The height of the bottom shelf shall be

L162 = 3,83 mm ± 0,15 mm

from reference plane Z.

The spacing between the bottom shelf and each of the other shelves shall be

L163 = 3,0 mm ± 0,1 mm

L164 = 6,0 mm ± 0,1 mm

L165 = 9,0 mm ± 0,1 mm

L166 = 12,0 mm ± 0,1 mm.

The spacing between adjacent shelves shall be

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L167 = 1,90 mm $^{+0,07}_{-0,02}$ mm.

The width of the shelf shall be

L168 = 3,6 mm ± 0,1 mm

around the semicircle part.

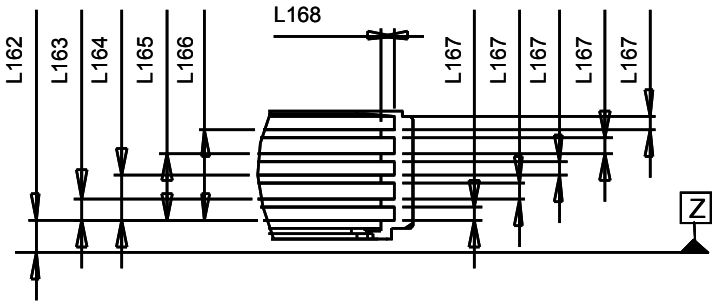

Figure 16 – Shelves built into the shutter

8.10 Shutter open/close bay (Figure 17)

The shutter open/close bay shall be at the left side of the cassette in order to open and close the shutter.

The shutter open/close bay shall be at a distance

L169 = 43,6 mm ± 0,2 mm

L170 = 67,6 mm ± 0,2 mm

from reference plane X.

The window of the shutter open/close bay shall be at a distance

L171 = 2,1 mm ± 0,2 mm

L172 = 28,3 mm ± 0,2 mm

from reference plane Z.

The corner of the shutter open/close bay shall be rounded with radius

R126 = 0,7 mm ± 0,2 mm.

The open/close bay and the shutter open/closed sensor shall consist of one hollow.

The height of the shutter open/close window shall be at a distance

L173 = 2,8 mm ± 0,1 mm

L174 = 8,50 mm ± 0,15 mm

from reference plane Z.

The angle of the side wall of the upper window shall be

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α110 = 45 ° ± 1 °

α111 = 45 ° ± 1 °.

The angle of the side wall of the lower window shall be

α112 = 45 ° ± 1 °

α113 = 45 ° ± 1 °.

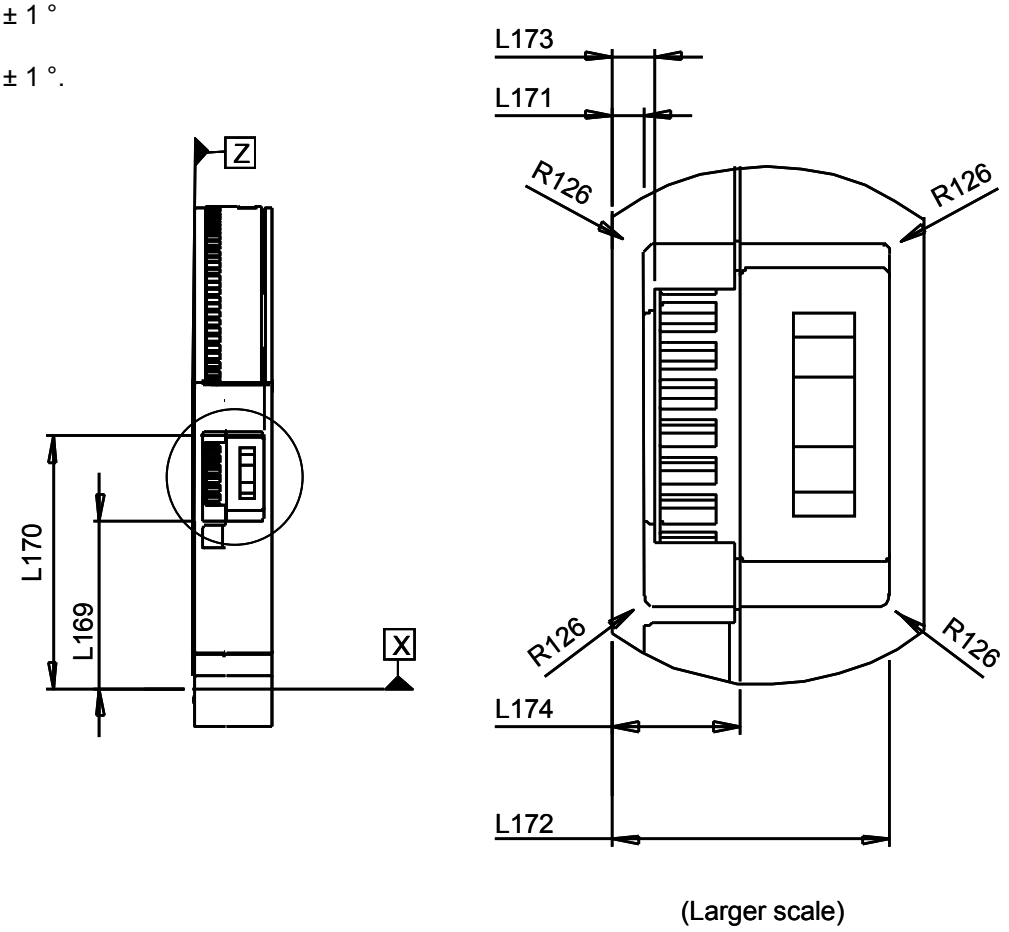

Figure 17 – Shutter open/close bay and location of magnetic field for shutter lock

8.11 Window for the shutter open/closed sensor (Figure 17, Figure 18, Figure 19)

In order to sense opening or closing of the shutter, a window for the open/closed sensor of the shutter shall be located above the open/close bay.

The window for the sensor shall be at a distance

L175 = 63,10 mm ± 0,25 mm

L176 = 49,60 mm ± 0,25 mm

from reference plane X.

The window for the sensor shall be at a distance

L177 = 12,0 mm $^{+0,0}_{-0,2}$ mm

from reference plane Z.

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The height of the window shall be

L178 = 16,0 mm ± 0,1 mm.

The curved wall shall be rounded with a radius

R127 = 67,6 mm ± 0,4 mm.

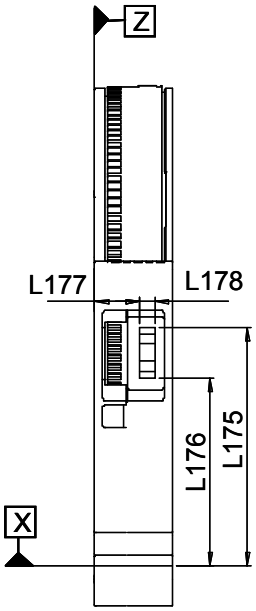

Figure 18 – Open/closed sensor of shutter

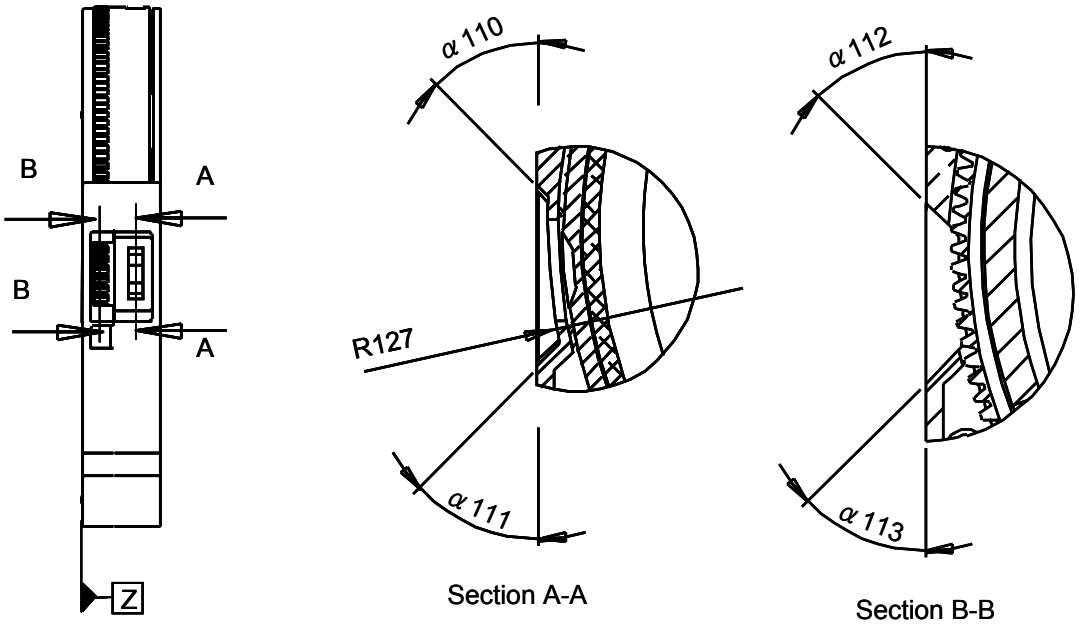

Figure 19 – Section of open/closed sensor of shutter

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8.12 Shutter lock mechanism (Figure 20)

When the cassette is not set in the changer system, the shutter shall be locked.

