

Audio recording — Minidisc system

The European Standard EN 61909:2000 has the status of a
British Standard

ICS 33.160.30

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

National foreword

This British Standard is the official English language version of EN 61909:2000. It is identical with IEC 61909:2000.

The UK participation in its preparation was entrusted by Technical Committee EPL/100, Audio, video and multimedia systems and equipment, to Subcommittee EPL/100/2, Recording, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 195 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 November 2000

© BSI 11-2000

ISBN 0 580 36673 1

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD

EN 61909

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 2000

ICS 33.160.30

English version

Audio recording - Minidisc system
(IEC 61909:2000)

Enregistrement audio
Système de minidisque
(CEI 61909:2000)

Tonaufzeichnung - Minidisc-System
(IEC 61909:2000)

This European Standard was approved by CENELEC on 2000-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

© 2000 CENELEC - All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

Foreword

The text of document 100B/259/FDIS, future edition 1 of IEC 61909, prepared by SC 100B, Audio, video and multimedia information storage systems, of IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61909 on 2000-08-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2001-05-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2003-08-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annex A is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61909:2000 was approved by CENELEC as a European Standard without any modification.

CONTENTS

Clause	Page
1 General	8
1.1 Scope	8
1.2 Normative references	8
1.3 Basic parameters	8
1.4 Definitions	9
2 Disc specification	15
2.1 Validity	15
2.2 Conditions for measurement of the mechanical dimensions	15
2.3 Other test conditions	15
2.4 Optical pick-up unit for disc measurements	15
2.5 Read out system	16
2.6 Outer diameter	16
2.7 Centre hole	17
2.8 Thickness	17
2.9 Clamping block	17
2.10 Deflection	18
2.11 Protective coating	18
2.12 Optical requirements	19
2.13 Information area	20
2.14 Track pitch	20
2.15 Rotation	21
2.16 Vertical deviations of the information layer	21
2.17 Radial deviations of the track	21
2.18 Write conditions (valid only for recordable groove)	22
2.19 Read conditions	23
2.20 HF signals	24
2.21 Radial tracking signals (including lead-in and lead-out areas)	25
2.22 Tangential tracking signals (valid only for recordable groove and lead-out groove)	25
2.23 Address encoding (valid only for recordable groove and lead-out groove)	26
2.24 Operating conditions	26
2.25 Storage conditions	26
3 Optical stylus	33
4 Cartridge	33
4.1 Size	34
4.2 Mass	34
4.3 Centre hole on the bottom	34
4.4 Windows	34
4.5 Shutter	34
4.6 Horizontal centring of the disc on the player/recorder	35
4.7 Horizontal pre-position of the disc in the cartridge	35

Clause	Page
4.8 Vertical positioning of the disc on the player/recorder	35
4.9 Vertical clearance between the disc and the cartridge	36
4.10 Depth of the sensing holes	36
4.11 Depth of sensing ditch	37
4.12 Holding force	37
4.13 Operating conditions	37
4.14 Storage conditions	37
4.15 Protection of the information area on the disc	37
5 Address	47
5.1 Cluster concept	47
5.2 Pits	47
5.3 Groove	48
5.4 Disc layout	48
5.5 Border of a cluster	48
5.6 Conversion table from address to time	49
6 Pregroove modulation (valid only for recordable MD)	49
6.1 Validity	49
6.2 General parameters	49
6.3 FM modulation	50
6.4 Sector format	50
6.5 Data format	51
6.6 Error detection	51
6.7 Bit rate	51
6.8 ADIP encoder	52
7 EFM modulation	52
7.1 General	52
7.2 Subcode	52
8 ACIRC error correction system	55
8.1 General	55
8.2 ACIRC encoder	55
8.3 ACIRC decoder	55
9 Sector data structure	60
9.1 General	60
9.2 Scrambling	60
9.3 Sector sync	60
9.4 Sector header	60
9.5 Data field	61
10 Audio data	66
10.1 Audio sector data format	66
10.2 Audio data decoding	79
10.3 Additional information	98

Clause	Page
11 Data organization	116
11.1 General.....	116
11.2 Synchronization rules.....	117
11.3 Linking rules (valid only for recordable grooves).....	117
11.4 Lead-in area	118
11.5 Premastered area	125
11.6 UTOC area	125
11.7 Recordable user area.....	134
11.8 Lead-out area	137
11.9 Modified ISO 8859-1 code for the minidisc system.....	153
11.10 Music shifted JIS code for the minidisc system	153
11.11 Application rule for Japanese Katakana format	160
12 Serial copy management system.....	163
12.1 General.....	163
12.2 Recording rule on the MD.....	163
12.3 Playback rule to the digital audio interface.....	165
13 Shock proof memory system	166
13.1 Linear velocity.....	166
13.2 Shock proof feature.....	166
14 Application rules.....	167
14.1 Playback rules	167
14.2 Recording rules.....	167
14.3 Premastered MD	168
Annex A (informative) Recommendations and clarifications for the MD system.....	169
A.1 Principles of operation	169
A.2 Measurement of the disc reflectivity	170
A.3 Measurement of the optical disc unbalance	171
A.4 Measurement of the groove wobble amplitude.....	172
A.5 Beat of wobble and groove geometry	174
A.6 Environment operating and storage conditions	178
A.7 Measurement of the optimum recording power P_O	179
A.8 Measurement of jitter and signal frequency time errors.....	180
A.9 Local defects	183
A.10 Burst errors	183
A.11 Push-pull tracking signal.....	183
A.12 Noise in push-pull tracking signal.....	183
A.13 Diauges for centre hole on the disc	183
A.14 Compliance test of the MD cartridge	186
A.15 Area for braille.....	188
A.16 Long shutter	188
A.17 Extended volume and bend of cartridge	188
A.18 Definition of air cleanliness	189

	Page
A.19 Test of impact durability (recordable disc only).....	191
A.20 Measurement of the friction force	191
A.21 Label area	192
A.22 Wobble signal leakage into I_{sum}	193
Annex ZA (normative) Normative recommendations to international publications with their corresponding European publications.....	195
Figure 1 – Layout of the MD.....	14
Figure 2 – MiniDisc possible profile	27
Figure 3 – HF signal	28
Figure 4 – Spectral components of the time error versus the maximum allowed time error due to mastering or recording.....	29
Figure 5 – Typical shape of the error signal for tracking versus radial position	29
Figure 6 – Open-loop transfer function of the radial servo for an MD-recorder.....	30
Figure 7 – Open-loop transfer function of the radial servo for tracking measurement.....	30
Figure 8 – Operating conditions	31
Figure 9 – Roughness and irregularity (recordable disc only).....	32
Figure 10 – Optical stylus.....	33
Figure 11 – MD cartridge specifications for the premastered version.....	41
Figure 12 – MD cartridge specifications for the recordable version	45
Figure 13 – Maximum existing area of the disc	46
Figure 14 – ADIP encoder block diagram.....	52
Figure 15 – MD encoding/decoding system (main channel).....	54
Figure 16 – ACIRC encoder (add-on de-interleave + encoder)	56
Figure 17 – Integrated ACIRC decoder.....	57
Figure 18 – ACIRC decoder (CIRC decoder + add-on interleave).....	58
Figure 19 – Integrated ACIRC decoder.....	59
Figure 20 – Relation between 16 bit samples and data bytes	62
Figure 21 – Layout of a data block	63
Figure 22 – Scrambler structure	63
Figure 23 – Layout of the sync field.....	64
Figure 24 – Layout of the header field	64
Figure 25 – Sector construction of MD.....	65
Figure 26 – Synchronization rules	138
Figure 27 – Linking rule	139
Figure 28 – Sector structure of MD (general).....	140
Figure 29 – Sector structure of MD (programme area)	141
Figure 30 – Sector structure of MD (TOC sector = 0 (mandatory)).....	142
Figure 31 – Sector structure of MD (TOC sector = 1 (option))	143
Figure 32 – Sector structure of MD (TOC sector = 2 (option))	144
Figure 33 – Sector structure of MD (TOC sector = 3 (option))	145

	Page
Figure 34 – Sector structure of MD (TOC sector = 4 (option))	146
Figure 35 – Sector structure of MD (UTOOC sector = 0 (mandatory))	147
Figure 36 – Sector structure of MD (UTOOC sector = 1 (option))	148
Figure 37 – Sector structure of MD (UTOOC sector = 2 (option))	149
Figure 38 – Sector structure of MD (UTOOC sector = 4 (option))	150
Figure 39 – Mapping of JIS code to shifted JIS	156
Figure 40 – Example of transformation rule	161
Figure A.1 – Schematic set-up for reflectivity measurements	170
Figure A.2 – Unbalance versus read out time in a recordable MD system	171
Figure A.3 – Radial error signal	173
Figure A.4 – Groove wobble	174
Figure A.5 – Grooves “in phase”	351
Figure A.6 – Grooves “out of phase”	176
Figure A.7 – Groove geometry	176
Figure A.8 – ATER and BLER windows for a wide and deep groove	177
Figure A.9 – ATER and BLER windows for a narrow and shallow groove	177
Figure A.10 – Cyclic climatic test	179
Figure A.11 – Recording power (mW) versus block error rate	180
Figure A.12 – Examples of time errors	182
Figure A.13 – Diagauge	184
Figure A.14 – Disc base	185
Figure A.15 – Measurement method	185
Figure A.16 – Test gauge	186
Figure A.17 – Test method (4-forces)	187
Figure A.18 – Test method (3-forces)	187
Figure A.19 – The area for braille	188
Figure A.20 – Extended volume and bend of cartridge	189
Figure A.21 – Number of particles	190
Figure A.22 – Test of impact durability	191
Figure A.23 – Arrangement of head and disc for the measurement of friction force	192
Figure A.24 – Label area	193
Figure A.25 – Wobble signal leakage	194
Table 1 – ASCII – Code table	151
Table 2 – 6 bit format	152
Table 3 – Modified ISO 8859-1 code table for the minidisc system	154
Table 4 – JIS code table for minidisc system	155
Table 5 – Contents of MD external characters	157
Table 6 – Caption of illustrated characters	158
Table 7 – The translation between the Roman alphabet and Japanese katakana	162
Table 8 – Recording rule	164

AUDIO RECORDING – MINIDISC SYSTEM

1 General

1.1 Scope

This International Standard applies to the MiniDisc (MD). It defines the mechanical and electrical characteristics necessary to ensure the interchangeability of both premastered optical discs and recordable magneto-optical discs of 64 mm diameter for the compressed digital audio recording system.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60908:1999, *Compact disc digital audio system*

IEC 60958:1989, *Digital audio interface*

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

ISO 3901:1986, *Documentation – International Standard Recording Code (ISRC)*

ISO 8859-1:1998, *Information technology – 8 bit single byte coded graphic character sets – Part 1: Latin alphabet No. 1*

JISX0208:1990, *Code of the Japanese graphic character set for information interchange*

1.3 Basic parameters

1.3.1 Main parameters

Maximum playing and recording time:	approximately 74 min (stereo) approximately 148 min (mono)
Cartridge size:	68 depth × 72 width × 5 height (mm)

1.3.2 Disc parameters

Diameter of the disc:	64 mm
Starting diameter of the lead-in area:	29 mm
Diameter of the centre hole:	11 mm
Thickness of the disc:	1,2 mm
Track pitch:	1,6 µm
Scanning velocity:	1,2 m/s ~ 1,4 m/s

1.3.3 Optical parameters

Laser wavelength:	780 nm typical
Objective lens NA (numerical aperture):	0,45
Recording power:	2,5 mW ~ 5,0 mW
Recording strategy:	magnetic field modulation

1.3.4 Signal format

Modulation:	EFM
Error correction system:	advanced CIRC (ACIRC)

1.3.5 Transfer rates

Main data rate:	292 kbit/s
Sub-data rate:	36,5 kbit/s (premastered MD) 9,1 kbit/s (recordable MD)

1.3.6 Audio format

Number of channels:	2 channels. stereo or double play mono
Sampling frequency:	44,1 kHz
Coding:	ATRAC (adaptive transform acoustic coding)

1.4 Definitions

1.4.1 Definitions, symbols and abbreviations

For the purpose of this International Standard, the following definitions and abbreviations apply.

CLV:	constant linear velocity
groove:	the guidance track in which completely identical clocking and address information is seen at both edges on the recordable groove.

The pregroove is U-shaped

- a typical depth of $\frac{\lambda}{9n} \sim \frac{\lambda}{7n}$ ($n = 1,55 \pm 0,1$)
- a typical width of $1,0 \mu\text{m} \sim 1,2 \mu\text{m}$

pit: pits on the high reflectivity MD

Premastered effect ($I_3.. I_{11}$ effect)

- a typical depth of $1/5n$ ($n = 1,55 \pm 0,1$)
- a typical width of $0,45 \mu\text{m} \sim 0,7 \mu\text{m}$.

