INTERNATIONAL STANDARD

ISO/IEC 12862

Second edition
2011-05-01

Information technology — 120 mm (8,54 Gbytes per side) and 80 mm (2,66 Gbytes per side) DVD recordable disk for dual layer (DVD-R for DL)

Technologies de l'information — Disques DVD enregistrables de 120 mm (8,54 Go par face) et 80 mm (2,66 Go par face) pour double couche (DVD-R pour DL)

Reference number
ISO/IEC 12862:2011(E)

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
Web www.iso.org

Published in Switzerland

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Foreword

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

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.

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.

ISO/IEC 12862 was prepared by Ecma International (as ECMA-382) and was adopted, under a special "fast-track procedure", by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

This second edition cancels and replaces the first edition (ISO/IEC 12862:2009), which has been technically revised.

Introduction

Ecma Technical Committee TC31 was established in 1984 for the standardization of optical disks and optical disk cartridges (ODC). Since its establishment, TC31 has made major contributions to ISO/IEC JTC 1/SC 23 toward the development of International Standards for optical disks. Numerous standards have been developed by TC31 and published by Ecma, almost all of which have also been adopted by ISO/IEC under the fast-track procedure as International Standards. The following Ecma standards for DVD 120 mm and 80 mm have been published by Ecma and adopted by ISO/IEC JTC 1. These standards are based on original specifications from the DVD Forum.

ECMA-267 (2001) 120 mm DVD-Read-Only Disk, 3rd edition
ISO/IEC 16448

ECMA-268 (2001) 80 mm DVD-Read-Only Disk, 3rd edition
ISO/IEC 16449

ECMA-272 (1999) 120 mm DVD Rewritable Disk (DVD-RAM), 2nd edition
ISO/IEC 16824

ECMA-273 (1998) Case for 120 mm DVD-RAM Disks, 1st edition
ISO/IEC 16825

ECMA-279 (1998) 80 mm (1,23 Gbytes per side) and 120 mm (3,95 Gbytes per side) DVD-Recordable Disk
ISO/IEC 20563 (DVD-R), 1st edition

ECMA-330 (2005) 120 mm (4,7 Gbytes per side) and 80 mm (1,46 Gbytes per side) DVD Rewritable Disk
ISO/IEC 17592 (DVD-RAM), 3rd edition

ECMA-331 (2004) Cases for 120 mm and 80 mm DVD-RAM Disks, 2nd edition
ISO/IEC 17594

ECMA-338 (2002) 80 mm (1,46 Gbytes per side) and 120 mm (4,70 Gbytes per side) DVD Re-recordable
ISO/IEC 17342 Disk (DVD-RW), 1st edition

ECMA-359 (2004) 80 mm (1,46 Gbytes per side) and 120 mm (4,70 Gbytes per side) DVD Recordable Disk
ISO/IEC 23912 (DVD-R), 1st edition

ECMA-382 (2008) 120 mm (8,54 Gbytes per side) and 80 mm (2,66 Gbytes per side) DVD Recordable Disk
ISO/IEC 12862 for Dual Layer (DVD-R for DL), 1st edition

ECMA-384 (2008) 120 mm (8,54 Gbytes per side) and 80 mm (2,66 Gbytes per side) DVD Re-recordable
ISO/IEC 13170 Disk for Dual Layer (DVD-RW for DL), 1st edition

In April 2007, nine members proposed that TC31 develop a standard for 120 mm and 80 mm dual layer DVD recordable optical disks using organic dye recording technology. TC31 adopted this project, which resulted in ECMA-382 (2008).

In December 2009, a proposal was made that TC31 update this Ecma Standard for editorial corrections and clarifications. TC31 approved this proposal, which resulted in the second edition of ECMA-382.

This International Standard specifies two types of dual layer recordable optical disks, one (Type 1S) making use of recording on only a single side of the disk and yielding a nominal capacity of 8,54 Gbytes for a 120 mm disk and 2,66 Gbytes for an 80 mm disk, the other (Type 2S) making use of recording on both sides of the disk and yielding a nominal capacity of 17,08 Gbytes for a 120 mm disk and 5,32 Gbytes for an 80 mm disk.

Information technology — 120 mm (8,54 Gbytes per side) and 80 mm (2,66 Gbytes per side) DVD recordable disk for dual layer (DVD-R for DL)

1 Scope

This International Standard specifies the mechanical, physical and optical characteristics of a 120 mm and an 80 mm dual layer DVD recordable disk to enable the interchange of such disks. It specifies the quality of the pre-recorded, unrecorded and recorded signals, the format of the data, the format of the information zone, the format of the unrecorded zone, and the recording method, thereby allowing for information interchange by means of such disks. This disk is identified as a DVD recordable disk for dual layer (DVD-R for DL).

