

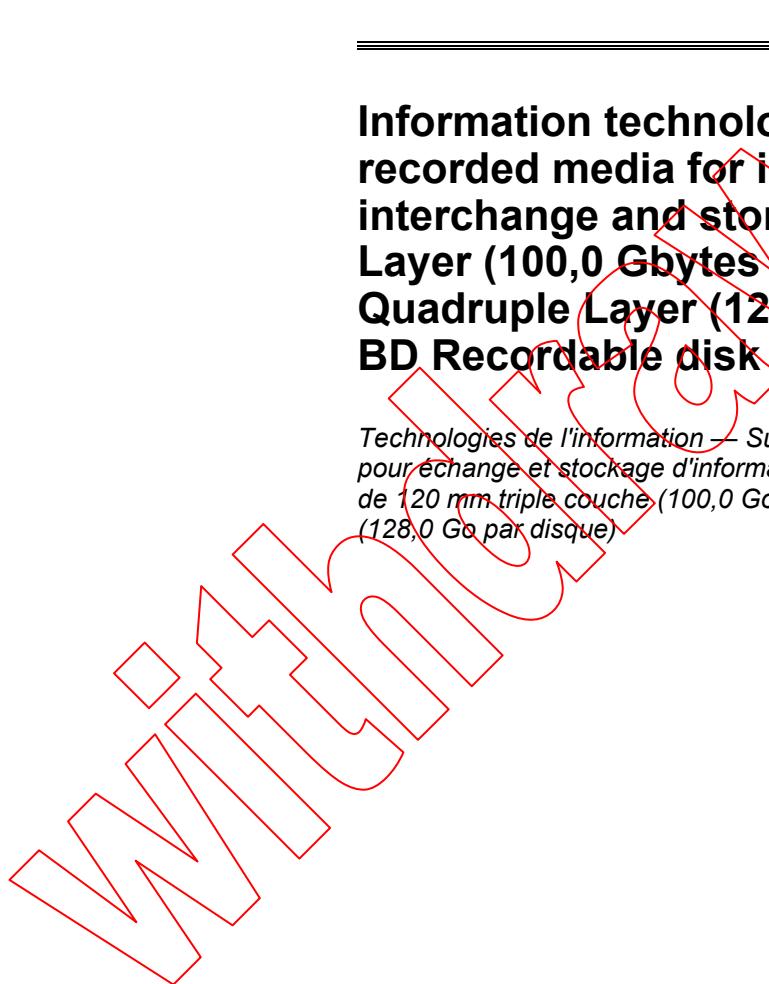
# STANDARD

**ISO/IEC  
30191**

First edition  
2013-07-01

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

*Technologies de l'information — Supports enregistrés numériquement pour échange et stockage d'information — Disques BD enregistrables de 120 mm triple couche (100,0 Go par disque) et quadruple couche (128,0 Go par disque)*



Reference number  
ISO/IEC 30191:2013(E)



© ISO/IEC 2013

Withdrawn

**COPYRIGHT PROTECTED DOCUMENT**

© ISO/IEC 2013

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  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

