INTERNATIONAL STANDARD

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Information technology — Data interchange on 300 mm optical disk cartridges of type WORM (Write Once Read Many) using irreversible effects — Capacity: 30 Gbytes per cartridge

Technologies de l'information — Échange de données sur cartouches de disque optique de 300 mm de type WORM (écriture unique et lectures multiples) avec effets irréversibles — Capacité: 30 Gbytes par cartouche

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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 3.

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 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.

ISO/IEC 20162 was prepared by ECMA (as ECMA-317) 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 L form a normative part of this International Standard. Annexes M to Q are for information only.

Information technology — Data interchange on 300 mm optical disk cartridges of type WORM (Write Once Read Many) using irreversible effects — Capacity: 30 Gbytes per cartridge

Section 1 — General

1 Scope

This International Standard specifies the characteristics of a 300 mm optical disk cartridge (ODC) of Type WORM (Write Once Read Many) using irreversible effects, with a capacity of 30 Gbytes. This WORM ODC's uses writing effects that are inherently irreversible. Written marks cannot be erased and attempted modifications of the written marks are detectable.

This International Standard specifies

- the conditions for conformance testing and the Reference Drive;
- the environments in which the cartridges are to be operated and stored;
- the mechanical, physical and dimensional characteristics of the cartridge, so as to provide mechanical interchange ability between data processing systems;
- the format of the information on the disk, both pre-written and user-written, including the physical disposition of the tracks and sectors, the error correction codes, the modulation methods used;
- the characteristics of the prerecorded information on the disk;
- the recording characteristics of the disk, enabling processing systems to write data onto the disk;
- the minimum quality of user-written data on the disk, enabling data processing systems to read data from the disk.

This International Standard provides for interchange 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 Cartridge (ODC)

An Optical Disk Cartridge shall be in conformance with this International Standard if it meets the mandatory requirements specified herein.

2.2 Generating System

A generating system shall be in conformance with this International Standard if the ODC 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 ODC 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 or International Optical Disk Cartridge standard(s) supported by the system for which conformance is claimed. This statement shall specify the number of the standard(s), including, where appropriate, the ODC Type(s), or the Types of side, and whether support includes reading only or both reading and writing.

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.

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

IEC 60950-1:2001 *Information technology equipment — Safety — Part 1: General requirements*

4 Terms and definitions

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

4.1 case: The housing for an optical disk, that protects the disk and facilitates disk interchange.

4.2 Clamping Reference Area: The area of the Clamping Zone used to define the Disk Reference Plane.

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

4.4 **Cyclic Redundancy Check (CRC**): A method for detecting errors in data.

4.5 **Data Zone:** An annular area within the user zone on the disk having a constant data clock frequency.

4.6 **defect management:** A method for handling defective areas on the disk.

4.7 **Disk Reference Plane:** A plane defined by the perfectly flat annular surface of an ideal spindle onto which the Clamping Reference Area of the disk is clamped, and which is normal to the axis of rotation.

4.8 **entrance surface:** The surface of the disk on to which the optical beam first impinges.

4.9 **Error Correction Code (ECC):** An error-detecting code designed to correct certain kinds of errors in data.

4.10 **format:** The arrangement or layout of information on the disk.

4.11 **hub:** The central feature on the disk which interacts with the spindle of the disk drive to provide radial centring and the clamping force.

4.12 **interleaving:** The process of allocating the physical sequence of units of data so as to render the data more immune to burst errors.

4.13 **Logical Sector:** The minimum addressable user data block.

4.14 **Logical Block Address:** The address of a block of data.

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

4.16 **mark edge:** The transition between a region with a mark and one without a mark or vice versa, along the track.

4.17 **mark edge recording:** A recording method that uses a mark edge to represent a Channel bit.

4.18 **optical disk:** A disk that will accept and retain information in the form of marks in a recording layer that can be read with an optical beam.

4.19 **optical disk cartridge (ODC):** A device consisting of a case containing an optical disk.

4.20 **polarization:** The direction of polarization of an optical beam is the direction of the electric vector of the beam.

4.21 **prerecorded mark:** A mark written on the recording layer during manufacturing of the disk.

4.22 **read power:** The read power is the optical power, incident at the entrance surface of the disk, used when reading.

4.23 **recording layer:** A layer of the disk on, or in, which data is written during manufacture and/or use.

4.24 **Reed-Solomon code:** An error detection and/or correction code that is particularly suited to the correction of errors that occur in bursts or are strongly correlated.

4.25 **space:** The area between marks along the track.

4.26 **spindle:** The part of the disk drive which contacts the disk and/or hub.

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

4.28 **track:** The path which is followed by the focus of the optical beam during one revolution of the disk.

4.29 **track pitch:** The distance between the centrelines of adjacent tracks, measured in a radial direction.

