BS ISO/IEC 30192:2016
Incorporating corrigendum August 2018

BSI Standards Publication

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

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 30192:2016

National foreword

This British Standard is the UK implementation of ISO/IEC 30192:2016.

The UK participation in its preparation was entrusted to Technical Committee ICT/-/1, Information systems co-ordination.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2018
Published by BSI Standards Limited 2018

ISBN 978 0 539 01863 9

ICS 35.220.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2016.

Amendments/corrigenda issued since publication

Date	Text affected
31 August 2018	Implementation of ISO corrected text January 2017: See ISO Foreword for details

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 30192:2016

INTERNATIONAL STANDARD

ISO/IEC 30192

Second edition
2016-06-15

Corrected version
2017-01

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

Technologies de l'information — Supports enregistrés numériquement pour échange et stockage d'information — Disques BD réinscriptibles de 120 mm simple couche (25,0 Go par disque) et double couche (50,0 Go par disque)

Reference number
ISO/IEC 30192:2016(E)

© ISO/IEC 2016

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 30192:2016

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office

Ch. de Blandonnet 8 • CP 401

CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11

Fax +41 22 749 09 47

copyright@iso.org

www.iso.org

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 30192:2016

Contents Page

1 Scope ... 1

2 Conformance ... 2
2.1 Optical Disk ... 2
2.2 Generating system ... 2
2.3 Receiving system ... 2
2.4 Compatibility statement ... 2

3 Normative references ... 2

4 Terms and definitions ... 3

5 Conventions and notations ... 7
5.1 Terminology ... 7
5.1.1 Meaning of words ... 7
5.1.2 Levels of grouping ... 7
5.2 Representation of numbers ... 7
5.3 Integer calculus ... 8
5.4 Names ... 8

6 List of acronyms ... 8

7 General descriptions of disk ... 11

8 General requirements ... 13
8.1 Environments ... 13
8.1.1 Test environment ... 13
8.1.2 Operating environment ... 13
8.1.3 Storage environment ... 14
8.1.4 Transportation ... 15
8.2 Safety requirements ... 15
8.3 Flammability ... 15

9 Reference drive ... 15
9.1 General ... 15
9.2 Environmental conditions ... 15
9.3 Optical system ... 15
9.4 Optical beam ... 17
9.5 HF read channel ... 17
9.6 Radial PP read channel ... 18
9.7 Disk Clamping ... 18
9.8 Rotation of the disk and Measurement Velocity ... 18
9.9 Normalized servo transfer function ... 19
9.10 Measurement Velocity and Reference servo for axial tracking ... 20
9.11 Measurement Velocity and Reference servo for radial tracking ... 21

10 Dimensional characteristics ... 22
10.1 General ... 22
10.2 Disk reference planes and reference axis ... 22
10.3 Overall dimensions ... 23
10.4 First transition Area ... 24
10.5 Protection ring ... 24
10.6 Clamping Zone ... 24
10.7 Second transition Area ... 24
10.8 Information Area ... 25
10.8.1 General ... 25
10.8.2 Subdivisions of Information Zone on SL disk ... 25
10.8.3 Subdivisions of Information Zone on DL disks ... 26
10.9 Rim Area ... 27

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

11 Mechanical characteristics 27
11.1 Mass 27
11.2 Moment of inertia 27
11.3 Dynamic imbalance 27
11.4 Axial runout 27
11.4.1 General 27
11.4.2 Residual axial tracking error 28
11.5 Radial runout 28
11.5.1 General 28
11.5.2 Residual radial tracking error on SL disks 28
11.5.3 Residual radial tracking error on DL disks 29
11.6 Durability of Cover Layer 29
11.6.1 Impact resistance of Cover Layer 29
11.6.2 Scratch resistance of Cover Layer 29
11.6.3 Repulsion of fingerprints by Cover Layer 29

12 Optical characteristics in Information Area 29
12.1 General 29
12.2 Refractive index of Transmission Stacks (TS) 29
12.3 Thickness of Transmission Stack(s) 30
12.3.1 Thickness of Transmission Stack of SL disks 30
12.3.2 Thickness of Transmission Stack of DL disks 30
12.4 Reflectivity 31
12.4.1 Reflectivity of Recording Layer of SL disks 31
12.4.2 Reflectivity of Recording Layer of DL disks 32
12.5 Birefringence 32
12.6 Angular deviation 32

13 Data format 33
13.1 General 33
13.2 Data Frames 35
13.3 Error-Detection Code (EDC) 35
13.4 Scrambled Data Frame 35
13.5 Data Block 36
13.6 LDC Block 37
13.7 LDC Code words 37
13.8 LDC Cluster 38
13.8.1 General 38
13.8.2 First interleave step 38
13.8.3 Second interleaving step 39
13.9 Addressing and Control Data 41
13.9.1 General 41
13.9.2 Address Units 41
13.9.3 User-Control Data 44
13.9.4 Byte/Bit assignments for User-Control Data 45
13.10 Access Block 45
13.11 BIS Block 47
13.12 BIS Code words 47
13.13 BIS Cluster 48
13.14 ECC Cluster 52
13.15 Recording Frames 53
13.16 Physical Cluster 53
13.17 17PP Modulation for Recordable data 53
13.17.1 General 53
13.17.2 Bit conversion rules 54
13.17.3 dc-control procedure 54
13.17.4 Frame Sync 54
13.18 Modulation and NRZI conversion 56

14 Physical Data Allocation and Linking 57
14.1 General 57
14.2 Recording-Unit Block (RUB) 57
14.2.1 General 57

AVA Documents
Document Sharing Hub

© ISO/IC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

14.2.2 Data Run-in ... 57
14.2.3 Data Run-out ... 58
14.2.4 Guard_3 field ... 59
14.3 Locating data relative to wobble addresses ... 60
14.3.1 General ... 60
14.3.2 Start-Position Shift (SPS) ... 60

15 Track format ... 61
15.1 General ... 61
15.2 Track shape ... 62
15.3 Track Path ... 64
15.4 Track Pitch ... 64
15.4.1 Track Pitch in BCA Zone ... 64
15.4.2 Track Pitch in Embossed HFM Areas ... 64
15.4.3 Track Pitch in Rewritable Areas ... 64
15.4.4 Track Pitch between Embossed HFM Area and Rewritable Area ... 65
15.5 Track layout of HFM Groove ... 65
15.5.1 General ... 65
15.5.2 Data Format ... 65
15.5.3 Addressing and Control Data ... 66
15.5.4 Recording Frames ... 69
15.6 Track layout of Wobbled Groove(s) ... 71
15.6.1 General ... 71
15.6.2 Modulation of wobbles ... 72
15.7 ADIP Information ... 73
15.7.1 General ... 73
15.7.2 ADIP-Unit Types ... 73
15.7.3 ADIP Word structure ... 75
15.7.4 ADIP Data structure ... 76
15.7.5 ADIP Error Correction ... 78
15.8 Disk Information in ADIP Aux Frame ... 80
15.8.1 General ... 80
15.8.2 Error protection for Disk-Information Aux Frames ... 80
15.8.3 Disk-Information Data structure ... 81

16 General description of Information Zone ... 112
16.1 General ... 112
16.2 Format of Information Zone on Single-Layer disk ... 112
16.3 Format of Information Zone on Dual-Layer disk ... 112

17 Layout of Rewritable Area of Information Zone ... 112

18 Inner Zone ... 116
18.1 General ... 116
18.2 Permanent Information & Control data (PIC) Zone ... 118
18.2.1 General ... 118
18.2.2 Content of PIC Zone ... 118
18.2.3 Emergency Brake ... 119
18.3 Rewritable Area of Inner Zone(s) ... 121
18.3.1 Protection-Zone 2 ... 121
18.3.2 INFO 2 / Reserved 8 ... 121
18.3.3 INFO 2 / Reserved 7 ... 121
18.3.4 INFO 2 / Reserved 6 ... 121
18.3.5 INFO 2 / Reserved 5 ... 122
18.3.6 INFO 2 / PAC 2 ... 122
18.3.7 INFO 2 / DMA 2 ... 122
18.3.8 INFO 2 / Control Data 2 ... 122
18.3.9 INFO 2 / Buffer 2 ... 122
18.3.10 OPC / Test Zone ... 122
18.3.11 Reserved ... 122
18.3.12 INFO1 / Buffer 1 ... 122
18.3.13 INFO 1 / Drive Area (optional) ... 122
18.3.14 INFO 1 / Reserved 3 ... 124
18.3.15 INFO 1 / Reserved 2 ... 124

© ISO/IEC 2016 – All rights reserved

AVA Documents Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

18.3.16 INFO 1 / Reserved 1 ... 124
18.3.17 INFO 1 / DMA 1 ... 124
18.3.18 INFO1 / Controle Data 1 ... 124
18.3.19 INFO1 / PAC 1 ... 124

19 Data Zone ... 124

20 Outer Zone(s) ... 125
20.1 General ... 125
20.2 INFO 3 / Buffer 4 ... 126
20.3 INFO 3 / DMA 3 ... 126
20.4 INFO 3 / Control Data 4 ... 126
20.5 Angular buffer ... 126
20.6 INFO 4 / DMA 4 ... 126
20.7 INFO 4 / Control Data 4 ... 126
20.8 INFO 4 / Buffer 6 ... 126
20.9 Protection-Zone 3 ... 126

21 Physical-Access Control Clusters ... 127
21.1 General ... 127
21.2 Layout of PAC Zones ... 127
21.3 General structure of PAC Clusters ... 128
21.4 Primary PAC Cluster (mandatory) ... 131
21.5 Disk Write-Protect PAC Cluster (optional) ... 134
21.6 IS1 and IS2 PAC Clusters ... 137

22 Disk Management ... 138
22.1 General ... 138
22.2 Disk-Management Structure (DMS) ... 138
22.2.1 General ... 138
22.2.2 Disk-Definition Structure (DDS) ... 139
22.2.3 Defect List (DFL) ... 143
22.2.4 Defect-List Header (DLH) ... 143
22.2.5 List of Defects ... 144
22.2.6 DFL Entries ... 146

23 Assignment of Logical-Sector Numbers (LSNs) ... 147

24 Characteristics of Grooved Areas ... 148

25 Method of testing for Grooved Area ... 148
25.1 General ... 148
25.2 Environment ... 148
25.3 Reference drive ... 148
25.3.1 General ... 148
25.3.2 Read power ... 148
25.3.3 Read channels ... 148
25.3.4 Tracking requirements ... 149
25.3.5 Scanning velocity ... 149
25.4 Definitions of signals ... 149

26 Signals from HFM Grooves ... 151
26.1 Push-Pull signal ... 151
26.2 HFM Wobble signal ... 151
26.3 Jitter of HFM signal ... 151

27 Signals from Wobbled Groove(s) ... 152
27.1 Phase depth ... 152
27.2 Push-Pull signal ... 152
27.3 Wobble signal ... 152
27.3.1 General ... 152
27.3.2 Measurement of NWS ... 152
27.3.3 Measurement of wobble CNR ... 152
27.3.4 Measurement of harmonic distortion requirements ... 153

28 Characteristics of Recording Layer ... 153

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

29 Method of testing for Recording Layer 154
29.1 General 154
29.2 Environment 154
29.3 Reference drive 154
29.3.1 General 154
29.3.2 Read power 154
29.3.3 Read channels 154
29.3.4 Tracking requirements 154
29.3.5 Scanning velocities 154
29.4 Write conditions 154
29.4.1 Write-pulse waveform 154
29.4.2 Write powers 155
29.4.3 Write conditions for jitter measurement 155
29.4.4 Write conditions for cross-erase measurement 155
29.4.5 Write conditions for inter-velocity overwrite measurements 155
29.5 Definition of signals 156

30 Signals from Recorded Areas 156
30.1 HF signals 156
30.2 Modulated amplitude 156
30.3 Reflectivity-Modulation product 157
30.4 Asymmetry 157
30.5 Jitter 157
30.6 Cross-erase 158
30.7 Inter-velocity overwrite 158
30.8 Read stability 159

31 Local defects 160

32 Characteristics of User Data 160

33 Method of testing for User Data 160
33.1 General 160
33.2 Environment 160
33.3 Reference drive 161
33.3.1 General 161
33.3.2 Read power 161
33.3.3 Read channels 161
33.3.4 Error Correction 161
33.3.5 Tracking requirements 161
33.3.6 Scanning velocities 161
33.4 Definition of signals 161

34 Minimum quality of recorded information 163
34.1 Random Symbol Error Rate 163
34.2 Maximum burst errors 163
34.3 User-written Data 163

35 BCA 164

Annex A (normative) Thickness of Transmission Stacks in case of multiple layers 165
A.1 General 165
A.2 Refractive Index n_i of all layers in Cover Layer and Spacer Layer 165
A.3 Thickness variation of the Transmission Stack 165
A.4 Example of thickness calculation for SL 165

Annex B (normative) Measurement of reflectivity 166
B.1 General 166
B.2 Calibration method 167
B.3 Measuring method 168

Annex C (normative) Measurement of scratch resistance of Cover Layer 169
C.1 General 169
C.2 Taber Abrasion test 169

Annex D (normative) Measurement of repulsion of grime by Cover Layer 171
D.1 General 171

© ISO/IEC 2016 – All rights reserved

AVA Documents Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

D.2 Specifications of stamp ... 171
D.3 Preparation of ink ... 172
D.4 Preparation of ink pad ... 172
D.5 Using ink pad and stamp ... 173

Annex E (normative) Measurement of wobble amplitude ... 174
E.1 Measurement methods ... 174
E.2 Calibration of filters ... 178

Annex F (normative) Write-pulse waveform for testing ... 179
F.1 General write-pulse waveform ... 179
F.2 N-1 write strategy A ... 179
F.3 N-1 write strategy B ... 181
F.4 N/2 write strategy ... 183
F.5 Definition of pulse widths and rise and fall times ... 186

Annex G (normative) Optimum Power Control (OPC) procedure for disk ... 187
G.1 General ... 187
G.2 Mathematical model for modulation versus power function ... 187
G.3 Procedure for determination of OPC parameters for disk ... 188
G.4 Write-power window ... 189

Annex H (normative) HF signal pre-processing for jitter measurements ... 190
H.1 General ... 190
H.2 General implementation of equalizer ... 190
H.3 Conventional Equalizer circuit ... 191
H.4 Limit Equalizer circuit ... 192
H.5 Specifications of supporting circuits ... 193
H.5.1 Amprifiers and filters ... 193
H.5.2 Open-loop transfer function for PLL ... 194
H.5.3 Slicer ... 195
H.6 Condition for measurement ... 195
H.7 Jitter measurement ... 196

Annex I (normative) Measurement procedure ... 197
I.1 General ... 197
I.2 Initial adjustments of Reference drive ... 197
I.3 Jitter measurement ... 197
I.4 Modulated amplitude measurements ... 198
I.5 Measurements of Resolution I_{2pp} / I_{8pp} and I_{3pp} / I_{8pp} ... 198
I.5.1 Method for measuring I_{2pp} and I_{8pp} ... 198
I.5.2 I_{3pp} / I_{8pp}, I_{8pp} / I_{8H} and asymmetry measurement procedure ... 199
I.6 Tracking-error signal measurements (PP_{norm} measurement procedure) ... 200
I.7 Residual error of axial tracking measurement procedure ... 201
I.8 Residual error of radial tracking measurement procedure ... 202
I.9 Random SER measurement ... 202

Annex J (informative) Measurement of birefringence ... 203
J.1 Principle of measurement ... 203
J.2 Measurements conditions ... 203
J.3 Example of measurement procedure ... 203
J.4 Interchangeability of measuring results ... 204

Annex K (informative) Measurement of thickness of Cover Layer and Spacer Layer ... 205
K.1 Focusing method ... 205
K.2 Interferometer method ... 206

Annex L (informative) Measurement of impact resistance of Cover Layer ... 208
L.1 General ... 208
L.2 Recommendation for drives ... 208
L.3 Measurements of impact resistance of Cover Layer ... 208

Annex M (informative) Groove deviation and wobble amplitude ... 210
M.1 Relation between normalized wobble signal and wobble amplitude ... 210
M.2 Tolerance of normalized wobble signal ... 210

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 23, *Digitally recorded media for information interchange and storage*.

