INTERNATIONAL STANDARD

ISO/IEC 20563

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Information technology — 80 mm (1,23 Gbytes per side) and 120 mm (3,95 Gbytes per side) DVD-recordable disk (DVD-R)

Technologies de l'information — Disque enregistrable DVD (DVD-R) de 80 mm (1,23 Gbytes *par face) et* 120 mm (3,95 Gbytes *par face) de diamètre*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. 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 International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 20563 was prepared by JISC (as Standard JIS X 6245:1999) with document support and contribution from ECMA and was adopted under a special "fast-track procedure", by Joint Technical Committee JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annexes A to N form a normative part of this International Standard. Annexes P to T are for information only.

Information technology — 80 mm (1,23 Gbytes per side) and 120 mm (3,95 Gbytes per side) DVD-recordable disk (DVD-R)

Section 1 — General

1 Scope

This International Standard specifies the mechanical, physical and optical characteristics of an 80 mm and a 120 mm DVD - Recordable disk to enable the interchange of such disks. It specifies the quality of the pre-recorded, unrecorded and the 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 (DVD-R) disk. Once data has been recorded on a DVD-R disk it cannot be modified. It can be read many times. Further data may be appended.

This International Standard specifies

- 80 mm and 120 mm nominal diameter disks that may 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 shall be in conformance with this International Standard if it meets the mandatory requirements specified for this 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 an optical disk according to 2.1.

3 Normative references

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

IEC 60950 *Safety of information technology equipment*

ISO 105-B02 *Textiles - Tests for colour fastness - Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

4 Terms and definitions

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

4.1 **Adhesive layer:** A layer of adhesive material bonding together the two parts of the disk.

4.2 **Channel bit:** The elements by which, after modulation, the binary values ZERO and ONE are represented on the disk by marks.

4.3 **Clamping Zone:** The annular part of the disk within which a clamping force is applied by a clamping device.

4.4 **Digital Sum Value (DSV):** The 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.

4.5 **Disk Reference Plane:** A 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.

4.6 **Dummy substrate:** A layer which may be transparent or not, that is provided for the mechanical support of the disk and/or of a recorded layer.

4.7 **Entrance surface:** The surface of the disk onto which the optical beam first impinges.

4.8 **Groove:** A trench-like feature of the disk, applied before the recording of any information, and used to define the track location. The groove is located nearer to the entrance surface than the land. The recording is made on the centre of the groove.

4.9 **Land:** The area between the grooves.

4.10 **Optical disk:** A disk that accepts and retains information in the form of recorded marks in a recording layer and that can be read by an optical beam.

4.11 **Physical sector number:** A serial number allocated to the physical sectors on the disk.

4.12 **Read-only disk:** An optical disk in which the information has been recorded during manufacture of the disk. The information cannot be modified and can only be read from the disk.

4.13 **Recording layer:** A layer of the disk on, or in, which data is recorded.

4.14 **Reed-Solomon code:** An error detection and/or correction code for the correction of errors.

4.15 **Reserved field:** A field set to all ZEROs unless otherwise stated, and reserved for future standardization.

4.16 **Sector:** The smallest addressable part of a track in the information zone of a disk that can be accessed independently of other addressable parts.

4.17 **Space:** The area in a track between successive marks

4.18 **Substrate:** A transparent layer of the disk, provided for mechanical support of the recording or recorded layer, through which the optical beam accesses the recording or recorded layer.

4.19 **Track:** A 360° turn of a continuous spiral.

4.20 **Track pitch:** The distance between adjacent average physical track centrelines of the wobbled grooves for the unrecorded disk, or between adjacent physical track centrelines of the train of recorded marks for the recorded disk, measured in the radial direction.