Pits are U-shaped on the low reflectivity MD

- a typical depth of $\frac{\lambda}{9n} \sim \frac{\lambda}{7n}$ ($n = 1,55 \pm 0,1$)
- a typical width of $0,45 \mu\text{m} \sim 0,7 \mu\text{m}$.

land: area between the grooves

NOTE In HF measurements (e.g. jitter) 'Land' is often used as the area between pits.

MM: magnetic field modulation

The EFM encoded information is recorded on the disc by switching an external magnetic field between two opposite directions. At every transition in the EFM signal, the magnetic field is switched.

H_{ext} : external magnetic field

the magnetic field that switches between two opposite directions (both perpendicular to the disc surface) according to the EFM encoded information

When laser heats up the magneto optic layer of the disc locally, this magnetic field causes a permanent magnetic domain in the magneto optic layer on the disc.

H_o : the optimum external magnetic field

The centre value of the range of external magnetic fields that will give results within specification.

CW: continuous wave

The laser light output is at a constant level.

P_o : the optimum recording power

the centre value of the range of recording powers that will give results within specification. For the measurement of P_o , see clause A.7

P_w : nominal recording power quantized by the write power table in TOC according to optimum recording power P_o

wobble: the pregroove in the disc is not a perfect spiral but is wobbled with:

- a typical amplitude of 30 nm;
- a spatial period of 54 μm to 64 μm .

When this wobble is locked to a frequency of 22,05 kHz, the velocity of the disc should be in the range of 1,2 m/s to 1,4 m/s

ADIP: address in pregroove

With an additional modulation of the groove wobble, the pregroove contains an address information called ADIP (see clause 6).

ATER: ADIP error rate

number of erroneous ADIP frames in proportion to the total number of frames.

jitter: the 1 s value of the time variations between consecutive I_3 transitions (land and pit) of the unequalized HF signal (random EFM data)

For the measurement of jitter, see clause A.8.

$\frac{\Delta P_o \times 100}{\Delta T \times P_o}$: temperature coefficient of the sensitive layer of the disc. It is expressed as the relative change in optimum recording power per degree Celsius temperature difference (%/ °C)

- HF signal: as defined in clause A.1, is measured before a.c. coupling (see figure 3).
The highest and lowest fundamental frequencies that occur in the EFM signal are 720 kHz and 196 kHz.
The peak-to-peak values of the highest and lowest fundamental frequencies are denoted by I_3 and by I_{11} respectively.
The top level of HF signal, which is given by the lowest fundamental frequency, is denoted by I_{top} .
- BLER: block error rate
number of erroneous EFM frames in proportion to the total number of frames
The BLER is measured at the entry to C1 decoder. At that stage, 1 block corresponds to 32 symbols
- crosstalk: the ratio between HF signal amplitude when on track and when between the tracks
- push pull: an off-track position of the scanning spot results in a diffraction pattern that is asymmetrical in the radial direction of the disc
Subtraction of the powers into the two halves of the aperture of the objective lens yields a servo signal for the track following (this signal is called the push pull signal).
- enhancement: the use of polarization-dependent optics to improve MO system performance
- ODU: optical disc unbalance
variation in the read signal amplitude with time as the optical pickup scans along the track due to non-uniformity of optical properties such as birefringence

1.4.2 Disc areas

Additional information about the areas mentioned below is given in clause 11.

The layout of the MD is given in figure 1.

The terms used to distinguish between the areas on the disc are:

information area: this area of an MD contains CLV clocking information and an address.

The information area of the disc is divided into five parts:

	Area	Premastered MD	Recordable MD
1	Lead-in	Yes	Yes
2	Premastered	Yes	Optional
3	UTOC	No	Yes
4	Recordable user	No	Yes
5	Lead-out	Yes	Yes

lead-in area:	contains premastered information with the table of contents (TOC)
premasted area:	contains premastered information tracks
UTOOC area:	contains: – the user table of contents for the information tracks in the recordable user area after (partial) recording; – the power calibration area; – the reserved area.
recordable user area:	in this area, the tracks with user information are recorded
lead-out area:	contains premastered pits on the premastered MD, or premastered groove on the recordable MD

NOTE 1 The premastered area together with the recordable user area is called the programme area.

NOTE 2 The UTOC area together with the recordable user area is called the recordable area.

NOTE 3 The recordable MD with the optional premastered area is called hybrid MD.

1.4.3 Signals

Premastered signals: the premastered signals are measured with a set-up as defined in 2.4.1.

I_o :	blank area level
I_{top} :	top level of premastered I_{11} signal
I_{slice} :	decision level of EFM slicer (digitizer)
I_{11}/I_{top} :	modulation amplitude of premastered I_{11} signal
asymmetry = $((I_{slice}/I_{11}) - 0,50) \times 100 \%$ (see figure 3)	
I_3/I_{top} :	modulation amplitude of premastered I_3 signal
I_1 :	land level
I_g :	groove level
	groove level > land level for the recordable area
$RC=2(I_1 - I_g)/(I_1 + I_g)$:	radial contrast

For premastered pits: I_g (resp. I_1) is defined as the averaged (=15 μ s) HF signal, measured in the groove (resp. on land) before a.c. coupling.

$|I_1 - I_2|/I_{\text{top}}$ at 0,1 μm radial offset:

push-pull amplitude for the premastered pits area

$(I_1 - I_2)$ is measured after low-pass filtering ($f < 5$ kHz).

$I_1 - I_2$ denotes the optical power difference in two halves of the reflected beam measured at far field.

This push-pull signal is measured in the open loop situation for the tracking servo. Due to the eccentricity of the disc the read spot scans several tracks.

By assuming a sinewave relation between tracking signal and tracking error, one obtains from the peak-to-peak value of the error signal, the tracking signal value at a radial offset of 0,1 μm (track spacing is 1,6 μm).

$|I_1 - I_2|/I_g$ at 0,1 μm radial offset:

push-pull amplitude for the premastered grooves area (recordable area)

$(I_1 - I_2)$ is measured after low-pass filtering ($f < 5$ kHz)

$I_w = (I_1 - I_2)$:

wobble signal

$(I_1 - I_2)$ is measured after band-pass filtering ($10 < f < 30$ kHz).

$I_{w\text{-rms}}/(I_1 - I_2)_{\text{pp}}$:

normalized wobble signal (see clause A.4.)

noise in radial tracking signal:

measured in the closed loop situation in a frequency band from 500 Hz to 10 kHz (servo band width 200 Hz) at integration time of 20 ms

recorded signals:

measured with a standard MO differential detection set-up (see 2.4.1 and clause A.1.)

This implies that no polarization optics are used, other than the splitter immediately in front of detectors D_1 and D_2 . All MO signals in this standard therefore apply to signals without enhancement. See note to clause A.1.

I_{sum} :

$D_1 + D_2$

I_{11}/I_{sum} :

modulation amplitude of recorded I_{11} signal in $D_1 - D_2$

I_3/I_{sum} :

modulation amplitude of recorded I_3 signal in $D_1 - D_2$

ODU =

optical disc unbalance

$|D_1 - D_2|/I_{\text{max}}/(D_1 + D_2)$

D_1 and D_2 are measured after low-pass filtering ($f < 100$ Hz).

1.4.4 Reflectivity

The reflectivity of a disc is fixed as high or low throughout the disc.

Reflectivity	Premastered MD	Recordable MD
High reflectivity MD	Yes	–
Low reflectivity MD	Yes	Yes

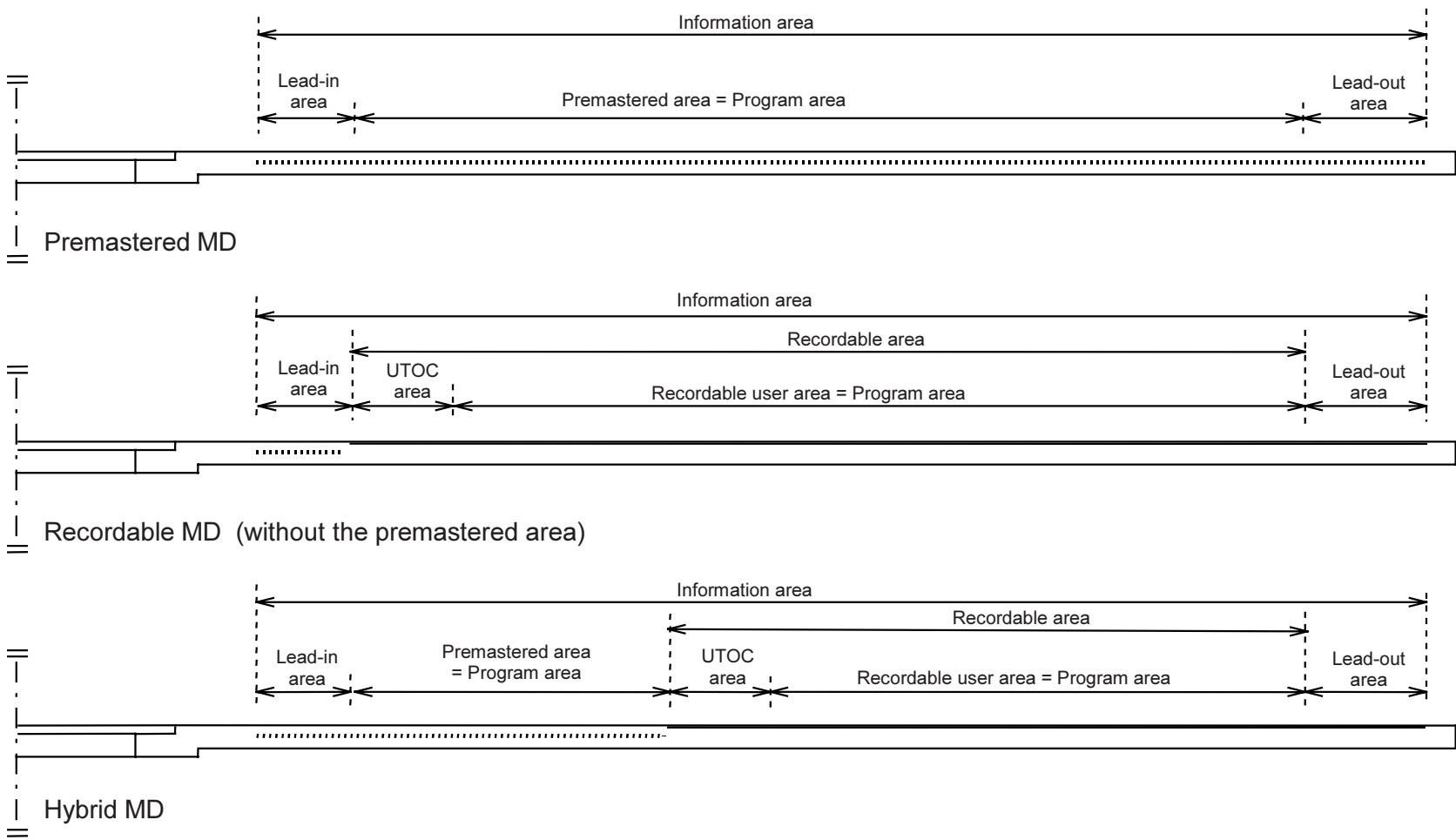


Figure 1 – Layout of the MD

Disc centre

IEC 630/2000

2 Disc specification

2.1 Validity

These specifications are valid for both premastered MD and recordable MD (including hybrid MD) unless otherwise specified.