This second edition cancels and replaces the first edition (ISO/IEC 30192:2013), of which it constitutes a minor revision. It also incorporates the Technical Corrigendum ISO/IEC 30192:2013/Cor 1:2015.

This corrected version of ISO/IEC 30192:2017 incorporates the following corrections as well as other minor editorial modifications:

— in Annex F, the two Figures previously entitled “F.6.” have been corrected and one figure was re-numbered as Figure F.7.;

— Figure H.2. was replaced.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

Introduction

In March 2002, nine companies known as the Blu-ray Disc Founders, or BDF, came together to create optical-disk formats with the large capacity and high-speed transfer rates that would be needed for recording and reproducing of high-definition video content. This joint effort turned out to be fruitful and the BDF issued the first version of its Blu-ray Disc™ Rewritable Format Part1 Version 1.0, in June of 2002.

Then, in October 2004, more than a hundred companies joined and the BDF became an open forum called the Blu-ray Disc Association (BDA). The BDA issued Version 2.1 of the Blu-ray Disc™ Rewritable Format Part1 in October 2005 and Version 3.0 in June of 2010.

By the end of 2010, over a hundred million of Blu-ray Disc™ had already been shipped and the Blu-ray™ devices such as players, recorders, game consoles and PC drives were in use all over the world.

The BDA also conducts verification activities for both disks and devices and has established more than ten Testing Centres in Asia, Europe and the USA.

The BDA gave consumer applications the highest priority in the first few years. But it was known, of course, that International Standardization would be required before many government entities and their contractors would be allowed to use Blu-ray Disc™. In February and January of 2011, ISO/IEC JTC 1/SC 23 and JIIMA (Japan Image and Information Management Association) formally requested the BDA to consider International Standardization. The reason for this was to enable the inclusion of writable BDs, along with DVDs and CDs, in an International Standard specifying test methods for the estimation of lifetime of optical storage media for long-term data storage. In October 2011, the president of the BDA responded that his organization had decided to pursue International Standards of the basic physical formats for the Recordable and Rewritable Blu-ray Disc™.

In December 2011, BDA sent project proposals for the International standardization of four formats to ISO/IEC JTC 1/SC 23 via the Japan national body. They are 120 mm Single Layer (25,0 Gbytes per disk) and Dual Layer (50,0 Gbytes per disk) BD Recordable disks, 120 mm Single Layer (25,0 Gbytes per disk) and Dual Layer (50,0 Gbytes per disk) BD Rewritable disks, 120 mm Triple Layer (100,0 Gbytes per disk) and Quadruple Layer (128,0 Gbytes per disk) BD Recordable disks and 120 mm Triple Layer (100,0 Gbytes per disk) BD Rewritable disk.

This International Standard specifies the mechanical, physical and optical characteristics of a 120 mm rewritable optical disk with a capacity of 25,0 Gbytes or 50,0 Gbytes.

Some technical errors were found during the editorial work for JIS X 6232, which is the Japanese Industrial Standard identical with ISO/IEC 30192:2013. In December of 2014, a Defect Report was submitted by the Japan national body of ISO/IEC JTC 1/SC 23. The project editor proposed a Draft Technical Corrigendum for ISO/IEC 30192:2013 and it was approved by ISO/IEC JTC 1/SC 23 in May of 2015.This International Standard is the updated First edition of ISO/IEC 30192:2013, including the Technical Corrigendum and additional corrections for some minor editorial errors.

A few additional specifications are required in order to write and read video recording applications, such as the BDMV and BDAV formats, which have been specified by the BDA for use on BD Recordable disks. These specifications, which are related to the Application, the file system and the Content-protection system, are required for the disk, the generating system and the receiving system. For more information of the Application, the Content-protection system and the additional requirements for the Blu-ray™ Format specifications, see http://www.blu-raydisc.info.

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this document may involve the use of patents.

ISO and IEC take no position concerning the evidence, validity and scope of these patent rights.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

The holders of these patent rights have assured ISO and IEC that they are willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of holders of these patent rights are registered with ISO and IEC. Information may be obtained from the following.

Hitachi Consumer Electronics Co., Ltd.
Intellectual Property Management
292 Yoshida-cho, Totsuka-ku, Yokohama 244-0817 Japan

Hitachi, Ltd.,
IT Platform R&D Management Division Patent Strategy
322-2 Nakazato, Odawara-shi, Kanagawa-Ken 250-0872 Japan

Panasonic Corporation
Intellectual Property Center
OBP Panasonic Tower 8th Floor, 2-1-61, Shiromi, Chuoh-ku, Osaka, 540-6208, Japan

Pioneer Corporation
Intellectual Property Division, Legal and Intellectual Property Division,
1-1, Shin-Ogura, Saiwai-ku, Kawasaki-Shi, Kanagawa, 212-0031, Japan

Sony Corporation
IP Asset Management Department, Intellectual Property Division,
1-7-1, Konan, Minato-ku, Tokyo, 108-0075, Japan

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO (www.iso.org/patents) and IEC (http://patents.iec.ch) maintain on-line databases of patents relevant to their standards. Users are encouraged to consult the databases for the most up to date information concerning patents.

NOTE Blu-ray™, Blu-ray Disc™ and the logos are trademarks of the Blu-ray Disc Association.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 30192:2016

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

1 Scope

This International Standard specifies the mechanical, physical and optical characteristics of a 120 mm rewritable optical disk with a capacity of 25,0 Gbytes or 50,0 Gbytes. It specifies the quality of the recorded and unrecorded signals, the format of the data and the recording method, thereby allowing for information interchange by means of such disks. User data can be written, read and overwritten many times using a reversible method. A conforming disk is identified as a BD Rewritable disk.

This International Standard specifies the following:

— two related but different Types of this disk;

— conditions for conformance;

— environments in which the disk is to be operated and stored;

— mechanical and physical characteristics of the disk, which allow mechanical interchange between data processing systems;

— format of the information on the disk, including the physical disposition of the Tracks and Sectors;

— error-correcting codes and coding method used;

— characteristics of the signals recorded on the disk, which enable data processing systems to read data from the disk.

This International Standard provides for interchange of disks between drives. Together with a standard for volume and file structure, it provides for full data interchange between data processing systems.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

2 Conformance

2.1 Optical Disk

A claim of conformance with this International Standard shall specify the Type implemented. An optical disk shall be in conformance with this International Standard if it meets all mandatory requirements specified for its Type.

2.2 Generating system

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

2.3 Receiving system

A receiving system shall be in conformance with this International Standard if it is able to handle both Types of optical disks according to 2.1.

2.4 Compatibility statement

A claim of conformance by a Generating or Receiving system with this International Standard shall include a statement listing any other standards supported. This statement shall specify the numbers of the standards, the optical disk Types supported (where appropriate) and whether support includes reading only or both reading and writing.

3 Normative references

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

ISO/IEC 646, *Information technology — ISO 7-bit coded character set for information interchange*

ISO 9352, *Plastics — Determination of resistance to wear by abrasive wheels*

IEC 60068-2-2, *Environment testing — Part 2-2: Tests — Test B: Dry heat*

IEC 60068-2-30, *Environment testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60950-1, *Information technology equipment — Safety — Part 1: General requirements*

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

4 Terms and definitions

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

4.1
Application
application specified for a *BD* (4.2), for instance a video application, which requires areas for a Content-protection system and for its own Defect-Management system on the disk

4.2
BD
disk having a *Cover Layer* (4.4) around 0,1 mm thick and a *Substrate* (4.37) around 1,1 mm thick on which data is read or recorded by an OPU using 405 nm laser diode and NA = 0,85 lens

Note 1 to entry: User Data recorded on the disk is formatted using 17PP modulation and an LDC+BIS code.

4.3
Channel bit
element by which the binary value ZERO or ONE is represented by *Pits* (4.24)/*Marks* (4.18) and *Spaces* (4.36) on the disk

4.4
Cover Layer
transparent layer with precisely-controlled optical properties that covers the Recording Layer closest to the Entrance surface of the disk

4.5
Data Zone *n*
area between the Inner Zone and the Outer Zone on *Layer Ln* (4.17)

4.6
Defective Cluster
Cluster in the *User-Data Area* (4.41) that has been registered in the Defect List because it has become unreliable or uncorrectable

4.7
Digital-Sum Value
DSV
arithmetic sum obtained from a bit stream by assigning the decimal value +1 to *Channel bits* (4.3) set to ONE and the decimal value –1 to channel bits set to ZERO

4.8
Disk reference plane
plane defined by the perfect flat annular surface of an ideal spindle onto which the Clamping Area of the disk is clamped that is normal to the axis of rotation

4.9
Embossed HFM Area
area on the disk where information has been stored by means of an *HFM Groove* (4.13) during the manufacture of the disk

4.10
Entrance surface
surface of the disk onto which the optical beam first impinges

4.11
Erased Groove
blank Groove on the disk that has been erased by irradiating the Track using only erase power levels P_{E1O} and P_{E2O} as determined by the OPC algorithm

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

4.12
Groove
trench-like feature of the disk connected to a Recording Layer

Note 1 to entry: In case of a Single-Layer disk, the Groove can be carried by the *Substrate* (4.37) and in case of a Dual-Layer disk, one Groove can be carried by the Substrate and the other Groove by the *Spacer Layer* (4.35) or the *Cover Layer* (4.4) (see Figure 1 and Figure 2). Grooves are used to define *Track* (4.38) locations.

The Groove corresponds to the area that has been exposed to the mastering spot.

In general, the Groove can be depression in the carrier or an elevation on the carrier.

If the Groove is nearer to the *Entrance surface* (4.10) than the Land (see Figure 54), the recording method is called "On-Groove recording". If the Groove is farther from the *Entrance surface* (4.10) than the Land, the recording method is called "In-Groove recording".

In the BD Rewritable system, there are three types of Groove:

— *Wobbled Groove* (4.43) in Rewritable Area containing address information;

— *HFM Groove* (4.13) in *Embossed HFM Area* (4.9) containing Permanent Information and Control data;

— Straight Groove without any modulation in the BCA Zone.

4.13
High-Frequency Modulated Groove
HFM groove
Grooves (4.12) modulated in the radial direction with a rather high bandwidth signal

Note 1 to entry: HMF Groove creates a data channel with sufficient capacity and data rate for replicated information.

4.14
Information Area
area on the disk in which information can be recorded

4.15
Information Zone
recorded part of the *Information Area* (4.14)

4.16
Land
surface of the Recording Layer between successive windings of a *Groove* (4.12)

4.17
Layer L*n*
one Recording Layer of the disk identified by *n*

Note 1 to entry: Layer L(n + 1) is closer to the *Entrance surface* (4.10) of the disk than Layer Ln.

4.18
Marks
feature of the Recording Layer which may take the form of amorphous domains in the crystalline recording film that can be sensed by the optical read-out system

Note 1 to entry: The pattern of Marks and *Spaces* (4.36) represents the data on the disk.

4.19
Measurement Velocity
Measurement Velocity is the linear velocity at which the disk is measured during reading

Note 1 to entry: *nx* Measurement Velocity means the Measurement Velocity of *n* times the *Reference Velocity* (4.30).

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

4.20
Modulation bit
alternative form representing the data that is more suited to be transmitted via a communication channel or to be stored on a storage system

4.21
NRZ/NRZI conversion
method of conversing a Modulation-bit stream into a physical signal

4.22
Padding
process in a drive to fill up the missing Sectors in a 64K Cluster, which is consisting of 32 Sectors, with all 00h data when the host supplies less than 32 Sectors and need to fill up the Cluster

4.23
Phase Change
physical effect by which an area of a Recording Layer is irradiated by a laser beam and heated so as to change from a crystalline state to an amorphous state and vice versa

4.24
Pits
features of the Recording Layer which may take the form of depressions in or elevations on the *Land* (4.16) surface, that can be sensed by the optical read-out system

Note 1 to entry: The pattern of Pits and *Spaces* (4.36) represents the data on the disk.

4.25
Polarization
direction of the electric field vector of an optical beam

Note 1 to entry: The plane of Polarization is the plane containing the electric field vector and the direction of propagation of the beam.

4.26
Protective Coating
optional additional layer on top of the *Cover Layer* (4.4) provided for extra protection against scratches and other types of damage

4.27
Read-Modify-Write
process in a drive, when one or more but less than 32 Sector(s) in a Cluster have to be rewritten, to read full content of a 64K Cluster, which consists of 32 Sectors, replace the Sector(s) concerned and write back the full Cluster to the disk

4.28
Recording Layer
part of the disk consisting of a stack of films of specific materials on or in which data is written during manufacture and/or use

4.29
Recording Velocity
linear velocity at which the disk is recorded

Note 1 to entry: *n*x Recording Velocity means the Recording Velocity of *n* times the *Reference Velocity* (4.30).

4.30
Reference Velocity
linear velocity that results in the nominal Channel-bit rate of 66,000 Mbit/s

Note 1 to entry: *n*x Reference Velocity means *n* times the Reference Velocity.

4.31
Reserved
<value> value(s) not used in this International Standard

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

Note 1 to entry: In future standards, the value can be released.

4.32
Reserved
<field> field(s) not specified in use, to be ignored in interchange and to be set to ZERO as value

Note 1 to entry: In future standards, the use of a field can be defined and value(s) can be assigned.

4.33
Rewritable Area
area on the disk where information can be recorded by means of *marks* (4.18) and *spaces* (4.36) using the phase-change effect and during the manufacture and/or use of the disk

4.34
Sector
minimum-size addressable data part of a *Track* (4.38) in the *Information Zone* (4.15)

4.35
Spacer Layer
transparent layer with precisely-controlled optical properties separating two *Recording Layers* (4.28)

4.36
Spaces
areas separating *Pits* (4.24) or *Marks* (4.18) in the tangential direction in the context of HF signals

Note 1 to entry: The pattern of Pits/Marks and Spaces represents the data on the disk.

4.37
Substrate
layer, which may be transparent or not, provided for mechanical support of the *Recording Layer(s)* (4.28)

4.38
Track
360° turn of the continuous spiral formed by a *Groove* (4.12)

4.39
Track Pitch
distance between centrelines of a *Groove* (4.12) in adjacent *Tracks* (4.38), measured in the radial direction

4.40
Transmission Stack
all layers together between the *Entrance surface* (4.10) of the disk and the *Recording Layer* (4.28) concerned

Note 1 to entry: In other words, the Transmission Stack of a specific Recording Layer consists of all layers that are passed through by the light beam when accessing that Recording Layer.

4.41
User-Data Area
collection of all Data Zone(s) on the disk and consists only of the Clusters in which User Data can be recorded

4.42
Virgin Groove
blank *Groove* (4.12) on the disk which has never been recorded nor erased

4.43
Wobbled Groove
Groove (4.12) that has a periodic sinusoidal deviation from its average centreline

Note 1 to entry: By modulating the sinusoidal deviation, the wobble provides address information and general information about the disk.

4.44
Zone
annular area of the disk

Documents
Document Sharing Hub
© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

5 Conventions and notations

5.1 Terminology

5.1.1 Meaning of words

In this International Standard, the following words have a special meaning.

May: indicates an action or feature that is optional.

Optional: describes a feature that may or may not be implemented.
If implemented, the feature shall be implemented as described.

Shall: indicates an action or feature that is mandatory and to be implemented to claim compliance with this International Standard.