	Page
<b>Foreword .....</b>	<b>xiii</b>
<b>Introduction.....</b>	<b>xiv</b>
<b>1 Scope .....</b>	<b>1</b>
<b>2 Conformance .....</b>	<b>2</b>
<b>2.1 Optical disk .....</b>	<b>2</b>
<b>2.2 Generating system .....</b>	<b>2</b>
<b>2.3 Receiving system .....</b>	<b>2</b>
<b>2.4 Compatibility statement.....</b>	<b>2</b>
<b>3 Normative references.....</b>	<b>2</b>
<b>4 Terms and definitions .....</b>	<b>3</b>
<b>5 Conventions and notations .....</b>	<b>7</b>
<b>5.1 Terminology .....</b>	<b>7</b>
<b>5.1.1 Meaning of words .....</b>	<b>7</b>
<b>5.1.2 Levels of grouping .....</b>	<b>7</b>
<b>5.2 Representation of numbers.....</b>	<b>7</b>
<b>5.3 Integer calculus .....</b>	<b>8</b>
<b>5.4 Names .....</b>	<b>8</b>
<b>6 List of acronyms .....</b>	<b>9</b>
<b>7 General description of disk .....</b>	<b>11</b>
<b>8 General requirements.....</b>	<b>13</b>
<b>8.1 Environments.....</b>	<b>13</b>
<b>8.1.1 Test environment.....</b>	<b>13</b>
<b>8.1.2 Operating environment.....</b>	<b>13</b>
<b>8.1.3 Storage environment .....</b>	<b>14</b>
<b>8.1.4 Transportation .....</b>	<b>15</b>
<b>8.2 Safety requirements .....</b>	<b>15</b>
<b>8.3 Flammability .....</b>	<b>15</b>
<b>9 Reference drive .....</b>	<b>16</b>
<b>9.1 General .....</b>	<b>16</b>
<b>9.2 Measurement conditions .....</b>	<b>16</b>
<b>9.3 Optical system .....</b>	<b>16</b>
<b>9.4 Optical beam .....</b>	<b>17</b>
<b>9.5 HF read channel .....</b>	<b>17</b>
<b>9.6 Radial PP read channel .....</b>	<b>18</b>
<b>9.7 Disk Clamping .....</b>	<b>18</b>
<b>9.8 Rotation of disk and Measurement Velocity .....</b>	<b>18</b>
<b>9.9 Normalized servo transfer function .....</b>	<b>19</b>
<b>9.10 Measurement Velocities and Reference servos for axial tracking .....</b>	<b>19</b>
<b>9.10.1 General .....</b>	<b>19</b>
<b>9.10.2 Reference servo for axial tracking at 1x Measurement Velocity .....</b>	<b>20</b>
<b>9.10.3 Reference servo for axial tracking at 2x Measurement Velocity .....</b>	<b>21</b>
<b>9.11 Measurement Velocities and Reference servos for radial tracking .....</b>	<b>22</b>
<b>9.11.1 General .....</b>	<b>22</b>
<b>9.11.2 Reference servo for radial tracking at 1x Measurement Velocity .....</b>	<b>22</b>
<b>9.11.3 Reference servo for radial tracking at 2x Measurement Velocity .....</b>	<b>23</b>
<b>10 Dimensional characteristics.....</b>	<b>24</b>
<b>10.1 General .....</b>	<b>24</b>

10.2	Disk reference planes and reference axis .....	25
10.3	Overall dimensions .....	26
10.4	First transition Area .....	26
10.5	Protection ring .....	26
10.6	Clamping Zone .....	27
10.7	Second transition Area .....	27
10.8	Information Area .....	27
10.8.1	General .....	27
10.8.2	Subdivision of Information Zone on TL disk .....	28
10.8.3	Subdivision of Information Zone on QL disks .....	29
10.9	Rim Area .....	30
11	Mechanical characteristics .....	32
11.1	Mass .....	32
11.2	Moment of inertia .....	32
11.3	Dynamic imbalance .....	32
11.4	Axial runout .....	32
11.4.1	General .....	32
11.4.2	Residual axial tracking error for 1x Measurement Velocity .....	32
11.4.3	Residual axial tracking error for 2x Measurement Velocity .....	33
11.5	Radial runout .....	33
11.5.1	General .....	33
11.5.2	Residual radial tracking error on 1x Measurement Velocity .....	33
11.5.3	Residual radial tracking error on 2x Measurement Velocity .....	34
11.6	Durability of Cover Layer .....	34
11.6.1	Impact resistance of Cover Layer .....	34
11.6.2	Scratch resistance of Cover Layer .....	34
11.6.3	Repulsion of fingerprints by Cover Layer .....	34
12	Optical characteristics in Information Area .....	35
12.1	General .....	35
12.2	Refractive index of the Transmission Stacks (TS) .....	35
12.3	Thickness of Transmission Stacks (TS) .....	35
12.3.1	Thickness of Transmission Stack of TL disks .....	35
12.3.2	Example of target thickness of Spacer Layers for TL disks .....	36
12.3.3	Thickness of Transmission Stacks of QL disks .....	36
12.3.4	Example of target thickness of Spacer Layers for QL disks .....	37
12.4	Reflectivity of Recording Layers .....	40
12.5	Birefringence .....	40
12.6	Angular deviations .....	41
13	Data Format .....	42
13.1	General .....	42
13.2	Data Frame .....	44
13.3	Error-Detection Code (EDC) .....	44
13.4	Scrambled Data Frame .....	44
13.5	Data Block .....	45
13.6	LDC Block .....	46
13.7	LDC Code words .....	46
13.8	LDC Cluster .....	47
13.8.1	General .....	47
13.8.2	First interleaving step .....	47
13.8.3	Second interleaving step .....	48
13.9	Addressing and Control Data .....	50
13.9.1	General .....	50
13.9.2	Address Units .....	50
13.9.3	User Control Data .....	54
13.9.4	Byte/Bit assignments for User Control Data .....	54
13.10	Access Block .....	56
13.11	BIS Block .....	56
13.12	BIS Code words .....	57