4.21 **Zone:** An 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 List of acronyms

6.1 General

BP	Byte Position
BPF	Band Pass Filter
CLV	Constant Linear Velocity
CPR_MAI	Copyright Management Information
DSV	Digital Sum Value
ECC	Error Correction Code
EDC	Error Detection Code
HF	High Frequency
ID	Identification Data
IED	ID Error Detection (code)
LPF	Low-Pass Filter
LSB	Least Significant Byte
MSB	Most Significant Byte
NRZI	Non Return to Zero Inverted
OPC	Optimum Power Control
PBS	Polarizing Beam Splitter
PCA	Power Calibration Area
PI	Parity (of the) Inner (code)
PO	Parity (of the) Outer (code)
PUH	Pick-Up Head
RMA	Recording Management Area
RMD	Recording Management Data
RS	Reed-Solomon (code)
SYNC Code	Synchronization Code
lsb	least significant bit
msb	most significant bit

7 General description

The 80 mm and 120 mm optical disks that are the subject of this International Standard consist of two substrates bonded together by an adhesive layer, so that the recording layer (single-sided disk) or recording layers (double-sided disk) are on the inside. The centring of the disk is performed on the edge of the centre hole of the assembled disk on the side currently read. Clamping is performed in the Clamping Zone. The DVD-Recordable Disk (DVD-R) may be either double-sided or single-sided with respect to the number of recording layers. A double-sided disk has a recording layer on the inside of each substrate. A single-sided disk has one substrate with the recording layer on the inside and a dummy substrate without a recording layer. An unrecorded DVD-R disk provides for the data to be irreversibly written by a drive. A recorded disk provides for the data to be read many times by an optical beam of a drive. A recorded DVD-R disk is equivalent to a DVD-Read-Only Disk. Figure 1 shows schematically a double-sided and a single-sided disk.

Type 1S consists of a substrate, a single recording layer, an adhesive layer, and a dummy substrate. The recording layer can be accessed from one side only. The nominal capacity is 1,23 Gbytes for an 80 mm disk and 3,95 Gbytes for a 120 mm disk.

Type 2S consists of two substrates, two recording layers, and an adhesive layer. From one side of the disk only one recording layer can be accessed. The nominal capacity is 2,26 Gbytes for an 80 mm disk and 7,9 Gbytes for a 120 mm disk.