When the disk cassette is set in the changer system, the shutter shall be able to rotate freely by means of the unlock magnet.

The shutter is opened by the shutter driving gear in the changer system engaged with the shutter open/close bay portion of the cassette, and rotates clockwise when opening.

The shutter is closed by the shutter driving gear in the changer system engaged with the shutter open/close bay of the cassette, and rotates counterclockwise when closing.

The shutter lock for open or close the shutter shall be driven with a lock lever release magnet.

Note: For cases where the disk cassette is removed from the changer and the shutter is not closed completely, a ratchet mechanism is installed such that it can be turned in only the direction to close the shutter by hand.

The center of the magnetic field for unlocking the shutter shall be located at

L179 = 16,9 mm ± 0,2 mm

from reference plane X

L180 = 6,6 mm ± 0,2 mm

from reference plane Y.

The magnetic field on the surface of a cassette for unlocking of a shutter shall be

700 gauss min.

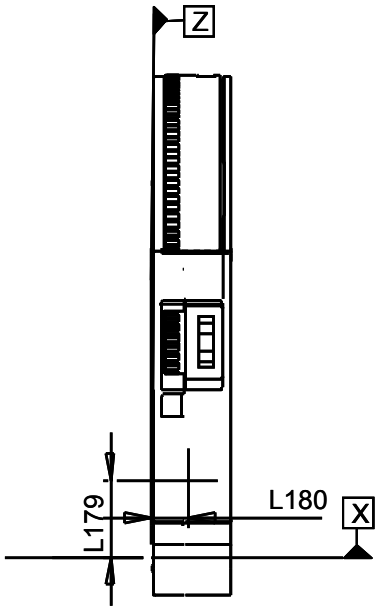

Figure 20 – magnetic field for shutter lock

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8.13 Ring tray (Figure 21)

The disk shall be set on a ring tray. The cassette shall include five ring trays.

The ring trays shall be drawn out one by one from the cassette by means of a pull-out lever in the changer system.

The ring tray shall be conveyed by disk pickers. The ring tray shall have two chucking parts on the outer side. A ring tray shall not make contact with the light incident surface of the data recording area at least in the case of carrying the disk cassette.

The inner and outer diameters of the ring tray shall be

L181 = 122,4 mm ± 0,2 mm

L182 = 126,0 mm ± 0,2 mm.

The difference between the arc on the opposite side of the chuck and ideal arc shall be less than 0,2 mm.

The diameter of the part of the tray holding the disk shall be the length of

L183 = 121,4 mm $^{+0,2}_{-0,0}$ mm.

Deviation from an ideal curve of the edge of the part where the disk is set should be 0,2 mm or less.

Convex warping of the ring tray shall not occur. The difference between concave warping of the ring tray and a flat plane shall be less than 0,2 mm.

The difference between the back surface of the ring tray and an ideal surface shall be less than 0,3 mm.

The depth of the ring tray at L184 shall be

L184 = 1,5 mm ± 0,1 mm.

The depth of the ring tray at L182 shall be

L185 = 2,0 mm ± 0,1 mm.

The sidewall of the tray shall extend from the depth

L186 = 0,5 mm ± 0,1 mm

at the angle

α114 = 30 ° ± 1 °.

The distance between two chucking parts of the ring tray shall be

L187 = 106,0 mm ± 0,2 mm

L188 = 102,0 mm ± 0,2 mm.

The distance from the center of the ring tray to the chucking part shall be

L189 = 38,0 mm ± 0,2 mm

L190 = 35,3 mm ± 0,2 mm.

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The clearance angle of chucking part shall be

α115 = 40 ° ± 2 °.

The corners of the chucking part shall be rounded with radii

R128 = 1,0 mm ± 0,2 mm

R129 = 1,0 mm ± 0,2 mm.

The front edge of the flange shall be cut off the corner with a distance

C102 = 0,4 mm ± 0,1 mm.

The rear edge of the flange shall be cut off the corner with a distance

C103 = 0,4 mm ± 0,1 mm.

The diameter of the rear surface of the ring tray shall be

L191 = 121,4 mm $^{+0,2}_{-0,0}$ mm.

The rear edge of the ring tray shall be rounded with a radius

R130 = 0,5 mm ± 0,1 mm.

The rear of the ring tray shall be chamfered at a distance

L192 = 57,4 mm ± 0,2 mm

from the center of the ring tray.

The angle between the rear surface and chamfered surface shall be

α116 = 15 ° ± 1 °.

The thickness of the inner portion from the chucking part of the ring tray shall be

L193 = 2,70 mm $^{+0,00}_{-0,06}$ mm.

The thickness of the outer portion from the chucking part of the ring tray shall be

L194 = 2,90mm $^{+0,00}_{-0,06}$ mm.

The distance from the front surface of the ring tray to the rear of the flange shall be

L195 = 1,7 mm ± 0,1 mm.

When the shutter is open, the chucking part of the ring tray shall be less than

0,5 mm from the ideal position in X direction

0,5 mm from the ideal position in Y direction

0,5 mm from the ideal position in Z direction.

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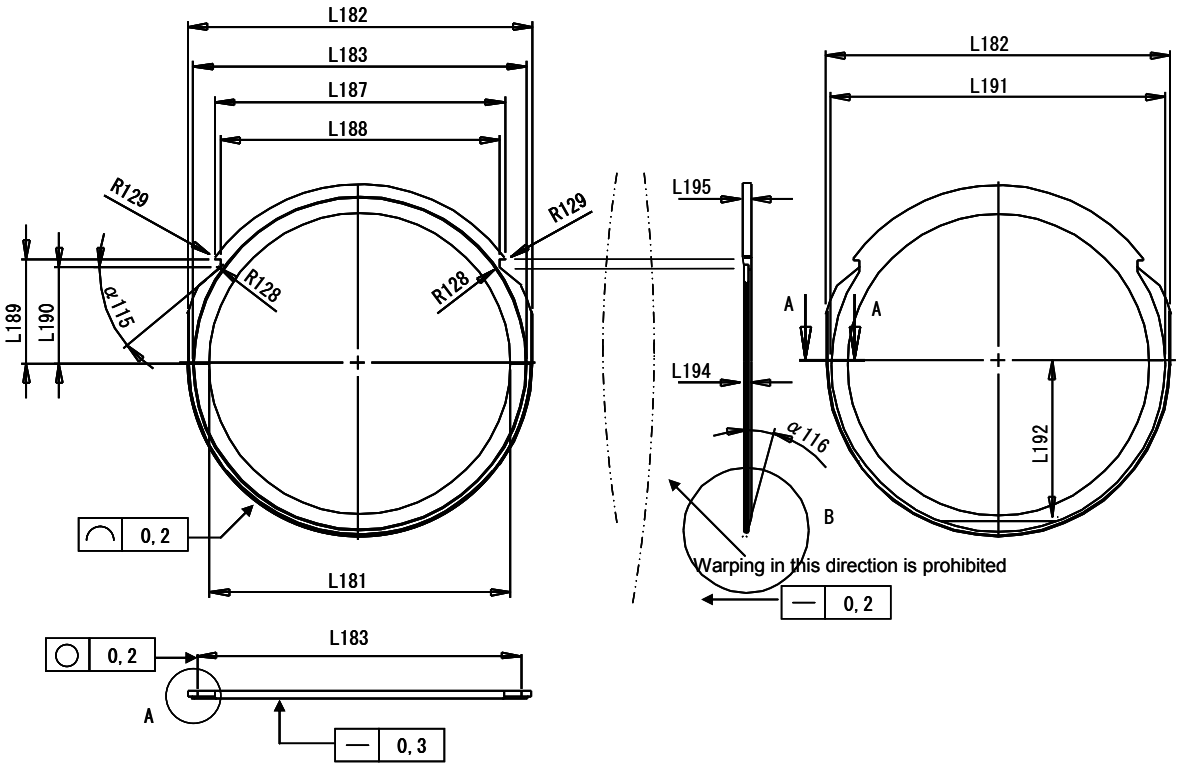