Should: indicates an action or feature that is optional, but its implementation is strongly recommended.

5.1.2 Levels of grouping

Many times, data is collected into that data can be collected into higher level groups. For the clarity of the grouping hierarchy, in this International Standard, the following levels of hierarchy will be used.

Frame: the lowest level of grouping. Generally, frames contain bytes of information.

Block: the second level of grouping. Generally, blocks consist of a number of frames.

Cluster: the highest level of grouping. Clusters consist of several blocks.

Fragment: a level of grouping that can be applied by the application. A certain amount of data will be allocated to a (fixed) number of consecutive Clusters.

5.2 Representation of numbers

A measured value $x_{\mathbf{measured}}$ may be rounded off to the least significant digit of the corresponding specified value x before being compared with this specified value.

EXAMPLES:

— The specification is: $x = 1{,}26\ ^{+0{,}01}_{-0{,}02}$:
(nominal value = 1,26 with a positive tolerance of +0,01 and a negative tolerance of –0,02)
  — A measured value in the range $1{,}235 \leq x_{\mathbf{measured}} < 1{,}275$ fulfills this specification.

— The specification is: $x \leq 0{,}3$:
  — A measured value $x_{\mathbf{measured}} < 0{,}35$ fulfills this specification
  (rounding off is applied for $0{,}30 < x_{\mathbf{measured}} < 0{,}35$: $x_{\mathbf{rounded}} = 0{,}3$).

— The specification is: $x < 0{,}3$:
  — A measured value $x_{\mathbf{measured}} = 0{,}299$ fulfills this specification
  (no rounding off needs to be applied).
  — A measured value $x_{\mathbf{measured}} = 0{,}3$ exactly does not fulfill this specification.

In case the specified value is given as “maximum x units” or “minimum x units”, the measured value shall not be rounded off before comparing to the specified value. Parameters given in this way shall not violate the specified limits set by the exact value of x.

EXAMPLEs:

— The specification is maximum 0,3 mm:
  — A measured value of 0,300 mm fulfills this specification.
  — A measured value of 0,301 mm does not fulfill this specification.

— The specification is minimum 3 dB:
  — A measured value of 3,00 dB fulfills this specification.
  — A measured value of 2,99 dB does not fulfill this specification.

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

Numbers in decimal notation are represented by the digits 0 to 9. The decimal symbol is "," (comma). In large numbers, the " " (space) can be used as digit grouping symbol.

Numbers in hexadecimal notation are represented by the hexadecimal digits 0 to 9 and A to F in parentheses or followed by lowercase "h". The character x in hexadecimal numbers represents any digit 0 to 9 or A to F.

Numbers in binary notation and bit patterns are represented by strings of digits 0 and 1, with the most-significant bit shown to the left. The character *x* in binary numbers represents a digit 0 or 1.

Negative values of numbers in binary notation are given as two's complement.

In a pattern of *n* bits, bit $b_{(n-1)}$ shall be the most-significant bit (msb) and bit b_0 shall be the least-significant bit (lsb). Bit $b_{(n-1)}$ shall be recorded first.

An uninterrupted sequence of *m* 0's in a bit pattern can be represented by $[0^m]$.

The setting of bits is denoted by ZERO and ONE.

In data fields composed of bytes, the data is recorded so that the Most-Significant Byte (MSB), identified as Byte 0, shall be recorded first and the Least-Significant Byte (LSB) last.

In a field of 8*n* bits, bit $b_{(8n-1)}$ shall be the most-significant bit (msb) and bit b_0 the least-significant bit (lsb). Bit $b_{(8n-1)}$ shall be recorded first.

In data fields composed of nibbles, the data is recorded so that the most-significant nibble, identified as Nibble 0, shall be recorded first and the least-significant nibble last.

In a field of 4*n* bits, bit $b_{(4n-1)}$ shall be the most-significant bit (msb) and bit b_0 the least-significant bit (lsb). Bit $b_{(4n-1)}$ shall be recorded first.

A range of values is indicated as $x \sim y$, where the limits *x* and *y* are included in the range.

A list of integers is indicated as *i* .. *j*. The list contains all integers between *i* and *j* as well as *i* and *j* (e.g. $k = 0 .. 7$). If the step size is different from one, this is indicated as: *i*, (*i* + step) .. *j* (e.g. $k = 1, 4 .. 16$, where step = 3).

A group of parameters is indicated as Param *m*..*n* or P_m .. P_n. The group contains all parameters with an index between *m* and *n* as well as *m* and *n* (e.g. byte 16..31, bit 7..4, Add0 .. Add255).

If *x* is nearly equal to *y*, then it is expressed as $x \approx y$.

5.3 Integer calculus

div(*n*,*d*) represents the integer part of the division of *n* by *d*.
mod(*n*,*d*) represents the remainder of the division of *n* by *d*: mod(*n*,*d*) = *n* – *d* × div(*n*,*d*).

EXAMPLE div(+11,+3) = +3 div(–11,+3) = –3 div(+11,–3) = –3 div(–11,–3) = +3
mod(+11,+3) = +2 mod(–11,+3) = –2 mod(+11,–3) = +2 mod(–11,–3) = –2

5.4 Names

The names of specific entities, e.g. particular tracks, fields, etc., are given with an initial capital. Other terms having explicitly-defined meanings for the purposes of this International Standard are also capitalized.

6 List of acronyms

ac alternating current

ADIP Address In Pre-Groove

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

APC	Automatic Power Control
AU	Address Unit
AUN	Address-Unit Number
BCA	Burst-Cutting Area
BIS	Burst-Indicating Subcode
BPF	Band-Pass Filter
CAV	Constant Angular Velocity
cbs	Channel bits
CNR	Carrier-to-Noise Ratio
dc	direct current
DDS	Disk-Definition Structure
DFL	Defect List
DI	Disk Information
DL	Dual Layer
DMA	Disk-Management Area
DMS	Disk-Management Structure
DOW	Direct OverWrite
DOW(*n*)	the *n*-th Overwrite
DOW(0)	the initial recording
DSV	Digital-Sum Value
DWP	Disk Write Protect
EB	Emergency Brake
ECC	Error-Correction Code
EDC	Error-Detection Code
FAA	First ADIP Address (of Data Zone)
FS	Frame Sync
FWHM	Full Width at Half Maximum
HF	High Frequency
HFM	High-Frequency Modulated
HMW	Harmonic-Modulated Wave
HPF	High-Pass Filter
HTL	High-To-Low
LAA	Last ADIP Address (of Data Zone)
LDC	Long-Distance Code
LPF	Low-Pass Filter
LSB	Least-Significant Byte
lsb	least-significant bit
LSN	Logical-Sector Number
MM	MSK Mark
MSB	Most-Significant Byte
ms	Millisecond

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

msb	most-significant bit
MSK	Minimum-Shift Keying
MW	Monotone Wobble
NA	Numerical Aperture
NHWS	Normalized HFM-Wobble Signal
NRD	Non-Re-allocatable Defect
NRZ	Non-Return-to-Zero
NRZI	Non-Return-to-Zero Inverting
ns	Nanosecond
NWL	Nominal Wobble Length
NWS	Normalized Wobble Signal
OPU	Optical Pick-up Unit
PAA	Physical ADIP Address
PAC	Physical-Access Control
PBA	Possibly Bad Area
PIC	Permanent Information and Control data
PLL	Phase-Lock Loop
PoA	Post-amble
PP	Push-Pull
pp	peak-to-peak
PrA	Pre-amble
ps	Picosecond
PSN	Physical-Sector Number
RH	Relative Humidity
RMTR	Repeated Minimum-Transition Run-length
R-M-W	Read-Modify-Write
RS	Reed-Solomon (code)
RT	Relative Thickness
RUB	Recording-Unit Block
RxI_n	Reflectivity × I_n Resolution
RxM	Reflectivity × Modulation
SER	Symbol Error Rate
SHD	Second-Harmonic Distortion
SHL	Second-Harmonic Level
SL	Single Layer
SNR	Signal-to-Noise Ratio
SPS	Start-Position Shift
STW	Saw-Tooth Wobble
Sync	Synchronization
TP	Track Pitch
TS	Transmission Stack

Documents
Document Sharing Hub
© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

wbs Wobbles

WP Write Protect

7 General descriptions of disk

The 120 mm optical disk that is the subject of this International Standard consists of a Substrate of about 1,1 mm nominal thickness. Clamping is performed in the Clamping Zone.

The Recording Layer of the disk may use phase-change recording technology. Recorded amorphous Marks have lower reflection than the crystalline Spaces of Unrecorded Layer(s).

This International Standard provides for two Types of disks

Type SL disk: the Substrate is covered with a Recording Layer, consisting of several films. On top of this Recording Layer, a transparent Cover Layer of 0,1 mm is applied with precisely-defined optical characteristics (see Figure 1). The capacity is 25,0 Gbytes.

Type DL disk: the Substrate is covered with two Recording Layers, each consisting of several films. The two Recording Layers are separated by a transparent Spacer Layer of about 0,025 mm. The first Recording Layer seen from the read-out side of the disk shall be semi-transparent. On top of this Recording Layer, a transparent Cover Layer of about 0,075 mm is applied. Both the Spacer Layer and the Cover Layer shall have precisely-defined optical characteristics (see Figure 2). The capacity is 50,0 Gbytes.

To improve scratch resistance of the disk, the Cover Layer optionally can be protected with an additional hard coating.

Data can be written and overwritten onto the disk with a high-power focused optical beam. The data can be read with a low-power focused optical beam, using the difference in the reflectivity of the amorphous Marks and the crystalline Spaces.

The Recording Layer(s) contain Wobbled Groove(s) with addresses that enable a speed control and navigation system for data to be read from or written to the Recording Layer concerned.

Recording and reading of the data is accomplished through the Cover Layer or through the total stack of Cover Layer, first Recording Layer and Spacer Layer, depending on which Recording Layer is involved.

For reference purposes, a layer that the light beam passes through when accessing a certain Recording Layer is called a Transmission Stack of that specific Recording Layer (see Figure 1 and Figure 2).

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

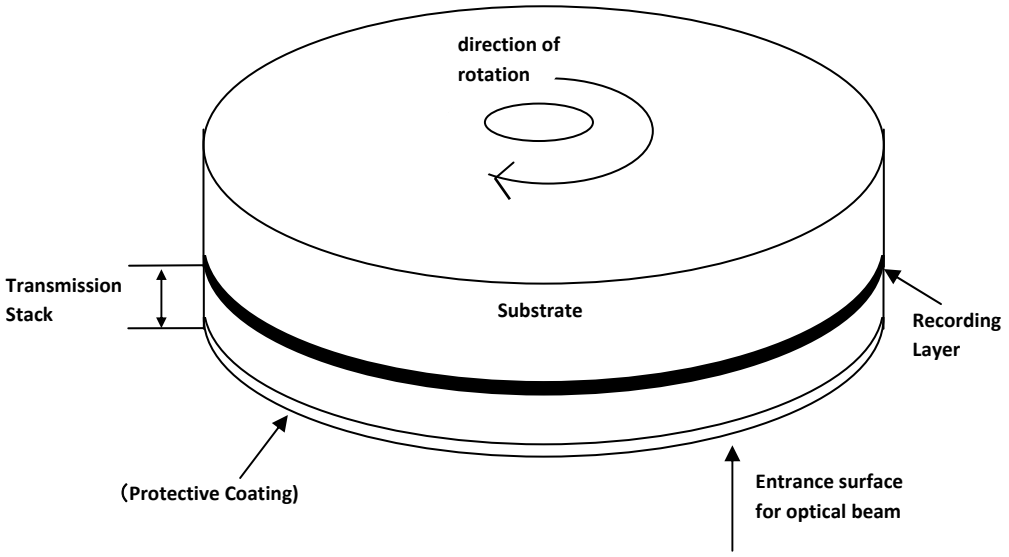

Figure 1 — Outline of Type SL disk

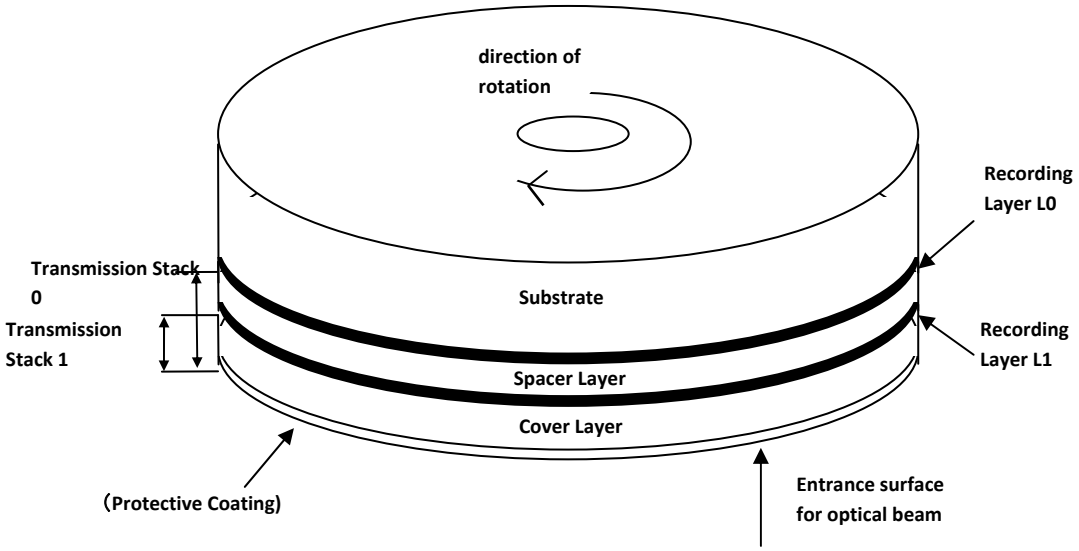

Figure 2 — Outline of Type DL disk

This International Standard specifies two kinds of Recording Velocity: 1x and 2x.

Figure 3 shows the Recording Velocity requirements for each Disk Type. At least one of the Write Strategies is reqired for each Recording Velocity.

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

Disk Type	Mark polarity	Push-Pull polarity	Layer Type	Recording Velocity	
				1x	2x
Type SL	HTL	On-Groove	SL	m	m
Type DL	HTL	On-Groove[a]	DL	m	m
m Mandatory. [a] Groove polarity shall be On-Groove for both Layer L0 and Layer L1.					

Figure 3 — Recording Velocity requirements for Disk Type

8 General requirements

8.1 Environments

8.1.1 Test environment

8.1.1.1 General

During measurements for testing conformance of a disk with this International Standard, the disk shall be in the test environment. The test environment is the environment where the air immediately surrounding the disk shall have following properties:

— temperature: (23 ± 2) °C;
— relative humidity: 45 % to 55 %;
— atmospheric pressure: 86 kPa to 106 kPa.

No condensation on the disk shall occur. Before testing, the disk shall be conditioned in this environment for a sufficient time.

8.1.1.2 Test conditions for sudden changes in operating environment

Some parameters can be rather sensitive to changes in the operating environment. Where specified, the following two tests shall be performed. In both cases, the required specifications shall be fulfilled during the time it takes for the disk to acclimatize to the new environment.

a) apply a sudden change in relative humidity, while keeping the temperature at a constant level: relative humidity = 90 %, temperature = 25 °C → relative humidity = 45 %, temperature = 25 °C (see Figure 4).

b) apply a sudden change in temperature, while keeping the absolute humidity at a constant level (≈ 10,4 g/m^3): temperature = 25 °C, relative humidity = 45 % → temperature = 55 °C, relative humidity = 10 % (see Figure 4).