2.2 Conditions for measurement of the mechanical dimensions

Ambient temperature:	23 °C ± 2 °C
Relative humidity:	50 % RH ± 5 % RH
Air pressure:	86 kPa to 106 kPa
Air cleanliness:	class 100 000. See clause A.18.
Conditioning before testing:	minimum 48 h

2.3 Other test conditions

Ambient temperature:	15 °C to 35 °C
Relative humidity:	45 % RH to 75 % RH
Air pressure:	86 kPa to 106 kPa

2.4 Optical pick-up unit for disc measurements

2.4.1 Optical

	For premastered MD	For recordable MD
Laser wavelength	780 nm ± 10 nm	780 nm ± 10 nm
NA	0,45 ± 0,01	0,45 ± 0,01
Direction of polarization	Circular	E-vector perpendicular to pregroove
Polarization ratio on disc ($I_{\perp}/I_{\parallel}$)	—	> 45
Retardation of read out optics ($\Delta p - \Delta s$)	—	< 10°
Wave front distortion (w.f.d.)	< 0,05 λ	< 0,05 λ
Rim-intensity of the pupil Tangential	> 0,5	0,7 ± 0,1
Rim-intensity of the pupil Radial	> 0,5	0,1 ± 0,05

2.4.2 Magnetic (during recording)

	For premastered MD	For recordable MD
Magnetic field perpendicular to the MO layer at laser spot position	–	$8 \text{ kA/m} < H_{\text{ext}} < 24 \text{ kA/m}$ ($100 \text{ Oe} < H_{\text{ext}} < 300 \text{ Oe}$)
Risetime of the magnetic field (–90 % to +90 %)	–	<200 ns

2.5 Read out system

	Characteristics to be specified	Requirements	Remarks
2.5.1	Read out principle	Diffraction for premastered pits Kerr effect for recorded signals	
2.5.2	Read out mode	By reflection, through transparent disc	
2.5.3	Track shape	One spiral	No track interruption in information area
2.5.4	Transition between pits and groove	At the transition between pits and groove the premastered signals may be out of specification for a duration of $t < 50 \mu\text{s}$	
2.5.5	Disc geometry	See figure 2	

2.6 Outer diameter

	Characteristics to be specified	Requirements	Remarks
2.6.1	Outer diameter	$\varnothing 64,0 \text{ mm} \pm 0,2 \text{ mm}$	Measured at $23 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ and $50 \text{ } \% \text{ RH} \pm 5 \text{ } \% \text{ RH}$ $\varnothing 64,8 \text{ mm} \pm 0,2 \text{ mm}$ is optionally permitted for recordable MD
2.6.2	Eccentricity	$\pm 0,1 \text{ mm}$	Relative to centre hole (largest inner circle) measured at the height less than 0,6 mm from the reference plane
2.6.3	Edge shape	Free from burrs; chamfer or radius are permitted.	See figure 2
2.6.4	Disc mass	3 g ~ 6 g	Excluding clamping plate. Glass substrate (9 g) is permitted for measurements and adjustments only

2.7 Centre hole

	Characteristics to be specified	Requirements	Remarks
2.7.1	Diameter	$\varnothing 11^{+0,07}_0$ mm See clause A.13.	Measured at $23\text{ °C} \pm 2\text{ °C}$ and $50\text{ \% RH} \pm 5\text{ \% RH}$
2.7.2	Shape of centre hole	Cylindrical	
2.7.3	Edge shape	A chamfer or radius is permitted. Burr at the information side of the disc are permitted.	See figure 2

2.8 Thickness

	Characteristics to be specified	Requirements	Remarks
2.8.1	Thickness of premastered disc ($D \leq \varnothing 62$ mm) ($\varnothing 62$ mm $< D \leq \varnothing 64$ mm)	$1,2^{+0,15}_{-0,1}$ mm See figure 2	Including both protective coating and printing. See figure 2 Including both protective coating and printing
2.8.2	Thickness of recordable disc ($D \leq \varnothing 62$ mm) ($\varnothing 62$ mm $< D \leq \varnothing 64,8$ mm)	$1,2^{+0,12}_{-0,1}$ mm See figure 2	Including protective coating. See figure 2 Including both protective coating and printing

2.9 Clamping block

	Characteristics to be specified	Requirements	Remarks
2.9.1	Clamping area	$\varnothing 11,4\text{ mm} \leq D \leq \varnothing 16,4\text{ mm}$	See figure 2
2.9.2	Outer diameter of clamping block	$\varnothing 16,8\text{ mm} \pm 0,1\text{ mm}$	
2.9.3	Thickness of clamping plate	$0,4\text{ mm} \pm 0,04\text{ mm}$	ISO 683-13 type 8 ferritic stainless steel
2.9.4	Height of clamping plate	$1,8\text{ mm} \pm 0,1\text{ mm}$	From the reference plane of the disc, $D \leq \varnothing 9,0\text{ mm}$
2.9.5	Nominal height of information layer	$2,0\text{ mm} \pm 0,1\text{ mm}$	From the reference plane of the disc
2.9.6	Maximum clamping force	5 N	Disc and cartridge shall not be broken by the maximum clamping force

2.10 Deflection

	Characteristics to be specified	Requirements	Remarks
2.10.1	Maximum deflection	$\pm 0,2 \text{ mm}$	$\varnothing 29 \text{ mm}$ to maximum $\varnothing 65 \text{ mm}$
2.10.2	Maximum deflection, averaged over one revolution	$\pm 0,15 \text{ mm}$	$\varnothing 29 \text{ mm}$ to maximum $\varnothing 65 \text{ mm}$
2.10.3	Maximum angular deviation of the beam incident surface from the disc reference plane	$\pm 0,6^\circ$	Within information area ($\varnothing 29 \text{ mm}$ to maximum $\varnothing 62 \text{ mm}$)
2.10.4	Maximum angular deviation of the reflected beam in the radial direction, from the normal line of the disc reference plane (including unparallelism of disc substrate)	$\pm 1,6^\circ$ $\pm 1,2^\circ$	Within information area ($\varnothing 29 \text{ mm}$ to maximum $\varnothing 62 \text{ mm}$ diameter) For premastered MD For recordable MD

2.11 Protective coating

	Characteristics to be specified	Requirements	Remarks
2.11.1	Protective coating diameters	Shall not exceed dimensions of the disc	See figure 2
2.11.2	Protective coating side of disc	See figure 2	
2.11.3	Reflectivity	Not defined	
2.11.4	Thickness of protective coating	$< 20 \text{ }\mu\text{m}$ ($D \leq \varnothing 62 \text{ mm}$)	For recordable MD only
2.11.5	Coating	Shall not disturb external magnetic field	For recordable MD only
2.11.6	Friction force ($-25^\circ\text{C} \leq T < -15^\circ\text{C}$) ($-15^\circ\text{C} \leq T \leq +70^\circ\text{C}$)	$< 10 \text{ mN}$ $< 6 \text{ mN}$	For recordable MD only at the down force of 20 mN See clause A.20.
2.11.7	Impact durability	> 100 times	For recordable MD only within specifications after the test See clause A.19
2.11.8	Roughness of surface	$< R_{\text{max}} = 1,6 \text{ }\mu\text{m}$	For recordable MD only baseline $L = 0,8 \text{ mm}$ $D \leq \varnothing 62 \text{ mm}$ See figure 9

	Characteristics to be specified	Requirements	Remarks
2.11.9	Irregularity of the surface	$<10 \mu\text{m}$	For recordable MD only. See figure 9. $D \leq \varnothing 62 \text{ mm}$ Disc is recommended to minimize the irregularity
2.11.10	Maximum gradient of the surface	$25 \mu\text{m/mm}$	For recordable MD only. See figure 9
2.11.11	Contact durability	$>2 \times 10^6$ pass	For recordable MD only – for a single track – disc is rotating at scanning velocity – tracing with dummy head at the down force of 20 mN-dummy head See clause A.20 – wear in thickness $<1 \mu\text{m}$

2.12 Optical requirements

NOTE Within the information area.

	Characteristics to be specified	Requirements	Remarks
2.12.1	Thickness of transparent disc substrate	$1,2 \text{ mm} \pm 0,1 \text{ mm}$	($\varnothing 29 \text{ mm}$ to max. $\varnothing 62 \text{ mm}$) excluding reflective layer, protective coating
2.12.2	Refractive index of transparent substrate	$1,55 \pm 0,1$	
2.12.3	Maximum birefringence of transparent substrate	100 nm	Double pass parallel beam nominal incidence
2.12.4	Optical disc unbalance	$\text{ODU} < 0,05$	for recordable groove only. ODU includes birefringence, within recordable area $\varnothing 32 \text{ mm}$ to maximum $\varnothing 61 \text{ mm}$ See clause A.3.

	Characteristics to be specified	Requirements	Remarks
2.12.5	Reflection and double pass substrate transmission	$R > 70 \%$ $15 \% < R < 25 \%$	For high reflectivity MD For low reflectivity MD See clause A.2.
2.12.6	Wavelength sensitivity of R	$\Delta R/R_{780} < \begin{smallmatrix} +50 \\ -30 \end{smallmatrix} \%$	In parallel beam wave length range 630 nm ~ 830 nm
2.12.7	Maximum variation of reflection and double pass substrate transmission	$\Delta R/R < \pm 10 \%$ frequency ≤ 100 Hz	Disc rotating at scanning velocity
2.12.8	Optical quality of the disc	Wave front distortion $< 0,05 \lambda$	$D \leq$ (the outer diameter of the lead-out area + 1) mm $\varnothing$
2.12.9	Inner diameter of the reflective and/or sensitive layer	$\varnothing 25 \text{ mm} \pm 1 \text{ mm}$	Recordable MD only
2.12.10	Outer diameter of the reflective and/or sensitive layer	Minimum $\varnothing 63 \text{ mm}$	Recordable MD only

2.13 Information area

	Characteristics to be specified	Requirements	Remarks
2.13.1	Outer diameter of lead-in area	$\varnothing 32 \begin{smallmatrix} +0,2 \\ -0,2 \end{smallmatrix} \text{ mm}$	Measured at $23 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ and $50 \pm 5 \%$ RH
2.13.2	Outer diameter of programme area (D_p)	$D_p \leq \varnothing 61 \text{ mm}$	Measured at $23 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ and 50% RH $\pm 5 \%$ RH
2.13.3	Maximum starting diameter of lead-in area	$\varnothing 29 \text{ mm}$	Measured at $23 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ and 50% RH $\pm 5 \%$ RH
2.13.4	Minimum outer diameter of lead-out area	$\varnothing (D_p + 2) \text{ mm}$ $\varnothing 62 \text{ mm}$	Measured at $23 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ and 50% RH $\pm 5 \%$ RH for $D_p \leq 60$ for $60 < D_p \leq 61$

2.14 Track pitch

	Characteristics to be specified	Requirements	Remarks
2.14.1	Track pitch	$1,6 \mu\text{m} \pm 0,1 \mu\text{m}$	In programme area and lead-in/out area

2.15 Rotation

	Characteristics to be specified	Requirements	Remarks
2.15.1	Sense of rotation	Counter clockwise	Seen from read out side
2.15.2	Scanning velocity	1,20 m/s ~ 1,40 m/s	
2.15.3	Maximum velocity variation on one disc	$\pm 0,01$ m/s	On one disc, for frequency <1 Hz

2.16 Vertical deviations of the information layer

NOTE As observed by the optical stylus, so included are tolerances on thickness, refractive index, and deflection.

	Characteristics to be specified	Requirements	Remarks
2.16.1	Maximum vertical deviation of the information layer from the nominal value for frequencies <500 Hz	$\pm 0,3$ mm	
2.16.2	Maximum. r.m.s. value for frequencies <500 Hz	$\pm 0,25$ mm	
2.16.3	Maximum vertical acceleration for frequencies <500 Hz	10 m/s ²	Disc rotating at scanning velocity
2.16.4	Maximum vertical deviation for frequencies >500 Hz	± 1 μ m	

2.17 Radial deviations of the track

	Characteristics to be specified	Requirements	Remarks
2.17.1	Maximum eccentricity of track radius for frequencies <500 Hz	± 50 μ m	Relative to centre hole (largest inner circle) including both circularity and dynamic runout measured at the height less than 0,6 mm from the reference plane
2.17.2	Maximum radial acceleration (eccentricity and unroundness) for frequencies <500 Hz	1,0 m/s ²	Disc rotating at scanning velocity
2.17.3	Maximum radial deviation for frequencies <500 Hz	See 2.21.3.	

2.18 Write conditions (valid only for recordable groove)

	Characteristics to be specified	Requirements	Remarks
2.18.1	General recording strategy	Magnetic field Modulation (MM) Recording in wide groove CW recording power.	
2.18.2	Nominal recording power of a disc	P_w in TOC	For $T = 25^\circ \text{C}$; P_w is indicated on the recording power table in the TOC
2.18.3	Nominal recording power range for all discs	$2,5 \text{ mW} \leq P_w \leq 5,0 \text{ mW}$	For $T = 25^\circ \text{C}$, CW in the central spot
2.18.4	Minimum recording power sensitivity of a disc	For $P_w^{+0,18}_{-0,20} P_w$ Disc shall be recordable within the specification	For $T = 25^\circ \text{C}$ $H_0 = 16 \text{ kA/m}$
2.18.5	Minimum magnetic field sensitivity range	For $P_0 \pm 0,2 P_0$ disc shall be recordable within the specification for $8 \text{ kA/m} < H_{\text{ext}} < 24 \text{ kA/m}$	For measurement of P_0 see clause A.7, for P_0 disc shall be recordable within the specification for $6,4 \text{ kA/m} < H_{\text{ext}} < 24 \text{ kA/m}$
2.18.6	Overwrite conditions	Equal to write conditions	
2.18.7	Temperature dependence of recording power	$-0,7 \text{ }^\circ\text{C}$ $< \frac{\Delta P_0 \times 100}{\Delta T \times P_0} < -0,3 \text{ }^\circ\text{C}$	
2.18.8	Wavelength sensitivity of recording power	Optimum recording power of the disc shall be within 10 % for $770 \text{ nm} < \lambda < 830 \text{ nm}$.	Sensitivity measured with a constant laser spot size on the disc
2.18.9	Radial tracking	Offset $< 0,1 \text{ } \mu\text{m}$	Relative to centre of average pregroove position. See 2.21
2.18.10	Overwrite ability	$> 10^6$ times within the specification	With non-contact magnetic head

2.19 Read conditions

	Characteristics to be specified	Requirements	Remarks
2.19.1	Power in read spot	$\leq 0,7 \text{ mW}$	CW, in the central spot
2.19.2	Read stability	$>10^6$ times successively read from a single track, the disc should remain within the specification	For $P_{\text{read}} = 0,7 \text{ mW}$ and $T = 70 \text{ }^{\circ}\text{C}$
2.19.3	Radial tracking	Offset $< 0,1 \text{ }\mu\text{m}$	Relative to centre of average pregroove position. See 2.21

2.20 HF signals

See figure 3.

