INTERNATIONAL STANDARD

ISO/IEC 16969

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Information technology — Data interchange on 120 mm optical disk cartridges using +RW format — Capacity: 3,0 Gbytes and 6,0 Gbytes

Technologies de l'information — Échange de données sur cartouches de disque optique de 120 mm utilisant le format +RW — Capacité: 3,0 Gbytes et 6,0 Gbytes

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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.

This International Standard was prepared by ECMA (as ECMA-274) 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.

Annexes A to J form an integral part of this International Standard, annexes K to N are for information only.

Information technology - Data interchange on 120 mm optical disk cartridges using +RW format - Capacity: 3,0 Gbytes and 6,0 Gbytes

Section 1 - General

1 Scope

This International Standard specifies the mechanical, physical and optical characteristics of 120 mm rewritable optical disks with capacities of 3,0 Gbytes and 6,0 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. The data can be written, read and overwritten many times using the phase change method. These disks are identified as +RW.

This International Standard specifies

– two related but different Types of this disk (see clause 7),

– the conditions for conformance,

– the environments in which the disk is to be tested, operated and stored,

– the mechanical, physical and dimensional 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,

– the characteristics of the signals recorded on the disk, thus enabling data processing systems to read the data from the disk.

This International Standard provides for the interchange of disks between optical 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 both 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 ECMA and International 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 reference

The following standard contains provisions which, through reference in this text, constitutes provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the

possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60950:1999, *Safety of information technology equipment.*

4 Definitions

For the purposes of this International Standard the following definitions apply.

4.1 Alternating Fine Clock Mark (AFCM): A single cycle deviation of the track from the average track centreline which is recorded periodically.

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

4.3 Clamping Zone: The annular part of the disk within which the clamping force is applied by the 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, provided for the mechanical support of the disk, and in some cases, of the recording layer as well.

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

4.8 field: A subdivision of a sector.

4.9 interleaving: The process of reallocating the physical sequence of units of data so as to render the data more immune to burst errors.

4.10 land and 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 in the groove.

4.11 mark: A feature of the recording layer which may take the form of an amorphous domain, a pit, or any other type or form that can be sensed by the optical system. The pattern of marks and spaces represents the data on the disk.

4.12 phase change: A physical effect by which the area of a recording layer irradiated by a laser beam is heated so as to change from an amorphous state to a crystalline state and vice versa.

4.13 Physical Sector: The smallest addressable part of a track in the Information Zone of a disk that can be accessed independently of other addressable parts of the Zone.

4.14 recording layer: A layer of the disk on which data is written during manufacture and / or use.

4.15 Reed-Solomon code (RS): An error detection and / or correction code.

4.16 segment number: Angular location information contained in wobble data.

4.17 space: A feature of the recording layer which may take the form of an crystalline, a non-pit, or any other type or form that can be sensed by the optical system. The pattern of marks and spaces represents the data on the disk.

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

4.19 track: A 360° turn of a continuous spiral.

4.20 track number: Radial location information contained in the wobble data, designating the track count in the rewritable region of the disk.

4.21 track pitch: The distance between adjacent track centrelines, measured in a radial direction.

4.22 wobble: A continuous sinusoidal deviation of the track from the average centreline. Location information is included as frequency modulated data in the wobble.

4.23 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. 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.

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

In each data field, 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 $8n$ 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.

5.2 Names

The names of entities, e.g. specific tracks, fields, etc., are given with an initial capital.

6 List of acronyms

ADIP	Address in Pre-groove	LSB	Least Significant Byte
AFCM	Alternating Fine Clock Mark	msb	Most Significant Bit
BP	Byte Position	MSB	Most Significant Byte
BPF	Band Pass Filter	NRZ	Non Return to Zero
CAV	Constant Angular Velocity	NRZI	Non Return to Zero Inverted
CLV	Constant Linear Velocity	OPC	Optimum Power Control
DCB	Disk Control ECC Block	PBS	Polarizing Beam Splitter
DCC	d.c. component suppression Control	PDL	Primary Defect List
DMA	Defect Management Area	PI	Parity of Inner-code
DSV	Digital Sum Value	PLL	Phase Locked Loop
ECC	Error Correction Code	PSN	Physical Sector Number
EDC	Error Detection Code	PO	Parity of Outer-code
FM	Frequency Modulation	RS	Reed-Solomon code
HF	High Frequency	RUB	Recording Unit Block
ID	Identification Data	SDL	Secondary Defect List
IED	ID Error Detection code	SI	Spare Interval
LPF	Low Pass filter	SL	Spare Length
LSN	Logical Sector Number	SPS	Start Position Shift
lsb	Least Significant Bit	SYNC	Synchronization code

7 General description of the optical disk

The optical disk that is the subject of this International Standard consists of two substrates bonded together by an adhesive layer, so that the recording layer(s) is (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 accessed. Clamping is performed in the Clamping Zone. This International Standard provides for two Types of such disks.

