INTERNATIONAL STANDARD

ISO/IEC 15898

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Information technology — Data interchange on 356 mm optical disk cartridges — WORM, using phase change technology — Capacity: 14,8 Gbytes and 25 Gbytes per cartridge

Technologies de l'information — Échange de données sur cartouches de disques optiques 356 mm *[WORM], utilisant la technologie de changement de phase — Capacité:* 14,8 Gbytes *et* 25 Gbytes *par cartouche*

Contents

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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. 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.

International Standard ISO/IEC 15898 was prepared by ECMA (as ECMA-260) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval of national bodies of ISO and IEC.

Annexes A to Q form an integral part of this International Standard. Annex R is for information only.

Information technology — Data interchange on 356 mm optical disk cartridges — WORM, using phase change technology — Capacity: 14,8 Gbytes and 25 Gbytes per cartridge

Section 1 - General

1 Scope

This International Standard specifies the characteristics of 356 mm Optical Disk Cartridges (ODCs) of the type providing for information to be written once and read many times.

This International Standard specifies:

- definitions of essential concepts,
- the environment in which the characteristics shall be tested,
- the environments in which the cartridge shall be operated and stored,
- the mechanical, physical and dimensional characteristics of the case and of the optical disk,
- the optical characteristics and the recording characteristics for recording the information once and for reading it many times, so as to provide physical interchangeability between data processing systems.
- the format for the physical disposition of the tracks and sectors, the error correction codes, the modulation methods used for recording and the quality of the recorded signals.

Together with a standard for volume and file structure, this International Standard provides for full data interchange between data processing systems.

2 Conformance

2.1 Optical disk cartridge

An optical disk cartridge shall be in conformance with this International Standard if it meets all the mandatory requirements herein.

2.2 Generating system

A manufacturer of a system generating an ODC for interchange shall be in conformance with this International Standard if the ODC it generates is in accordance with 2.1.

2.3 Receiving system

A manufacturer of a system receiving an ODC for interchange shall be entitled to claim 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. This statement shall specify the number of the standard(s) and whether support includes reading or both reading and writing.

3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were 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 editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

IEC 950:1991, *Safety of information technology equipment.*

4 Definitions

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

4.1 actual write power: The actual write power is two times the recording beam power exiting the objective lens for a time averaged measurement of 50 % duty cycle optical pulses where the pulse length is measured at one half the peak power.

4.2 air sandwich disk: A disk which consists at least of a substrate with a recording layer and a cover separated by two annular spaces providing an enclosed air gap for the recording layer.

4.3 band: An annular area of the optical disk recording zone.

4.4 baseline reflectance: The reflectance of an unwritten, non-grooved area of a disk through the protective layer.

4.5 birefringence: The property of a material which causes incident light waves of different polarizations to be refracted differently by the material.

4.6 case: An enclosure which protects the optical disk and carrier from contamination and damage due to physical handling. The case may include space for physical labelling, write-inhibit features and provisions for automatic handling to facilitate disk interchange.

4.7 clamping zone: The annular part of the disk within which the clamping force is applied by the clamping device.

4.8 cover sheet: A transparent covering placed at a pre-determined distance from the recording surface to protect the optical disk from surface contamination and to cause surface contaminants to be out of focus.

4.9 cross-talk level: The ratio of the level of a spurious signal generated by an adjacent track to the level of the signal of that track.

4.10 cyclic redundancy check (CRC): A method to detect errors in data.

4.11 defect management: In real time, refers to automated programs for altering read or write power, focus or tracking when difficulties are detected, and for the decision to abandon sectors of high error content. In batch mode, refers to guidelines for disk rewrite or retirement.

Note - Disk retirement is retention of a disk which can be read but not written.

4.12 disk reference plane: A plane defined by the perfectly flat annular surface of an ideal spindle which contacts the clamping zone of the disk and which is normal to the axis of rotation.

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

4.14 error correction code (ECC): An error-detecting code designed to correct certain kinds of errors in data.