	Characteristics to be specified	Requirements			
		High reflectivity	Low reflectivity		
		Premastered	Premastered		Recorded
		Pits	Pits	Grooves	Grooves
		Including lead-in and lead-out areas			Excluding lead-out area
2.20.1	Modulation amplitude				
	I_3 / I_{top}	0,3 ~ 0,7	>0,15	—	—
	I_{11} / I_{top}	≥0,6	0,3 ~ 0,6	—	—
	I_{11} / I_{sum}	—	—	—	0,03 ~ 0,08
	I_3 / I_{11}	—	—	—	>0,35
2.20.2	Asymmetry	−15 ~ +5 %	−15 ~ +10 %	—	< ±20 %
2.20.3	Block Error Rate (averaged over any 10 s)	< 3×10^{-2}	< 3×10^{-2}	—	< 3×10^{-2}
2.20.4	Crosstalk	< 50 %	< 50 %	—	—
2.20.5	Carrier-to-noise ratio for periodic effects in the range from 200 kHz ~ 720 kHz	— ($f \leq 4$ kHz).	—	—	>46 dB (BW = 10 kHz)
2.20.6	Jitter (see 1.4.1 and clause A.8)	<30 ns	<40 ns	—	<40 ns
2.20.7	Signal frequency time errors (see clause A.8)	The spectral components of the time errors should be below the values given in figure 4 ($f \leq 4$ kHz)	The spectral components of the time errors should be below the values given in figure 4 ($f \leq 4$ kHz)	—	The spectral components of the time errors should be below the values given in figure 4 ($f \leq 4$ kHz).
NOTE The requirement describes the time errors due to the mastering or recording.					

2.21 Radial tracking signals (including lead-in and lead-out areas)

- For a recorder, the bandwidth of the radial servo is > 700 Hz (see figure 6).
- For the measurement of noise, the band width of the radial servo is 200 Hz (see figure 7).

	Characteristics to be specified	Requirements			
		High reflectivity	Low reflectivity		
		Premastered	Premastered		Recorded
		Pits	Pits	Grooves	Grooves
2.21.1	Push pull amplitude	0,04 ~ 0,07	0,04 ~ 0,11	0,09 ~ 0,18	0,09 ~ 0,18
2.21.2	Variation on push pull amplitude	< ±15 %	< ±15 %	< ±15 %	< ±15 %
2.21.3	Noise in radial tracking signal	<0,03 µm r.m.s.	<0,02 µm r.m.s.	<0,02 µm r.m.s.	<0,02 µm r.m.s.
2.21.4	RC	+0,23 ~ +0,40	+0,18 ~ +0,30	-0,20 ~ -0,35	-0,20 ~ -0,35
2.21.5	Variations on RC	< ±15 %	< ±15 %	< ±15 %	< ±15 %
NOTE Large radial contrast (RC > 0,3) on the recordable groove with gentle slopes may cause:					
a) the increase on ATER in case of the defocusing (+1 µm) (see clause A.5).					
b) the increase on BLER due to the leak of the wobble to the MO signals.					

2.22 Tangential tracking signals (valid only for recordable groove and lead-out groove)

	Characteristics to be specified	Requirements			
		High reflectivity	Low reflectivity		
		Premastered	Premastered		Recorded
		Pits	Pits	Grooves	Grooves
2.22.1	Locking frequency for groove wobble	—	—	22,05 kHz	22,05 kHz
2.22.2	Normalized wobble signal (see clause A.4)	—	—	0,035 ~ 0,050 (for track pitch 1,6 µm)	0,035 ~ 0,050 (for track pitch 1,6 µm)
2.22.3	CNR of wobble	—	—	>35 dB BW = 1 kHz	>35 dB BW = 1 kHz

2.23 Address encoding (valid only for recordable groove and lead-out groove)

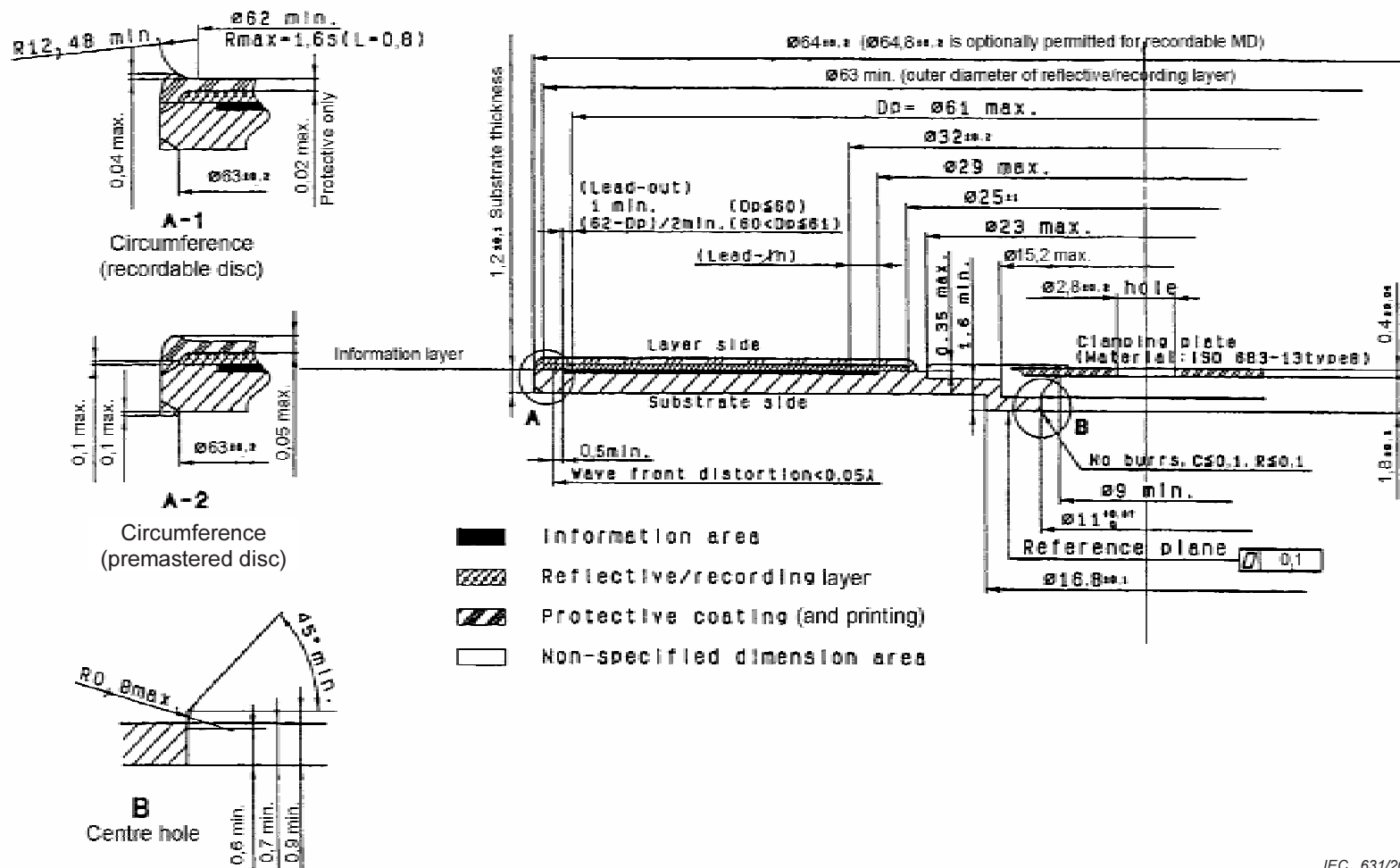
	Characteristics to be specified	Requirements			
		High reflectivity	Low reflectivity		
		Premastered	Premastered		Recorded
		Pits	Pits	Grooves	Grooves
2.23.1	Wobble modulation	—	—	ADIP	ADIP
2.23.2	ATER (averaged over any 10 s)	—	—	<3 %	<3 %
2.23.3	Maximum number of successive erroneous frames	—	—	3 ADIP frames	3 ADIP frames
2.23.4	Wobble leak into I_{sum}	—	—	<0,07	<0,07
(Duration >227 µs on all of the recordable grooves. See clause A.22.)					

2.24 Operating conditions

	Characteristics to be specified	Requirements	Remarks
2.24.1	Operating temperature range	$T = -25\text{ °C to }+70\text{ °C}$	
2.24.2	Absolute humidity	0,5 g/m ³ to 60 g/m ³	
2.24.3	Relative humidity	10 % RH to 95 % RH	
2.24.4	Maximum temperature transition	50 °C	On one disc in playing time
2.24.5	Maximum humidity transition	30 % RH	On one disc in playing time
NOTE See figure 8 and clause A.6.			

2.25 Storage conditions

	Characteristics to be specified	Requirements	Remarks
2.25.1	Maximum storage temperature range	$T = -40\text{ °C to }+80\text{ °C}$	See clause A.6
NOTE It is applied not only in the horizontal position but also in vertical and inclined positions indefinitely.			



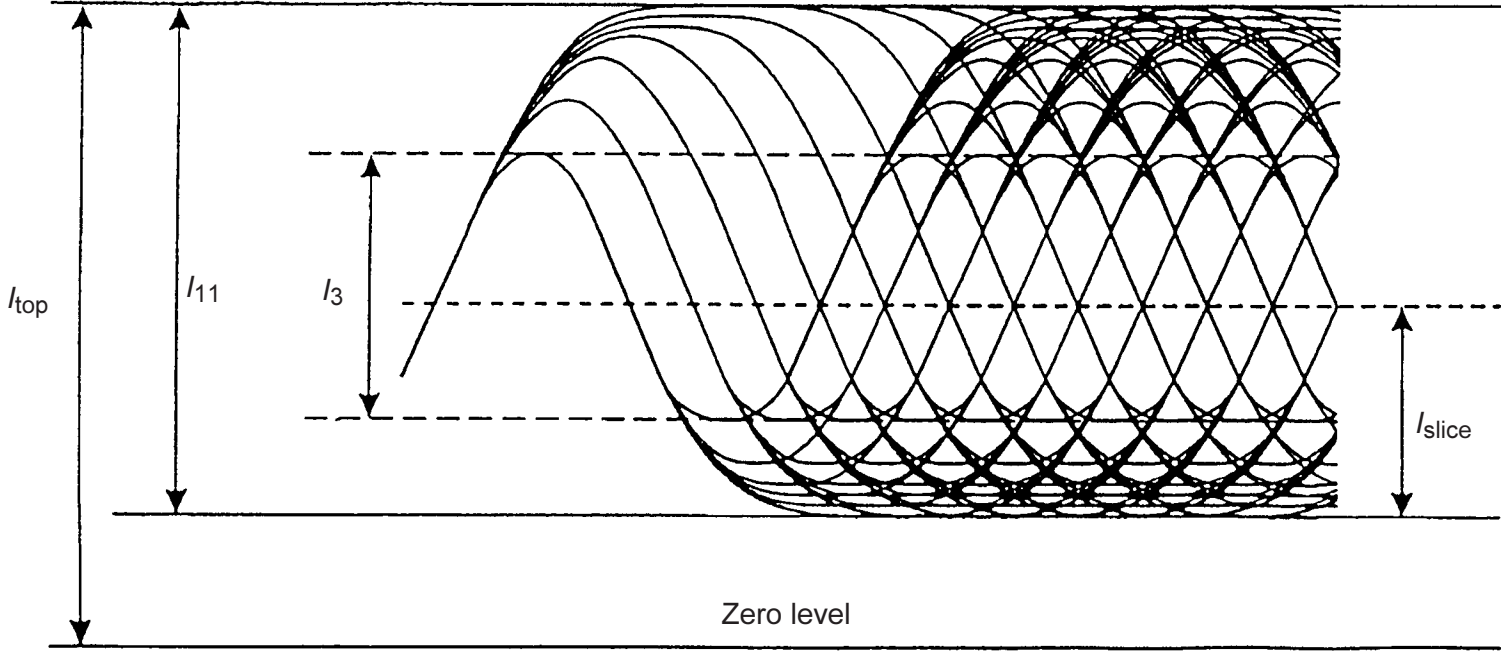
NOTE 1 The information layer is above $2 \pm 0,1$ mm from reference plane (not including disc deflection).

NOTE 2 The eccentricity of the track radius $50 \mu\text{m}$ relative to centre hole (including both circularity and dynamic radial run out).

NOTE 3 The clamping area is between $\varnothing 11,4$ mm and $\varnothing 11,4$ mm in reference plane.

NOTE 4 The largest inner circle of the centre hole is defined up to the height of $0,6$ mm from the reference plane (see detail B).