13.13	BIS Cluster .....	58
13.14	ECC Cluster .....	62
13.15	Recording Frames .....	63
13.16	Physical Cluster .....	63
13.17	17PP Modulation for Recordable data .....	63
13.17.1	General .....	63
13.17.2	Bit conversion rules .....	64
13.17.3	dc-control procedure .....	64
13.17.4	Frame Sync .....	64
13.18	Modulation and NRZI conversion .....	66
14	Physical Data Allocation and Linking .....	67
14.1	General .....	67
14.2	Recording-Unit Block (RUB) .....	67
14.2.1	General .....	67
14.2.2	Data Run-in .....	67
14.2.3	Data Run-out .....	68
14.2.4	Guard_3 field .....	69
14.3	Locating data relative to wobble addresses .....	70
15	Track Format .....	71
15.1	General .....	71
15.2	Track shape .....	71
15.3	Track path .....	72
15.4	Track Pitch .....	73
15.4.1	Track Pitch in Zone reserved for BCA .....	73
15.4.2	Track Pitch in Embossed HFM Area .....	73
15.4.3	Track Pitch in Recordable Areas .....	73
15.4.4	Track Pitch between Embossed HFM Area and Recordable Area .....	73
15.5	Track layout of HFM Groove .....	73
15.5.1	General .....	73
15.5.2	Data Format .....	74
15.5.3	Addressing and Control Data .....	75
15.5.4	Recording Frames .....	79
15.6	Track layout of Wobbled Grooves .....	80
15.6.1	General .....	80
15.6.2	Modulation of wobbles .....	81
15.6.3	Wobble polarity .....	82
15.7	ADIP information .....	82
15.7.1	General .....	82
15.7.2	ADIP-Unit Types .....	83
15.7.3	ADIP word structure .....	83
15.7.4	ADIP data structure .....	84
15.7.5	ADIP error correction .....	88
15.8	Disk Information in ADIP Aux Frame .....	90
15.8.1	General .....	90
15.8.2	Error protection for Disk Information Aux Frames .....	90
15.8.3	Disk-Information Data structure .....	91
16	General description of Information Zone .....	137
16.1	General .....	137
16.2	Format of Information Zone on Triple-Layer disk .....	137
16.3	Format of Information Zone on Quadruple-Layer disk .....	137
17	Layout of Recordable Area of Information Zone .....	137
18	Inner Zone(s) .....	147
18.1	General .....	147
18.2	Permanent Information & Control Data (PIC) Zone .....	154
18.2.1	Genarel .....	154
18.2.2	Content of PIC Zone .....	154
18.2.3	Emergency Brake .....	156

18.3	Recordable Area of Lead-in Zone of TL disk .....	158
18.3.1	Protection-Zone 2 .....	158
18.3.2	Buffer .....	158
18.3.3	INFO 2 / Reserved 8 .....	158
18.3.4	INFO 2 / Reserved 7 .....	158
18.3.5	INFO 2 / Reserved 6 .....	158
18.3.6	INFO 2 / Reserved 5 .....	159
18.3.7	INFO2 / PAC 2 .....	159
18.3.8	INFO2 / DMA 2 .....	159
18.3.9	INFO2 / Control Data 2 .....	159
18.3.10	INFO2 / Buffer 2 .....	159
18.3.11	OPC 0 / Test Zone .....	159
18.3.12	Usage of OPC Areas .....	159
18.3.13	OPC 0 / OPC 0 Buffer .....	161
18.3.14	TDMA 0 .....	161
18.3.15	INFO1 / Pre-write Area .....	161
18.3.16	INFO1 / Drive Area .....	161
18.3.17	INFO1 / DMA 1 .....	162
18.3.18	INFO 1 / Control Data 1 .....	163
18.3.19	INFO 1 / PAC 1 .....	163
18.4	Recordable Area of Inner Zone 1 of TL disk .....	163
18.4.1	Buffer .....	163
18.4.2	OPC 1 / Test Zone .....	163
18.4.3	Reserved .....	163
18.4.4	INFO 2 / Reserved 8 .....	163
18.4.5	INFO 2 / Reserved 7 .....	163
18.4.6	INFO 2 / Reserved 6 .....	163
18.4.7	INFO 2 / Reserved 5 .....	163
18.4.8	INFO2 / PAC 2 .....	163
18.4.9	INFO 2 / DMA 2 .....	164
18.4.10	INFO 2 / Control Data 2 .....	164
18.4.11	INFO 2 / Buffer 2 .....	164
18.4.12	TDMA 1 .....	164
18.4.13	Reserved .....	164
18.4.14	INFO1 / Pre-write Area .....	164
18.4.15	INFO1 / Drive Area .....	164
18.4.16	INFO1 / DMA 1 .....	164
18.4.17	INFO 1 / Control Data 1 .....	164
18.4.18	INFO 1 / PAC 1 .....	164
18.5	Recordable Area of Inner Zone 2 of TL disk .....	165
18.5.1	Buffer .....	165
18.5.2	OPC 2 / Test Zone .....	165
18.5.3	OPC 2 / OPC 2 Buffer .....	165
18.5.4	Reserved .....	165
18.5.5	INFO 2 / Reserved 8 .....	165
18.5.6	INFO 2 / Reserved 7 .....	165
18.5.7	INFO 2 / Reserved 6 .....	165
18.5.8	INFO 2 / Reserved 5 .....	165
18.5.9	INFO 2 / Reserved .....	165
18.5.10	INFO2 / DMA 2 .....	165
18.5.11	INFO2 / Control Data 2 .....	166
18.5.12	INFO2 / Buffer 2 .....	166
18.5.13	TDMA 2 .....	166
18.5.14	Buffer .....	166
18.5.15	INFO1 / Pre-write Area .....	166
18.5.16	INFO1 / Drive Area .....	166
18.5.17	INFO1 / DMA 1 .....	166
18.5.18	INFO 1 / Control Data 1 .....	166
18.5.19	INFO 1 / Reserved .....	166
18.6	Recordable Area of Lead-in Zone of QL disk .....	166