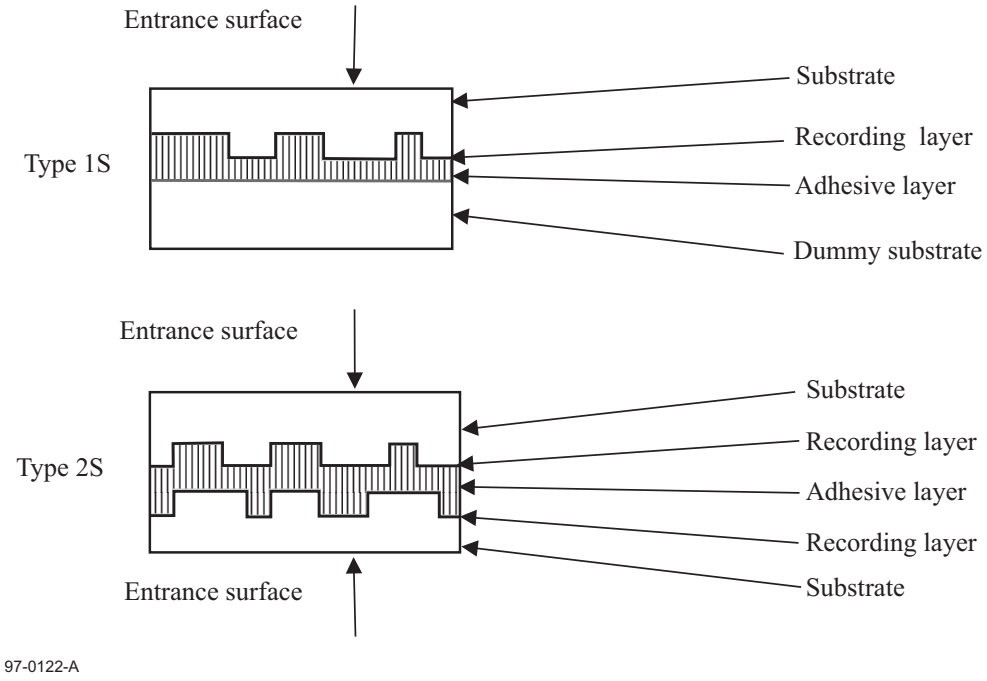


Figure 1 — Disk outline

8 General requirements

8.1 Environments

8.1.1 Test environment

The test environment is the environment where the air immediately surrounding the disk has the following properties.

	a) For dimensional measurements	b) For other measurements
temperature :	23 °C ± 2 °C	15 °C to 35 °C
relative humidity:	45 % to 55 %	45 % to 75 %
atmospheric pressure:	86 kPa to 106 kPa	86 kPa to 106 kPa

Unless otherwise stated, all tests and measurements shall be made in this test environment.

8.1.2 Operating environment

8.1.2.1 Recorded and unrecorded disk

This International Standard requires that an optical disk which meets all mandatory requirements of this International Standard in the specified test environment provides data interchange over the specified ranges of environmental parameters in the operating environment.

Disks used for data interchange shall be operated under the following conditions, when mounted in the drive supplied with voltage and measured on the outside surface of the disk.

The disk exposed to storage conditions shall be conditioned in the operating environment for at least two hours before operating.

temperature:	-25 °C to 70 °C
relative humidity:	3 % to 95 %
absolute humidity:	0,5 g/m^3 to 60 g/m^3
temperature gradient:	15 °C/h max.
relative humidity gradient:	10 %/h max.

There shall be no condensation of moisture on the disk.

8.1.2.2 Unrecorded disk environmental conditions during recording

The disk exposed to storage conditions shall be conditioned in the recording environment for at least two hours before operating.

temperature:	-5 °C to 55 °C
relative humidity:	10 % to 95 %
absolute humidity:	0,5 g/m^3 to 30 g/m^3

There shall be no condensation of moisture on the disk.

8.1.3 Storage environment

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

temperature:	-20 °C to 50 °C
relative humidity:	5 % to 90 %
absolute humidity:	1 g/m^3 to 30 g/m^3
atmospheric pressure:	75 kPa to 106 kPa
temperature variation:	15 °C /h max.
relative humidity variation:	10 %/h max.

Recorded and unrecorded disks shall be in conformance to clauses 12 and 14 after being subjected to the light fastness test. See annex L.

8.1.4 Transportation

This International Standard does not specify requirements for transportation; guidance is given in annex T.

8.2 Safety requirements

The disk shall satisfy the requirements of Standard IEC 60950, when used in the intended manner or in any foreseeable use 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 Standard IEC 60950.

