INTERNATIONAL STANDARD

ISO/IEC 11695-1

Second edition
2015-05-15

Identification cards — Optical memory cards — Holographic recording method —

Part 1:
Physical characteristics

Cartes d'identification — Cartes à mémoire optique — Méthode d'enregistrement holographique —

Partie 1: Caractéristiques physiques

Reference number
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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identifcation*.

This second edition cancels and replaces the first edition (ISO/IEC 11695-1:2008), which has been technically revised.

ISO/IEC 11695 consists of the following parts, under the general title *Identification cards — Optical memory cards — Holographic Recording Method*:

— *Part 1: Physical characteristics*

— *Part 2: Dimensions and location of the accessible optical area*

— *Part 3: Optical properties and characteristics*

— *Part 4: Logical data structures*

Introduction

This part of ISO/IEC 11695 is one of a series of International Standards defining the parameters for optical holographic memory cards and the use of such cards for the storage and interchange of digital data.

These International Standards recognize the existence of different methods for recording and reading Information on optical memory cards, the characteristics of which are specific to the recording method employed. In general, these different recording methods will not be compatible with each other. Therefore, the Standards are structured to accommodate the inclusion of existing and future recording methods in a consistent manner.

This part of ISO/IEC 11695 is specific to optical memory cards using the holographic recording method. Characteristics which apply to other specific recording methods are found in separate Standards documents.

This part of ISO/IEC 11695 defines the physical characteristics and the extent of compliance with, addition to, and/or deviation from the relevant base document, ISO/IEC 11693-1.

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Certego GmbH

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Identification cards — Optical memory cards — Holographic recording method —

Part 1: Physical characteristics

1 Scope

This part of ISO/IEC 11695 defines the physical characteristics of optical memory cards using the holographic recording method.

2 Normative references

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

ISO/IEC 7810, *Identification cards — Physical characteristics*

ISO/IEC 7816-1, *Identification cards — Integrated circuit cards — Part 1: Cards with contacts — Physical characteristics*

ISO/IEC 10373-1, *Identification cards — Test methods — Part 1: General characteristics*

ISO/IEC 11695-2, *Identification cards — Optical memory cards — Holographic recording method — Part 2: Dimensions and location of accessible optical area*

ISO/IEC 11695-3, *Identification cards — Optical memory cards — Holographic recording method — Part 3: Optical properties and characteristics*

ISO/IEC 11695-4, *Identification cards — Optical memory cards — Holographic recording method — Part 4: Logical data structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11695-2, ISO/IEC 11695-3 and the following apply.

3.1
holographic recording method
writing and/or pre-formatting of digital data on the holographic memory card in the form of holograms

3.2
hologram
microscopic structure which can be written by optical energy into an accessible optical area causing diffraction of a read-out beam of certain wavelength by illumination

Note 1 to entry: A hologram is the representation of a two-dimensional code of digital data on the holographic memory card.

3.3
amplitude hologram
type of hologram which modulates the amplitude of a read-out beam in the read-out process

3.4
phase hologram
type of hologram which modulates the phase of a read-out beam in the read-out process

3.5
thick hologram
hologram in which the thickness is n times the wavelength of the writing/reading beam where *n* >10

3.6
thin hologram
hologram characterized by the thickness of the recording medium containing the hologram, whereby the hologram has the same order as the wavelength of the writing/reading beam

3.7
holographic memory card
card containing an accessible optical area to which holograms can be written using external optical energy

3.8
accessible optical area
partition of the holographic memory card which is available to be accessed by the read and/or write beam of the holographic read-out and/or recording system used

3.9
storage layer
specific layer of the holographic memory card, located between the protective layer and the reflective layer, which contains specific materials to permit writing and/or reading back holographic recorded data by optical means

3.10
protective layer
transparent layer of material within the holographic memory card which is placed on top of the storage layer and able to provide protection against scratches, humidity and damage caused by environmental influence

3.11
reflective layer
layer of material within the holographic memory card placed between substrate layer and storage layer to reflect the writing and reading beam so that the holographic memory card can be read-out in reflection mode

3.12
substrate layer
layer of material of an holographic memory card providing a flat and smooth surface for both the reflective and storage layers attaching the storage medium to the card body, when the substrate layer is not the card body

3.13
polarization
property of electromagnetic waves, such as light, that describes the direction of the transverse electric field

Note 1 to entry: More generally, the polarization of a transverse wave describes the direction of oscillation in the plane perpendicular to the direction of travel.