8.1.2 Operating environment

A disk in conformance with this International Standard shall provide data interchange over the specified ranges of environmental parameters in the operating environment. The operating environment is the environment where the air immediately surrounding the disk shall have the following properties:

— temperature: 5 °C to 55 °C;
— relative humidity: 3 % to 90 %;
— absolute humidity: 0,5 g/m^3 to 30 g/m^3;
— atmospheric pressure: 60 kPa to 106 kPa.

There shall be no condensation of moisture on the disk. If a disk has been exposed to conditions outside those specified above, it shall be acclimatized in an operating environment for at least 2 hours before use.

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

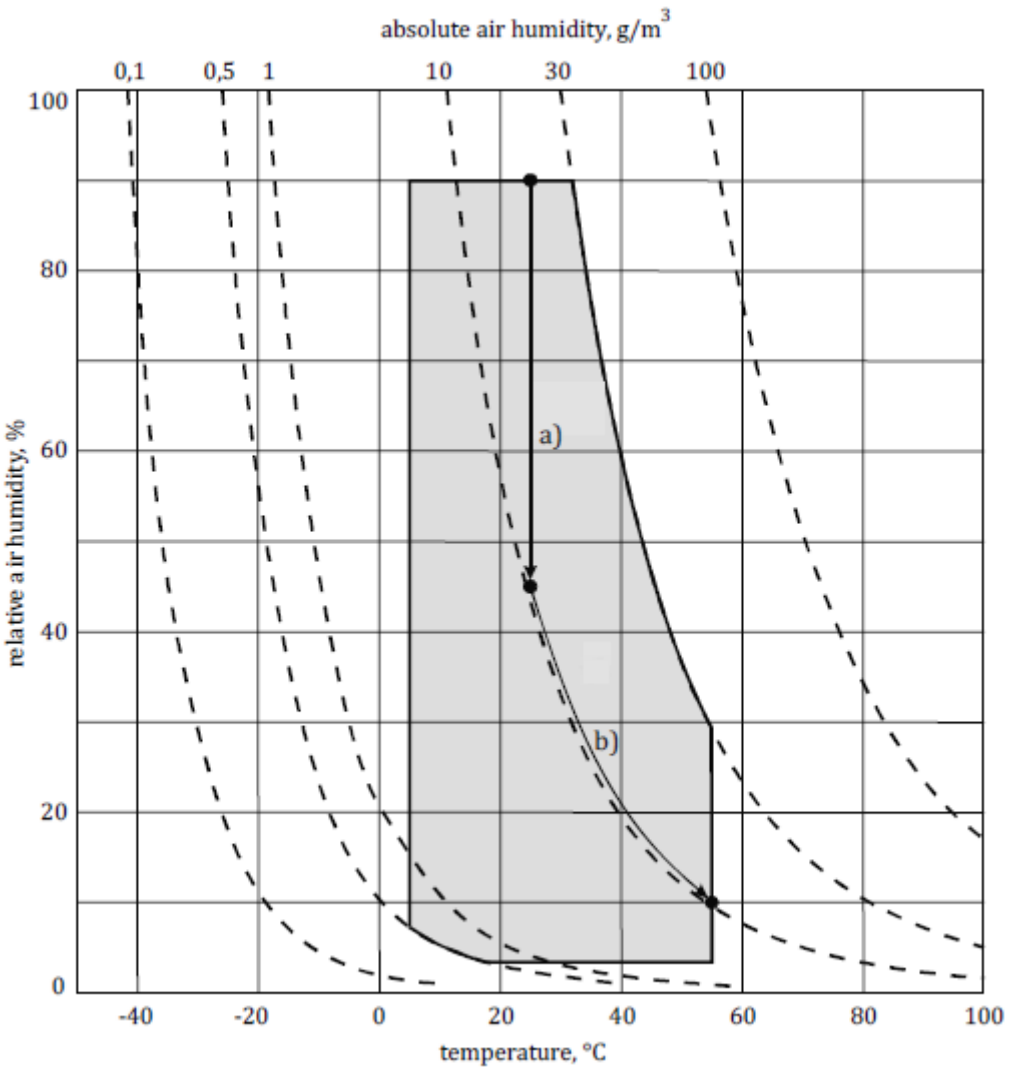

Figure 4 — Operating environment

8.1.3 Storage environment

8.1.3.1 General

The storage environment is an environment where the air immediately surrounding the optical disk shall have the following properties:

— temperature: –10 °C to 55 °C;
— relative humidity: 5 % to 90 %;
— absolute humidity: 1 g/m^3 to 30 g/m^3;
— atmospheric pressure: 60 kPa to 106 kPa;
— temperature variation max.: 15 °C/h;
— relative humidity variation max.: 10 %/h.

8.1.3.2 Climatic storage tests

To check environmental stability of the disk, it shall be exposed to the following environments:

— Dry heat test according to IEC 60068-2-2 Ba:
  T = 55 °C, RH = 50%, 96 hours.
— Damp heat cycle test according to IEC 60068-2-30 Db:
  T_{high} = 40 °C, T_{low} = 25 °C, RH = 95 %, cycle time = (12 + 12) hours, 6 cycles.

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

After exposure to these environmental conditions, one should allow for some recovery time before measuring (24 hours or 48 hours).

8.1.4 Transportation

8.1.4.1 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 mandatory conditions for transportation or for packaging.

8.1.4.2 Packaging

8.1.4.2.1 General

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

8.1.4.2.2 Temperature and humidity

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

8.1.4.2.3 Impact loads and vibrations

a) Avoid mechanical loads that would distort the shape of the disk.
b) Avoid dropping the disk.
c) Disks 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.

8.2 Safety requirements

The disk shall satisfy the requirement of IEC 60950-1, when used in the intended manner or in any foreseeable uses in an information system.

8.3 Flammability

The disk shall be made from materials that comply with the flammability class for HB materials, or better, as specified in IEC 60950-1.

9 Reference drive

9.1 General

A Reference drive shall be used for the measurement of optical and electrical signal parameters in order to confirm that a disk is in conformance with the requirements of this International Standard. The characteristincs of the critical components of this device are specified in Clause 9.

9.2 Environmental conditions

During tests, the disk shall be in a test environment as defined in 8.1.1, unless stated otherwise.

9.3 Optical system

The basic set-up of the optical system of the Reference drive used for measuring specified (over)write and read parameters is shown in Figure 5. Different components and locations of components are permitted, provided that the performance remains the same as that of the set-up in Figure 5.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

The optical system shall be aligned such that the focused optical beam is perpendicular to the Recording Layer on which the beam is focused at the radius where the measurement is to be performed.

The optical system shall be such that the detected light reflected from the Entrance surface of the disk is minimized so as not to affect the accuracy of the measurements.

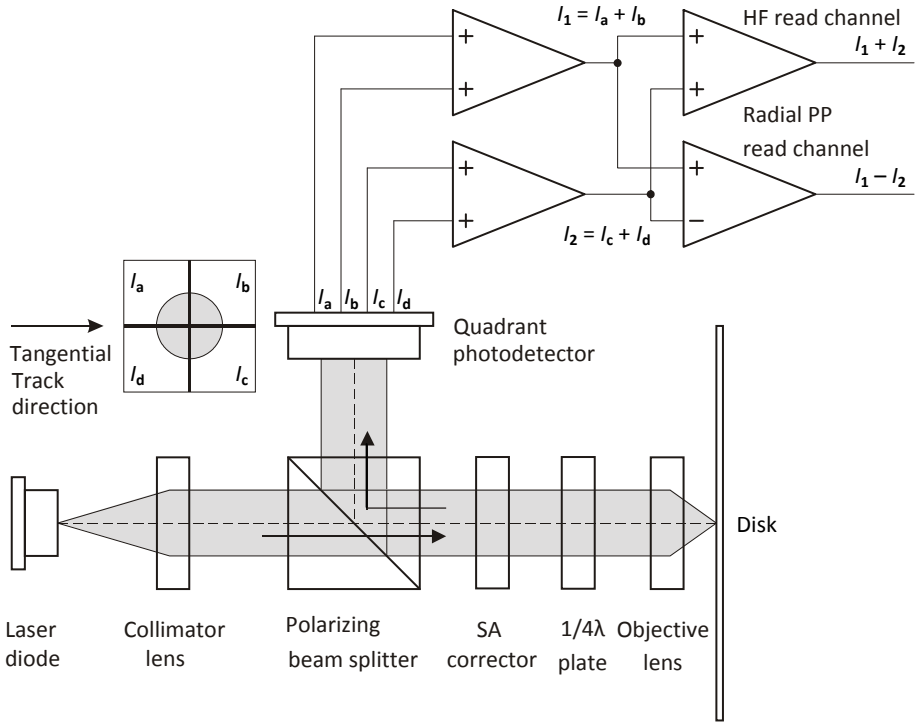

Figure 5 — Optical system of Reference drive

A polarizing beam splitter and a quarter-wavelength plate shall be used to separate the entrance light beam, coming from the laser diode, and light beam reflected by the optical disk going towards the photodetector. The light beam transmitted through the splitter shall have a p:s intensity ratio of at least 100:1.

The optical beam shall be compensated for Spherical Aberrations (SA) such that these aberrations are minimized for the thickness of the Transmission Stack of the Recording Layer on which the beam is focused at the radius where the measurement is to be performed.

During measurements on one Layer of a Dual-Layer disk, light reflected from the other Layer can influence the measurements on the Layer under investigation. To cope with these effects, the photodetector shall have limited dimensions. Its length and width shall be smaller than $M \times 5$ μm, where M is the transversal optical magnification from the disk to its conjugate plane near the quadrant photodetector.

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

9.4 Optical beam

The focused optical beam used for writing and reading data shall have the properties listed below.

— Wavelength (λ) of the laser beam: (405 ± 5) nm

— Polarization: circular

— NA: 0,85 ± 0,01

— Light intensity at the rim of the pupil of the objective lens relative to the maximum intensity:
  — in the tangential direction: (60 ± 5) %
  — in the radial direction: (65 ± 5) %

— Maximum wave-front aberration at the Recording Layer(s): 0,033 × λ rms
(after correction of tilt and spherical aberrations)

— Maximum relative-intensity noise of the laser diode: –125 dB/Hz

$$\left(10 \times \log\left\{\frac{ac\ light\ density / Hz}{dc\ light\ power}\right\}\right)$$

— Normalized detector size: $S/M^2 \leq 25\ \mu m^2$
(where S is the total surface of the quadrant photodetector)

— Read power for disk testing (average):
  — SL disk: (0,35 ± 0,1) mW
  — DL disk: (0,70 ± 0,1) mW

— Write power and pulse shape: see 29.4.2 and Annex F

9.5 HF read channel

The HF read channel is provided to supply a signal from which User Data can be retrieved. This signal is generated by summing the currents from all four elements of the photodetector ($I_a + I_b + I_c + I_d$). These currents are modulated by the user-written information due to the difference in reflectivity of the Marks and Spaces caused by the Phase-Change effects.

In the frequency range from dc to 22 MHz the HF read channel, including the photodetectors, shall have a flat amplitude response within ±1,0 dB relative to its dc gain.

The group delay variation shall be maximum 2 ns pp in the frequency range from 3 MHz to 22 MHz.

For measurement of jitter, the characteristics of the signal processing, the data slicer and the PLL, etc. are specified in Annex H.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

9.6 Radial PP read channel

The radial PP read channel provides the tracking-error signal to control the servo for radial tracking of the optical beam. It also provides a wobble signal from which the information modulated on the Grooves can be retrieved.

The radial tracking error is generated as a signal $[(I_a + I_b) - (I_c + I_d)]$ related to the difference in the amount of light in the two halves of the exit pupil of the objective lens.

The read amplifiers including the photodetectors in the radial PP read channel shall have a flat amplitude response within ±1,0 dB relative to their dc gain from dc to 8 MHz.

9.7 Disk Clamping

While its parameters are being measured, the disk shall be clamped between two concentric rings covering most of the Clamping Zone (see 10.6). The top Clamping Area shall have the same inner and outer diameters as the bottom Clamping Area (see Figure 6).

Clamping shall occur between d_{in} = (23,5 ± 0,5) mm and d_{out} = (32,5 ± 0,5) mm.

The total clamping force shall be F_1 = 2,0 N ± 0,5 N.

In order to prevent warping of the disk under the moment of force generated by the clamping force and the chucking force F_2, which is exerted by the tapered cone on the rim of the centre hole of the disk, F_2 shall not exceed 0,5 N (see Figure 6).

The top angle α of the tapered cone for centring of the disk shall be 40,0° ± 0,5°.

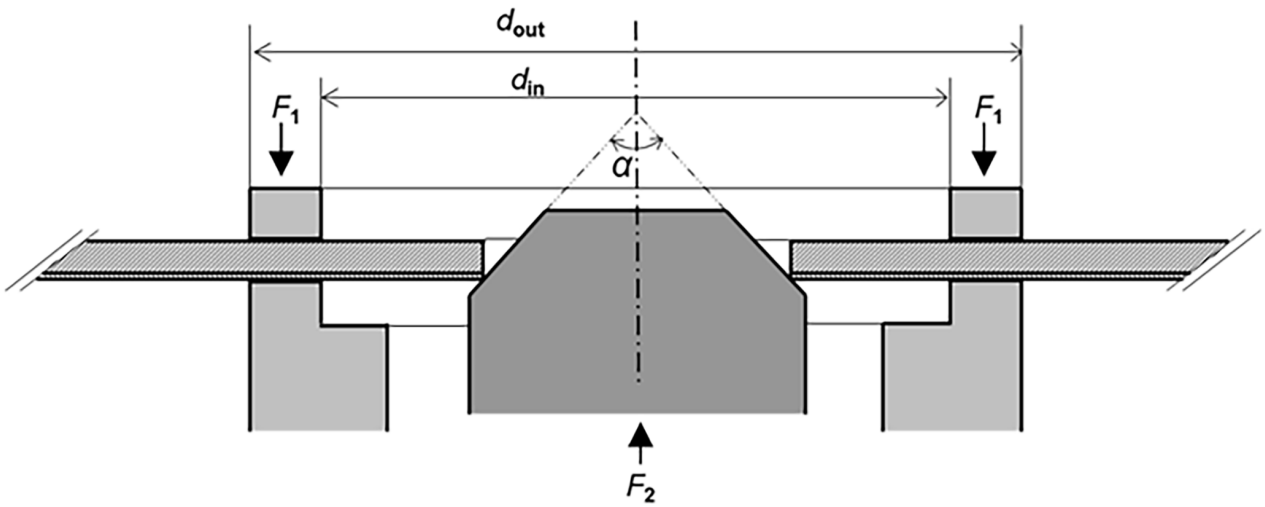

Figure 6 — Clamping conditions for measurement

9.8 Rotation of the disk and Measurement Velocity

The direction of rotation shall be counter-clockwise as viewed from the objective lens.

All specifications are based on a tangential speed during reading that is equal to the Reference Velocity. This corresponds to a Constant Linear Velocity of 4,917 m/s.

Tests for determining the recording characteristics of BD Rewritable disks shall be carried out at all Velocities defined in each of the DI Units that are present on the disk (see 15.8.3).

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

9.9 Normalized servo transfer function

In order to specify the servo systems for axial and radial tracking, a function $H_N(i\omega)$ is used. It specifies the nominal values of the open-loop transfer function H of the Reference servo(s).

$$H_N(i\omega) = \frac{1}{3} \times \left(\frac{\omega_0}{i\omega}\right)^2 \times \frac{1 + \frac{3 \times i\omega}{\omega_0}}{1 + \frac{i\omega}{3 \times \omega_0}} \times \left(1 + \frac{\omega_{int}}{i\omega}\right)^K$$

where

ω = 2π × f;

ω_0 = 2π × f_0;

ω_{int} = 2π × f_{int};

i^2 = –1;

K = order of integrator.