Type S consists of a substrate, a single recording layer and a dummy substrate. The recording layer can be accessed from one side only. The nominal capacity is 3,0 Gbytes.

Type D consists of two substrates and two recording layers. From each side of the disk only one of the recording layers can be accessed. The nominal capacity is 6,0 Gbytes.

Data can be written onto the disk as marks in the form of amorphous spots in the crystalline recording layer and can be overwritten with a focused optical beam, using the phase change effect between amorphous and crystalline states. The data can be read with a focused optical beam, using the phase change effect as the difference in the reflectivity between amorphous and crystalline states. The beam accesses the recording layer through a transparent substrate of the disk.

The disk is specified with two different velocity ranges, CAV and CLV with one velocity range being a subset of the other. Each disk shall be recordable over the entire range of velocities specified for that disk.

Part of the disk contains read-only data for the drive in the form of pits embossed by the manufacturer. This data can be read using the diffraction of the optical beam by the embossed pits.

Figure 1 shows schematically the two Types.

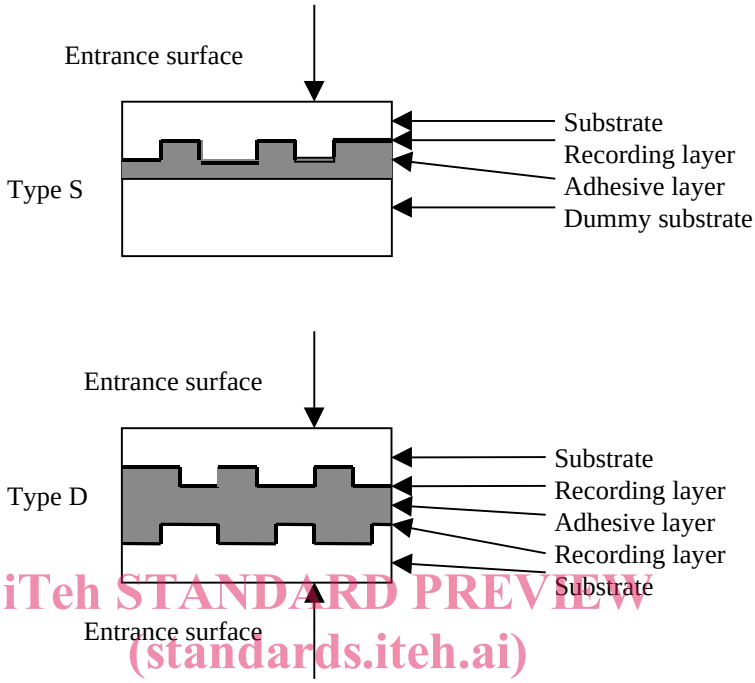


Figure 1 - Types of 120 mm +RW disks

8 General Requirements

8.1 Environments

8.1.1 Test environment

In the test environment, the air immediately surrounding the disk shall have the following properties:

Temperature	: 23 °C ± 2 °C
Relative humidity	: 45 % to 55 %
Atmospheric pressure	: 60 kPa to 106 kPa

No condensation on the optical disk shall occur. Before testing, the optical disk shall be conditioned in this environment for 48 h minimum. It is recommended that, before testing, the entrance surface of the optical disk shall be cleaned according to the instructions of the manufacturer of the disk.

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

8.1.2 Operating environment

This International Standard requires that a disk which meets all requirements of this International Standard in the specified test environment 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 has the following properties:

temperature	: 5 °C to 55 °C
relative humidity	: 3 % to 85 %
absolute humidity	: 1 g/m^3 to 30 g/m^3
atmospheric pressure	: 60 kPa to 106 kPa
temperature gradient	: 10 °C/h max.
relative humidity gradient	: 10 %/h max.

No condensation on the optical disk shall occur. If an optical disk has been exposed to conditions outside those specified in this clause, it shall be acclimatized in an allowed operating environment for at least 2 h before use.

8.1.3 Storage environment

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

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

No condensation on the optical disk shall occur.