3.14
birefringence
decomposition of a ray of light into two rays (the ordinary ray and the extraordinary ray) when it passes through certain types of material, depending on the polarization of the light

Note 1 to entry: This effect occurs when the structure of the material is anisotropic.

4 Holographic Memory Cards — Physical Characteristics

4.1 Dimensions

4.1.1 Card height and width

ISO/IEC 7810 applies.

4.1.2 Card thickness

ISO/IEC 7810 applies.

4.1.3 Card corners

ISO/IEC 7810 applies.

4.1.4 Card edges

ISO/IEC 7810 applies.

4.2 Construction

4.2.1 Card construction

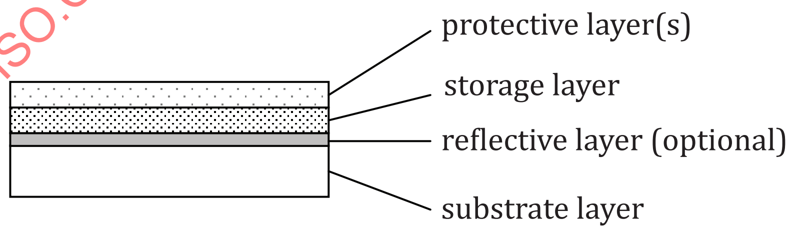
ISO/IEC 7810 applies.

4.2.2 Cross-section at accessible optical area

See Figure 1.

The holographic memory card contains an accessible optical area which is laminated, bonded, or inserted into the card body.

The accessible optical area is composed of different layers: a substrate layer, a reflective layer, a storage layer and one or more protective layers to protect the sub-layers from damage e.g. by surface damage, humidity and other environmental influence.



NOTE Drawing not to scale.

Figure 1 — Section of a holographic memory card at the accessible optical area

4.3 Physical characteristics

4.3.1 Protective layer(s)

There are one or multiple protective layers to protect the sub-layers (storage layer, reflective layer) from surface damage, humidity and other environmental influence.

The protective layer has to be transparent for the writing and reading beam.

When using reading or writing light with linear or circular polarization, the protective layer has to be free of birefringence.

The protective layer ensures that the holographic memory card can survive the action of a destructive influence to the extent that it continues to show optical characteristics which conform to the base standard. Test methods are specified in ISO 10373-1.

4.3.2 Storage layer

The storage layer is a photosensitive material applied to the reflective or substrate layers. Examples of materials, which can be used are:

— high-resolution photographic silver-halide film (e.g. Kodak 649F, Agfa 8E75HD);

— silver-halide sensitized gelatin (e.g. BB-640 from Holographic Recording Technologies);

— dichromated gelatin (DCG) (e.g. Geola PFG-04);

— photoresists (e.g. Shipley AZ-1350);

— photopolymers (e.g. Dupont OmniDex);

— functionalized comb-shaped liquid crystalline polymers (see Reference [13]).

The thickness of the storage layer may vary depending on the specific optical characteristics of the material chosen. To be in compliance, materials used shall conform to the optical requirements as specified in ISO/IEC 11695-3.

The material composing the storage layer determines the parameters for recording and reading of holograms (wavelength of writing/reading beam, writing/reading power) as well as the type of holograms, which can be recorded (thin hologram/thick hologram, amplitude/phase). The material as well as the parameters for recording and/or reading holograms shall be specified by the card manufacturer.