Figure 2 – MiniDisc possible profile



IEC 632/2000

Figure 3 – HF signal

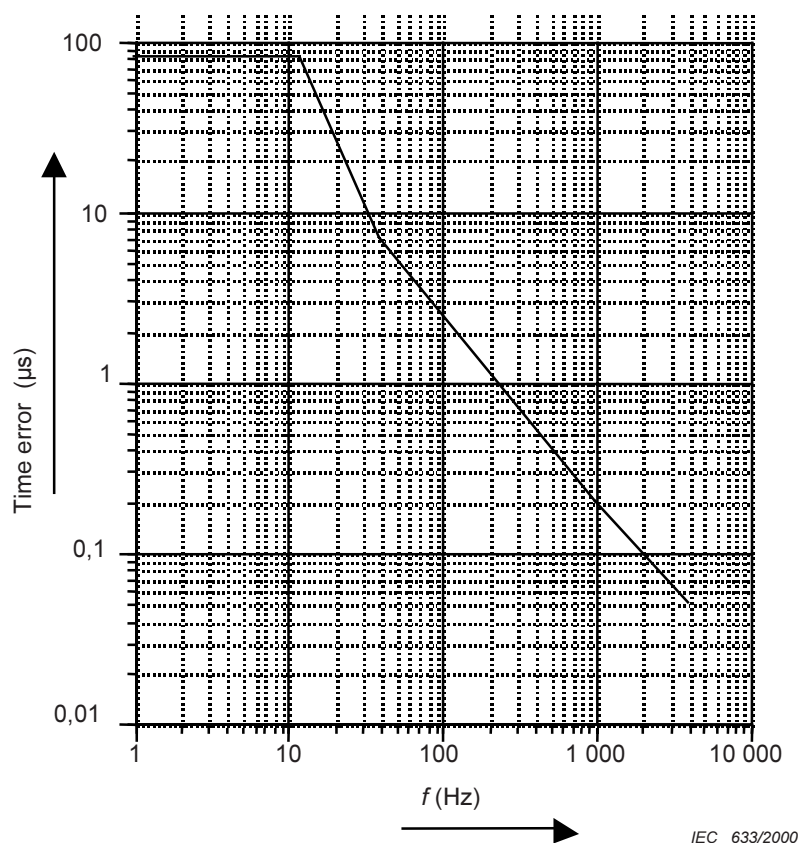


Figure 4 – Spectral components of the time error versus the maximum allowed time error due to mastering or recording

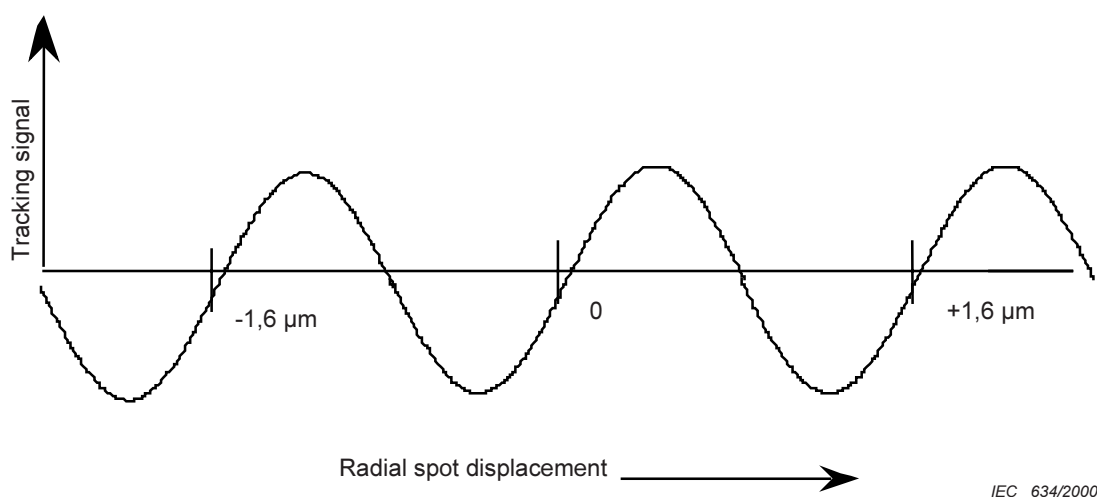


Figure 5 – Typical shape of the error signal for tracking versus radial position

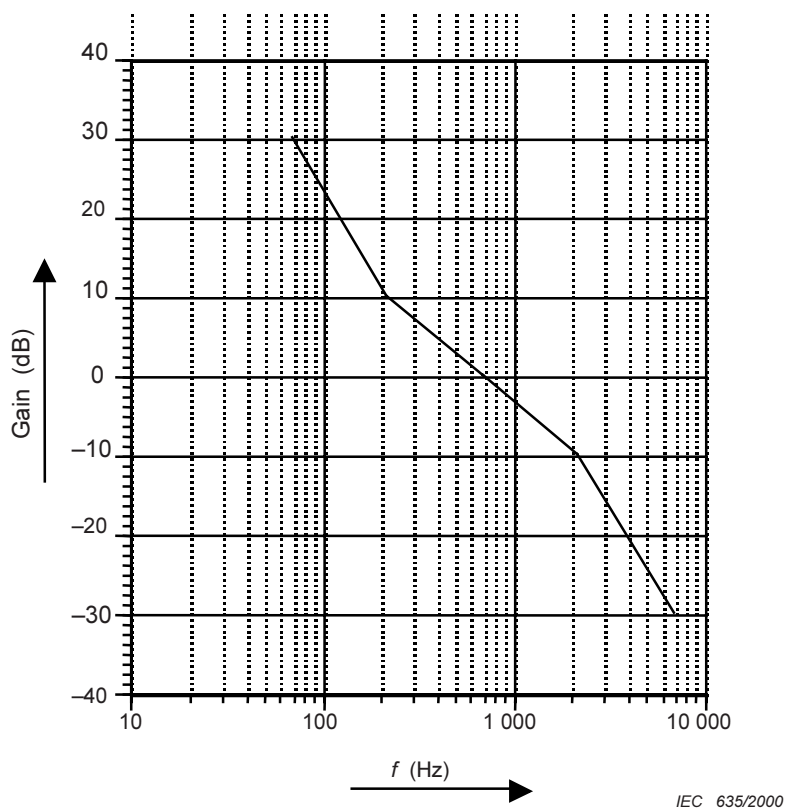


Figure 6 – Open-loop transfer function of the radial servo for an MD-recorder

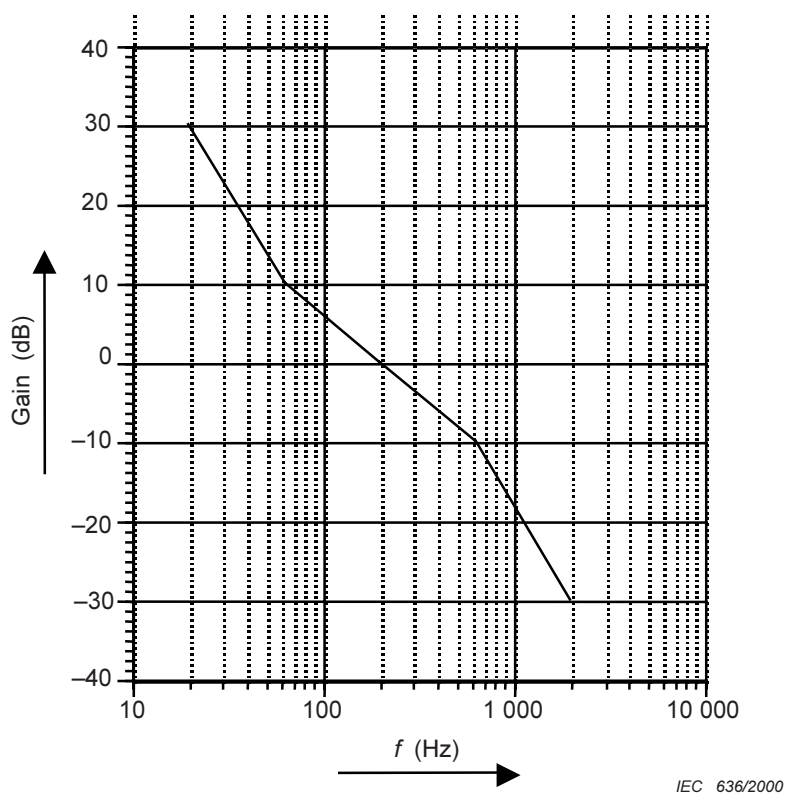


Figure 7 – Open-loop transfer function of the radial servo for tracking measurement