8.1.4 Transportation

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

8.2 Safety requirements

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

8.3 Flammability

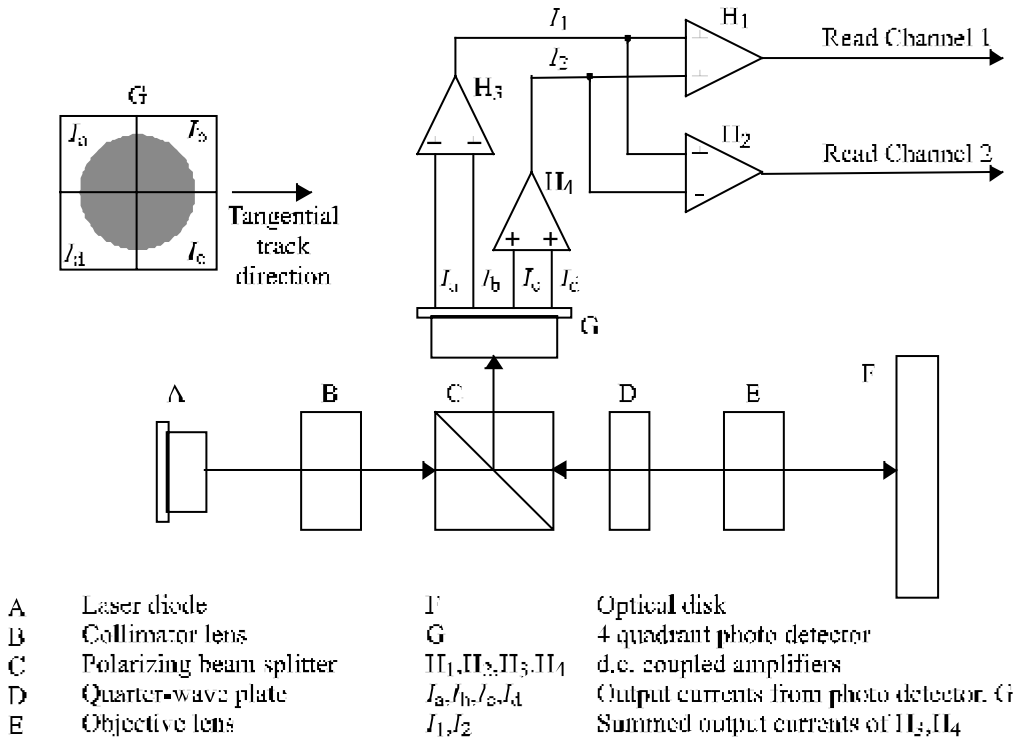
The disk and its components shall be made from materials that comply with the flammability class for HB materials, or better, as specified in Standard IEC 60950.

9 Reference Drive

The Reference Drive shall be used for the measurement of optical parameters for conformance with the requirements of this International Standard. The critical components of this device have the characteristics specified in this clause.

9.1 Optical system

The basic set-up of the optical system of the Reference Drive used for measuring the (over)write and read parameters is shown in figure 2. Different components and locations of components are permitted, provided that the performance remains the same as that of the set-up in figure 2. 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	4 quadrant photo detector
C	Polarizing beam splitter	H_1,H_2,H_3,H_4	d.c. coupled amplifiers
D	Quarter-wave plate	I_a,I_b,I_c,I_d	Output currents from photo detector G
E	Objective lens	I_1,I_2	Summed output currents of H_3,H_4

Figure 2- Optical system of the Reference Drive

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.

9.2 Optical beam

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

a) Wavelength (λ) $650\,\text{nm}^{+10\,\text{nm}}_{-5\,\text{nm}}$

b) Numerical aperture of the objective lens (NA) 0,60 ± 0,01

c) The objective lens shall be compensated for spherical aberrations caused by a parallel substrate with nominal thickness (0,6 mm) and nominal refractive index (1,55).

d) Wave front aberration 0,033 × λ rms max.

e) Light intensity at the rim of the pupil of the the 30 % to 50 % of the maximum intensity objective lens in radial direction and 40 % to 60 % in the tangential direction.

f) Polarization Circularly polarized light

g) Read power 1,0 mW ± 0,1 mW

h) Write power and pulse width see annex E

i) Relative Intensity Noise (RIN)* of laser diode -134 dB/Hz max.

*RIN (dB/Hz) = 10 log [(a.c. light power density / Hz) / d.c. light power]

9.3 Read channel 1

Read channel 1 shall be provided to generate signals from the marks and spaces in the recording layer. This Read channel shall be used for reading the embossed information, using the diffraction of the optical beam by the marks, and be used for reading the user-written information, using the change in reflectivity of the marks and spaces due to the phase change effect. The read amplifiers after the photo detectors in the Read channel shall have a flat response within 1 dB from d.c. to 20 MHz.