18.6.1	Protection-Zone 2 .....	166
18.6.2	Buffer .....	167
18.6.3	INFO 2 / Reserved 8 .....	167
18.6.4	INFO 2 / Reserved 7 .....	167
18.6.5	INFO 2 / Reserved 6 .....	167
18.6.6	INFO 2 / Reserved 5 .....	167
18.6.7	INFO2 / PAC 2 .....	167
18.6.8	INFO2 / DMA 2 .....	167
18.6.9	INFO2 / Control Data 2 .....	167
18.6.10	INFO2 / Buffer 2 .....	167
18.6.11	OPC 0 / Test Zone .....	167
18.6.12	Buffer .....	168
18.6.13	INFO1 / Pre-write Area .....	168
18.6.14	INFO1 / Drive Area .....	168
18.6.15	INFO1 / DMA 1 .....	168
18.6.16	INFO 1 / Control Data 1 .....	168
18.6.17	INFO 1 / PAC 1 .....	168
18.7	Recordable Area of Inner Zone 1 of QL disk .....	168
18.7.1	Buffer .....	168
18.7.2	OPC 1 / Test Zone .....	168
18.7.3	INFO 2 / Reserved 8 .....	168
18.7.4	INFO 2 / Reserved 7 .....	169
18.7.5	INFO 2 / Reserved 6 .....	169
18.7.6	INFO 2 / Reserved 5 .....	169
18.7.7	INFO2 / PAC 2 .....	169
18.7.8	INFO2 / DMA 2 .....	169
18.7.9	INFO 2 / Control Data 2 .....	169
18.7.10	INFO 2 / Buffer 2 .....	169
18.7.11	TDMA 0 .....	169
18.7.12	Buffer .....	169
18.7.13	INFO1 / Pre-write Area .....	169
18.7.14	INFO1 / Drive Area .....	169
18.7.15	INFO1 / DMA 1 .....	170
18.7.16	INFO 1 / Control Data 1 .....	170
18.7.17	INFO 1 / PAC 1 .....	170
18.8	Recordable Area of Inner Zone 2 of QL disk .....	170
18.8.1	Buffer .....	170
18.8.2	INFO 2 / Reserved 8 .....	170
18.8.3	INFO 2 / Reserved 7 .....	170
18.8.4	INFO 2 / Reserved 6 .....	170
18.8.5	INFO 2 / Reserved 5 .....	170
18.8.6	INFO 2 / Reserved .....	170
18.8.7	INFO2 / DMA 2 .....	171
18.8.8	INFO2 / Control Data 2 .....	171
18.8.9	INFO2 / Buffer 2 .....	171
18.8.10	TDMA 1 .....	171
18.8.11	Buffer .....	171
18.8.12	OPC 2 / Test Zone .....	171
18.8.13	OPC 2 / OPC 2 Buffer .....	171
18.8.14	TDMA 2 .....	171
18.8.15	INFO1 / Pre-write Area .....	171
18.8.16	INFO1 / Drive Area .....	171
18.8.17	INFO1 / DMA 1 .....	172
18.8.18	INFO 1 / Control Data 1 .....	172
18.8.19	INFO 1 / Reserved .....	172
18.9	Recordable Area of Lead-out Zone of QL disk .....	172
18.9.1	OPC 3 / Test Zone .....	172
18.9.2	Buffer .....	172
18.9.3	INFO 2 / Reserved 8 .....	172
18.9.4	INFO 2 / Reserved 7 .....	172