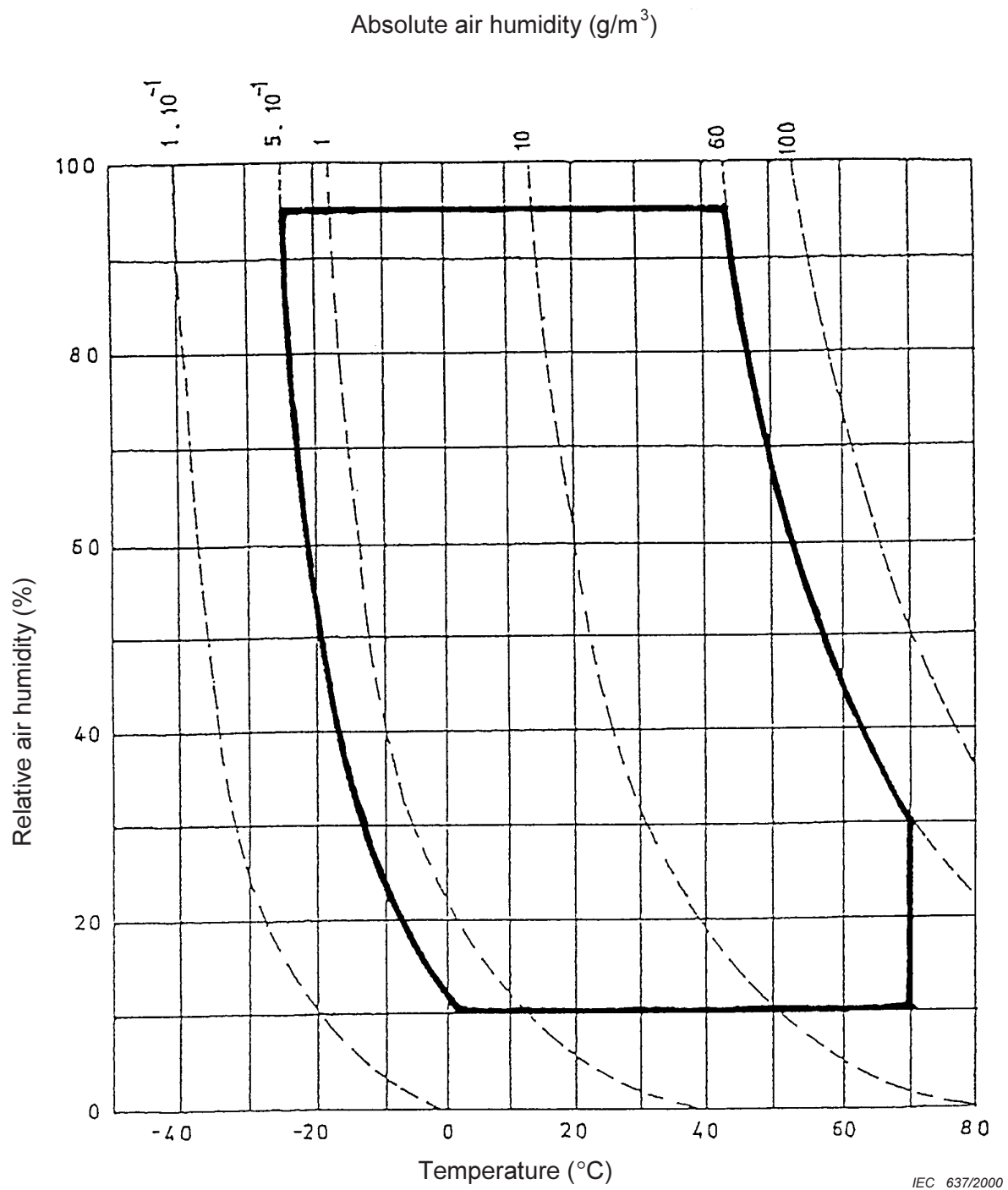


Figure 8 – Operating conditions

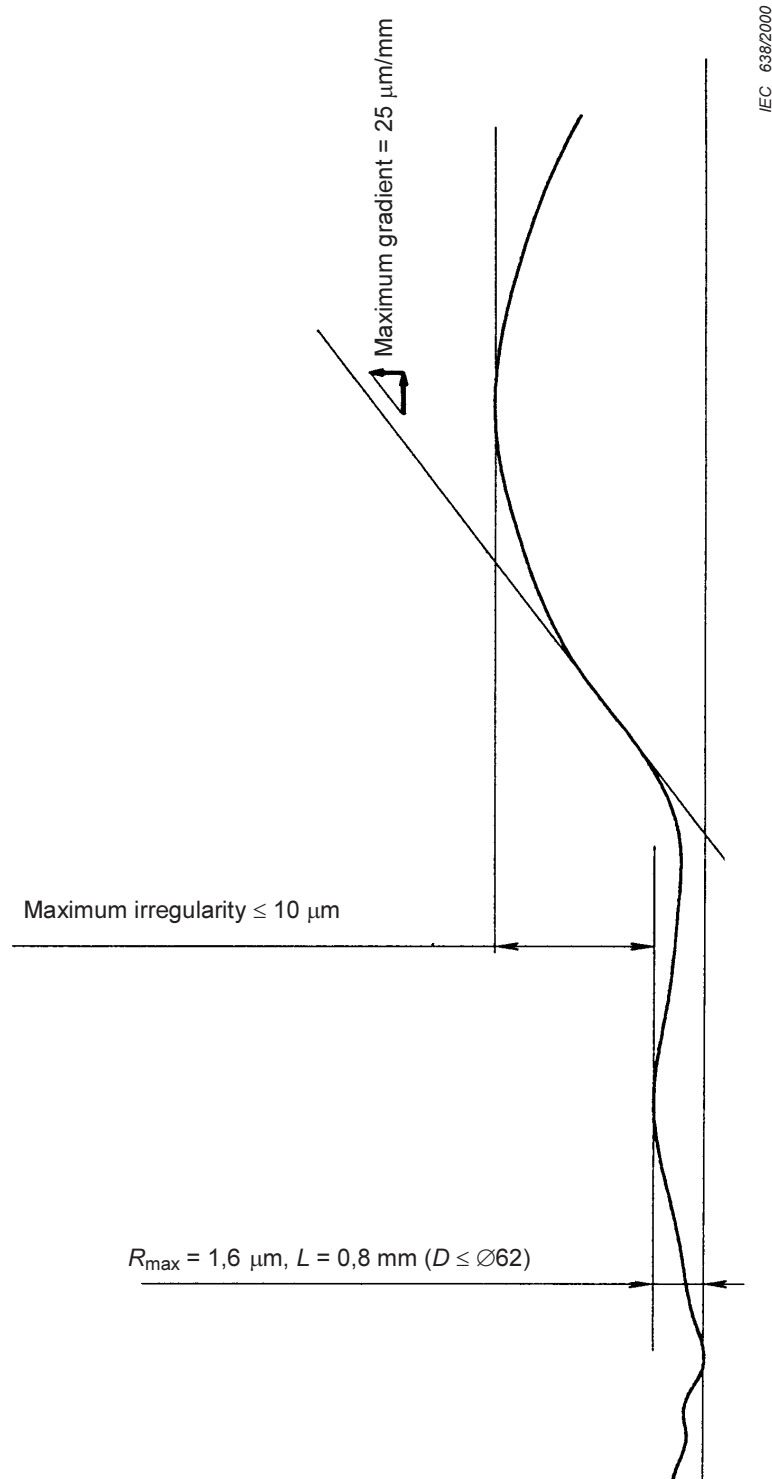


Figure 9 – Roughness and irregularity (recordable disc only)

3 Optical stylus

The wavelength λ and the numerical aperture (NA) shall fulfil the requirement:

$$\lambda/NA \leq 1,75 \mu\text{m}$$

The stylus should be diffraction limited.

The information is viewed through a transparent, plane parallel plate of 1,2 mm thickness, with a refractive index of about 1,55.

The system is optimized for a wavelength between 0,77 μm and 0,83 μm (e.g. laser wavelength of Aluminum Gallium Arsenide).

The depth of focus of the optical stylus is approximately 2 μm .

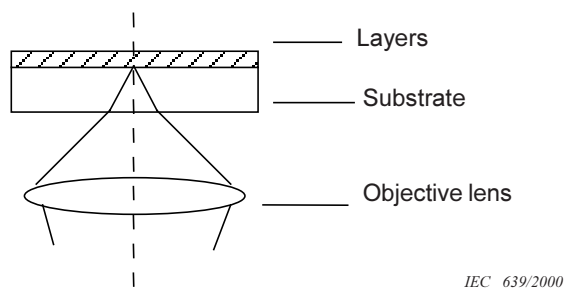


Figure 10 – Optical stylus

For further description of the optical principles of the MD system, see clause A.1.

4 Cartridge

See figure 11 and figure 12 for clarification.

The conditions for the measurements of the mechanical dimensions are:

- Ambient temperature: 23 °C ± 2 °C
- Relative humidity: 50 % RH ± 5 % RH
- Air pressure: 86 kPa to 106 kPa
- Air cleanliness: class 100 000
- Conditioning before testing: minimum 48 h

4.1 Size

	Characteristics to be specified	Requirements	Remarks
4.1.1	Width	$72 \begin{smallmatrix} 0 \\ -0,4 \end{smallmatrix}$ mm	
4.1.2	Depth	$68 \begin{smallmatrix} +0,6 \\ 0 \end{smallmatrix}$ mm	
4.1.3	Thickness (area 1) (area 2)	5 mm $\pm$ 0,2 mm maximum; 5,5 mm	Applicable areas are specified in note 22 to figure 11 and to figure 12, clauses A.15 and A.17. The surfaces of the cartridge shell shall be free of steps or projections
4.1.4	Flatness of four reference surfaces	Within 0,1 mm peak-to-peak Within 0,4 mm peak-to-peak	See clause A.14. Total holding force to the reference posts = 0

4.2 Mass

	Characteristics to be specified	Requirements	Remarks
4.2.1	Maximum mass	30 g	Including the disc

4.3 Centre hole on the bottom

	Characteristics to be specified	Requirements	Remarks
4.3.1	Diameter	$18 \begin{smallmatrix} +0,15 \\ -0,1 \end{smallmatrix}$ mm	

4.4 Windows

4.4.1 Configuration

Bottom-sided for premastered MD.

Both-sided for recordable MD.

	Characteristics to be specified	Requirements	Remarks
4.4.2	Width	$17 \begin{smallmatrix} +0,4 \\ 0 \end{smallmatrix}$ mm	

4.5 Shutter

4.5.1 Configuration

Bottom-sided for premastered MD.

Both-sided for recordable MD.

	Characteristics to be specified	Requirements	Remarks
4.5.2	Size	Bottom side can be extended to cover centre hole	Thickness of the cartridge shall remain within specifications. See clause A.16
4.5.3	Opening stroke	$\geq 18,5$ mm	
4.5.4	Unlocking force	$< 0,8$ N	Unlocking force should be applied only when the shutter is opening or closing
4.5.5	Locking force	> 7 N (for metal shutter) > 5 N (for plastic shutter)	
4.5.6	Sliding force	$< 0,7$ N at $-25\text{ }^{\circ}\text{C} \leq T \leq +70\text{ }^{\circ}\text{C}$	X-axis force onto around the shutter hole should be less than 0,2 N
4.5.7	Material	Metal or plastic	
4.5.8	Backlash between shutter and shutter-lock	$< 0,6$ mm	When shutter is closed

4.6 Horizontal centring of the disc on the player/recorder

	Characteristics to be specified	Requirements	Remarks
4.6.1	Horizontal centring tolerance of the disc	$(X - 26)^2 + (Y - 31)^2 \leq (0,15)^2$ mm	From the centre of the reference hole of the cartridge

4.7 Horizontal pre-position of the disc in the cartridge

	Characteristics to be specified	Requirements	Remarks
4.7.1	Horizontal pre-positioning tolerance of the disc	$(X - 26)^2 + (Y - 31)^2 \leq (0,8)^2$ mm	From the centre of the reference hole of the cartridge

4.8 Vertical positioning of the disc on the player/recorder

	Characteristics to be specified	Requirements	Remarks
4.8.1	Height of the reference plane of the disc	$1,15\text{ mm} \pm 0,13\text{ mm}$	From the reference plane of the cartridge

4.9 Vertical clearance between the disc and the cartridge

Disc is set at the height = 1,15 mm

	Characteristics to be specified	Requirements	Remarks
4.9.1	Maximum vertical deviation at centre	$+0,28$ $-0,33$ mm	$\varnothing \leq 23,0$ mm
4.9.2	Maximum vertical deviation at outer diameter	$+0,66$ $-0,70$ mm	The values are calculated by accumulating the permitted tolerances for the worst case including vertical deviations of the disc, tolerances of the disc thickness and height/tilt of the turntable not including flatness of the reference plane of the disc. See figure 13
4.9.3	Minimum clearance at the operating conditions	The cartridge should not touch the disc under the disc positioning condition due to the recorder/player as described in remarks	Tilt on the turntable $\leq \pm 0,3^\circ$ Clamping height 1,15 mm $\pm$ 0,13 mm Flatness of the posts of the recorder/player within 0,1 mm peak-to-peak Holding conditions, see clause A.14. Operating conditions, see 2.24.

4.10 Depth of the sensing holes

4.10.1 Write protect

Premastered MD	—	Minimum 3 mm
Recordable MD	Write permitted	1 mm $\pm$ 0,15 mm
	Write protected	Minimum 3 mm

4.10.2 Reflectivity

High reflectivity MD	0 mm $\pm$ 0,15 mm
Low reflectivity MD	Minimum 2 mm

4.11 Depth of sensing ditch

4.11.1 Head lifting

Premastered MD	2,5 mm ± 0,1 mm
Recordable MD	0,7 mm ± 0,05 mm

4.12 Holding force

	Characteristics to be specified	Requirements	Remarks
4.12.1	Holding force at one point	≤ 1 N	See note 16 to figure 11 and to figure 12. Recommendation: if holding force is nearly 1 N at one point, it should be applied on the reverse side of the reference surfaces
4.12.2	Total holding force	1,5 ~ 4 N	Also see clause A.14. The specifications of the cartridge are guaranteed under the holding conditions as shown in clause A.14

4.13 Operating conditions

See 2.24.

NOTE A cartridge may be deformed, if the temperature profile of the cartridge in the recorder/player is not uniform.

4.14 Storage conditions

See 2.25.

4.15 Protection of the information area on the disc

The cartridge shall be constructed so as to avoid contact between any part of the cartridge and the information area on the disc which might cause damage to the latter.

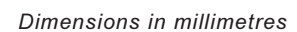
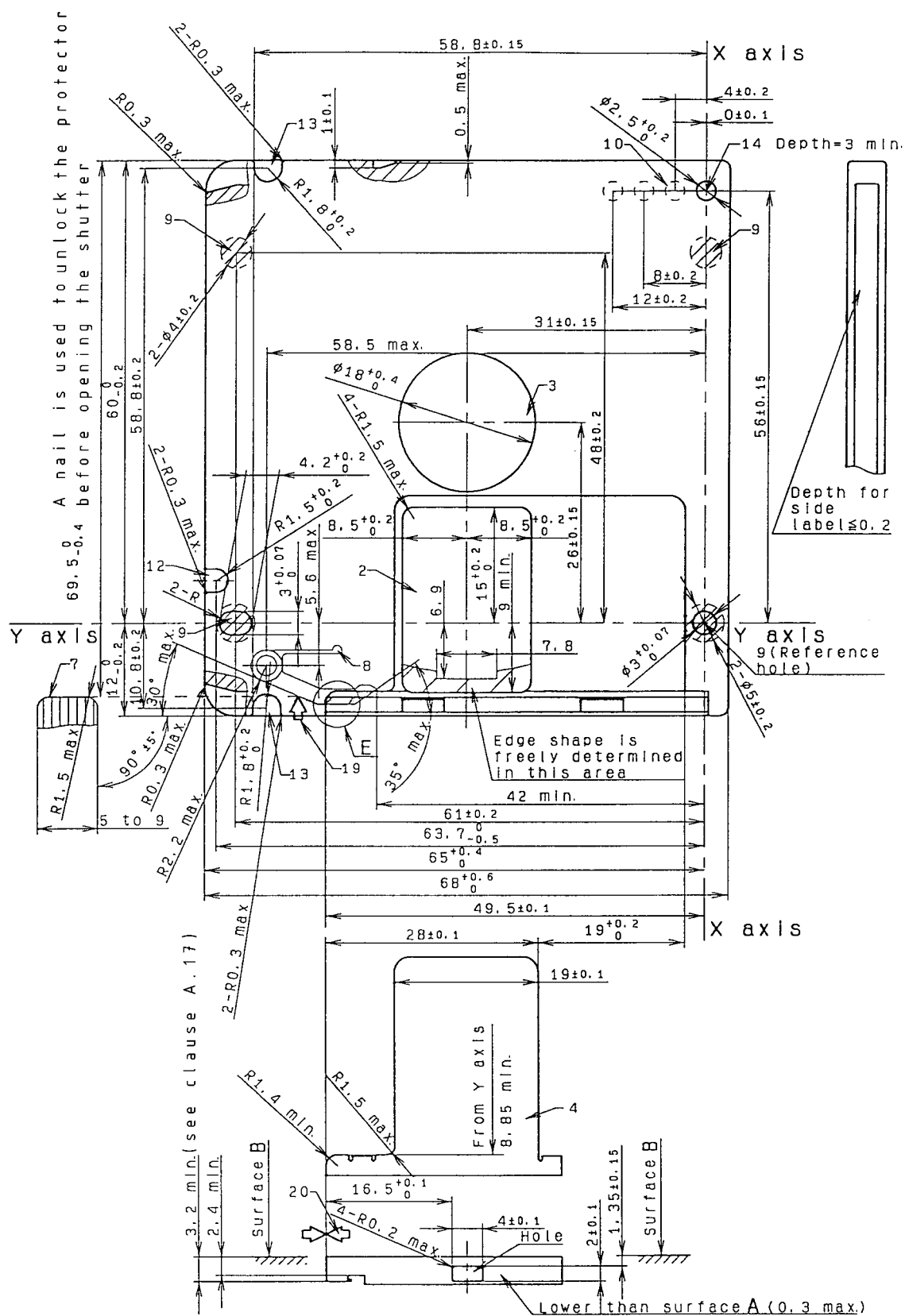