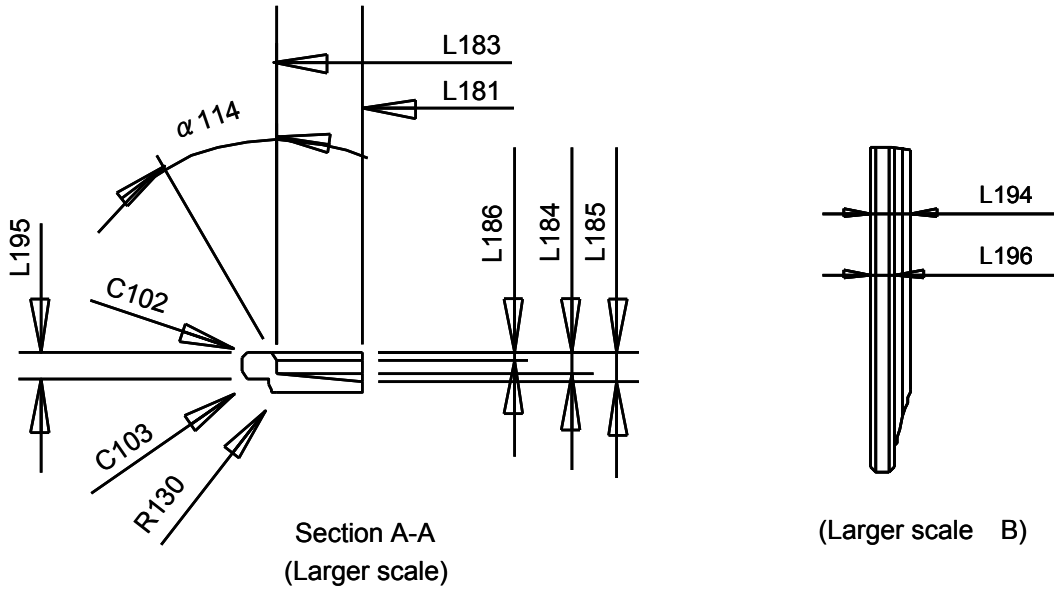

Figure 21 – Ring tray

8.14 Feet (Figure 22)

The cassette shall have four feet on the under shell.

The distance from the center of the foot to reference plane X shall be

L196 = 3,7 mm ± 0,2 mm

L197 = 98,6 mm ± 0,2 mm.

The distance from the center of the foot to reference plane Y shall be

L198 = 16,0 mm ± 0,2 mm

L199 = 108,0 mm ± 0,2 mm

L200 ＝2,0 mm ± 0,2 mm

L201 = 94,0 mm ± 0,2 mm.

The height of a foot shall be

L202 = 0,3 mm ± 0,04 mm.

The diameter of a foot shall be

D103 = 2 mm ± 0,2 mm

in reference plane Z.

The taper of the foot shall be

α117 = 45 ° ± 10 °.

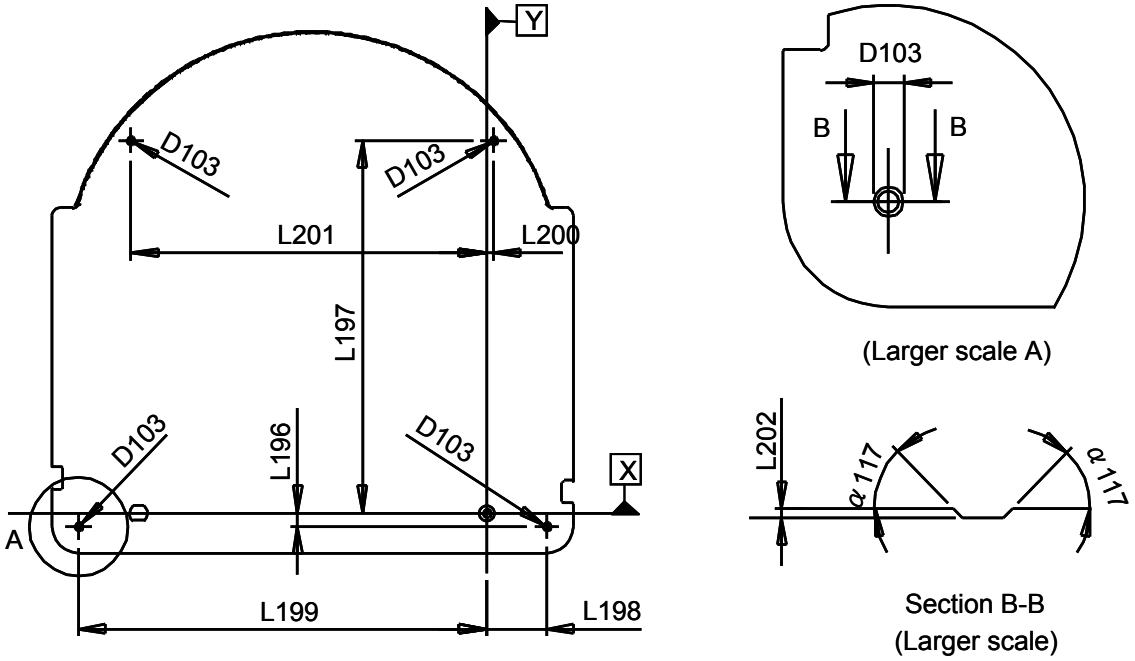

Figure 22 – Feet

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8.15 RFID tag (Figure 23)

An RFID tag shall be installed on inside wall of the cassette.

The direction of the emitted field shall be normal to side wall of the cassette.

The center of the RFID tag shall be

L203 = 14,1 mm ± 0,2 mm

from reference plane X,

L204 = 19,6 mm ± 0,2 mm

from reference plane Z.

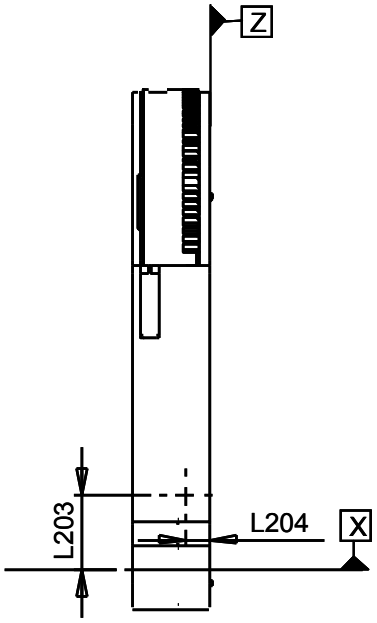

Figure 23 – RFID tag

8.16 Label area (Figure 24)

The cassette shall have two label areas on top surface and back surface, with the following dimensions

For the top surface:

L205 = 54,3 mm ± 0,2 mm

L206 = 31,0 mm + $^{+0,5}_{-0,0}$ mm

L207 = 17.0 mm ± 0,2 mm

L208 = 126,0 mm $^{+0,5}_{-0,0}$ mm

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R131 = 0,3 mm ± 0,1 mm

For the back surface:

L209 = 1,6 mm ± 0,2 mm

L210 = 18,0 mm $^{+0,5}_{-0,0}$ mm

L211 = 2,0 mm ± 0,2 mm

L212 = 96,0 mm $^{+0,5}_{-0,0}$ mm

R132 = 0,3 mm ± 0,1 mm

The label area shall be recessed by 0,2 mm min. on both surfaces.