4.3.3 Reflective layer

The reflective layer is necessary when the hologram is read out in reflection mode for thin holograms. The reflective layer is metallic: metals which can be used include aluminium, silver, gold, titanium and chromium. The thickness of the reflective layer may vary depending on the specific optical characteristics of the selected material. To be in compliance, materials and thickness of reflective layer shall conform to the reflectivity requirements as specified in ISO/IEC 11695-3. Typical thickness values of metallic layers vary between 50 nm and 200 nm.

4.3.4 Substrate layer

The substrate layer can be the card body itself; it can consist of the same materials as the card body or it can be made of other material which provides a flat and smooth surface on one side and the ability to attach the optical (holographic) storage medium on the other.

The surface roughness of the substrate layer shall be less than Ra = 100 nm.

The thickness of the substrate layer may vary depending on the materials used and the manufacturing process employed.

4.3.5 Additions

The addition of integrated circuit chips with or without contacts, tipping, embossing, magnetic stripe materials and/or signature panel materials shall not alter the characteristics of the holographic memory card to the extent that, during normal use of the card, the accessible optical area is likely to become incapable of meeting the characteristics specified for it in this part of ISO/IEC 11695.

4.3.6 Bending stiffness

ISO/IEC 7810 applies.

4.3.7 Card warpage

ISO/IEC 7810 applies.

4.3.8 X-rays

ISO/IEC 7816-1 applies.

4.3.9 Toxicity

ISO/IEC 7810 applies.

4.3.10 Ultraviolet light

ISO/IEC 7816-1 applies.

4.3.11 Light transmittance

ISO/IEC 7810 applies.

4.3.12 Bending properties

ISO/IEC 7816-1 applies.

4.3.13 Resistance to chemicals

ISO/IEC 7810 applies.

4.3.14 Atmospheric requirements

The card shall still function in accordance with this part of ISO/IEC 11695 when exposed to

— gaseous concentrations of less than 0,1 µg/kg of SO_2, H_2S, or NO_x,

NOTE NO_x means NO, NO_2 or a mixture of NO and NO_2.

— salt (NaCl) concentrations of less than 2,7 µg/m^3.

4.3.15 Durability

ISO/IEC 7810 applies.

4.3.16 Dimensional stability and warpage with temperature and humidity

ISO/IEC 7810 applies.

4.3.17 Default test environment and conditioning

ISO/IEC 10373-1 applies, as well as the following conditions:

— atmospheric pressure, 75 kPa to 105 kPa;

— condensation, none permitted.

Annex A
(informative)

Holographic Data Storage

A.1 Holographic Data Storage

Holography is a general recording method by coherent light beams, which can be used for any information recording – from digital to pictorial and volume imaging. Holography is a two step process. In the first step (recording) a hologram is produced from an object. In the second step (read-out) an image of the object is reconstructed from the hologram by illumination.

A.1.1 Creation of holograms

A hologram is produced from an object. One method to produce a hologram is by the interference of two light beams, the object beam and the reference beam: a scattered beam from the object interferes with the reference beam the resulting interference pattern is called hologram of the object. The hologram can then be recorded on a photosensitive medium.

The object can be a real three-dimensional object (volume object). It can also be a two-dimensional image of a digital code (e.g. matrix or bar code), which can be applied to the object beam by an amplitude modulator.