4.15 error detection and correction (EDAC): A family of methods in which redundancy is added to data in known fashion and is written with the data. Upon readback, a decoder removes the redundancy and uses the redundant information to detect and correct erroneous channel symbols.

4.16 format: The arrangement or layout of the data on a data medium.

4.17 hub: The central feature on the disk which interacts with the spindle of the disk drive to provide radial centring and clamping force and, in some cases, axial location.

4.18 interleaving: The process of allocating the physical sequence of units of data to render the data more immune to burst errors.

4.19 mark: A feature of the recording layer that may take the form of an amorphous spot, crystalline spot, a pit, or other form that can be sensed by the optical system. The pattern of marks represents the data on the disk.

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

4.21 mark edge recording: A recording method which uses a mark edge to represent a channel bit.

4.22 narrow band signal-to-noise ratio: The ratio of the root mean square (RMS) voltage of a signal at a specified frequency to the RMS voltage of the noise in a specified bandwidth, expressed in decibels.

4.23 noise floor: The noise spectrum in a specified bandwidth.

4.24 optical disk: A disk containing information in the form of marks in a recording layer that can be read with an optical beam.

4.25 optical disk carrier: A framework which captures and holds an optical disk except when the optical disk is mounted on the disk drive spindle. The carrier provides the interface with the equipment for handling of an optical disk. The carrier and the optical disk are permanently mated and as a sub-assembly interchangeable with any case, disk drive or library equipment.

4.26 optical disk cartridge (ODC): A device consisting of a case containing an optical disk and carrier.

4.27 optical retardation: The change, after passage through a birefringent material, of the phase between two orthogonally, linearly polarized plane waves associated with a given propagation direction.

4.28 perimeter ring: An outside diameter feature of the optical disk to provide an interface to the carrier and to handling devices of an optical disk drive.

4.29 pre-formatted mark: A mark written by the manufacturer for use by the optical disk drive.

4.30 protective layer: A transparent layer on the disk provided for mechanical protection of the recording layer, through which the optical beam accesses the recording layer.

4.31 read power: The incident power specified at the entrance surface that can be used to read the data on the disk without damaging the recording layer.

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

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

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

4.35 tilt: The angle which the normal to the entrance surface makes with the normal to the disk reference plane.

4.36 track: A 360 ° segment of the path which is to be followed by the read beam during reading or the write beam during writing.

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

4.38 write power: The incident power specified at the entrance surface used to produce marks.

4.39 zone: An annular area of the disk.

5 Conventions and notations

Bits and bytes mean data bits and bytes unless otherwise specified.

5.1 Representation of numbers

The following conventions apply to numbers:

- A measured value is rounded off to the least significant digit of the corresponding 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. A value ≥ 0,015 is rounded up to 0,02 and a value < 0,015 is rounded down to 0,01.
- 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 the sector headers, character data are recorded according to the IRV of ISO/IEC 646.
- All other data are stored as binary integers.
- Multiple-byte binary data are stored least significant byte first.

5.2 Names

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

6 List of acronyms

AM	Address mark
CRC	Cyclic Redundancy Code
DCF	Data Control Field
DMA	Defect Management Area
DM-M	Delay Modulation Mark
EDAC	Error Detection and Correction
ECC	Error Correction Code
GDL	Grown Defect List
ID	Inside diameter
IDENT	Identification
LSB	Least Significant Byte
MSB	Most Significant Byte
NRZ	Non Return to Zero
OD	Outside diameter
ODC	Optical Disk Cartridge
PAD	Tracking pad
PDL	Primary Defect List
RA	Reallocation Area
RLL	Run length limited (code)
RPM	Revolutions per minute
R-S/LDC	Reed-Solomon long distance code
SDL	Secondary Defect List
VFO	Variable frequency oscillator

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 and carrier sub-assembly.

The case provides protection from contaminants and during human handling. The case has an access door for automatic unload and load of the carrier and the disk.

The carrier supports and retains the disk during loading into the drive or unloading from it, and while being moved by an automated library storage device.