18.9.5	INFO 2 / Reserved 6 .....	172
18.9.6	INFO 2 / Reserved 5 .....	172
18.9.7	INFO2 / Reserved .....	172
18.9.8	INFO 2 / DMA 2 .....	173
18.9.9	INFO 2 / Control Data 2 .....	173
18.9.10	INFO 2 / Buffer 2 .....	173
18.9.11	TDMA 3 .....	173
18.9.12	INFO1 / Pre-write Area .....	173
18.9.13	INFO1 / Drive Area .....	173
18.9.14	INFO1 / DMA 1 .....	173
18.9.15	INFO 1 / Control Data 1 .....	173
18.9.16	INFO 1 / Reserved .....	173
19	Data Zone .....	174
20	Outer Zones .....	174
20.1	General .....	174
20.2	Recordable Area of Outer Zones .....	175
20.2.1	INFO3 / Buffer 4 .....	175
20.2.2	INFO3 / DMA 3 .....	175
20.2.3	INFO3 / Control Data 3 .....	175
20.2.4	Angular buffer .....	175
20.2.5	INFO4 / DMA 4 .....	176
20.2.6	INFO4 / Control Data 4 .....	176
20.2.7	INFO4 / Buffer 6 .....	176
20.2.8	DCZ0 / Test Zone, DCZ1 / Test Zone, DCZ2 / Test Zone and DCZ3 / Test Zone .....	176
20.2.9	Usage of DCZ Area .....	176
20.2.10	Protection-Zone 3 .....	177
21	Physical-Access Control Clusters .....	178
21.1	General .....	178
21.2	Layout of PAC Zones .....	178
21.3	General structure of PAC Clusters .....	179
21.4	IS1 and IS2 PAC Clusters .....	183
22	Disk Management .....	184
22.1	General .....	184
22.2	Recording Management .....	184
22.2.1	Sequential-Recording Mode (SRM) .....	184
22.2.2	Recording User Data in SRR .....	184
22.2.3	SRR status .....	185
22.2.4	Closing SRR .....	185
22.3	Temporary Disk-Management Areas (TDMA) .....	185
22.3.1	General .....	185
22.3.2	TDMA Access Indicators .....	185
22.4	Disk-Management Structure (DMS) .....	186
22.4.1	General .....	186
22.4.2	Temporary Disk-Management Structure (TDMS) .....	187
22.4.3	TDMS in Sequential-Recording Mode .....	187
22.4.4	Temporary Disk-Definition Structure (TDDS) .....	188
22.4.5	Temporary Defect List (TDFL) .....	194
22.4.6	Sequential-Recording Range Information (SRRI) .....	195
22.5	Unrecorded (blank) disk structure .....	197
22.5.1	General .....	197
22.5.2	Pre-recorded Areas on Unrecorded disk .....	197
22.5.3	Pre-recorded BCA .....	204
22.5.4	Pre-recorded INFO 2 / Reserved 5, Reserved 8 and Pre-recorded INFO1 / Pre-write Area .....	204
22.5.5	Pre-recorded INFO 1 / PAC 1 and Pre-recorded INFO2 / PAC 2 .....	204
22.5.6	OPC 0 / Test Zone , OPC 1 / Test Zone, OPC 2 / Test Zone and OPC 3 / Test Zone .....	205
22.5.7	TDMA0 .....	205
22.5.8	Initialization of disk .....	205
22.6	Recorded (Closed) disk structure .....	206

22.6.1	General .....	206
22.6.2	DMA Zones .....	206
22.6.3	Disk-Management Structure (DMS) .....	206
23	Assignment of Logical-Sector Numbers (LSNs) .....	210
24	Characteristics of Grooved Areas .....	211
25	Method of testing for Grooved Area .....	211
25.1	General .....	211
25.2	Environment .....	211
25.3	Reference drive .....	211
25.3.1	General .....	211
25.3.2	Read power .....	211
25.3.3	Read channels .....	211
25.3.4	Tracking requirements .....	212
25.3.5	Scanning velocities .....	212
25.4	Definition of signals .....	212
26	Signals from HFM Grooves .....	214
26.1	Push-Pull polarity .....	214
26.2	Push-Pull signal .....	214
26.3	Wobble signal .....	214
26.4	Jitter of HFM signal .....	214
27	Signals from Wobbled Grooves .....	215
27.1	Phase depth .....	215
27.2	Push-Pull signal .....	215
27.3	Wobble signal .....	215
27.3.1	General .....	215
27.3.2	Measurement of NWS .....	215
27.3.3	Measurement of wobble CNR .....	216
27.3.4	Measurement of harmonic distortion of wobble .....	216
28	Characteristics of Recording Layer .....	216
29	Method of testing for Recording Layer .....	217
29.1	General .....	217
29.2	Environment .....	217
29.3	Reference drive .....	217
29.3.1	General .....	217
29.3.2	Read power .....	217
29.3.3	Read channels .....	217
29.3.4	Tracking requirements .....	217
29.3.5	Scanning velocities .....	217
29.4	Write conditions .....	218
29.4.1	Write-pulse waveform .....	218
29.4.2	Write powers .....	218
29.4.3	Write conditions for i-MLSE measurement .....	219
29.5	Definition of signals .....	219
30	Signals from Recorded aAreas .....	220
30.1	HF signals .....	220
30.2	Modulated amplitude .....	220
30.3	Reflectivity-Modulation product .....	221
30.4	Asymmetry .....	221
30.5	i-MLSE .....	222
30.6	Read stability .....	222
31	Local defects .....	224
32	Characteristics of User Data .....	224
33	Method of testing for User Data .....	225
33.1	General .....	225