Here, f_0 is the 0 dB crossover frequency of the open-loop transfer function. The crossover frequencies of the lead-lag network of the servo are given by the following:

— lead break frequency: $f_1 = f_0 / 3$;
— lag break frequency: $f_2 = f_0 \times 3$.

The term $\left(1 + \frac{\omega_{int}}{i\omega}\right)$ in the formula above represents an integrator function. Such an integrator or equivalent function is used to further reduce of low-frequency components, especially those due to deviations with frequencies equal to the rotational frequency of the disk or its harmonics.

Also, f_{int} is the 3 dB crossover frequency of the integrator function.

Another frequency of importance is the frequency f_X at which a sinusoidal displacement with an amplitude equal to the maximum allowed residual tracking error e_{max}, corresponds to the maximum expected acceleration α_{max}. This frequency can be calculated as follows:

$$f_X = \frac{1}{2\pi}\sqrt{\frac{\alpha_{max}}{e_{max}}}$$

Because the tracking-error signals from the disk can have rather large variations, the tracking-error signal fed into each Reference servo loop shall be adjusted to a fixed level (effectively calibrating the total loop gain), which guarantees the specified bandwidth.

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

9.10 Measurement Velocity and Reference servo for axial tracking

Regarding the open-loop transfer function $H(f)$ of the Reference servo for axial tracking, $|1 + H(f)|$ is shown schematically by the shaded area in Figure 7.

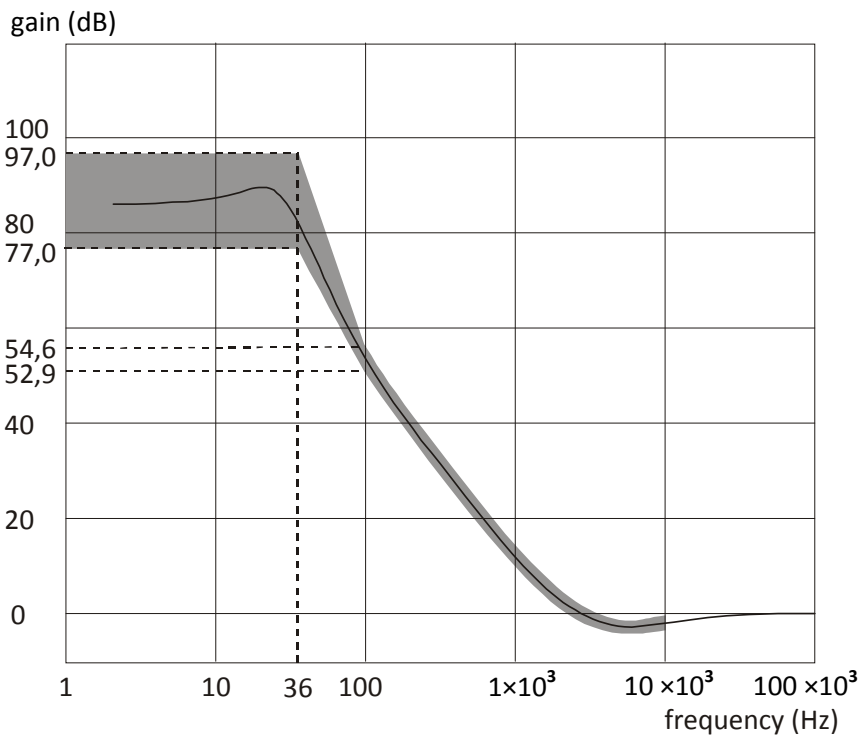

Figure 7 — Servo characteristic for axial tracking

The crossover frequency f_0 of $H_N(f)$ (see 9.9) used to define the limits of $|1 + H(f)|$, is specified by the following formula. where α_{max} = 6,0 m/s^2 is the maximum expected axial acceleration due to local disturbances, and α_{max} is multiplied by a factor m = 1,25 for servo margin. The tracking error e_{max}, caused by this $m \times \alpha_{max}$, shall be 55 nm. Thus, the 0 dB crossover frequency shall be:

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{3 \times m \times \alpha_{max}}{e_{max}}} = \frac{1}{2\pi}\sqrt{\frac{3 \times 1{,}25 \times 6{,}0}{55 \times 10^{-9}}} = 3{,}2 \text{ kHz}$$

The integrator 3 dB crossover frequency shall be: f_{int} = 100 Hz.

In the frequency range 100 Hz to 10 kHz:
$|1 + H(f)|$ shall be within –10 % to +10 % of $|1 + H_N(f)|$.

In the frequency range 36 Hz to 100 Hz:
$|1 + H(f)|$ shall be within the limits defined by the following four points:
52,9 dB at 100 Hz ($|1 + H_N(f)|$ at 100 Hz – 10 %);
54,6 dB at 100 Hz ($|1 + H_N(f)|$ at 100 Hz + 10 %);
77,0 dB at 36 Hz ($|1 + H_N(f)|$ at 36 Hz – 10 %);
97,0 dB at 36 Hz ($|1 + H_N(f)|$ at 36 Hz – 10 % + 20 dB).

In the frequency range up to 36 Hz:
$|1 + H(f)|$ shall be between 77,0 dB and 97,0 dB.

The frequency f_x has the following value: $f_x = \frac{1}{2\pi}\sqrt{\frac{\alpha_{max}}{e_{max}}} = \frac{1}{2\pi}\sqrt{\frac{6{,}0}{55 \times 10^{-9}}} \approx 1{,}6 \text{ kHz}$

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

9.11 Measurement Velocity and Reference servo for radial tracking

Regarding the open-loop transfer function $H(f)$ of the Reference servo for radial tracking, $|1 + H(f)|$ is shown schematically by the shaded area in Figure 8.

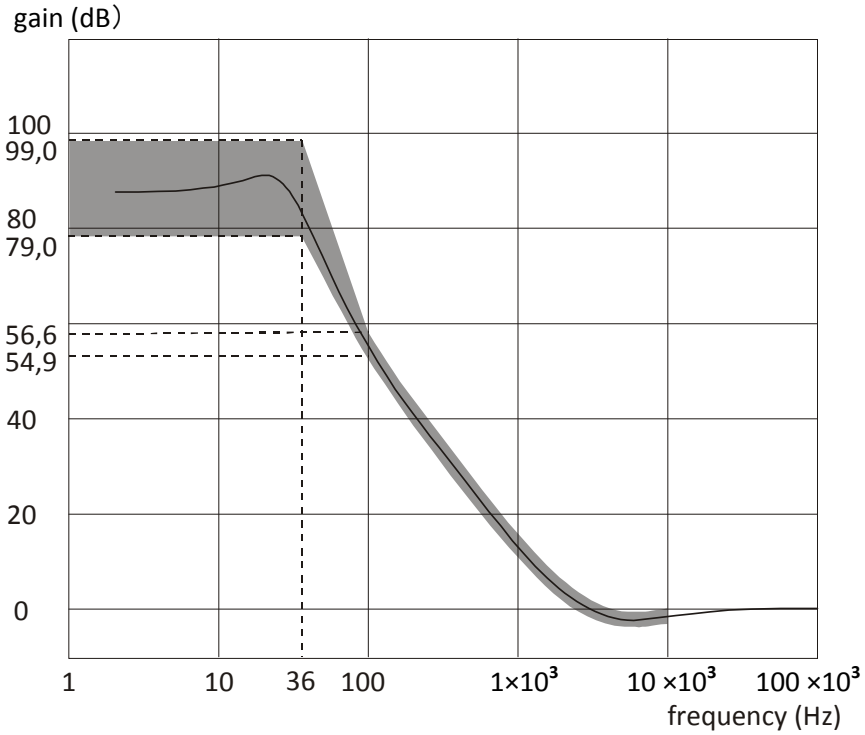

Figure 8 — Servo characteristic for radial tracking

The crossover frequency f_0 of $H_N(f)$ (see 9.9) which is used to define the limits of $|1 + H(f)|$, is specified by the following formula, and α_{max} = 2,2 m/s^2 is the worst-case maximum expected radial acceleration due to local disturbances, which α_{max} is multiplied by a factor m = 1,25 for servo margin. The tracking error e_{max}, caused by this $m \times \alpha_{max}$, shall be 16 nm. Thus, the 0-dB crossover frequency shall be as follows.

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{3 \times m \times \alpha_{max}}{e_{max}}} = \frac{1}{2\pi}\sqrt{\frac{3 \times 1{,}25 \times 2{,}2}{16 \times 10^{-9}}} = 3{,}6 \text{ kHz}$$

The integrator 3 dB crossover frequency shall be: f_{int} = 100 Hz.

In the frequency range 100 Hz to 10 kHz:
$|1 + H(f)|$ shall be within –10 % to +10 % of $|1 + H_N(f)|$

In the frequency range 36 Hz to 100 Hz:
$|1 + H|$ shall be within the limits defined by the following four points:

54,9 dB at 100 Hz ($|1 + H_N(f)|$ at 100 Hz – 10 %)
56,6 dB at 100 Hz ($|1 + H_N(f)|$ at 100 Hz + 10 %)
79,0 dB at 36 Hz ($|1 + H_N(f)|$ at 36 Hz – 10 %)
99,0 dB at 36 Hz ($|1 + H_N(f)|$ at 36 Hz – 10 % + 20 dB)

In the frequency range up to 36 Hz:
$|1 + H(f)|$ shall be between 79,0 dB and 99,0 dB.

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

The frequency f_x has the following value: $f_x = \frac{1}{2\pi}\sqrt{\frac{\alpha_{max}}{e_{max}}} = \frac{1}{2\pi}\sqrt{\frac{2{,}2}{16\times10^{-9}}} \approx 1{,}8\ \text{kHz}$

10 Dimensional characteristics

10.1 General

Dimensional characteristics are specified for those parameters deemed mandatory for interchange and compatible use of the disk. Where there is freedom of design, only the functional characteristics of the elements described are indicated. Figure 9 shows the dimensional requirements in summarized form. The different parts of the disk are described from the centre hole to the outside Rim.

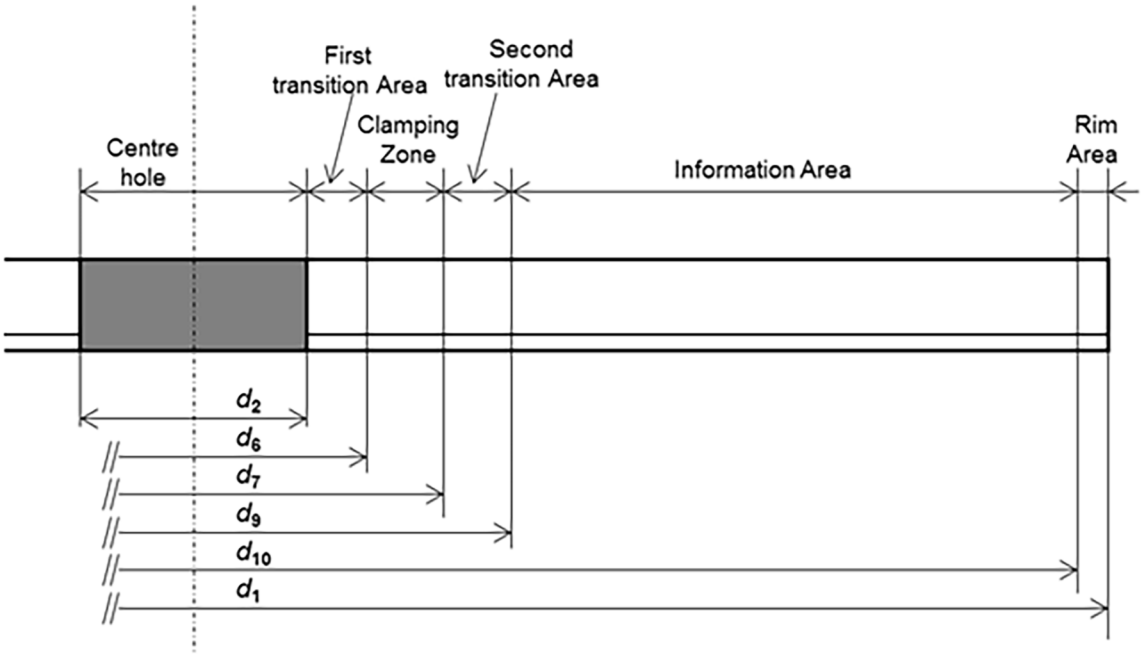

Figure 9 — Overview of disk dimensions

10.2 Disk reference planes and reference axis

For Disk reference planes, see also Figure 10 and Figure 11.

The Disk reference plane P is the plane determined by the surface of the Clamping Zone (see 10.6) at the read-out side of the disk.

The Disk reference plane Q is the plane determined by the surface of the Clamping Zone at the Substrate side of the disk.

The reference axis A is the axis through the middle of the centre hole, perpendicular to the Disk reference plane P.

The Disk reference plane R is a plane parallel to the Disk reference plane P. The distance between Disk reference plane R and Disk reference plane P shall be e_4 = 100 ± 25 μm towards the inside of the disk (see Figure 10 and Figure 11).

The Disk reference plane R shall intersect with Recording Layer L0 at Layer L0's average position between radius r_a = 23 mm and r_b = 24 mm (Layer L0 is the only Recording Layer on an SL disk or the deepest Recording Layer on a DL disk).