The optical disk is recordable on both sides. Data is written onto the disk as marks in the form of crystalline spots in the amorphous recording layer with a focused optical beam, using the phase-change effect between crystalline and amorphous states. The composition of the recording layer is such that the marks cannot be erased or transformed back into an unrecorded state. The data can be read with a focused optical beam, using the phase-change effect as the reflective difference between amorphous and crystalline states. The beam accesses the recording layer through a thin transparent protective layer (cover sheet) on the disk surface.

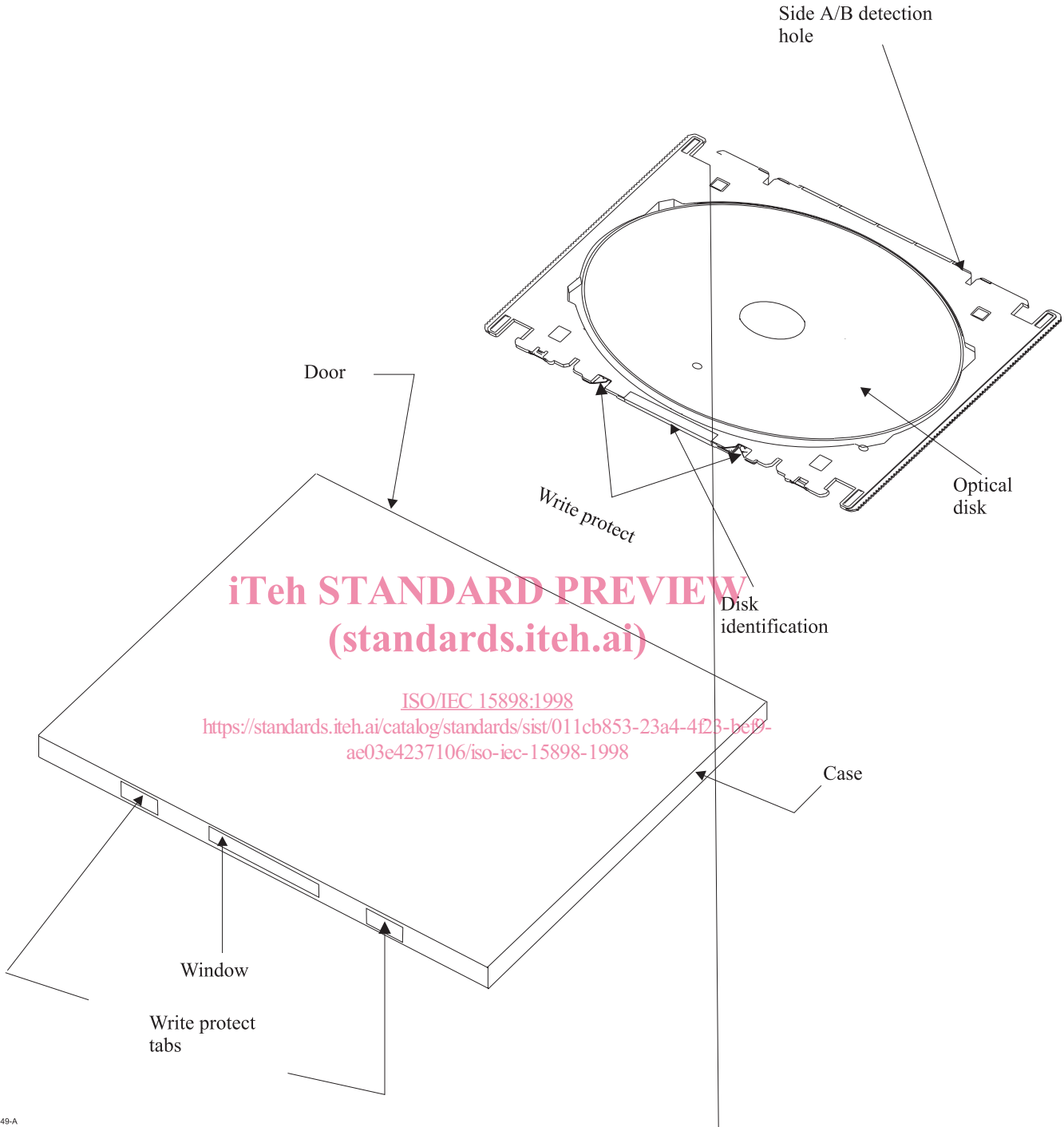

Figure 1 - Optical disk cartridge

8 General requirements

8.1 Environments

8.1.1 Test environment

Unless otherwise specified, tests and measurements made on the ODC to check the requirements of this International Standard shall be carried out in an environment where the air immediately surrounding the ODC is within the following conditions.