33.2	Environment .....	225
33.3	Reference drive .....	225
33.3.1	General.....	225
33.3.2	Read power.....	225
33.3.3	Read channels.....	225
33.3.4	Error correction.....	225
33.3.5	Tracking requirements .....	225
33.3.6	Scanning velocities .....	225
33.4	Definition of signals.....	226
34	Minimum quality of recorded information.....	227
34.1	Symbol Error Rate .....	227
34.2	Maximum burst errors .....	227
34.3	User-written Data .....	227
35	BCA .....	228
<b>Annex A (normative) Thickness of Transmission Stacks in case of multiple layers .....</b>		229
A.1	General.....	229
A.2	Refractive index $n_i$ of all layers .....	229
A.3	Thickness variations of Transmission Stack for a TL disk .....	229
A.4	Thickness variations of Transmission Stack for a QL disk .....	229
A.5	Thickness variations of Spacer Layers for a TL disk.....	230
A.6	Thickness variations of Spacer Layers for a QL disk.....	230
A.7	Example of thickness calculation for a TL disk.....	231
<b>Annex B (normative) Measurement of reflectivity .....</b>		232
B.1	General.....	232
B.2	Calibration method .....	232
B.3	Measuring method .....	233
B.4	Procedure for compensating stray light effect from observed reflectivity .....	234
<b>Annex C (normative) Measurement of scratch resistance of Cover Layer .....</b>		236
C.1	General.....	236
C.2	Taber Abrasion test .....	236
<b>Annex D (normative) Measurement of repulsion of grime by Cover Layer.....</b>		238
D.1	General.....	238
D.2	Specifications of stamp .....	238
D.3	Preparation of ink .....	239
D.4	Preparation of ink pad .....	239
D.5	Using ink pad and stamp .....	240
<b>Annex E (normative) Measurement of wobble amplitude .....</b>		241
E.1	Measurement methods .....	241
E.2	Calibration of filters .....	245
<b>Annex F (normative) Write-pulse waveform for testing .....</b>		246
F.1	General write-pulse waveform.....	246
F.2	Extended N-1 write strategy .....	247
F.3	Extended Castle write strategy .....	250
F.4	Definition of pulse widths and rise and fall times .....	254
<b>Annex G (normative) Optimum Power Control (OPC) procedure for media .....</b>		255
G.1	General.....	255
G.2	Mathematical model for modulation versus power function .....	255
G.3	Procedure for determination of OPC parameters for media .....	257
G.4	Procedure to determine Beta value .....	257
<b>Annex H (normative) HF signal Pre-processing for i-MLSE(Integrated-Maximum Likelihood Sequence Error Estimation) measurements .....</b>		259
H.1	General.....	259
H.2	General implementation of i-MLSE measurement system .....	259
H.3	Specifications of Analogue filters (HPF, LPF) .....	259
H.4	Specifications of A/D converter .....	260