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

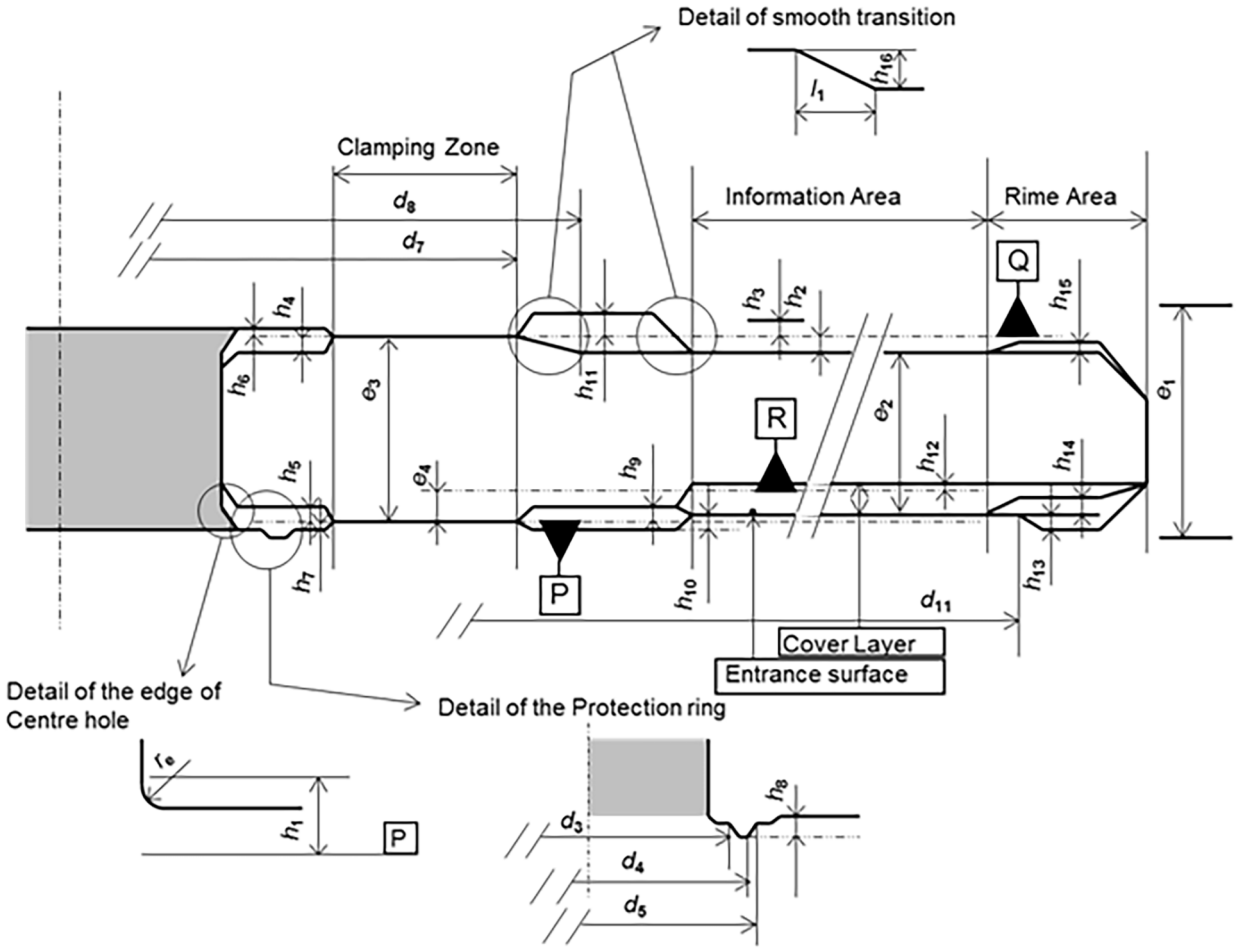

Figure 10 — Details of disk dimensions

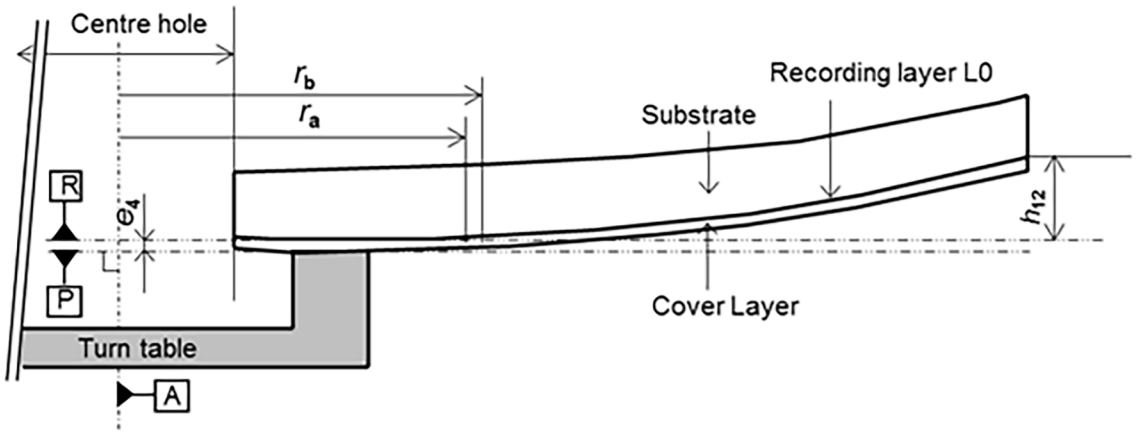

Figure 11 — Details of Disk reference planes P and R and Recording Layer

L0 10.3 Overall dimensions

The overall outer diameter of the disk shall be d_1 = (120,0 ± 0,3) mm (see Figure 9).

The diameter of the centre hole shall be d_2 = $15{,}00\ ^{+0{,}10}_{0{,}00}$ mm (see Figure 9).

There shall be no burr on the edge of the centre hole at the read-out side.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

The edge of the centre hole at the read-out side is the reference for centring the disk and shall be rounded off or chamfered. The rounding radius shall be maximum r_e = 0,1 mm. The height of chamfer shall be maximum 0,1 mm above the bottom surface of the First transition Area. The rounding or chamfer shall be maximum h_1 = 0,25 mm from Disk reference plane P (see detail in Figure 10).

The maximum thickness of the disk is defined as the distance in the direction of the reference axis A between the highest structure protruding from the Entrance surface of the disk and the highest structure protruding from the top surface of the disk.

Maximum thickness of the disk, including Cover Layer, Protective Coating and Label printing, at any radius shall be e_1 = 1,40 mm (see Figure 10).

Minimum thickness of the disk in the Information Area shall be e_2 = 0,90 mm.

Outside the Clamping Zone, the top surface may be inside the Disk reference plane Q by maximum h_2 = 0,4 mm.

Outside the Clamping Zone, the top surface may be outside the Disk reference plane Q by maximum h_3 = 0,1 mm (see Figure 10).

10.4 First transition Area

In the Inner Area inside the Clamping Zone ($d < d_6$), the surfaces may be inside the Disk reference planes P and Q by maximum h_5 = 0,20 mm and maximum h_4 = 0,12 mm, respectively. These surfaces may be uneven or may have burrs up to maximum h_7 = 0,05 mm and h_6 = 0,05 mm outside the Disk reference planes P and Q, respectively (see Figure 9 and Figure 10).

10.5 Protection ring

An optional ring-shaped protrusion in the Inner Area of the disk that can prevent full contact between the surface of the disk and a surface on which such a disk is laid down. By applying such a ring, the chance for damage to the read-out side of the disk can be minimized.

When applied, the Protection ring shall be located between diameter d_3 = 17,5 mm and diameter d_5 = 21,0 mm. Between d_3 and diameter d_4 = 20,5 mm, the height of the Protection ring shall be maximum 0,12 mm above the clamping surface.

Between d_4 and d_5, the height of the Protection ring shall sink gradually to the surrounding surface (see Figure 10).

10.6 Clamping Zone

The inner diameter of the disk Clamping Zone shall be $d_6 \leq 23{,}0$ mm
The outer diameter of the disk Clamping Zone shall be $d_7 \geq 33{,}0$ mm (see Figure 9).

The thickness of the disk within the Clamping Zone shall be $e_3 = 1{,}20^{+0{,}10}_{-0{,}05}$ mm (see Figure 10).

Within the Clamping Zone, ($d_6 < d < d_7$), both sides of the disk shall be flat within maximum 0,1 mm.
Within the Clamping Zone, ($d_6 < d < d_7$), both sides of the disk shall be parallel within maximum 0,1 mm.

10.7 Second transition Area

The Second transition Area is an area between the Clamping Zone and the Information Area: $d_7 < d < d_9$ (see Figure 9).

In the Second transition area, the surface at the read-out side of the disk may be inside the reference plane P by maximum h_9 = 0,12 mm. This surface may be outside the Entrance surface in the Information Area by maximum h_{10} = 0,01 mm (see Figure 10).

© ISO/IEC 2016 – All rights reserved

AVA Documents Document Sharing Hub

Full document details: BS ISO/IEC 30192:2016

In the Second transition area, the top surface of the disk may be outside the Disk Reference plane Q by maximum h_{11} = 0,2 mm.

The step from the top surface in the area to the top surface in the Information Area is h_{16}. The distance between the start and the end diameters of the step is l_1. If h_{16} > 0,2 mm, then the slope down to the top surface of the Information Area shall be smooth and l_1 > 1,8 mm, as indicated in Figure 10. If the top surface in the Information Area is stepped down from the top surface in the Second transition area, then the step shall end within diameter d_8 = 40,0 mm.

10.8 Information Area

10.8.1 General

The information area shall extend from diameter d_9 = 42 mm to diameter d_{10} = 117 mm (see Figure 9 and Figure 12).

On each Recording Layer, the Data Zone shall be located between inner diameter d_{DZI} and outer diameter d_{DZO}. The Data Zones on all Recording Layers shall have the same storage capacity.

The inner diameter d_{DZI} on Recording Layer L*n* shall be d_{DZIn} = $48{,}0^{0{,}0}_{-0{,}2}$ mm while and the outer diameter d_{DZO} on Recording Layer L*n* shall be d_{DZOn} ≤116,2 mm.

The area between d_9 and d_{DZI} is called the Inner Zone and the area between d_{DZO} and d_{10} is called the Outer Zone (see Figure 12). The total thickness of the disk in the Information Area is as specified in 10.3.

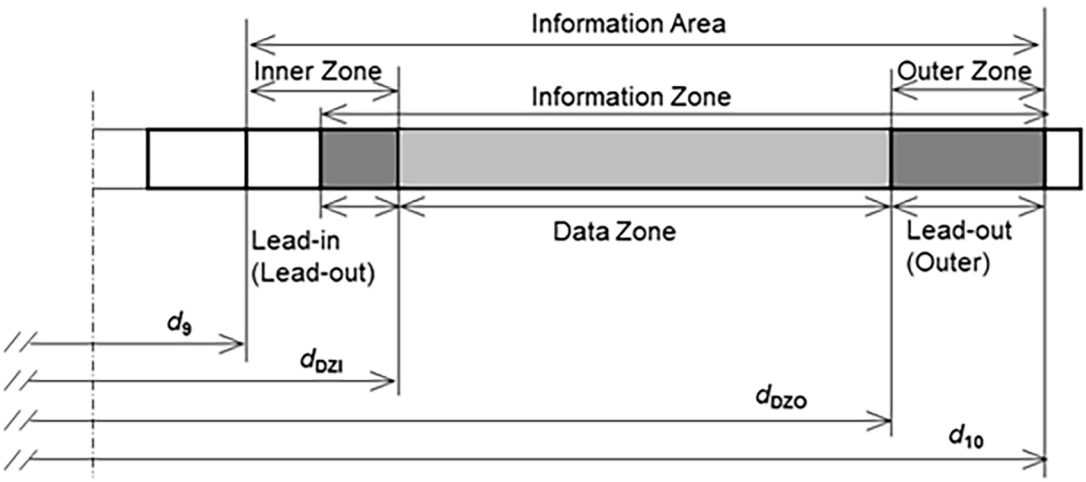

Figure 12 — Division of Information Area

10.8.2 Subdivisions of Information Zone on SL disk

The Information Area is used to record the Information Zone.

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

The Information Zone is subdivided into the following main parts (see Figure 13):
— Lead-in Zone (part of the Inner Zone);
— Data Zone;
— Lead-out Zone (Outer Zone).

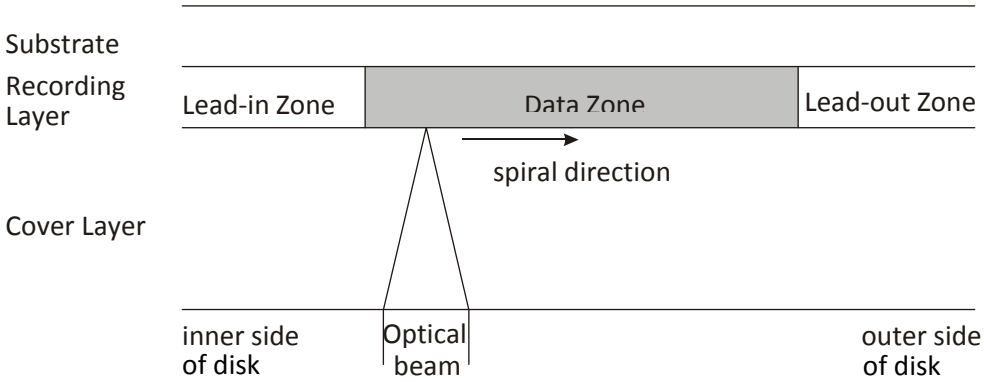

Figure 13 — Subdivision of Information Zone on SL disk

The Lead-in Zone starts in the area extending from 44,0 mm to 44,4 mm in diameter and shall end at the beginning of the Data Zone at diameter d_{DZI}.

The Lead-out Zone shall start at the end of the Data Zone at diameter d_{DZO} and shall end at minimum 117 mm in diameter.

10.8.3 Subdivisions of Information Zone on DL disks

The Information Area is used to record the Information Zone, divided over the two Recording Layers.
The Information Zone is subdivided into the following main parts (see Figure 14).

On Recording Layer L0
— Lead-in Zone (part of the Inner Zone 0),
— Data Zone 0, and
— Outer Zone 0.

On Recording Layer L1
— Outer Zone 1,
— Data Zone 1, and
— Lead-out Zone (part of the Inner Zone 1).

On Layer L0, the spiral Groove shall run from the inner side of the disk towards the outer side of the disk.
On Layer L1, the spiral Groove shall run from the outer side of the disk towards the inner side of the disk.

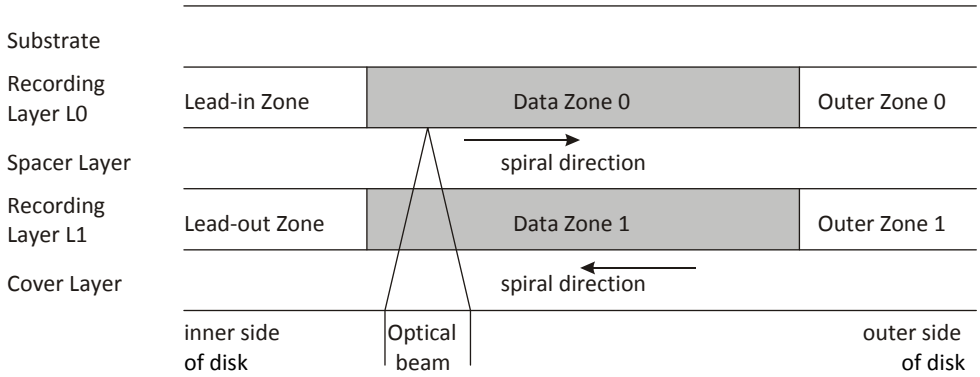

Figure 14 — Subdivision of Information Zone on DL disk

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

The Lead-in Zone starts in the area extending from 44,0 mm to 44,4 mm in diameter and shall end at the beginning of the Data Zone 0 at diameter d_{DZI0}.

The Outer Zone 0 shall start at the end of the Data Zone 0 at diameter d_{DZO0} and shall end at minimum 117 mm in diameter.

The Outer Zone 1 shall start at minimum 117 mm in diameter and shall end at the beginning of Data Zone 1 at diameter d_{DZO1}.

The Lead-out Zone shall start at the end of the Data Zone 1 at diameter d_{DZI1} and shall end in the area extending from diameter 44,0 mm to diameter 44,4 mm.

10.9 Rim Area

The Rim Area is the area outside the Information Area, starting at d_{10} and extending to the outer diameter of the disk (see Figure 9).

In the first 0,5 mm of the Rim Area, the surface at the read-out side of the disk shall not be outside the Entrance surface in the Information Area.

In the remainder of the Rim Area, the surface at the read-out side of the disk shall not be outside the Entrance surface in the Information Area by maximum h_{13} = 0,05 mm (see Figure 10).

In the Rim Area, the surface at the read-out side of the disk may be inside the Entrance surface in the Information Area by maximum h_{14} = 0,12 mm (see Figure 10).

In the Rim Area, the top surface of the disk shall not be outside the top surface in the Information Area by maximum h_{15} = 0,05 mm (see Figure 10).

11 Mechanical characteristics

11.1 Mass

The mass, m, of the disk shall be 12 g $\leq m \leq$ 17 g.

11.2 Moment of inertia

The moment of inertia of the disk shall be ≤0,032 g.m^2.

11.3 Dynamic imbalance

The dynamic imbalance of the disk shall be ≤ 2,5 g.mm.

11.4 Axial runout

11.4.1 General

When measured by an optical system using the Reference servo for axial tracking and with the disk rotating at a scanning velocity of 4,917 m/s (for all capacities), the distance between each Recording Layer and the Disk reference plane R (see Figure 10 and Figure 11) in the direction of the reference axis A shall be maximum h_{12} = 0,3 mm over the entire disk.

Within one Track (one revolution), the deviation of each Recording Layer from its average position in the direction of the reference axis A shall be maximum 0,1 mm.

At the inner side of the disk, rotating at a velocity of 4,917 m/s, this corresponds to a maximum acceleration of about 4,6 m/s^2, based upon a sinusoidal deviation at the rotational frequency of the disk.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

Due to the integrator function in the reference servo (see 9.10), this component will be suppressed sufficiently such that the residual tracking errors as defined in 11.4.2 are mainly due to local disturbances.