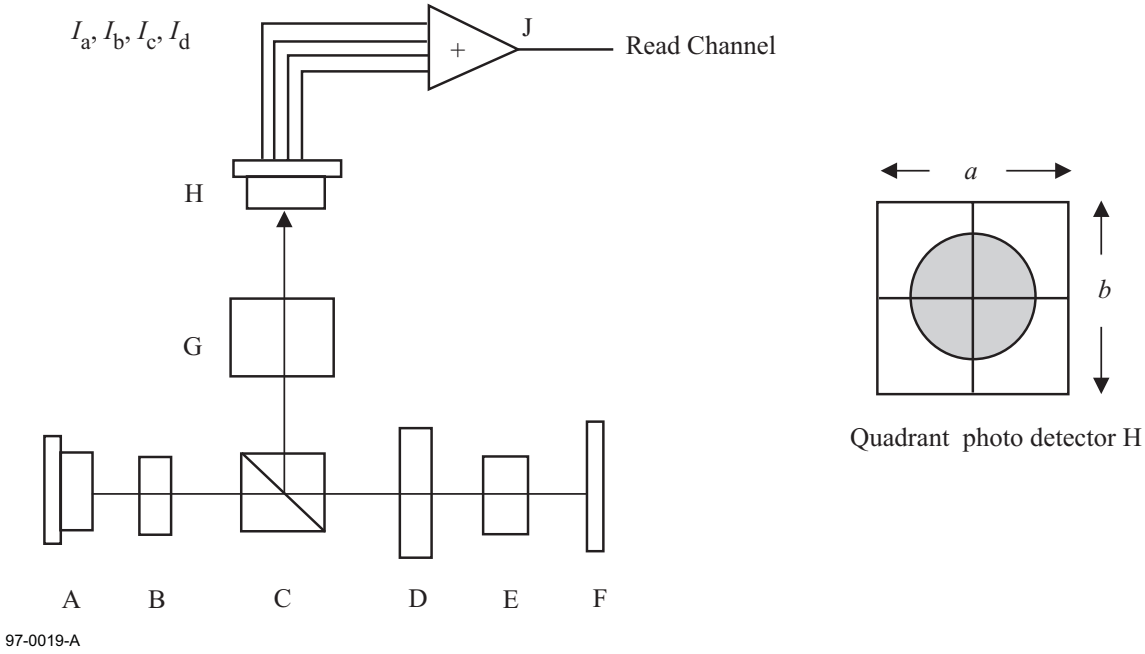
9 Reference measurement devices

The reference measurement devices for recorded disks and for unrecorded disks shall be used for the measurements of optical parameters for conformance with this International Standard. The critical components of these devices have specific properties defined in this clause.

9.1 Pick Up Head (PUH)

9.1.1 PUH for measuring recorded disks

The optical system for measuring the optical parameters is shown in figure 2. It shall be such that the detected light reflected from the entrance surface of the disk is minimized so as not to influence the accuracy of measurement. The combination of the polarizing beam splitter C with the quarter-wave plate D separates the incident optical beam and the beam reflected by the optical disk F. The beam splitter C shall have a p-s intensity/reflectance ratio of at least 100. Optics G generates an astigmatic difference and collimates the light reflected by the recorded layer of the optical disk F for astigmatic focusing and read-out. The position of the quadrant photo detector H shall be adjusted so that the light spot becomes a circle the centre of which coincides with the centre of the quadrant photo detector H when the objective lens is focused on the recorded layer. An example of such a photo detector H is shown in figure 2.



A Laser diode
B Collimator lens
C Polarizing beam splitter
D Quarter-wave plate
E Objective lens
F Optical disk
G Optics for the astigmatic focusing method
H Quadrant photo detector
I_a, I_b, I_c, I_d Output currents from the quadrant photo detector
J d.c. coupled amplifier