H.5	Specifications of Offset canceller .....	260
H.6	Specifications of Auto Gain Controller (AGC) .....	260
H.7	Specifications of Interpolator .....	261
H.8	Specifications of Phase Lock Loop .....	262
H.9	Specifications of Digital Equalizer .....	263
H.10	Specifications of Adaptive Equalizer .....	263
H.11	Specifications of Viterbi decoder .....	263
H.12	Description of i-MLSE (Integrated-Maximum Likelihood Sequence Error Estimation) .....	264
H.12.1	General .....	264
H.12.2	General implementation of i-MLSE detection units .....	264
H.12.3	Pattern detector .....	265
H.12.4	Metric Difference calculator .....	266
H.12.5	Error rate estimation .....	267
H.12.6	i-MLSE calculation .....	269
<b>Annex I (normative) Measurement procedures .....</b>		<b>271</b>
I.1	General .....	271
I.2	Initial adjustments of Reference drive .....	271
I.3	i-MLSE measurement .....	272
I.4	Modulated amplitude measurements .....	272
I.5	Measurement of Resolution $I_{3pp} / I_{8pp}$ (informative) .....	272
I.6	Measurement of Modulation $I_{8pp} / I_{8H}$ and $I_{3pp} / I_{8H}$ .....	273
I.7	Asymmetry measurement .....	274
I.7.1	General .....	274
I.7.2	Sampling method .....	274
I.7.3	Level calculation block (Averaging method) .....	276
I.7.4	Asymmetry calculation .....	277
I.8	Measurement of light reflectivity .....	278
I.8.1	General .....	278
I.8.2	Measurement procedure of light reflectivity .....	278
I.9	Tracking-error signal measurements ( $P_{P_{norm}}$ measurement procedure) .....	279
I.10	Residual error of axial tracking measurement procedure .....	281
I.11	Residual error of radial tracking measurement procedure .....	282
I.12	Random SER measurement .....	282
<b>Annex J (informative) Measurement of birefringence .....</b>		<b>283</b>
J.1	Principle of measurement .....	283
J.2	Measurements conditions .....	283
J.3	Example of measurement procedure .....	284
J.4	Interchangeability of measuring results .....	284
<b>Annex K (informative) Measurement of thickness of Cover Layer and Spacer Layer .....</b>		<b>285</b>
K.1	Focusing method .....	285
K.2	Interferometer method .....	285
<b>Annex L (informative) Measurement of impact resistance of Cover Layer .....</b>		<b>288</b>
L.1	General .....	288
L.2	Recommendation for drives .....	288
L.3	Measurements of impact resistance of Cover Layer .....	288
<b>Annex M (informative) Groove deviation and the wobble amplitude .....</b>		<b>290</b>
M.1	Relation between normalized wobble signal and wobble amplitude .....	290
M.2	Tolerances of normalized wobble signal .....	290
<b>Annex N (informative) Guideline for write pulse adjustment using L-SEAT edge-shift .....</b>		<b>292</b>
N.1	General .....	292
N.2	General implementation of edge-shift detection system .....	292
N.2.1	Edge-shift evaluation unit .....	292
N.2.2	Analogue filters (HPF, LPF) .....	292
N.2.3	AD Converter .....	292
N.2.4	Offset Canceller .....	293
N.2.5	Auto Gain Controller (AGC) .....	293
N.2.6	Interpolator .....	293

N.2.7	Phase Locked Loop .....	293
N.2.8	Digital Equalizer .....	293
N.2.9	Adaptive Equalizer .....	293
N.2.10	Viterbi decoder .....	293
N.2.11	L-SEAT evaluation block .....	294
N.3	HF signal processing for L-SEAT .....	294
N.3.1	General .....	294
N.3.2	Definition of L-SEAT .....	294
N.3.3	Edge detection bit patterns .....	295
N.4	General implementation of L-SEAT evaluation block .....	298
N.5	General write pulse adjustment procedure .....	299
	Bibliography .....	301