4.30 **write-inhibit hole:** A hole in the case which, when detected by the drive to be open, inhibits write operation.

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. 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.
- Letters and digits in parentheses represent numbers in hexadecimal notation.
- The setting of a bit is denoted by ZERO or ONE.
- Numbers in binary notation and bit combinations are represented by strings of digits 0 and 1.
- Numbers in binary notation and bit combinations are shown with the most significant bit to the left.

– Negative values of numbers in binary notation are given in TWO's complement.

– In each field the data is recorded so that the most significant byte (byte 0) is recorded first. Within each byte the least significant bit is numbered 0 and is recorded last, the most significant bit (numbered 7 in an 8-bit byte) is recorded first. This order of recording applies also to the data input of the Error Detection and Correction circuits and their output.

5.2 Names

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

6 List of acronyms

COF	Creeping One of Four (code)
CRC	Cyclic Redundancy Code
DCb	Data Channel bit
ECC	Error Correction Code
EDAC	Error Detection And Correction
FWHM	Full Width Half Maximum
IR	Internal Radius
QWT	Quadrature Wobble Tracking (mark)
LBA	Logical Block Address
lsb	least significant bit
LSB	Least Significant Byte
MR	Middle Radius
msb	most significant bit
MSB	Most Significant Byte
NSB	Next Significant Byte
ODC	Optical Disk Cartridge
OR	Outside Radius
PBA	Physical Block Address
PLL	Phase–Locked Loop
RFO	Read Focus Optimization
RLL	Run Length Limited (code)
R-S	Reed-Solomon (code)
SCb	Servo Channel bit
SDI	Specific Disk Information
SISIC	Selective Inter Symbol Interference Cancellation
WORM	Write Once Read Multiple

7 General description of the optical disk cartridge

The optical disk cartridge which is the subject of this International Standard consists of a case containing an optical disk.

The case is a protective enclosure for the disk. It has access windows covered by shutters. The windows are automatically uncovered by the drive when the cartridge is inserted into it.

The optical disk consists of two sides assembled together with their recording layers on the inside.

The optical disk is recordable on both sides. Data is written onto the disk with a focused optical beam as marks in the recording layer using irreversible effects, such that the marks cannot be erased or transformed back into an unrecorded state. The marks can be formed by either a phase transformation process, an alloy mode, or any other irreversible process yielding the recording characteristics specified in section 5. The data are read by detecting the intensity modulation of the reflected beam caused by the difference of reflectivity and diffraction of the recorded marks and the unrecorded regions. The beam accesses the recording layer through the transparent substrate of the disk.

The optical disk cartridge is designed to allow for use in a drive with optical access from both sides simultaneously.

8 General requirements

8.1 Environments

8.1.1 Test environment

The test environment is the environment where the air immediately surrounding the optical disk cartridge has the following properties:

temperature: 23 °C ± 2 °C

relative humidity: 45 % to 55 %

atmospheric pressure: 60 kPa to 106 kPa

air cleanliness: Class 100 000 (see annex A)

No condensation on or in the optical disk cartridge shall occur. Before testing, the optical disk cartridge shall be conditioned in this environment for 48 h minimum. It is recommended that, before testing, the entrance surface of the disk 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 an optical disk cartridge which meets all requirements of this Standard in the specified test environment provides data interchange over the specified ranges of environmental parameters in the operating environment. (See also annex M).

The operating environment is the environment where the air immediately surrounding the optical disk cartridge 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.

air cleanliness: office environment (see M.1)

No condensation on or in the optical disk cartridge shall occur. If an optical disk cartridge 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. (See also annex N).

8.1.3 Storage environment

The optical disk cartridge without any protective enclosure shall not be stored in an environment outside the range allowed for storage. The storage environment is defined as an environment where the air immediately surrounding the optical disk cartridge has 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.

air cleanliness: office environment (see M.1)

No condensation on or in the optical disk cartridge shall occur.

8.1.4 Transportation

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

8.2 Temperature shock

The optical disk cartridge shall withstand a temperature shock of up to 20 °C when inserted into, or removed from, the drive.

8.3 Safety requirements

The cartridge shall satisfy the safety requirements of IEC 60950-1, when used in the intended manner or in any foreseeable use in an information processing system.

8.4 Flammability

The cartridge and its components 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

The Reference Drive is a drive several critical components of which have well defined properties and which is used to test the write and read parameters of the disk for conformance to this International Standard. The critical components vary from test to test. This clause gives an outline of all components; components critical for tests in specific clauses are specified in those clauses.

9.1 Optical system

The basic set-up of the optical system of the Reference Drive used for measuring the write and read parameters is shown in figure 1. Different components and locations of components are permitted, provided that the performance remains the same as that of the set-up in figure 1. 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.