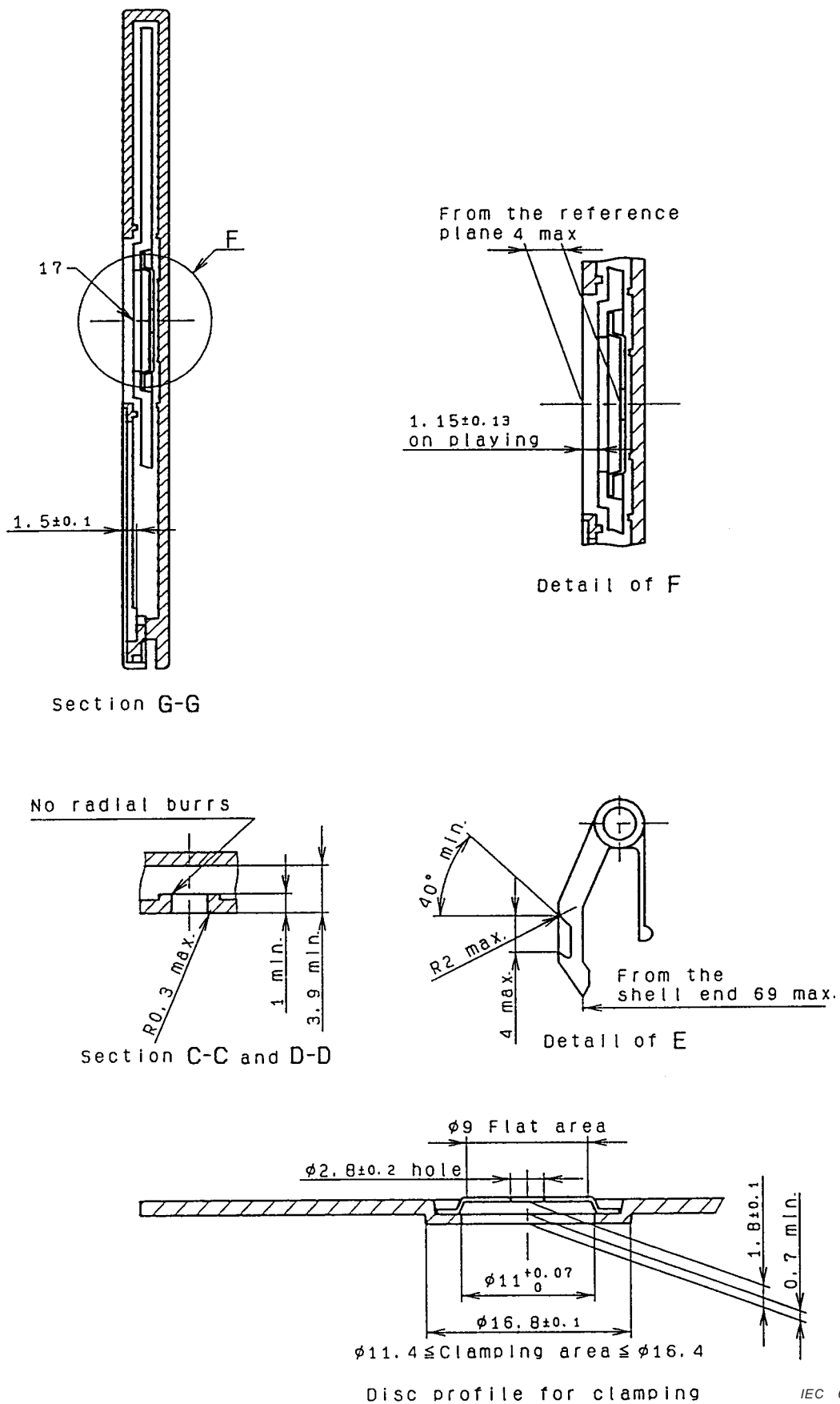
Figure 11a – Top and side views of MD cartridge specifications for the premastered version



IEC 641/2000

Dimensions in millimetres

Figure 11b – Bottom view and shutter of MD cartridge specifications for the premastered version



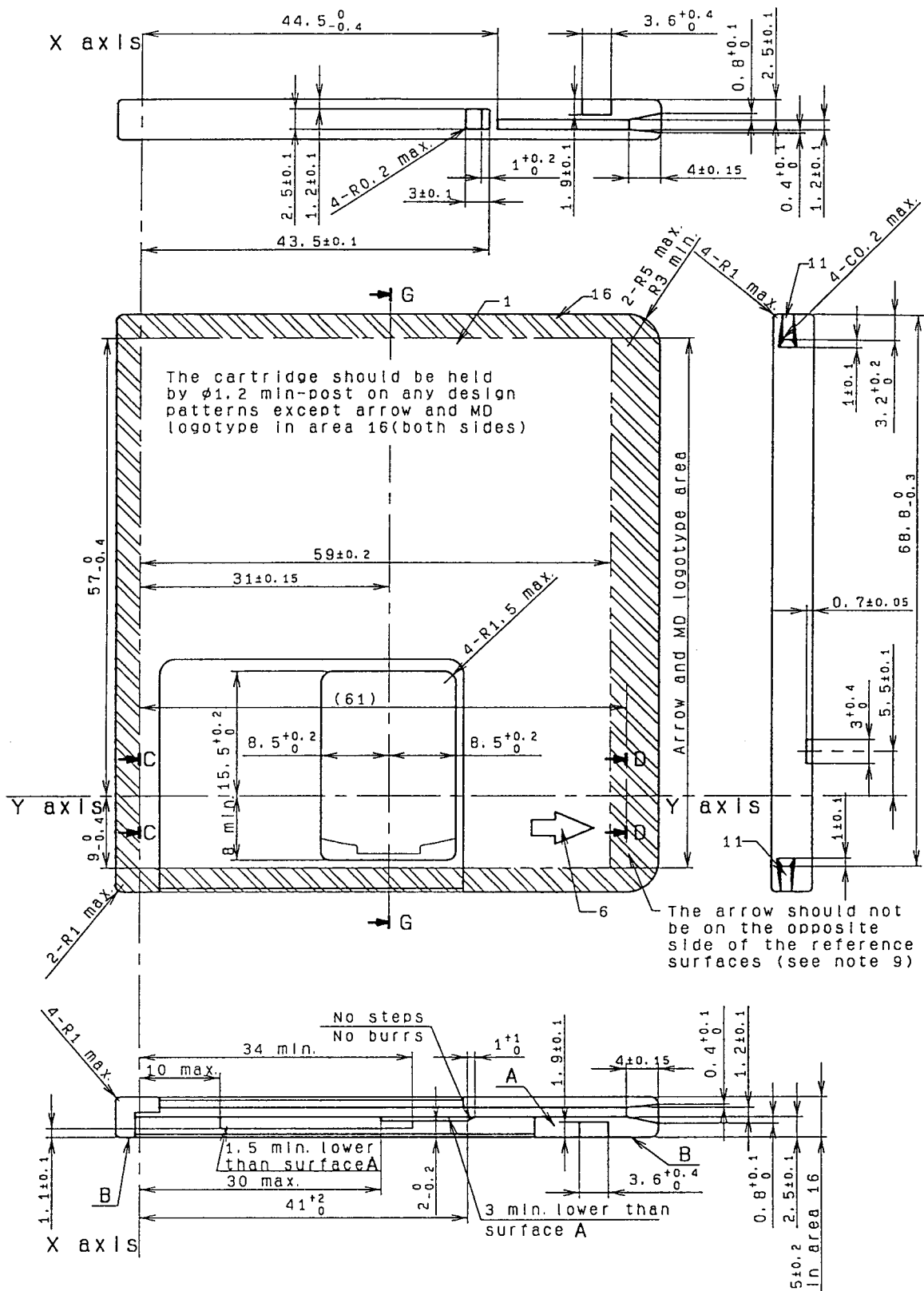
Dimensions in millimetres

Figure 11c – Details of disc clamp and shutter locks of the MD cartridge

NOTES

- * The edge of the label on any face shall be lower than the shell.
Any step or steep projection extending the shell shall not be in the label.
 - * Circular projection can be installed so as not to damage the information area on both sides of the disc, but shall not interfere with disc rotation (see detail of F in figure 11c). (See clause A.17.)
- | | | |
|-----|--|---|
| 1) | Cartridge size | 68(L) × 72(W) × 5(H) mm ² |
| 2) | Cartridge window | Single-sided |
| 3) | Centre hole | Back side only |
| 4) | Shutter | Single-sided, short shutter only |
| 5) | Shutter material | Plastic |
| 6) | Loading direction | |
| 7) | Shutter opening method | By running through a nail, do not keep touching with the shutter lock. |
| 8) | Shutter lock | Should be unlocked before the shutter will be opened. |
| 9) | Reference surfaces | Each area should be in the plane within a range of 0,1 parallel to reference plane. (See clause A.14). The cartridge flatness is 0,4 in the case free from holding force. The reference plane is defined by the three of the four surfaces. (See clause A.14.) |
| 10) | Detection hole | Hi-reflectivity disc-closed (closed-depth: 0, opened-depth: 2 min.) |
| 11) | Mis-insert protection | Another protecting method is allowed for drive. |
| 12) | Ditch for recording head up and down | For simple mechanism recordable MD player |
| 13) | Two ditches for power loading | |
| 14) | Detection hole for rewrite protecting | No relation to premastered cartridge, but hole should be opened. |
| 15) | Manual operated click for rewrite protection | No relation to premastered cartridge |
| 16) | Location to guide and stabilize the cartridge | Cartridge thickness is $5 \pm 0,2$ within the area including a part of the shutter. The force to stabilize the cartridge is less than 1 N at one point. (Total forces ≤ 4 N)
However, the specification of the cartridge is guaranteed under the conditions shown in clause A.14 and clause A.17.
The depth of arrow. MD-logotype and any design patterns are here (both sides) $\leq 0,2$. |
| 17) | Disc centre should be within the area as follows | $(X - 26)^2 + (Y - 31)^2 \leq (0,8)^2$
The bottom of the disc shall not be extended from the cartridge surface. |
| 18) | Disc positioning tolerance depending on drive | |
| | Maximum angular deviation from the reference plane | $\pm 0,3^\circ$ ($\pm 0,17$ at disc outer diameter) |
| | Clamping height from the reference plane | $1,15 \pm 0,13$ at disc centre |
| | The distance from disc centre to reference hole | $(X - 26)^2 + (Y - 31)^2 \leq (0,15)^2$ |
| 19) | Force to unlock the shutter lock | Less than 0,8 N |
| 20) | Force to slide the shutter | Less than 0,7 N, including the force to close the shutter (see 4.5.6) |
| 21) | Hooking force not to mis-open the shutter | More than 7 N (metal shutter), more than 5 N (plastic shutter) |
| 22) | Cartridge thickness (including label) Extended volume and bend | Thickness at area 16 is $5 \pm 0,2$,
Sum volume of the cartridge including extended volume and bend is 5,5 maximum in height. (See clause A.17.) |
| 23) | Cartridge weight (including disc) | Less than 30 g |
| 24) | Operating conditions | See 2.24. |
| 25) | Storage conditions | See 2.25. |