WITHDRAWN

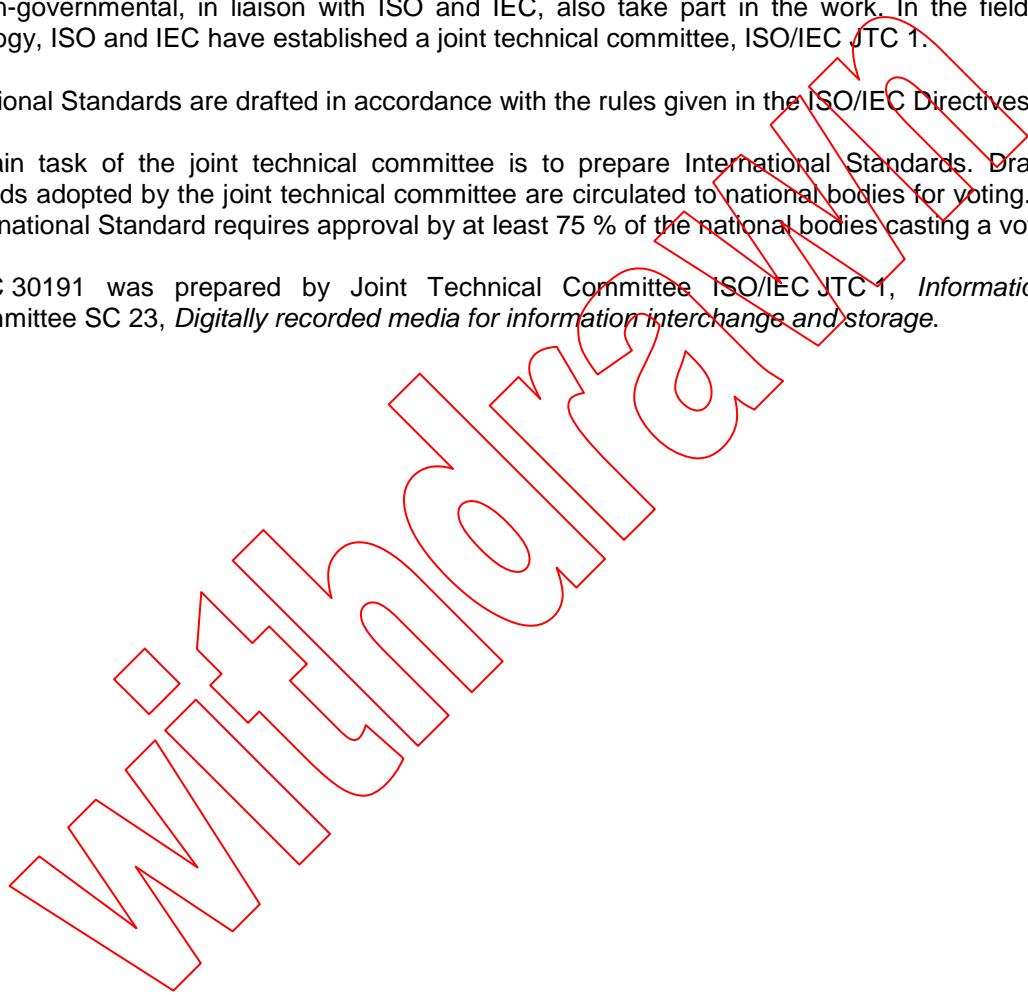
## Foreword

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

ISO/IEC 30191 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 23, *Digitally recorded media for information interchange and storage*.



## Introduction

In March 2002, 9 companies started BDF (Blu-ray Disc Founders) aiming for the creation of the Formats with large capacity and high speed transfer rate, that enable the recording and reproducing of the high definition video contents. In October 2004, more than 100 companies joined and BDF was changed to an open forum named BDA (Blu-ray Disc Association). In October 2005, BDA issued the first version of the Blu-ray Disc™ Recordable Format Part1 and in April 2008 Version 1.3 of Blu-ray Disc™ Recordable Format Part1 was issued, which enabled the Recording Velocity up to 6x. In June 2010, BDA issued Blu-ray Disc™ Recordable Format Part1 Version 2.0, which specifies the TL and QL of BD Recordable disk.

By the end of 2010, over 100 million Blu-ray Disc™ had already been shipped, and 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 10 Testing Centers 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, the chairs of ISO/IEC JTC 1/SC 23 and JIIMA (Japan Image & 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 Standard of the basic physical formats for the Recordable and Rewritable Blu-ray™ Formats.

In December of 2011, the BDA sent project proposals for the International standardization of 4 formats to ISO/IEC JT1/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 a 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 recordable optical disk with a capacity of 100,0 Gbytes or 128,0 Gbytes.

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 or 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.

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:

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 PatentStrategy  
322-2, Nakazato, Odawara-shi, Kanagawa, 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 & Intellectual Property Division,  
1-1, Shin-Ogura, Sawai-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](http://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 trademark of the Blu-ray Disc Association.

# Information technology — Digitally recorded media for information interchange and storage — 120 mm Triple Layer (100,0 Gbytes per disk) and Quadruple Layer (128,0 Gbytes per disk) BD Recordable disk

## 1 Scope

This International Standard specifies the mechanical, physical and optical characteristics of a 120 mm recordable optical disk with a capacity of 100,0 Gbytes or 128,0 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 once and read many times using a non-reversible method. This disk is identified as BD Recordable disk.

This International Standard specifies

- two related but different Types of this disk,
- the conditions for conformance,
- the environments in which the disk is to be operated and stored,
- the mechanical and physical characteristics of the disk, so as to provide mechanical interchange between data processing systems,
- the format of the information on the disk, including the physical disposition of the Tracks and Sectors,
- the error correcting codes and the coding method used,
- the characteristics of the signals recorded on the disk, enabling data processing systems to read the data from the disk.

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

## 2 Conformance

### 2.1 Optical disk

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 all two Types of optical disk 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 referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information interchange*

ISO 9352:1995, *Plastics — Determination of resistance to wear by abrasive wheels*

IEC 60068-2-2:1974, *Environmental testing — Part 2-2: Tests — Test B: Dry heat*

IEC 60068-2-30:2005, *Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60950-1:2005, *Information technology equipment — Safety — Part 1: General requirements*