9.2 Optical beam

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

a) Wavelength (λ) $685\ ^{+8\ nm}_{-8\ nm}$

b) Wavelength (λ) divided by the numerical aperture of the objective lens (NA) 1,181 µm ± 0,013 µm

c) Filling D/W of the aperture of the objective lens in both tangential and radial direction 1,22 ± 0,15

d) Variance of the wavefront of the optical beam near the recording layer after passing through an ideal substrate (thickness: 1,205, index of refraction: 1,51) 0 to $\lambda^2/180$

e) Polarization Circular

f) The optical power and pulse width for writing and reading shall be as specified in later clauses.

D is the diameter of the lens aperture and W is the beam diameter of the Gaussian beam where the intensity is $1/e^2$ of the maximum intensity.

9.3 Read Channel

A Read Channel, Channel 1, shall be provided to generate a read-out signal S from the pre-written and user-written marks in the recording layer, using the change in reflectivity and diffraction of the marks.

Signal S which measures the total amount of light reflected by the disk in the exit pupil of the objective lens, is the sum of the currents J_1, J_2, J_3, J_4 of the four-quadrant photodiodes. This signal is not equalized before detection. It shall be low-pass filtered with a 3-pole Butterworth filter with a cut-off frequency of one half the Channel clock frequency.

9.4 Tracking

Tracking error signals are generated to control the servos for the axial and radial tracking of the focus of the optical beam.

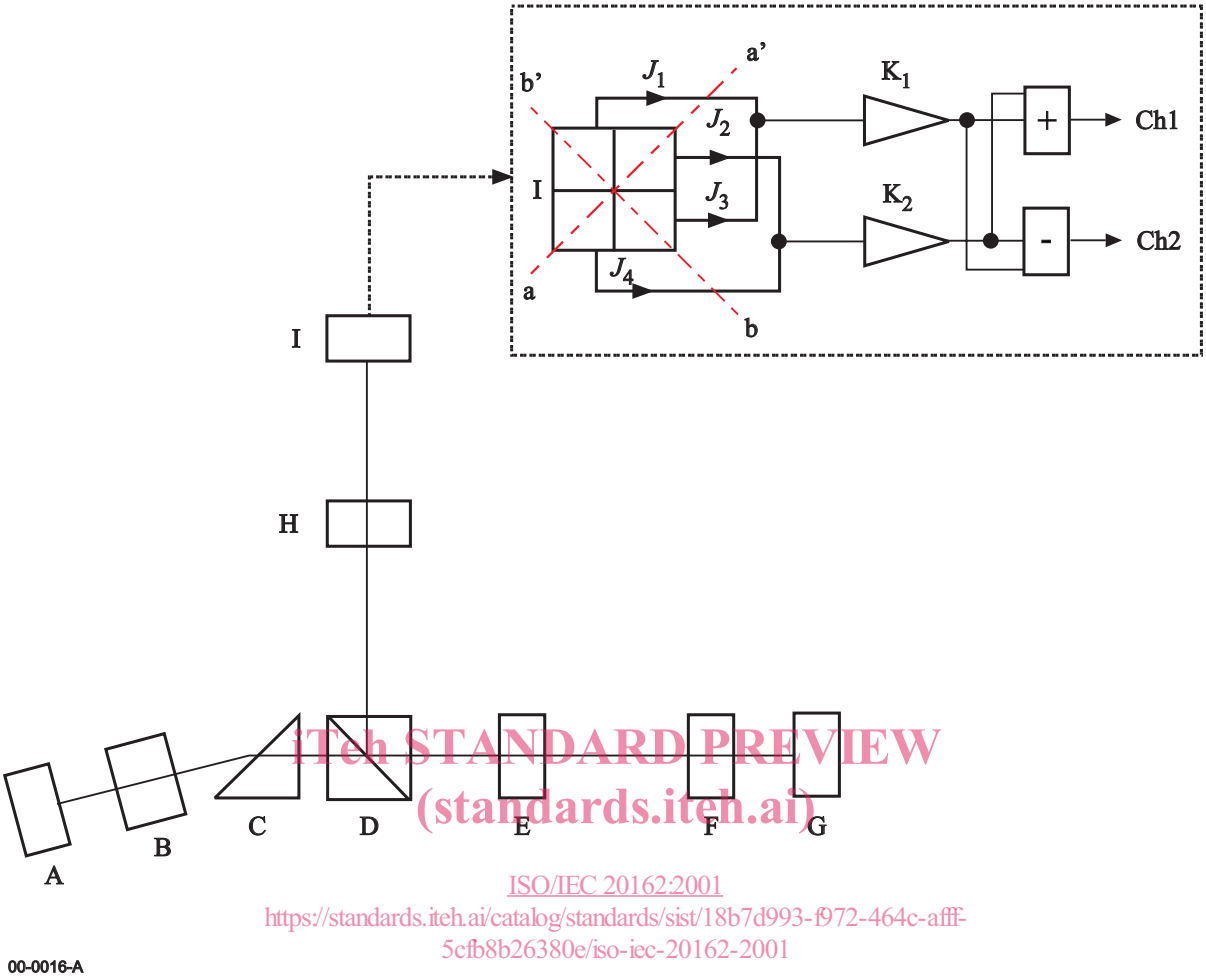
The axial tracking error signal Sa is derived in Channel 2 from the measurement of amplitudes of the four-quadrant photodiode currents when the light spot scans a dedicated area of the disk, as specified in 19.2.4.1.