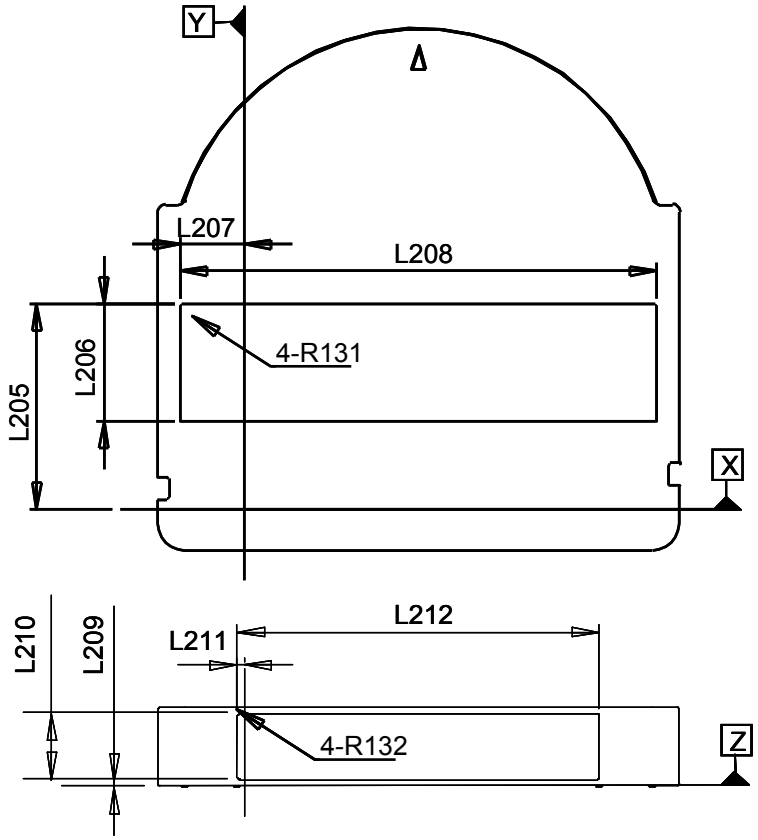

Figure 24 – Label area

8.17 Shutter center marks (Figure 25, Figure 26)

The shutter center marks shall be on the surface of the upper shell and the side wall of the shutter.

The shutter center marks shall be shaped as isosceles triangle.

When the shutter is closed, both of the shutter center marks shall align.

The shutter center mark shall be recessed.

The shutter center mark on the upper shell shall be

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L213 ＝122,6 mm ± 0,2 mm

from reference plane X.

The length of the shutter center mark on the upper shell shall be

L214 = 6,3 mm ± 0,1 mm

The shutter center mark on the upper shell shall be

L215 = 46,0 mm ± 0,2 mm

from reference plane Y.

The width of the shutter center mark on the upper shell shall be

L216= 3,8 mm ± 0,1mm.

The depth of the shutter center mark on the upper shell shall be

L217 = 0,3 mm ± 0,1 mm.

The three walls of the edge of the shutter center mark on the upper shell shall be at an angle

α118 = 45 ° ± 10 °.

When the shutter is closed, the distance between the shutter center mark of upper shell and that of the side wall of the shutter shall be less than 0,5 mm.

The shutter center mark on the shutter wall shall be

L218 = 15,8 mm ± 0,1 mm

from reference plane Z.

The length of the shutter center mark on the shutter wall shall be

L219 = 5,0 mm ± 0,1 mm

The width of the shutter center mark on the shutter wall shall be

L220 = 3,0 mm ± 0,1 mm

The depth of the shutter center mark on the shutter wall shall be

L221 = 0,3 mm ± 0,1 mm

The three walls of the edge of the shutter center mark on the shutter wall shall be at an angle

α119 = 45 ° ± 10 °

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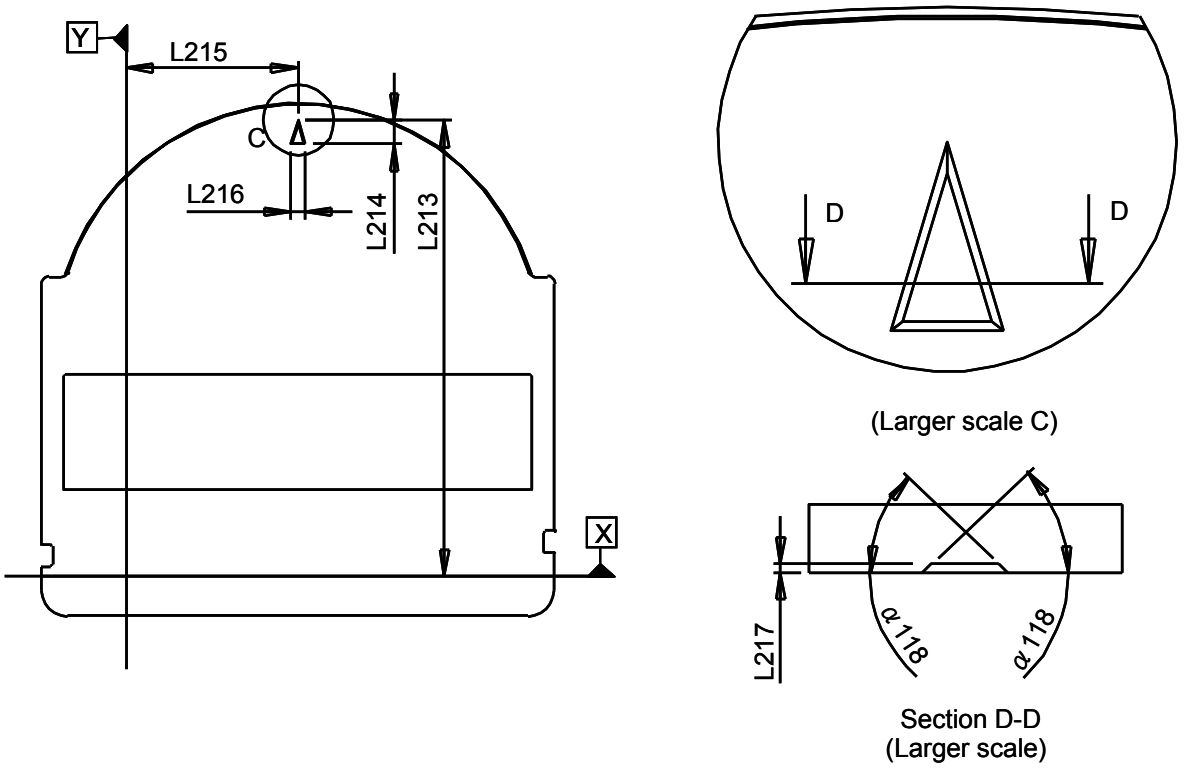