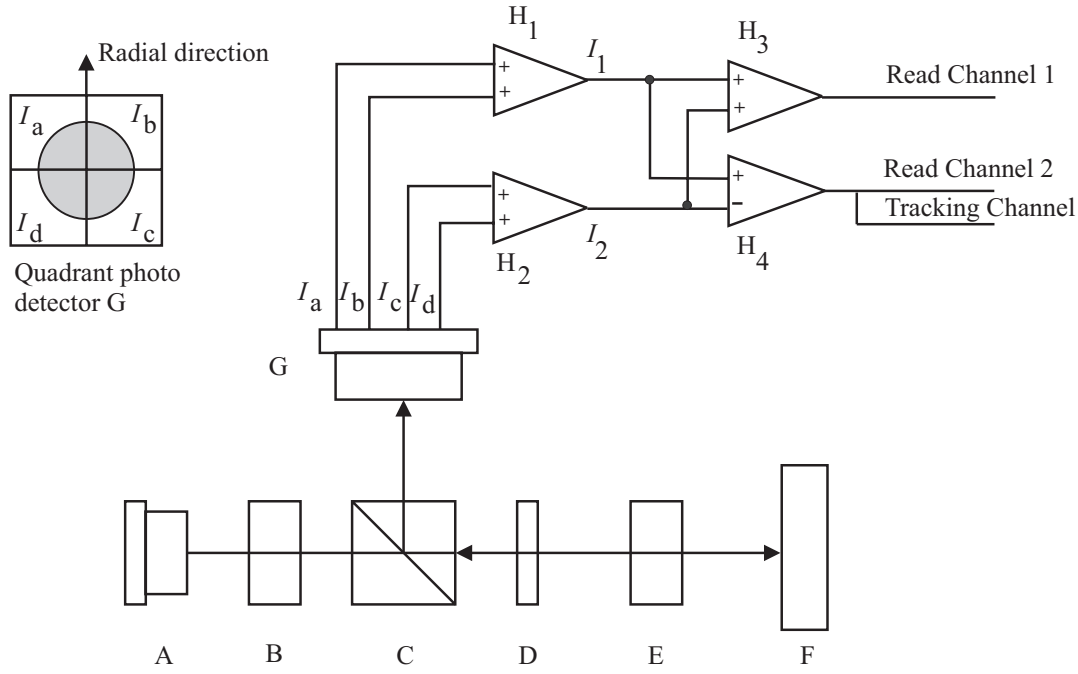
Figure 2 — Optical system of PUH for measuring Recorded disk

The characteristics of the PUH shall be as follows.

Wavelength (λ)	650 nm ± 5 nm
Polarization	circularly polarized light
Polarizing beam splitter	shall be used unless otherwise stated
Numerical aperture	0,60 ± 0,01
Light intensity at the rim of the pupil of the objective lens	60 % to 70 % of the maximum intensity level in radial direction, and over 90 % of the maximum intensity level in the tangential direction
Wave front aberration	0,033 λ rms max.
Relative intensity noise (RIN) 10 log [(a.c. light power density / Hz) / d.c. light power]	-134 dB/Hz max.

9.1.2 PUH for measuring unrecorded disks

The optical system for measuring the parameters is shown in figure 3. The optical system shall be used to measure the unrecorded disk specifications and for the recordings that are necessary for disk measurements. Different components and locations of the components are permitted, provided that the performance remains the same as the set-up in figure 3. The optical system shall be such that the detected light reflected from the entrance surface of the disk is minimized so as not to influence the accuracy of the measurements.



A	Laser diode	F	Optical disk
B	Collimator lens	G	Quadrant photo detector
C	Polarizing beam splitter	H_1, H_2, H_3, H_4	d.c.-coupled amplifier
D	Quarter-wave plate	I_a, I_b, I_c, I_d	Output currents from the quadrant photo detector
E	Objective lens		

Figure 3 — Optical system of PUH for measuring unrecorded disks

The combination of polarizing beam splitter C and a quarter-wave plate D shall separate the entrance optical beam from a laser diode A and the reflected optical beam from an optical disk F. The beam splitter C shall have a p-s intensity reflectance ratio of at least 100.

The focused optical beam used for writing and reading data shall have the following properties:

Wavelength (λ)	635 nm ± 5 nm
Polarization	circularly polarized light
Numerical aperture	0,60 ± 0,01
Light intensity at the rim of the pupil of the objective lens	Over 35 % of the maximum intensity level in the radial direction and over 50 % of the maximum intensity level in the tangential direction
Wave front aberration	0,033 λ rms max.
Relative intensity noise (RIN) of the laser diode 10 log [(a.c. light power density /Hz) / d.c. light power]	- 130 dB/Hz max.

9.2 Measurement conditions

9.2.1 Recorded and unrecorded disk

Scanning velocity at a Channel bit rate of 26,15625 Mbit/s	3,84 m/s ± 0,03 m/s
Clamping force	2,0 N ± 0,5 N
Clamping Zone	See 10.5 and annex A.
Tapered cone angle	40,0°± 0,5° see annex E