The radial tracking error signal Sr is derived from the measurement of amplitudes of the read out signal S in Channel 1 at the centres of the tracking marks, as specified in 19.2.4.2.

The requirement for the accuracy with which the focus of the optical beam must follow the tracks is specified in 19.2.4.3.

9.5 Rotation of the disk

The spindle shall position the disk as specified in 12.4. It shall rotate the disk at 16,67 Hz ± 0,20 Hz. The direction of rotation shall be clockwise on side A and counterclockwise on side B, when viewed from the disk entrance surface of the disk of this side.



A	Laser diode	H	Astigmatic lens
B	Collimator lens	I	Four-quadrant photodiode
C	Optional shaping prism	J_1, J_2, J_3, J_4	Currents of four-quadrant photodiode
D	Polarizing beam splitter	K_1, K_2	D.C.-coupled amplifiers
E	Optional quarter-wave plate	Ch1	Channel 1: Read out channel
F	Objective lens	Ch2	Channel 2: Axial tracking error channel
G	Optical disk	aa', bb'	Astigmatic focus line directions

Figure 1 — Optical system of the Reference Drive

Section 2 — Mechanical and physical characteristics

10 Dimensional and physical characteristics of the case

10.1 General description of the case

The case (see figure 2) is a rigid protective container of rectangular shape. It allows the spindle of the drive to clamp the disk by its hub and have a head window on both sides.

Shutters uncover the windows upon insertion into the drive, and automatically cover them upon removal from the drive. The case has write-inhibit, Side A / B detection features, and gripper slots and notches for an autochanger.

10.2 Relationship of Sides A and B

The features essential for physical interchangeability are represented in figure 2. When Side A of the cartridge faces upwards, Side B of the disk faces downwards. Sides A and B of the case are identical as far as a group of features are concerned. For this group, the description is given for one side only (references to Sides A and B can be changed to B or A, respectively).

Only the side identification features, the write inhibit feature and the bar code area, described in 10.5.3, 10.5.4, 10.5.7 and 10.5.12, respectively, are not identical for both sides of the case.

10.3 Reference axes of the case

There are three orthogonal reference axes X,Y,Z defining three references planes XY, XZ, YZ to which the dimensions of the case are referred.

The positions of these reference axes are shown on figure 3.

- The Reference Axes X and Y lie in the external plane of side A: Reference Axis X is located between the centres of the two locator slots of the case and Reference Axis Y is perpendicular to Reference Axis X at the middle of the bottom of the case.
- The Reference Axis Z is perpendicular to the Reference Axes X and Y at their crossing point.

10.4 Case drawings

The case is represented schematically by the following drawings.

- Figure 2 shows a composite drawing of Side A of the case in isometric form, with the major features identified from Side A.
- Figure 3 shows the envelope of the case with Reference Axes X, Y and Z.
- Figures 4a, 4b show the Side A / B indicator holes and labels.
- Figure 5 shows the details of the insertion slots and detents.
- Figure 6 shows the gripper slots and notches, used for automatic handling.
- Figure 7 shows the write-inhibit hole.
- Figure 8 shows the hub aperture and head window.
- Figure 9 shows the shutter opening features.
- Figures 10a, 10b show the user label areas.
- Figure 11 shows the bar code area.
- Figures 12a, 12b, 12c show the hub/disk structure and dimensions.
- Figure 13 shows the capture cylinder.

10.5 Dimensions of the case

The dimensions of the case shall be measured in the test environment. The dimensions of the case in an operating environment can be estimated from the dimensions specified in this clause.

10.5.1 Overall dimensions

The total length of the case (see figure 3) shall be

$$L_1 = 340{,}0 \text{ mm} \pm 0{,}4 \text{ mm}$$

The distance from the top of the case to the reference axis X shall be

$$L_2 = 60{,}0 \text{ mm} \pm 0{,}2 \text{ mm}$$

The distance from the bottom of the case to the reference axis X shall be

$$L_3 = 280{,}0 \text{ mm} \pm 0{,}2 \text{ mm}$$