Figure 25 – Shutter center mark

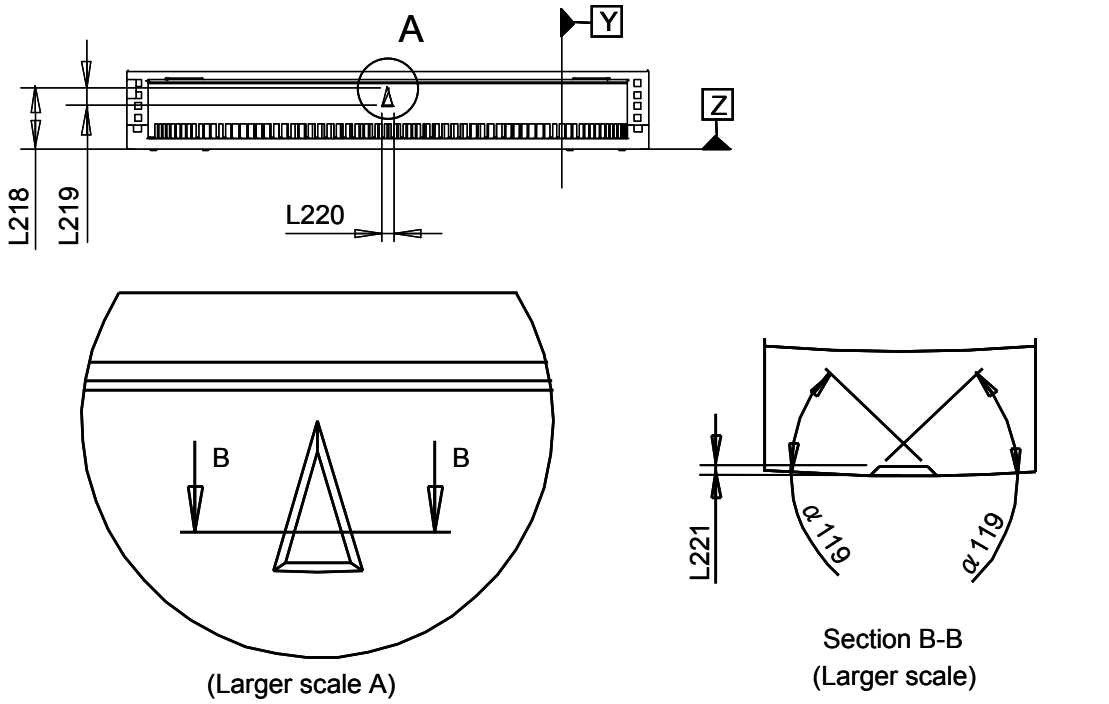

Figure 26 – Shutter center mark

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9 Mechanical characteristics

9.1 Material

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

9.2 Mass

The mass of the cassette without disks shall not exceed 200 g.

The mass of the cassette with disks shall not exceed 285 g.

9.3 Edge distortion

The cassette shall meet the requirement of the edge distortion test defined in Annex C.

9.4 Compliance

The cassette shall meet the requirement of the compliance (flexibility) test defined in Annex D.

9.5 Shutter opening force

The shutter opening force shall be less than 0,3 N.

The shutter shall not move when acted upon by a force of less than 0,15 N.

9.6 Frictional force of ring tray

The cassette shall meet the requirement of the friction force test defined in Annex E.

9.7 Edge distortion of the ring tray

The cassette shall meet the requirement of the edge distortion test defined in Annex F.

9.8 Disks in the cassette

The cassette shall hold disks all of the same type.

The five disks, starting from the bottom disk (nearest the under shell), are sequentially named disk 1, disk 2, disk 3, disk 4, and disk 5. Disk order shall not be changed.

10 RFID tag

10.1 Signal quality

On an RFID tag shall be recorded cassette ID for specifying a unique serial number of the cassette, media ID for specifying a unique serial number of the disk, the type of disk, the disk manufacturer core, and the manufacture date of the cassette. Media ID means a unique serial number written to the media in the burst cutting area of the optical disk.

The type of RFID tag shall be I-CODE LSI

The telecommunications standard is based on ISO 15693.

The readout quality of the RFID tag shall meet the requirement of the readout quality test defined in Annex G.

After data are recorded on the RFID tag, rewriting of the data shall not be possible. The cassette shall be shipped after data are recorded on the RFID tag.

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)							
:				Cassette ID				
11								(LSB)
12-15	Reserved							
16-31	Media ID for Disk1							
32-47	Media ID for Disk2							
48-63	Media ID for Disk3							
64-79	Media ID for Disk4							
80-95	Media ID for Disk5							
96	type of media							
97	Reserved							
98	(MSB)							
99				vendor code				(LSB)
100	(MSB)							
101				year of manufacture				(LSB)
102	month of manufacture date							
103	day of manufacture date							
104-111	Reserved							

Figure 24 - RFID tag structure

R_Byte \ Bit	7	6	5	4	3	2	1	0
0	Reserved				(MSB)			
1	disk manufacturer's code							(LSB)
2	Reserved							
3	Reserved							
4	(MSB)							
:				disk serial number				
15								(LSB)

Figure 25 – Media ID structure

Bytes 0 to 11 shall specify cassette ID

Bytes 16 to 31 shall specify the media ID for Disk 1 as follows:

Bits 3 to 0 in byte 16 shall be bits 11 to 8 of the disk manufacturer code.

Bits 7 to 0 in byte 17 shall be bits 7 to 0 of the disk manufacturer code.

Bytes 18 to 19 shall be reserved and set to (00h).

Bytes 20 to 31 shall be the disk serial number.

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Bytes 32 to 47 shall specify the media ID for Disk 2 as follows:

Bits 3 to 0 in byte 32 shall be bits 11 to 8 of the disk manufacturer code.

Bits 7 to 0 in byte 33 shall be bits 7 to 0 of the disk manufacturer code.

Bytes 34 to 35 shall be reserved and set to (00h).

Bytes 36 to 47 shall be the disk serial number.

Bytes 48 to 63 shall specify the media ID for Disk 3 as follows:

Bits 3 to 0 in byte 48 shall be bits 11 to 8 of the disk manufacturer code.

Bits 7 to 0 in byte 49 shall be bits 7 to 0 of the disk manufacturer code.

Bytes 50 to 51 shall be reserved and set to (00h).

Bytes 52 to 63 shall be the disk serial number.

Bytes 64 to 79 shall specify the media ID for Disk 4 as follows;

Bits 3 to 0 in byte 64 shall be bits 11 to 8 of the disk manufacturer code.

Bits 7 to 0 in byte 65 shall be bits 7 to 0 of the disk manufacturer code.

Bytes 66 to 67 shall be reserved and set to (00h).

Bytes 68 to 79 shall be the disk serial number.

Bytes 80 to 95 shall specify the media ID for Disk 5 as follows;

Bits 3 to 0 in byte 80 shall be bits 11 to 8 of the disk manufacturer code.

Bits 7 to 0 in byte 81 shall be bits 7 to 0 of the disk manufacturer code.

Bytes 82 to 83 shall be reserved and set to (00h).

Bytes 84 to 95 shall be the disk serial number.

Bytes 96 to 97 shall specify the type of media:

(00h): DVD-R(SL), (01h): DVD-R(DL), (02h): DVD+R(SL), (03h): DVD+R(DL),

(05h): DVD-RW(SL), (06h): DVD+RW(SL), (07h):BD-R(SL), (08h): BD-R(DL),

(09h):BD-R(TL), (0Ah):BD-R(QL), (0Bh): BD-RE(SL), (0Ch): BD-RE(DL),

(0Dh):BD-RE(TL), (0Eh):BD-RE(QL), (0F to FFh):Reserved

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Bytes 98 to 99 shall specify the vendor code

This Ecma Standard does not specify the content of these 2 bytes.

Unless otherwise agreed to by the interchange parties, this content shall be ignored in interchange.

Bytes 100 to 103 shall specify the manufacture date

Bytes 100 to 101 shall specify the year of manufacture

Bytes 102 shall specify the month of manufacture date

Bytes 103 shall specify the day of manufacture date

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Annex A
(normative)

Position of the cassette relative to the reference planes

This Annex shows the position of the cassette relative to the reference planes, as specified in Section 8.4.