This International Standard specifies the following:

— 120 mm and 80 mm nominal diameter disks that can be either single- or double-sided;

— 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 pre-recorded information on an unrecorded disk, including the physical disposition of the tracks and sectors, the error correcting codes and the coding method used;

— the format of the data and the recorded 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 from pre-recorded and unrecorded areas on the disk, enabling data processing systems to read the pre-recorded information and to write to the disks;

— 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 shall specify the type of the disk, i.e. its size and whether it is single-sided or double-sided. An optical disk is in conformance with this International Standard if it meets the mandatory requirements specified for this type.

2.2 Generating system

A generating system is 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 is in conformance with this International Standard if it is able to handle an optical disk in accordance with 2.1.

3 Normative references

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

ECMA-287, *Safety of electronic equipment*

4 Terms and definitions

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

4.1
anchor point
physical sector number corresponding to the specific logical sector number such as 16, 256, N-256 and N, where N is the maximum last-recorded address in logical volume space

NOTE The information in those sector numbers are used to fix Volume and File structure.

4.2
basic recording speed
recording speed at which a disk is under an obligation to be recorded

NOTE A basic recording speed is mandatory for each Class.

4.3
block SYNC guard area
recorded area in the first ECC block of the contiguous area of which recording is started from the unrecorded area by using 32K-Link

4.4
border zone
linking region that prevents the pick-up head from overrunning on an unrecorded area when a disk is played back in a partially recorded state

4.5
channel bit
elements by which, after modulation, the binary values ZERO and ONE are represented on the disk by marks

4.6
Clamping Zone
annular part of the disk within which a clamping force is applied by a clamping device

4.7
class
integer number, including 0, that indicates the basic recording speed supported by a disk

NOTE A group of recording speeds in a disk contains at least one basic recording speed which is mandatory for recording device and disk.

4.8
data zone
zone between the Lead-in Zone and the Middle Zone on Layer 0 and zone between the Middle Zone and the Lead-out Zone on Layer 1, in which user data is recorded

NOTE In Border recording mode, Border Zone is included in Data Zone.

4.9
data recordable zone
zone that is available to record user data

4.10
Digital Sum Value
DSV
arithmetic sum obtained from a bit stream by allocating the decimal value 1 to bits set to ONE and the decimal value –1 to bits set to ZERO

4.11
disk at once recording
recording mode in which the Lead-in Zone, the user data and the Lead-out Zone are recorded sequentially

4.12
disk reference plane
plane defined by the perfectly flat annular surface of an ideal spindle onto which the Clamping Zone of the disk is clamped, and which is normal to the axis of rotation

4.13
Disk Testing Area
DTA
area used for Optimum Power Control

NOTE 1 There are two kinds of Disk Testing Area on a disk.

NOTE 2 The Inner Disk Testing Area (IDTA) is located in the R-Information Zone and situated adjacent to the inside of the Recording Management Area. The Outer Disk Testing Area (ODTA) is fixed and situated adjacent to the outside of the fixed Middle Zone.

NOTE 3 The optional IDTA can be located on Layer 1 facing the special allocation in the Initial zone on Layer 0 as an option for devices, when NBCA is not applied on a disk.

NOTE 4 The ODTA can be added when shifted Middle Zone exists as an option for devices. In this case, added ODTA is called flexible Outer Disk Testing Area (flexible ODTA) and is situated adjacent to the outside of the shifted Middle Zone on Layer 0 and Layer 1 respectively.

4.14
ECC block address
absolute physical address used to define the recording position on the land of each area

NOTE 1 This address is pre-recorded as Land Pre-Pits and equal to the bit-inverted numbers from b23 to b4 of the Physical sector number recorded in the groove.

NOTE 2 Serially decremented numbers are assigned to blocks from the inner radius to the outer radius on Layer 0 and from the outer radius to the inner radius on Layer 1.

NOTE 3 The first ECC Block address in the Data Recordable Zone on Layer 0 is (FF CFFF).

NOTE 4 The bit-inverted number is calculated so that the bit value of ONE becomes that of ZERO and vice versa.

NOTE 5 The "ECC Block address" definition is specific to this International Standard.

4.15
Error Correction Code
ECC
mathematical computation yielding check bytes used for the detection and correction of errors in data

4.16
Error Detection Code
EDC
code designed to detect certain kinds of errors in data

NOTE Error Detection Code consists of data and the error detection parity.

4.17
finalization
action for changing into the state where the Lead-in, the Lead-out and the Middle Zones are recorded

NOTE 1 After Finalization, the information Zone from the Lead-in Zone to the Middle Zone on Layer 0 and from the Middle Zone to the Lead-out Zone on Layer 1 are recorded without any unrecorded areas.

NOTE 2 The disk will become write-protected once finalized.

4.18
groove
wobbled guidance track

4.19
incremental recording
recording mode in which the disk is recorded in several distinct recording operations (for example at different times and using different recording drives)

NOTE In this recording mode, the specified linking scheme shall be used.