temperature : 23 °C ± 2 °C
relative humidity : 45 % to 55 %
atmospheric pressure : 75 kPa to 110 kPa
air cleanliness : Class 100 000 (see annex A)
conditioning before testing : 48 h min.

Before testing, the ODC shall be conditioned in this environment for 48 h minimum. No condensation on or in the ODC shall occur.

8.1.2 Operating environment

Optical disk cartridges used for data interchange shall be operated in an environment where the air immediately surrounding the optical disk and carrier is within the following conditions when the drive has reached its stable operating conditions.

temperature : 10 °C to 50 °C
relative humidity : 10 % to 80 %
wet bulb temperature : 29 °C max.
atmospheric pressure : 75 kPa to 110 kPa
temperature gradient : 10 °C / h max.
relative humidity gradient : 10 % / h max.
air cleanliness : Class 100 000 (see annex A)

No condensation on r in the ODC shall be allowed to occur.

If an ODC has been exposed during storage and/or transportation to conditions outside those specified above, it shall be acclimatized in the operating environment for at least 2 h before use.

8.1.3 Storage environment

Storage environment is the ambient condition to which the ODC, without any additional protective enclosure, is exposed when stored.

8.1.3.1 Short-term storage

For a time of six consecutive weeks the optical disk cartridge within its specified shipping package shall not be exposed to the environmental conditions outside those given below.

temperature : -20 °C to +55 °C
relative humidity : 5 % to 90 %
wet bulb temperature : 29 °C max.
atmospheric pressure : 75 kPa to 110 kPa
temperature gradient : 20 °C / h max.
relative humidity gradient : 20 % / h max.

No condensation on or in the optical disk assembly shall be allowed to occur.

8.1.3.2 Long-term storage

For a storage period longer than six consecutive weeks the optical disk cartridge shall not be exposed to environmental conditions outside those given below.

temperature : -10 °C to 50 °C
relative humidity : 10 % to 90 %
wet bulb temperature : 29 °C max.
atmospheric pressure : 75 kPa to 110 kPa
temperature gradient : 15 °C / h max.

relative humidity gradient : 10 % / h max.
air cleanliness : Class 100 000 (see annex A)

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

8.1.4 Transportation

This International Standard does not specify requirements for transportation but guidance is given in annex R.

8.2 Temperature shock

In the operating environment an ODC shall be capable of withstanding a thermal 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 Standard IEC 950 and its components shall not constitute any safety or health hazard when used in its 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 Standard IEC 950.

9 Reference Drive

The Reference Drive is a drive for which several critical components have well defined properties and which is used to test write and read parameters of the disk for conformance to this International Standard.

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 2. Different components and locations of components are permitted, provided that the performance remains the same as that of the setup 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) Write and read wavelength : 680 nm ± 10 nm

b) Numerical aperture (NA) : 0,50 ± 0,01

c) Focused spot size in each dimension : 0,75 µm ± 0,04 µm

d) Wave front at recording layer : ≤ 0,045 rms

(through 90 µm thick coversheet)
and coma3 : ≤ | 0,10 | rms
and astig3 : ≤ | 0,13 | rms
and spher3 : ≤ | 0,10 | rms

where:

coma3 = third order coma aberration
astig3 = third order astigmatism aberration
spher3 = third order spherical aberration

e) Polarization of the light: circular

f) Detection method:

- Reflected light collected by central aperture method
- Transitions detected by gated second derivative method

g) The data rate for testing shall be 30 Mega channel bits per second.