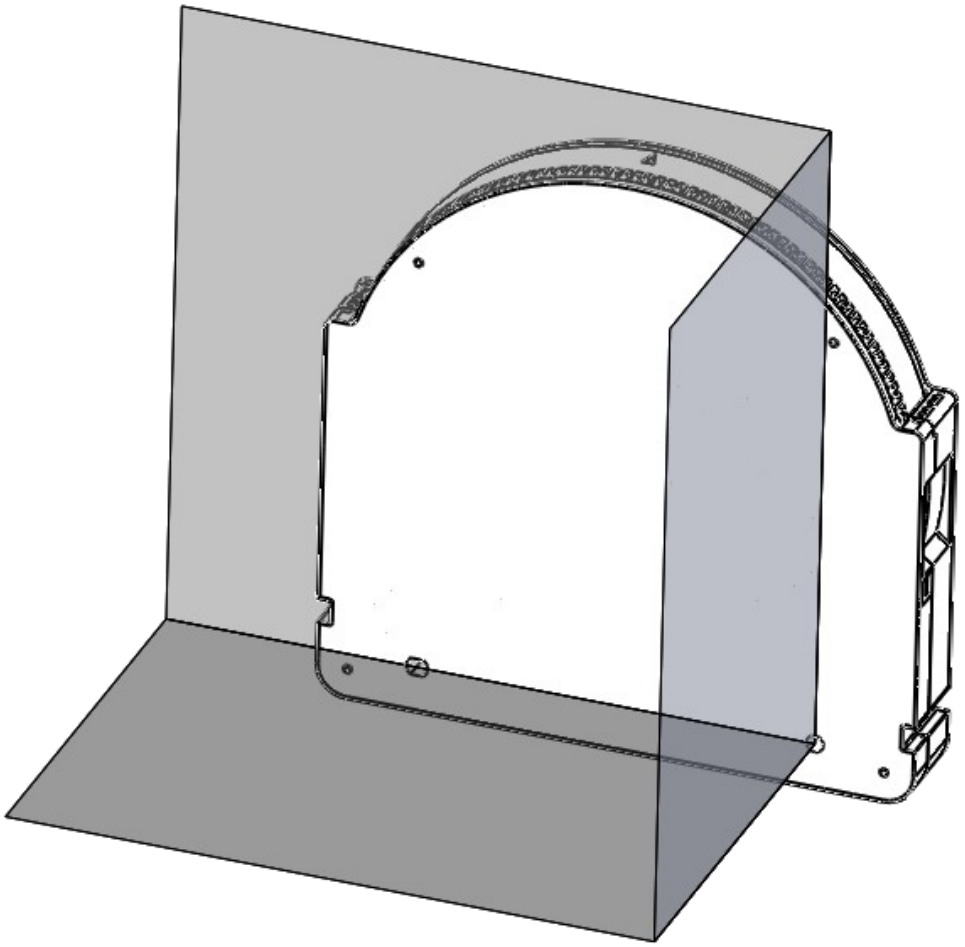

Figure A.1 – Position of the cassette

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Annex B
(informative)

Air cleanliness class 100 000

The classification of air cleanliness is based on a particle count with a maximum allowable number of specified minimum-sized particles per unit volume, and on a statistical average particle size distribution.

B.1 Definition

The particle count shall not exceed a total of 3 500 000 particles per cubic meter of a size 0,5 µm and larger. The statistical average particle size distribution is given in Figure A.1. Class 100 000 means that 3 500 000 particles per cubic meter of a size of 0,5 µm and larger are allowed, but only 25 000 particles per cubic meter of a size of 5,0 µm and larger. It shall be recognized that single sample distribution may deviate from this curve because of local or temporary conditions. Counts below 350 000 particles per cubic meter are unreliable except when a large number of a samplings is taken.

B.2 Test method

For particles of size in the range of 0,5 µm to 5,0 µm, equipment employing light-scattering principles shall be used. The air in the controlled environment is sampled at a known flow rate. Particles contained in the sampled air are passed through an illuminated sensing zone in the optical chamber of the instrument. Light scattered by individual particles is received by a photo detector which converts the light pulses into electrical current pulses. An electronic system relates the pulse height to particle size and counts the pulses such that the number of particles in relation to particle size is registered or displayed.

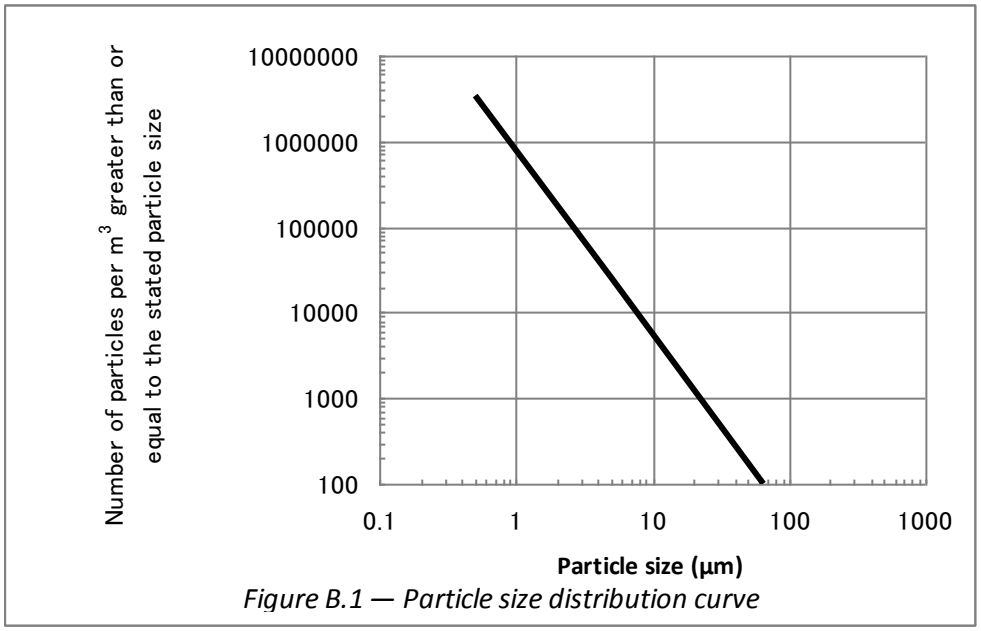

Figure B.1 — Particle size distribution curve

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Annex C
(normative)

Edge distortion test

The distortion test checks whether the cassette is free from unacceptable distortions and protrusions along its edges. The test is made by causing the cassette to pass through the vertical slot of a gauge.

C.1 Test gauge specification

The gauge shall be made of a suitable material, for example, chrome-plated carbon steel. The inner surfaces shall be polished to a surface finish of 5 µm peak-to-peak.

The dimensions shall be as follows (Figure C.1):

La= 138mm

Lb= 138,5mm ±0,1 mm

Lc= 8,0mm ±0,1 mm

Ld= 21,1mm ±0,02mm

Le≥ 26.1mm ±0,1 mm

C.2 Requirements

When the cassette is inserted vertically into the gauge, a vertical force F1 of 1,5 N maximum (without the cassette weight) applied to the center of the top edge of the cassette shall cause the cassette to pass through the gauge.

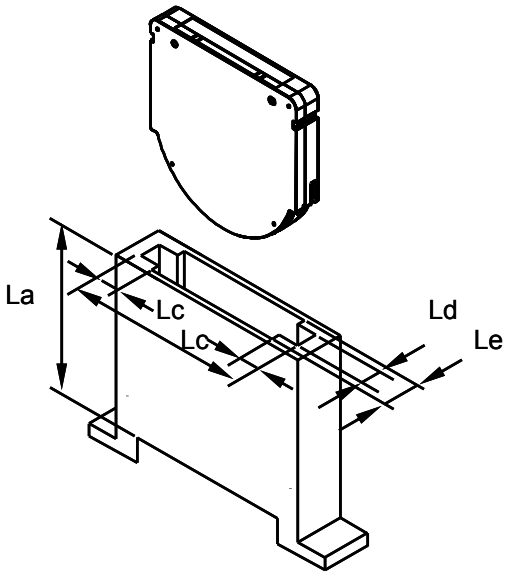

Figure C.1 – Edge distortion gauge for the cassette

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Annex D
(normative)

Compliance test

The compliance test checks the flatness and flexibility of the cassette by forcing the four reference surfaces of the cassette onto a plane. The test is conducted by placing the cassette on the supports of a gauge and applying forces on the cassette opposite to the supports.

D.1 Test gauge specification

The test gauge consists of a base plate on which four posts P1, P2, P3, and P4 are fixed so as to correspond to the four surfaces S1, S2, S3, and S4, respectively (Figure D.1). The location of the four reference surfaces S1, S2, S3, and S4 is defined in 8.4. (Figure 4).

The dimensions are as follows (Figure D.2):

Posts P_1 and P_2

Da = 6,50 mm ± 0,01 mm

Db = 3,90 mm $^{+\ 0,02}_{-\ 0,00}$ mm

Lf = 0,5 mm ± 0,1 mm

Lg = 3,0 mm ± 0,1 mm

The top area of posts P1 and P2 has a chamfer.

Posts P3 and P4

Dc = 5,00 mm ± 0,01 mm

After assembly, both the upper annular surfaces with outer diameter Da of the two posts P_1 and P_2 and the upper surfaces of the two posts P_3 and P_4 shall lie between two horizontal planes spaced 0,01 mm apart.