4.20
information zone
zone comprising the Lead-in Zone, the Data Zone, the Middle Zone and the Lead-out Zone

4.21
initial information zone
zone comprising the Lead-in Zone, the Data Recordable Zone, the fixed Middle Zone and the Lead-out Zone

4.22
land
area between the grooves

4.23
Land Pre-Pit
LPP
pits embossed on the land during the manufacture of the disk substrate, which contain address information

4.24
Lead-in Zone
zone comprising Physical sectors adjacent to the inside of the Data Zone on Layer 0

4.25
Lead-out Zone
zone comprising Physical sectors adjacent to the inside of the Data Zone on Layer 1

NOTE When the recording of user data is finished on Layer 0, the Lead-out Zone is located adjacent to the inside of the Middle Zone on Layer 1.

4.26
middle zone
zone comprising physical sectors adjacent to the outside of the Data Zone on Layer 0 and Layer 1

NOTE 1 The fixed Middle Zone is located outside the Data Recordable Zone of a disk.

NOTE 2 The shifted Middle Zone can be added at the inner radius of the fixed Middle Zone as an option for devices, depending on the size of the Data Zone and located outside of the Data Zone.

4.27
Recording Management Area
RMA
area containing the Recording Management Data (RMD), situated adjacent to the inside of the Lead-in Zone on Layer 0 and the Lead-out Zone on Layer 1

4.28
Recording Management Data
RMD
information about the recording on the disk, including information on each recording mode

NOTE 1 Two kinds of RMD format are specified.

NOTE 2 Format1 RMD contains the information related to incremental recording mode and disk at once recording mode.

NOTE 3 Format4 RMD contains the information related to incremental recording mode, including Layer jump recording mode.

4.29
R-Information zone
zone comprising the Inner Disk Testing Area (IDTA) and the Recording Management Area (RMA)

4.30
re-mapping
replacement mechanism for physical layer to replace original anchor point with renewed anchor point

4.31
RZone
ECC blocks that are continuous on a layer and assigned to user data on Layer 0 and/or Layer 1 during incremental recording mode

4.32
sector
smallest addressable part of a track in the information zone of a disk that can be accessed independently of other addressable parts

4.33
substrate
transparent layer of the disk, provided for mechanical support of the recording or recorded layer, through which the optical beam accesses the recordable/recorded layer

4.34
track
360° turn of a continuous spiral of recorded marks or groove

4.35
track pitch
distance between adjacent average physical track centrelines of the wobbled grooves for the unrecorded disk, or between adjacent physical track centrelines of the successive recorded marks for the recorded disk, measured in the radial direction

4.36
zone
annular area of the disk

5 Conventions and notations

5.1 Representation of numbers

A measured value is rounded off to the least significant digit of the corresponding specified value. For instance, it implies that a specified value of 1,26 with a positive tolerance of + 0,01 and a negative tolerance of - 0,02 allows a range of measured values from 1,235 to 1,275.

Numbers in decimal notations are represented by the digits 0 to 9.

Numbers in hexadecimal notation are represented by the hexadecimal digits 0 to 9 and A to F in parentheses.

The setting of bits is denoted by ZERO and ONE.

Numbers in binary notations and bit patterns are represented by strings of digits 0 and 1, with the most significant bit shown to the left.

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

In each field the data is recorded so that the most significant byte (MSB), identified as Byte 0, is 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 $b_{(8n-1)}$ is recorded first.

5.2 Names

The names of entities, e.g. specific tracks, fields, areas, zones, etc. are given a capital initial.

6 Abbreviated terms

AP	Amplitude of the land Pre-Pit signal (without wobble amplitude)
AR	Aperture Ratio (of the Land Pre-Pit after recording)
BP	Byte Position
BPF	Band Pass Filter
CLV	Constant Linear Velocity
CNR	Carrier to Noise Ratio
DCC	DC Component suppress control

DSV	Digital Sum Value
ECC	Error Correction Code
EDC	Error Detection Code
HF	High Frequency
ID	Identification Data
LA	Lead-out Attribute
IDTA	Inner Disk Testing Area
IED	ID Error Detection (code)
LPF	Low-Pass Filter
LPP	Land Pre-Pit
LSB	Least Significant Byte
lsb	least significant bit
MSB	Most Significant Byte
msb	most significant bit
NBCA	Narrow Burst Cutting Area
NRZI	Non Return to Zero Inverted
ODTA	Outer Disk Testing Area
OPC	Optimum Power Control
OTP	Opposite Track Path
PBS	Polarizing Beam Splitter
PI	Parity (of the) Inner (code)
PLL	Phase Locked Loop
PO	Parity (of the) Outer (code)
PSN	Physical Sector Number
PTP	Parallel Track Path
PUH	Pick-Up Head
RBP	Relative Byte Position
RBW	Resolution Bandwidth
RESYNC	Re-Synchronization
RMA	Recording Management Area
RMD	Recording Management Data
RS	Reed-Solomon (code)
SYNC	Synchronization