11.4.2 Residual axial tracking error

The residual axial tracking error of each Recording Layer for frequencies below 1,6 kHz (= f_X, see 9.10), measured using the Reference servo for axial tracking as specified in 9.10, shall be maximum 45 nm (displacement of the objective lens needed to move the focal point of the optical beam onto the Recording Layer).

Spikes in the residual axial tracking-error signal due to local defects, such as dust and scratches, shall be excluded. See Annex I.

The measuring filter shall be a Butterworth LPF, with f_{-3dB} = 1,6 kHz and slope = –60 dB/decade.

This means that for frequencies <1,6 kHz, the maximum local acceleration of the Recording Layer in the direction of the reference axis A will not exceed 6,0 m/s^2.

The rms noise value of the residual error signal in the frequency band from 1,6 kHz to 10 kHz, measured with an integration time of 20 ms and using the Reference servo for axial tracking, shall be at maximum 32 nm. The measuring filter shall be a Butterworth BPF, from f_{-3dB} = 1,6 kHz with slope = +60 dB/decade, to f_{-3dB} = 10 kHz with slope = –60 dB/decade.

11.5 Radial runout

11.5.1 General

The runout of the outer edge of the disk shall be maximum of 0,3 mm pp.

The radial runout of the Tracks in each Recording Layer (including eccentricity and unroundness) shall be measured by an optical system using the Reference servo for radial tracking, while the disk is rotating at a scanning velocity of 4,917 m/s (for all capacities).

The radial runout shall be maximum 75 μm pp (SL and DL disks).

At the inner side of the disk, rotating at a velocity of 4,917 m/s, this corresponds to a maximum acceleration of about 1,7 m/s^2, based upon a sinusoidal deviation at the rotational frequency of the disk.

Due to the integrator function in the Reference servo (see 9.11), this component will be suppressed sufficiently such that the residual tracking errors as defined in 11.5.2 and 11.5.3 are mainly due to local disturbances.

The residual tracking error shall be determined by applying the radial PP read channel ($I_1 – I_2$) signal for both measurement and radial servo control purposes as indicated in Figure 5.

11.5.2 Residual radial tracking error on SL disks

The residual radial tracking error for frequencies below 1,8 kHz (= f_X, see 9.11), measured using the reference servo for radial tracking as specified in 9.11, shall be a maximum of 9 nm.

Spikes in the residual radial tracking-error signal due to local defects, such as dust and scratches, shall be excluded. See Annex I.

The measuring filter shall be a Butterworth LPF, with f_{-3dB} = 1,8 kHz and slope = 60 dB/decade.

This means that for frequencies <1,8 kHz the maximum local acceleration of the Tracks in the radial direction will not exceed 1,5 m/s^2.

The rms noise value of the residual error signal in the frequency band from 1,8 kHz to 10 kHz, measured with an integration time of 20 ms and using the reference servo for radial tracking, shall be maximum 6,4 nm. The

© ISO/IEC 2016 – All rights reserved
Documents Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

measuring filter shall be a Butterworth BPF, from f_{-3dB} = 1,8 kHz with slope = +60 dB/decade, to f_{-3dB} = 10 kHz with slope = –60 dB/decade.

11.5.3 Residual radial tracking error on DL disks

The residual radial tracking error in each Recording Layer at frequencies below 1,8 kHz (= f_X, see 9.11), measured using the Reference servo for radial tracking as specified in 9.11, shall be a maximum of 13 nm.

Spikes in the residual radial tracking-error signal due to local defects, such as dust and scratches, shall be excluded. See Annex I.

The measuring filter shall be a Butterworth LPF, with f_{-3dB} = 1,8 kHz and slope = –60 dB/decade.

This means that for frequencies <1,8 kHz, the maximum acceleration of the Tracks in the radial direction will not exceed 2,2 m/s^2.

The rms noise value of the residual error signal in the frequency band from 1,8 kHz to 10 kHz, measured with an integration time of 20 ms and using the reference servo for radial tracking, shall be a maximum of 9,2 nm. The measuring filter shall be a Butterworth BPF, from f_{-3dB} = 1,8 kHz with slope = +60 dB/decade, to f_{-3dB} = 10 kHz with slope = –60 dB/decade.

11.6 Durability of Cover Layer

11.6.1 Impact resistance of Cover Layer

To prevent excessive damage by accidential impact, the Entrance surface of the disk should have a certain minimum impact resistance.

The minimum impact resistance can be tested by procedures described in Annex L.

11.6.2 Scratch resistance of Cover Layer

To prevent excessive scratching, the surface of the disk shall have at least a certain minimum hardness.

The scratch resistance shall be tested by a procedure described in Annex C.

11.6.3 Repulsion of fingerprints by Cover Layer

To prevent excessive contamination, the surface of the disk shall repel grime as much as possible.

The repulsion of grime shall be tested by a procedure described in Annex D.

12 Optical characteristics in Information Area

12.1 General

The following requirements shall be fulfilled within the Information Area of the disk.

These specifications of the Transmission Stacks (TS) include all possible layers on top of the Recording Layer concerned (such as gluing layers in case of foils, the Spacer Layer and the semi-transparent Recording Layer of Layer L1 in case of TS0, the Cover Layer and possibly a Protective coating).

12.2 Refractive index of Transmission Stacks (TS)

If the layers making up the total TS have different refractive indexes, then the procedure described in Annex A shall be followed.

The refractive index n of the Cover Layer and Spacer Layer of the disk shall be $1{,}45 \leq n \leq 1{,}70$.

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

12.3 Thickness of Transmission Stack(s)

12.3.1 Thickness of Transmission Stack of SL disks

The average thickness between radius r_a and radius r_b is called the Reference Thickness of the Transmission Stack (TS) on the disk (see 10.2 and Figure 11).

The thickness of the TS, measured over the whole disk, shall fulfill the following two requirements:

a) the thickness of the TS, as determined by its refractive index, shall be within the upper shaded area in Figure 15 (In case of a refractive index of 1,6 the thickness shall be between 95 μm and 105 μm and the dashed line indicates the nominal thickness as a function of the refractive index);

b) the maximum deviation ΔD of the thickness of the TS from the Reference Thickness shall meet the requirement $|\Delta D| \leq 2{,}0$ μm.

12.3.2 Thickness of Transmission Stack of DL disks

The average thickness between radius r_a and radius r_b is called the Reference Thickness of the related Transmission Stack (TS0 or TS1) on the disk.

The thickness of TS0 and TS1, measured over the whole disk, shall fulfill the following four requirements:

a) the thickness of TS0 (all layers on top of Layer L0), as determined by its refractive index, shall be within the upper shaded area in Figure 15 (in case of a refractive index of 1,6, the thickness shall be between 95 μm and 105 μm and the dashed line indicates the nominal thickness as a function of the refractive index);

b) the thickness of TS1 (all layers on top of Layer L1), as determined by its refractive index, shall be within the lower shaded area in Figure 15 (in case of a refractive index of 1,6, the thickness shall be between 70 μm and 80 μm and the dashed line indicates the nominal thickness as a function of the refractive index);

c) the thickness of the Spacer Layer shall be between 20 μm and 30 μm;

d) the maximum deviation ΔD of the thicknesses of TS0 and TS1 from their respective Reference Thicknesses shall meet the requirement $|\Delta D| \leq 2{,}0$ μm.

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

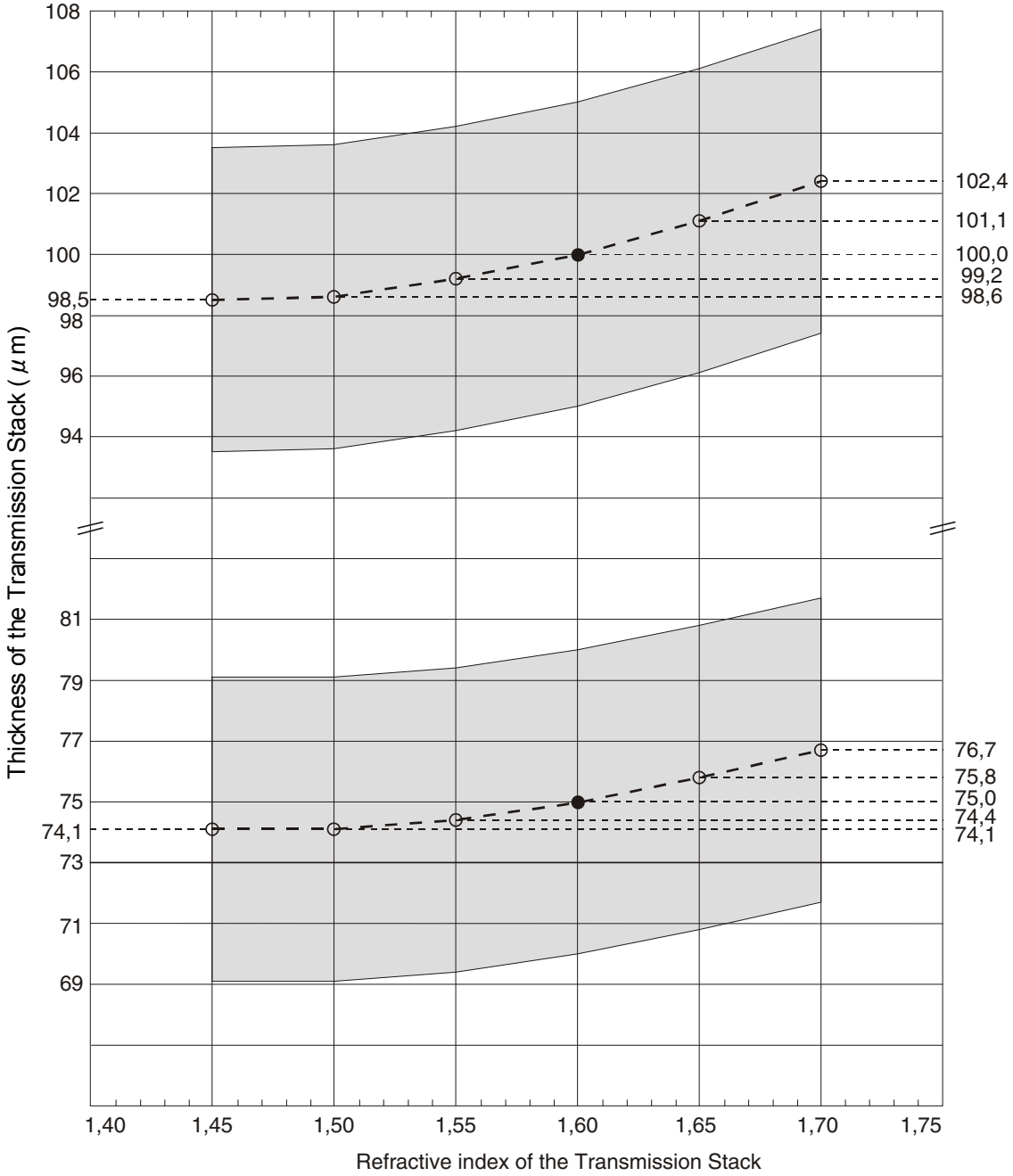

Figure 15 — Thickness of Transmission Stacks as function of refractive index

12.4 Reflectivity

12.4.1 Reflectivity of Recording Layer of SL disks

The reflectivity of the Recording Layer in the Information Zone, including transmission through the Cover Layer, shall fulfill the following requirements under the measurement conditions of Annex B:

— in Unrecorded Virgin Groove: R_{g-v} = 12 % to 24 %;

— in Unrecorded Erased Groove: R_{g-e} = 11 % to 24 %;
at each location on the disk: $0{,}75 \times R_{g-v} < R_{g-e} < 1{,}25 \times R_{g-v}$;

— in Recorded Grooves for the first ten DOW cycles: R_{8H} = 11 to 24 %;
at each location on the disk: $0{,}75 \times R_{g-v} < R_{8H} < 1{,}25 \times R_{g-v}$.

Written Marks shall have a lower reflectivity than the Unrecorded Layer.

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 30192:2016

12.4.2 Reflectivity of Recording Layer of DL disks

The reflectivity of each Recording Layer in the Information Zone, including transmission through the Transmission Stack concerned, shall fulfill the following requirements independent of the recording status of the other Recording Layer (whether Unrecorded, Recorded or partially Recorded) under the measurement conditions of Annex B:

— in Unrecorded Virgin Grooves: R_{g-v} = 4 % to 8 %;

— in Unrecorded Erased Grooves: R_{g-e} = 3,5 % to 8 %;
at each location on the disk: $0{,}75 \times R_{g-v} < R_{g-e} < 1{,}25 \times R_{g-v}$;

— in Recorded Grooves for the first ten DOW cycles: R_{8H} = 3,5 % to 8 %;
at each location on the disk: $0{,}75 \times R_{g-v} < R_{8H} < 1{,}25 \times R_{g-v}$.

Written Marks shall have a lower reflectivity than the Unrecorded Layer.

12.5 Birefringence

The in-plane birefringence of the Transmission Stacks shall be (see Annex J): $\Delta n_{//} \leq 1{,}5 \times 10^{-4}$.
The perpendicular birefringence of the Transmission Stacks shall be (see Annex J): $\Delta n_{\perp} \leq 1{,}2 \times 10^{-3}$.

12.6 Angular deviation

The angular deviation is the angle α between a parallel incident beam perpendicular to the Disk reference plane P and the reflected beam. The incident beam shall have a diameter in the range 0,3 mm to 1,0 mm. The angle α includes deflections of the Entrance surface and to lack of parallelism of the Cover Layer and/or Spacer Layer (see Figure 16).

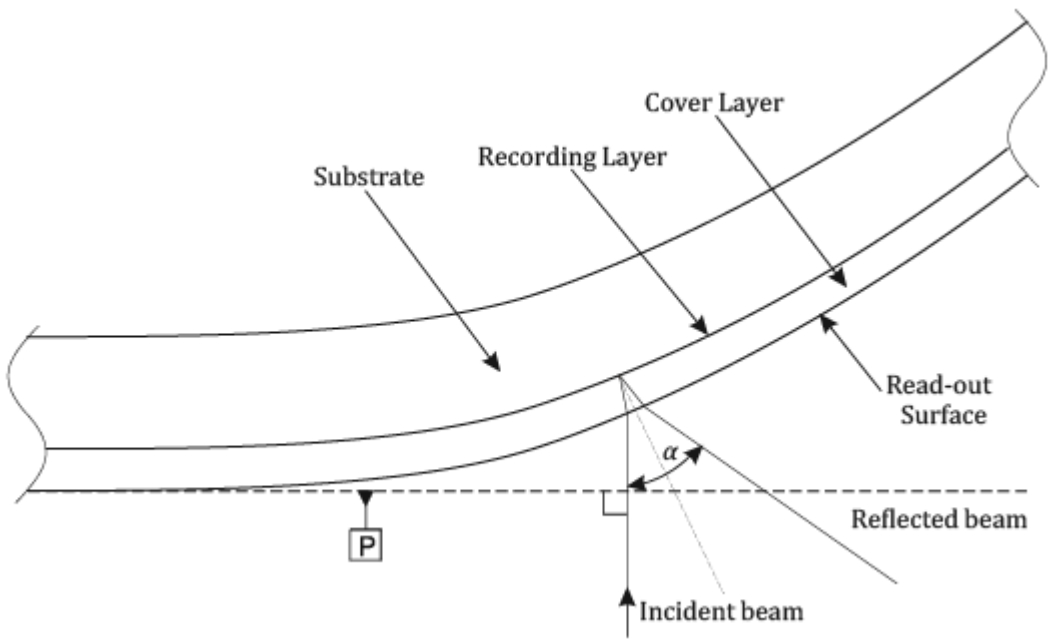

Figure 16 — Definition of angular deviation

The requirements for the angle α shall be as follows.