Positions of four posts P_1, P_2, P_3, and P_4

Each center of posts P_2, P_3, and P_4 shall be located at

L_h = 102,0 mm ± 0,1 mm

L_i = 6,0 mm ± 0,1 mm

L_j = 104,0 mm ± 0,1 mm

L_k = 85,5 mm ± 0,2 mm

from the center of the post P_1.

The cassette shall be placed with its reference surfaces onto the posts of the gauge placed horizontally. A vertical downward force F2 of 1,0 N shall be exerted on the cassette opposite each of the four posts.

D.2 Requirements

Under the conditions of D.1, three of the four surfaces S1 to S4 shall be in contact with the surface of their respective posts, and any gap between the remaining surface S and the surface of its post shall not exceed 0,1 mm.

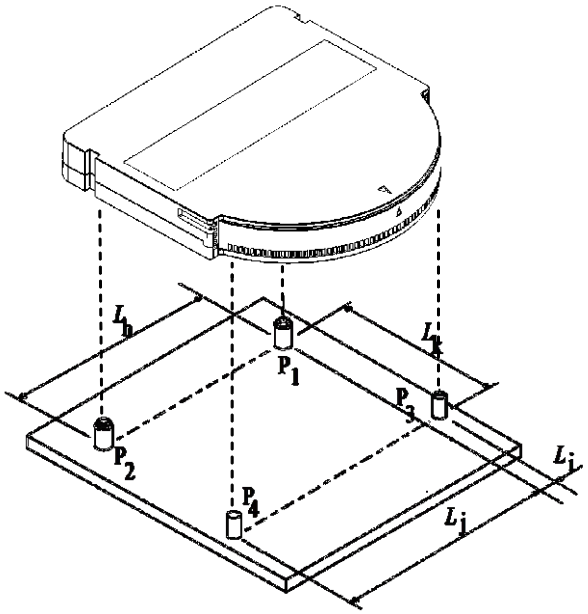

Figure D. 1 – Compliance gauge

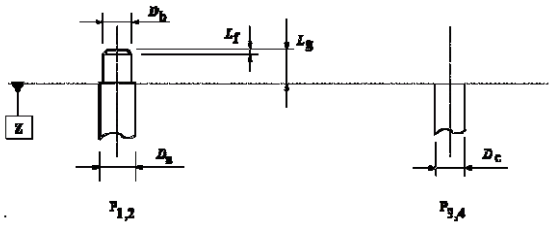

Figure D.2 – Details of posts

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Annex E
(normative)

Frictional force of ring tray

Frictional force of ring tray test checks whether the pulling force is sufficient to overcome the frictional force of the tray. The test is conducted by setting the cassette on the slope of a test gauge and finding the angle at which the ring tray moves.

E.1 Composition of Test gauge

The test gauge has a slope that is fixed by a hinge to the fixed base. The test gauge shall be read with a plate scale in units of degrees of slope angle.

E.2 Test method

The cassette shall be fixed on the slope while the shutter is open.

To measure the angle at which the ring tray moves, gradually increase the angle of the slope plate.

A disk shall examine without putting into a ring tray.

E.3 Requirements

The ring tray shall move at a slope greater than 30.0 °.

The ring tray shall not move at a slope less than 6.0 °.

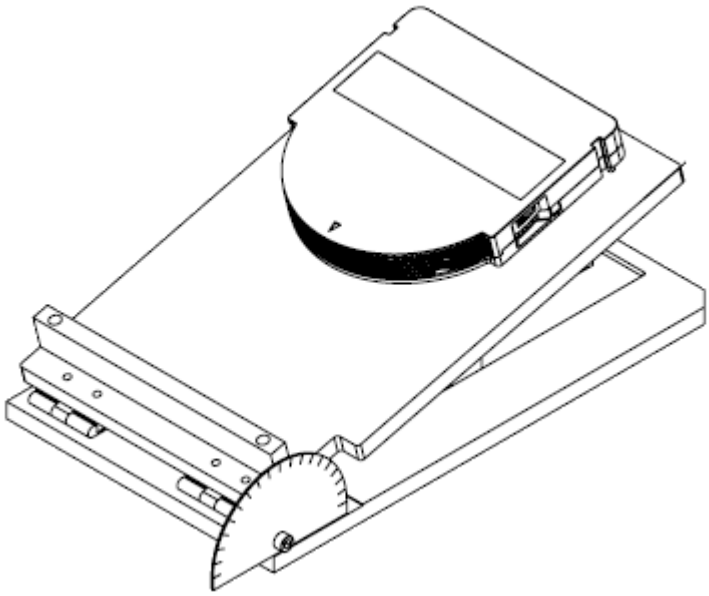

Figure E1 – Frictional force gauge

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Annex F
(**normative**)

Edge distortion test of the ring tray

The warp and twist test of a ring tray checks whether the direction of curvature of a ring tray and the extent of warping are permissible. The test is conducted by putting a ring tray on a horizontal plate and measuring the direction of warp, and then causing the ring tray to pass through the vertical slot of a gauge.

F.1 Test gauge specification (TBD)

The gauge shall be made of a suitable material, for example, chrome-plated carbon steel. The inner surfaces shall be polished to a surface finish of 5 µm peak-to-peak.

The dimensions shall be as follows (Figure F.1):

Ll= 132mm ±0,1 mm

Lm= 170,0mm ±0,1 mm

Ln= 70,0mm ±0,1 mm

Lo= 20,0mm ±0,1mm

Lp= 3,1mm ±0,02mm

Lq= 2,9mm ±0,02mm

Lr= 30,0mm ±0,1mm

Ls= 76,0mm ±0,1mm

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F.2 Requirements

The ring tray shall put in the bottom of the test gauge by self-weight.

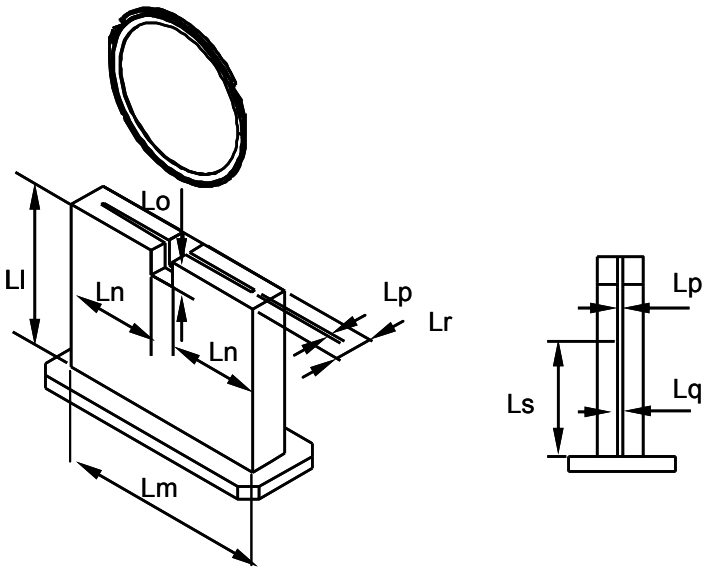

Figure F.1 – Edge distortion gauge of the ring tray

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Annex G
(normative)

Sensitivity test of RFID tag

The sensitivity test of the RFID tag checks whether the RFID tag has sufficient read sensitivity without crosstalk.

G.1 Method for checking read performance of RFID tag

The information on the RFID tag of a cassette is read using an RFID reader that has antenna output of 100 m W and antenna sensitivity of 3 dB. The three cassettes stacked on the table. Those cassettes are named cassette 1, cassette 2, and cassette 3 sequentially from top to bottom. The RFID reader is parallel to the desk along a line that passes through the center of the RFID tag of cassette 2. The distance from the side of a cassette to an antenna shall be 4,0 mm.

G.2 Requirements

The RFID reader shall be read the information of the RFID tag of the cassette 2 without cross talk from the RFID tags of cassette 1 and cassette 3.