Figure 11 – MD cartridge specifications for the premastered version



IEC 643/2000

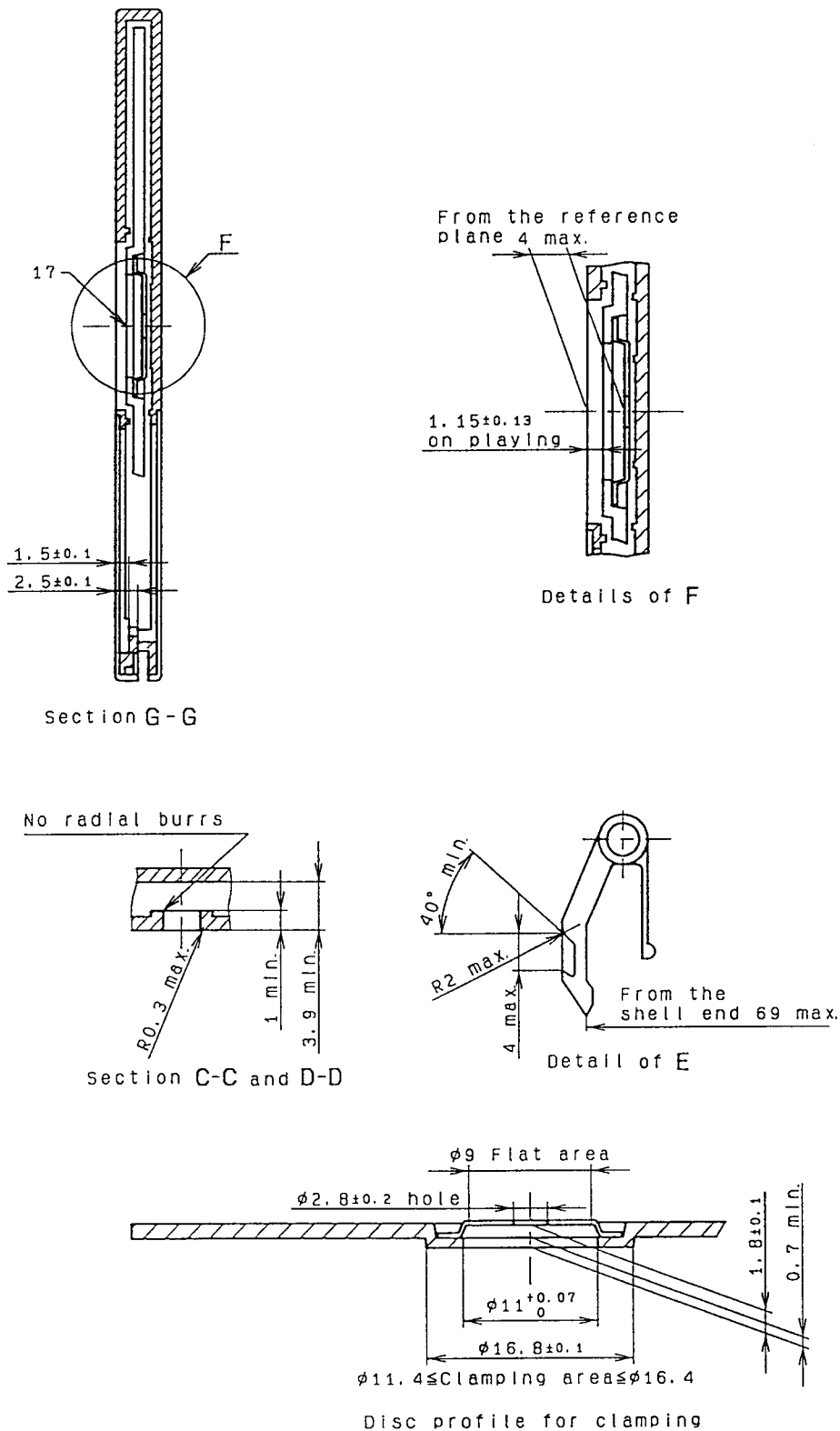
Dimensions in millimetres

Figure 12a – Top and side views of MD cartridge specifications for the recordable version



Dimensions in millimetres

Figure 12b – Bottom view and shutter of MD cartridge specifications for the recordable version



IEC 645/2000

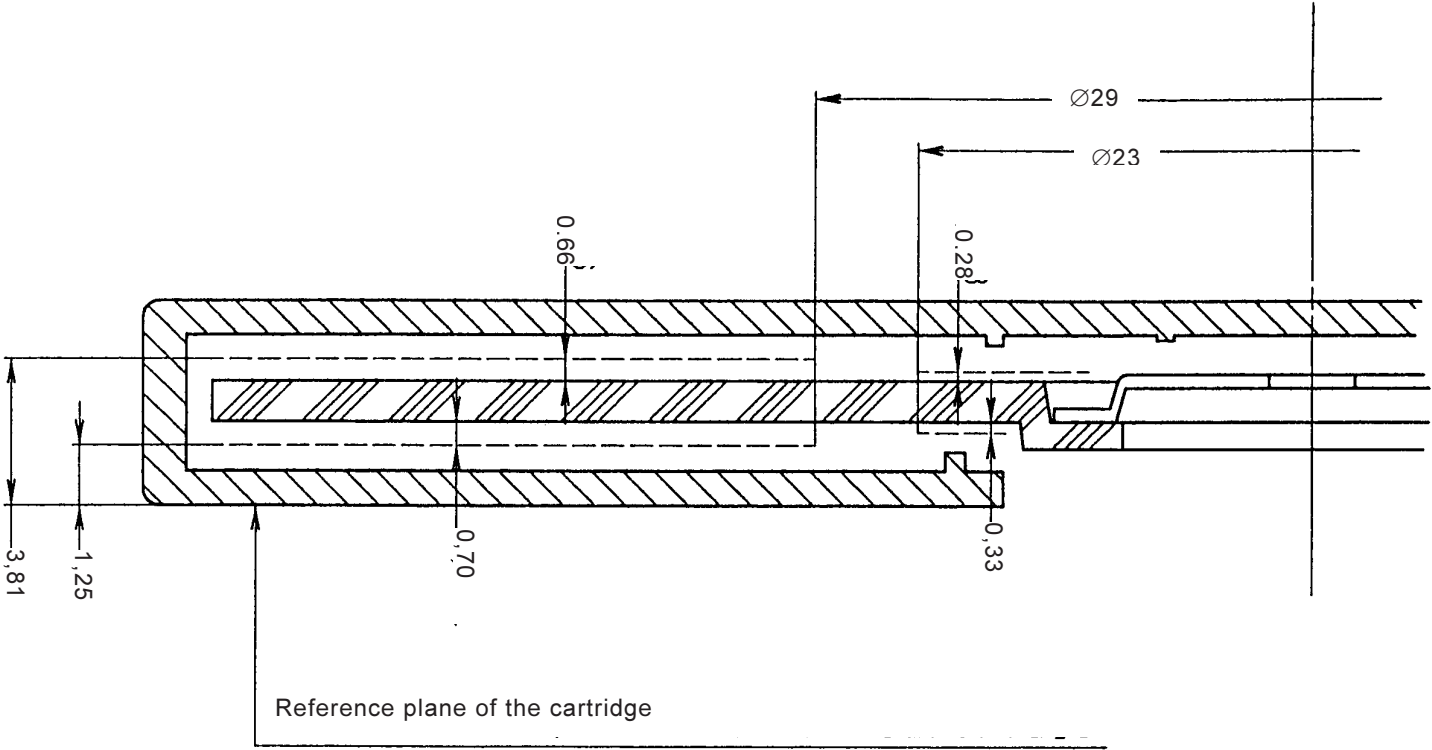
Dimensions in millimetres

Figure 12c – Details of disc clamp and shutter locks of MD cartridge

NOTES

- * The edge of the label on any face shall be lower than the shell.
Any step or steep projection extending the shell shall not be in the label.
- * Circular projection can be installed so as not to damage the information area on both sides of the disc, but shall not interfere with disc rotation (see detail of F in figure 12c). (See clause A.17.)
- 1) Cartridge size 68(L) × 72(W) × 5(H) mm²
- 2) Cartridge window Single-sided
- 3) Centre hole Back side only
- 4) Shutter Single-sided, short shutter only
- 5) Shutter material Plastic
- 6) Loading direction
- 7) Shutter opening method By running through a nail, do not keep touching with the shutter lock.
- 8) Shutter lock Should be unlocked before the shutter will be opened.
- 9) Reference surfaces Each area should be in the plane within a range of 0,1 parallel to reference plane. (See clause A.14). The cartridge flatness is 0,4 in the case free from holding force. The reference plane is defined by the three of the four surfaces. (See clause A.14.)
- 10) Detection hole Low-reflectivity disc-closed (closed-depth: 0, opened-depth: 2 min.)
- 11) Mis-insert protection Another protecting method is allowed for drive.
- 12) Ditch for recording head up and down For simple mechanism recordable MD player.
- 13) Two ditches for power loading
- 14) Detection hole for rewrite protecting Should be opened when no rewrite is wanted (initial depth = 1 ± 0,15)
- 15) Manual operated click for rewrite protection Only recordable
Any colour except red can be used for a slider.
- 16) Location to guide and stabilize the cartridge Cartridge thickness is 5 ± 0,2 within the area including a part of the shutter. The force to stabilize the cartridge is less than 1 N at one point. (Total forces ≤ 4 N)
However, the specification of the cartridge is guaranteed under the conditions as shown in clause A.14 and clause A.17.
The depth of arrow, MD-logotype and any design patterns are here (both sides) ≤ 0,2.
- 17) Disc centre should be within the area as follows $(X - 26)^2 + (Y - 31)^2 \leq (0,8)^2$
The bottom of the disc shall not be extended from the cartridge surface.
- 18) Disc positioning tolerance depending on drive
Maximum angular deviation from the reference plane ±0,3° (±0,17 at disc outer diameter)
Clamping height from the reference plane 1,15 ± 0,13 at disc centre
The distance from disc centre to reference hole $(X - 26)^2 + (Y - 31)^2 \leq (0,15)^2$
- 19) Force to unlock the shutter lock Less than 0,8 N
- 20) Force to slide the shutter Less than 0,7 N, including the force to close the shutter (see 4.5.6)
- 21) Hooking force not to mis-open the shutter More than 7 N (metal shutter) more than 5 N (plastic shutter)
- 22) Cartridge thickness (including label) Thickness at area 16 is 5 ± 0,2. Sum volume of the cartridge including extended volume and bend is 5,5 maximum in height. (See clause A.17.)
Extended volume and bend
- 23) Cartridge weight (including disc) Less than 30 g
- 24) Operating conditions See 2.24.
- 25) Storage conditions See 2.25.

Figure 12 – MD cartridge specifications for the recordable version



IEC 646/2000

Dimensions in millimetres

- NOTE 1 These values are calculated by accumulating the permitted tolerances for the worst cases.
- NOTE 2 The flatness of the 4-posts of the player/recorder is less than 0,1.
- NOTE 3 Not including the reference plane flatness of the disc.

Figure 13 – Maximum existing area of the disc

5 Address

5.1 Cluster concept

The MD system utilizes the cluster concept.

A sequence of EFM recording on the recordable grooves should be carried out at the unit of a cluster.

New address (cluster; sector) system is introduced according to this concept.

1 cluster = 36 sectors

1 sector = 1 subcode block = 1 CD-ROM block

Sectors and clusters are numbered in binary.

Clusters can be divided as cluster H and cluster L which correspond to MSByte cluster and LSByte cluster respectively.

In the lead-in area, the address should increase, and end with the address FFFFh 1Fh (cluster; sector) at the end of the lead-in area. The area next to the lead-in area should start with an address 0000h FCh.

From this point on, the address should increase monotonically and uninterrupted throughout the remainder of the disc.

This address (cluster H; cluster L; sector) is assigned at the absolute time (min; s; frame) slots on ADIP, subcode-Q and CD-ROM header as in CD-MO, CD and CD-ROM.

5.2 Pits

Cluster	N-1	N		N+1	
Sector	1 1	F F F F	0 0.....1 1	F F F F	0 0
	...E F	C D E F	0 1.....E F	C D E F	0 1...
		Sub-data	Main data		
		(4)	(32)		

- 1 cluster = 36 sectors
- Main data = 32 sectors : audio data
- Sub-data = 4 sectors : reserved
- Linking = 0 sector : no linking in the premastered pits

5.3 Groove

Cluster	N – 1	N			N + 1		
Sector	1 1 E F	F F F C D E	F F	0 0 1 1 0 1.....E F	F F F C D E	F F	0 0 0 1
		Linking (3)	Sub data (1)	Main data (32)			

1 cluster = 36 sectors

Main data = 32 sectors : audio data

Sub-data = 1 sector : reserved

Linking = 3 sectors : run-in, linking and run-out data

5.4 Disc layout

Area	Premastered address	Recordable address
Lead-in area	Sub-Q, sector header	None
Premastered area	Sub-Q, sector header	None
UTOC area	ADIP	Sector header
Recordable user area	ADIP	Sector header
Lead-out area		
pits	Sub-Q, sector header	None
groove	ADIP	None
NOTE 1 ADIP = address in pregroove on the recordable groove. Absolute time in ADIP format should be replaced by MD address (see clause 6). NOTE 2 MD address on Sub-Q and sector header. Absolute time on Sub-Q and CD-ROM header should be replaced by MD address (see clauses 7 and 9). NOTE 3 Linking: see 11.4 for further details.		

5.5 Border of a cluster

The physical border between the pits and the groove is between 1Fh sector and FCh sector.

The border of the error correction is in the middle of the FDh sector.

Therefore the linking point of EFM sequences is in the middle of the FDh sector (see 11.4).

For audio applications, a cluster is pointed by the address of a main data sector, but not sub-data sectors nor linking sectors.