— In the radial direction
  — under the normal test conditions specified in 8.1.1: $|\alpha|$ max. =0,60°
  — under the “sudden change” test conditions specified in 8.1.1: $|\alpha|$ max. =0,70°
— In the tangential direction
  — under the normal test conditions specified in 8.1.1: $|\alpha|$ max. =0,60°

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016

13 Data format

13.1 General

The data received from the source (application or host), called User Data Frames, are formatted in a number of steps before being recorded on the disk (see Figure 17).

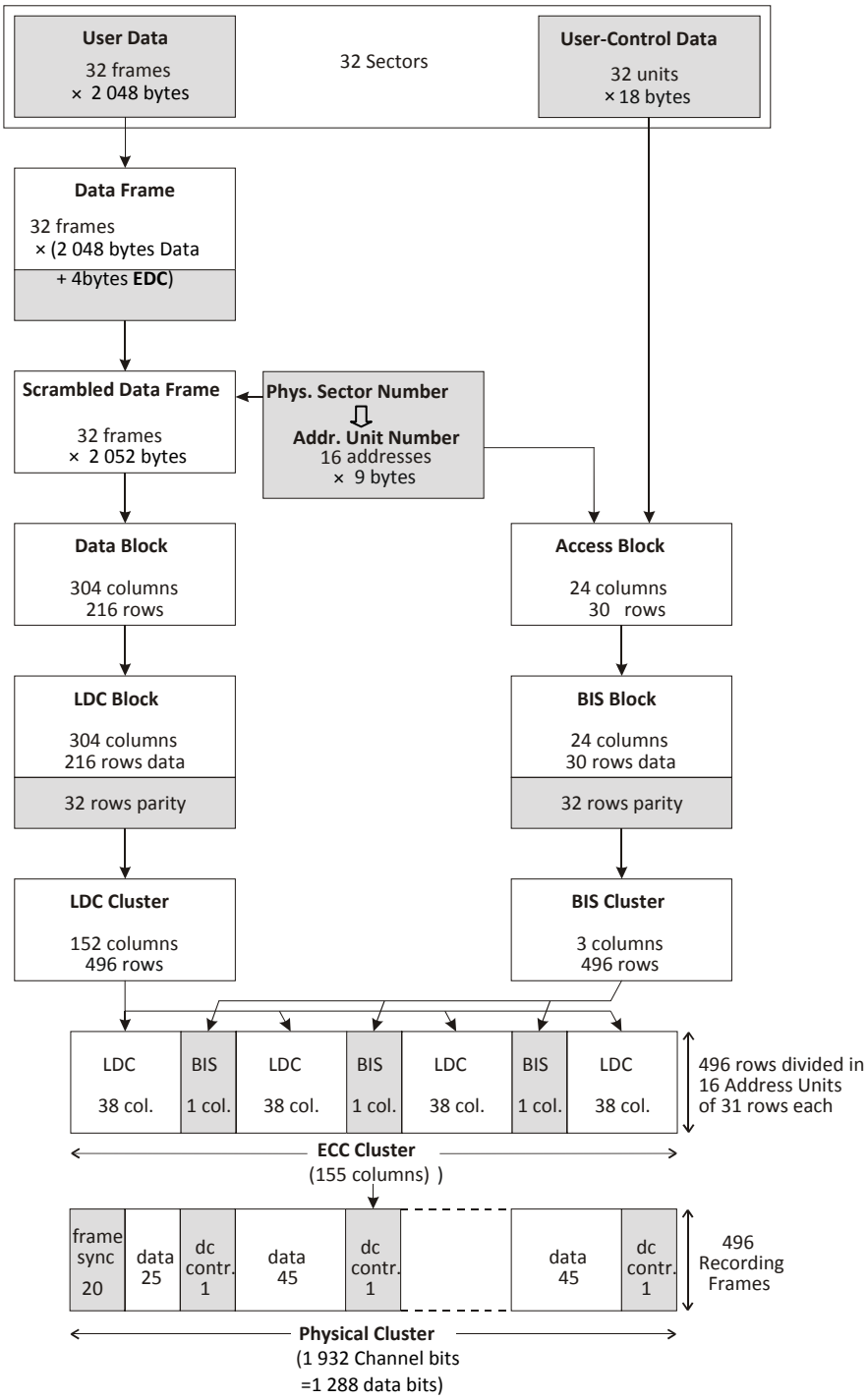

Figure 17 — Schematic representation of encoding process They are transferred successively into the following:

— Data Frames, Scrambled Data Frames, a Data Block, an LDC Block, and an LDC Cluster.

Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

The address and Control Data added by the BD Rewritable system are transferred successively into the following:

— an Access Block, a BIS Block, and a BIS Cluster.

The LDC Cluster and the BIS Cluster are multiplexed and modulated into the following:

— an ECC Cluster, subdivided into 16 Address Units;

— a Physical Cluster, consisting of 496 Recording Frames.

The data on BD Rewritable disks is recorded in 64K partitions, called Clusters, containing 32 Data Frames with 2 048 bytes of User Data. These Clusters are protected by the following two error-correction mechanisms.

— First, the data is protected by a Long Distance (LDC) Error-Correction Code, consisting of (248,216,33) Reed-Solomon (RS) code words. This code has ample parities and interleaving length with a good overall efficiency and can correct both random errors and burst errors.

— Secondly, the data is multiplexed with a powerful Burst-Indicating Subcode (BIS), which consists of (62,30,33) Reed-Solomon (RS) code words. These BIS code words carry addresses for allocation purposes and Control Information belonging to the User Data. They can also be used to indicate long burst errors, by means of which the LDC can efficiently perform erasure corrections.

The combination of these two codes is called an “LDC+BIS Code” (see Figure 18).

All the data is arranged in an array as indicated in Figure 18. This array is read in the horizontal direction, row after row, and recorded on the disk after insertion of additional dc-control bits, modulation, and insertion of Synchronization patterns.

The Error-Correction Codes are applied in the vertical direction, which gives a good basic break-up of burst errors on the disk. Additionally, the LDC code words have been interleaved in a diagonal direction.

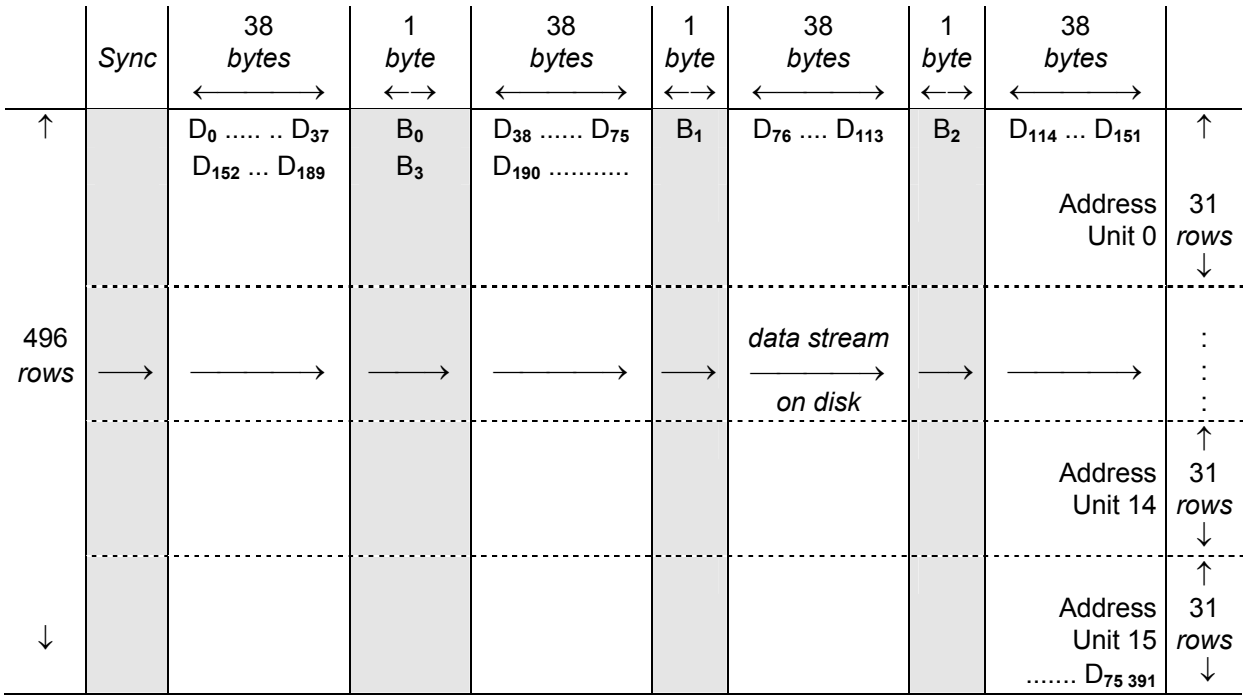

Figure 18 — Schematic representation of Physical Cluster on disk

Address Units, Physical Sectors and Logical Sectors are defined as follows.

Address Units:

© ISO/IEC 2016 – All rights reserved

Full document details: BS ISO/IEC 30192:2016

For the purpose of allocating the optical pick-up to a certain position on the disk, the Physical Cluster is subdivided into 16 Address Units, each consisting of 31 consecutive rows. The Address-Unit Numbers (AUN) provide a fast addressing mechanism embedded in the written data.

Physical Sectors:
A Data Frame accompanied by its Control Data is called a Sector. All Sectors in all Physical Clusters all over the disk (including the Inner and Outer Zones) are called Physical Sectors. All Physical Sectors have a virtual number assigned, called the Physical-Sector Number (PSN). These PSNs are not recorded onto the disk; however, they are synchronized with the AUNs.

Logical Sectors:
Not all Physical Sectors are available for storage of User Data delivered by the application or host. The Inner and Outer Zones are excluded. The remaining Sectors are available for storing User Data and are called Logical Sectors.

13.2 Data Frames

A Data Frame consists of 2 052 bytes: 2 048 bytes of User Data and 4 bytes of Error-Detection Code (EDC). The 2 048 User Data bytes are identified as ud_0 to $ud_{2\,047}$ and the 4 EDC bytes as $ed_{2\,048}$ to $ed_{2\,051}$ (see Figure 19).

↑	ud_0	↑
	:	
2 048	:	
User Data	:	
	:	*2 052*
↓	$ud_{2\,047}$	*bytes*
↑	$ed_{2\,048}$	
4	$ed_{2\,049}$	
EDC	$ed_{2\,050}$	
↓	$ed_{2\,051}$	↓

Figure 19 — Data Frame

13.3 Error-Detection Code (EDC)

The 4-byte field $ed_{2\,048}$ to $ed_{2\,051}$ shall contain an Error-Detection Code computed over the 2 048 bytes of User Data.

Considering the Data Frame as a single-bit field, starting with the most-significant bit of the first User Data byte (ud_0) and ending with the least-significant bit of the last EDC byte ($ed_{2\,051}$), then the msb will be $b_{16\,415}$ and the lsb will be b_0.

Each bit b_i of the EDC is shown as follows for i = 0 to 31.

$$EDC(x) = \sum_{i=31}^{0} b_i x^i = I(x) \bmod G(x)$$

where $I(x) = \sum_{i=16\,415}^{32} b_i x^i$ and $G(x) = x^{32} + x^{31} + x^4 + 1$

13.4 Scrambled Data Frame

Each Data Frame consisting of 2 052 bytes of User Data + EDC shall be scrambled with the output of the circuit defined in Figure 20, in which bits s_7 (msb) to s_0 (lsb) represent a scrambling byte at each 8-bit shift.

AVA Documents
Document Sharing Hub

© ISO/IEC 2016 – All rights reserved
Full document details: BS ISO/IEC 30192:2016

The heart of the circuit is a Linear-Feedback Shift Register (LFSR) based on the polynomial

$$\Phi(x) = x^{16} + x^{15} + x^{13} + x^{4} + 1.$$

Here, s_0 to s_{15} form a 16-bit shift register. At each shift clock the content of s_n shifts to s_{n+1} (n = 0..14), while s_0 is set to $s_{15} \oplus s_{14} \oplus s_{12} \oplus s_3$ ($\oplus$ stands for Exclusive-OR).

At the beginning of the scrambling procedure of each Data Frame, the shift register s_0 to s_{15} shall be preset with a value derived from the (virtual) PSN associated with the Data Frame (see Clause 17). The 16-bit preset value shall be composed in the following way:

— s_{15} shall be set to ONE;

— s_{14} .. s_0 shall be set to PS_{19} .. PS_5 of the PSN (see Figure 20).

The same preset value shall be used for all 32 Data Frames within the same Cluster.

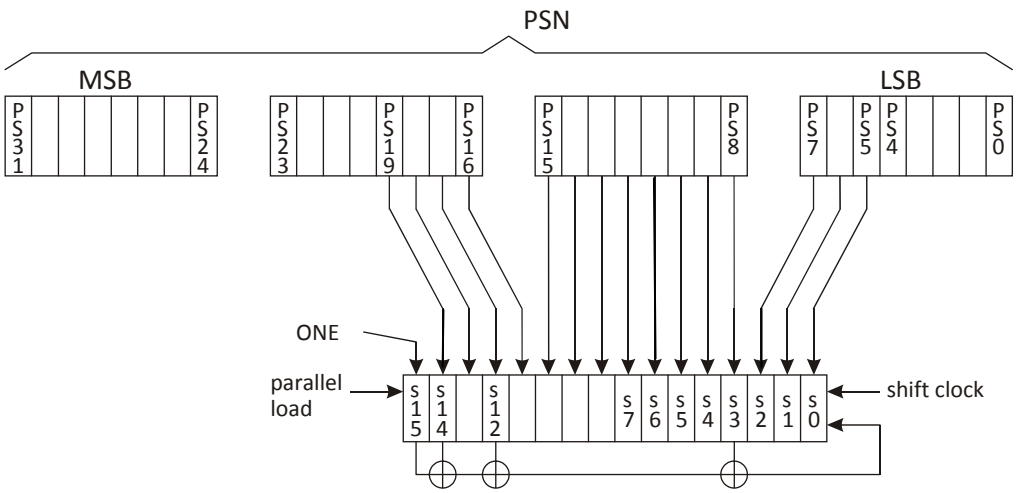

Figure 20 — Scrambler circuit

After loading the preset value, s_7 .. s_0 are taken out as scrambling byte S_0. Then, an 8-bit shift is repeated 2 051 times and the following 2 051 bytes are taken from s_7 .. s_0 as the scrambling bytes S_1 to $S_{2\,051}$.

The 2 052 bytes ud/ed$_k$ of the Data Frame become scrambled bytes d_k where:

d_k = ud/ed$_k \oplus S_k$ for k = 0 to 2 051; $\oplus$ stands for Exclusive-OR.

13.5 Data Block

In the next step, 32 Scrambled Data Frames (F = 0..31) are combined into one block of data as shown in Figure 21.

	←		*32 Frames*			→
	0	1	:	*F*	:	31
↑	$d_{0,0}$	$d_{0,1}$	:	$d_{0,F}$	:	$d_{0,31}$
	$d_{1,0}$	$d_{1,1}$	:	$d_{1,F}$	:	$d_{1,31}$
2 052	:		:	:	:	:
bytes	:		:	:	:	:
	$d_{2\,050,0}$	$d_{2\,050,1}$	:	$d_{2\,050,F}$	:	$d_{2\,050,31}$
↓	$d_{2\,051,0}$	$d_{2\,051,1}$	:	$d_{2\,051,F}$	:	$d_{2\,051,31}$

Figure 21 — 32 Scrambled Data Frames

© ISO/IEC 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 30192:2016