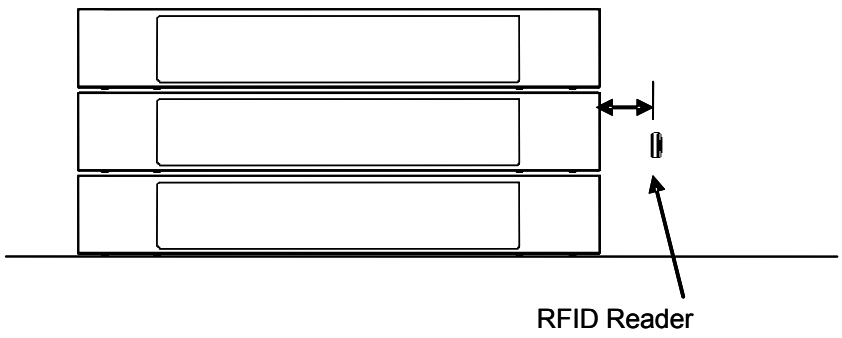

Figure G.1 – RDID tag test unit

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Annex H
(informative)

Office environment

H.1 Air cleanliness

Due to their construction and mode of operation optical disk cartridges have considerable resistance to the effects of dust particles around and inside the disk drive. Consequently it is not generally necessary to take special precautions to maintain a sufficiently low concentration of dust particles.

Operation in heavy concentrations of dust should be avoided e.g. in a machine shop or on a building site.

Office environment implies an environment in which personnel may spend a full working day without protection and without suffering temporary or permanent discomfort.

H.2 Effects of operation

In the office environment (as well as other environments) it is possible for an optical disk drive to degrade the quality of written marks if the read power is applied to a single track for a long period of time. This would happen if a media in a drive remains loaded, the drive remains in the ready status, and is in jump-back mode on one particular track. If this occurs at the maximum operating temperature (55 oC) and at the maximum allowable bias field (32 000 A/m), the marks on the media may be degraded. The media manufacturer's selection of the value for the maximum read powers allowed in the User Zone as well as the optical drive manufacturer's read power management method should reflect this possibility and be designed to minimize any risk to data integrity.

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Annex I
(informative)

Transportation

I.1 General

As transportation occurs under a wide range of temperature and humidity variations, for differing periods, by many methods of transport and in all parts of the world it is not possible to specify conditions for transportation or for packaging.

I.2 Packaging

The form of packaging should be agreed between sender and recipient or, in the absence of such agreement, is the responsibility of the sender. It should take account of the following hazards.

I.3 Temperature and humidity

Insulation and wrapping should be designed to maintain the conditions for storage over the estimated period of transportation.

I.4 Impact loads and vibration

a) Avoid mechanical loads that would distort the shape of the cassette.

b) Avoid dropping the cassette.

c) Cassettes should be packed in a rigid box containing adequate shock-absorbent material.

d) The final box should have a clean interior and a construction that provides sealing to prevent the ingress of dirt and moisture.

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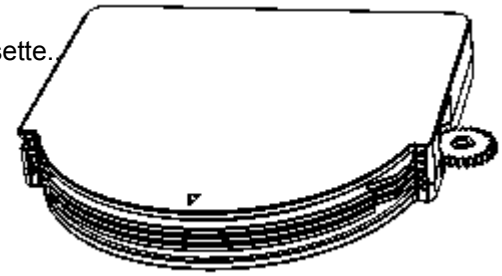
Annex J
(informative)

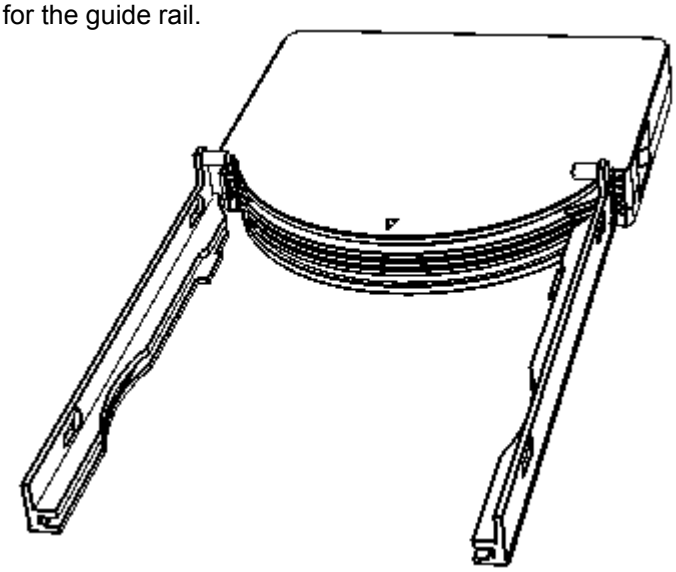
Operation for removing disk from the disk cassette

This is example of the operation for removing a disk from the cassette.

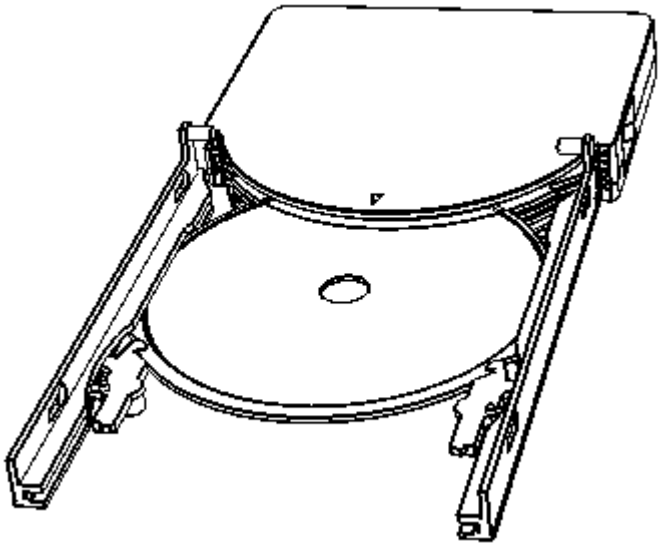
1. The shutter is opened by the gear.



2. The guide rail is put into a positioning hole for the guide rail.



3. Hooks are applied to the chucking parts of the ring tray, and the disk is pulled out.



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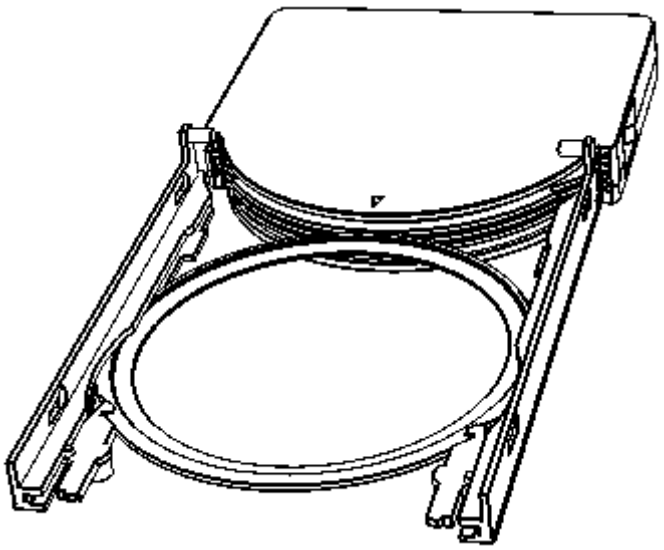
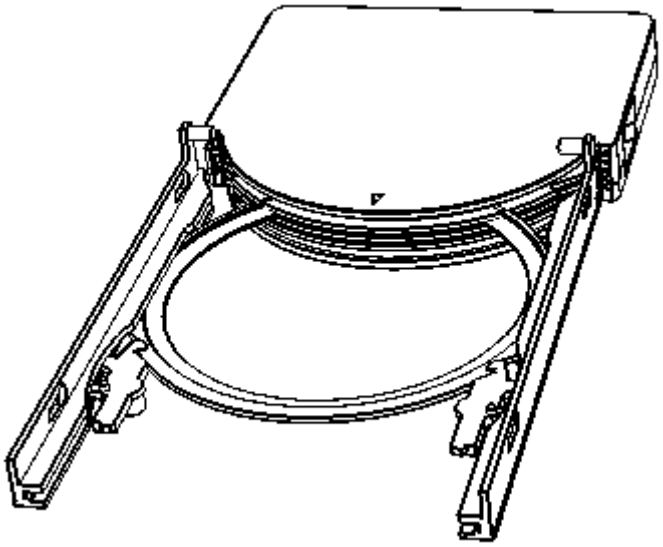
4. The disk is removed.



5. The ring tray is returned.



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