This method of producing holograms is depicted in Figure A.1

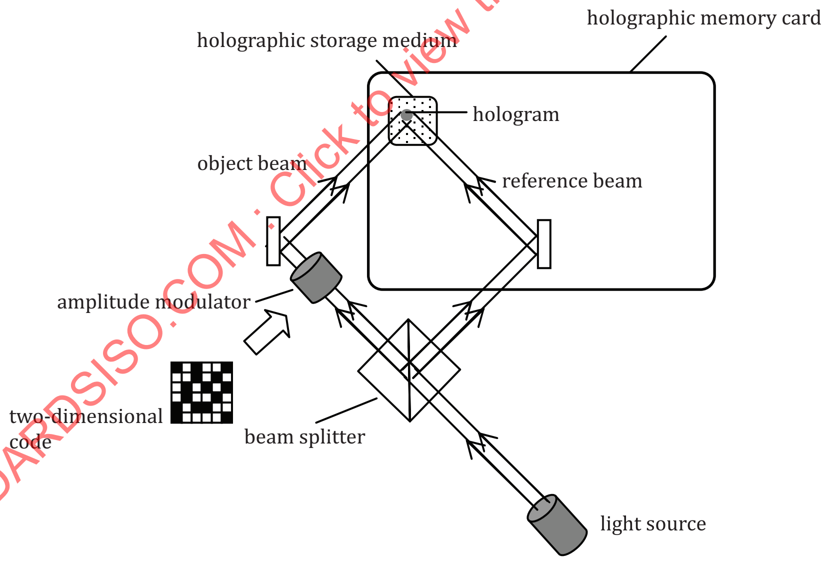


Figure A.1 — Schematic overview of a setup for holographic data storage by overlapping two coherent light beams

A.1.2 Readout of holograms

For the readout, the hologram is illuminated with a beam, having the same or similar properties to the reference beam used for the production of the hologram under the same angle of incidence used in the recording step. Holographic imaging is a wave front reconstruction process: by illuminating the hologram with the reference beam the object wave is reconstructed. The scattered light from the hologram produces an image of the object, which can be captured by a camera.

The readout process is depicted in Figure A.2

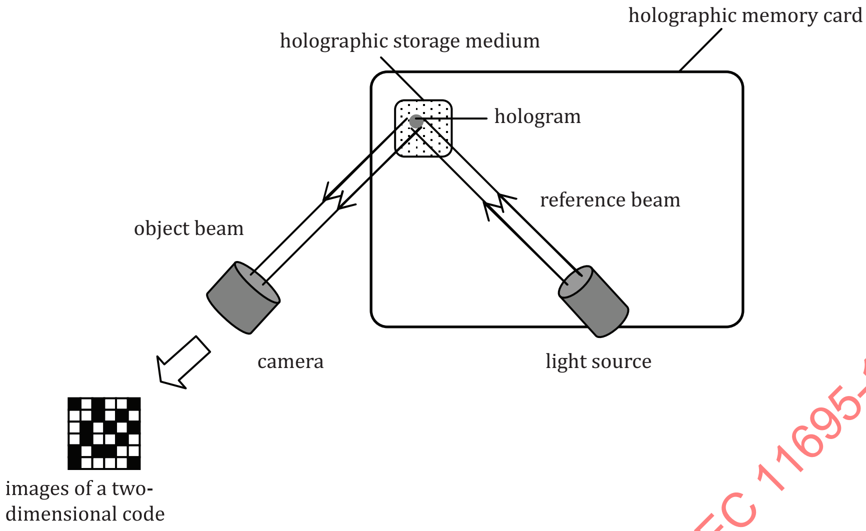


Figure A.2 — Setup for reading out a hologram

A.2 Types of holograms

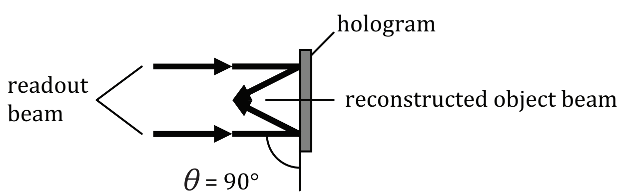
A.2.1 Reflection/transmission holograms

Reflection and transmission holograms differ in the geometry of the readout process. Reflection holograms are read out in reflection mode, meaning the light source for the readout beam and the camera are located on the same side of the hologram (holographic memory card). Transmission holograms are read out in transmission mode, meaning the light source for the readout beam and the camera are located on opposite sides of the hologram (holographic memory card).

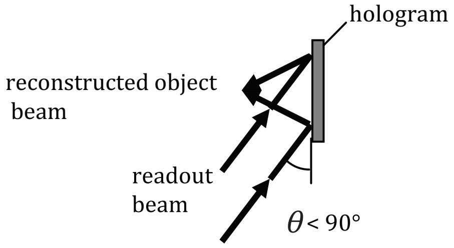
The storage medium for transmission holograms shall be transmissive for the readout beam whereas the storage medium for reflection holograms shall incorporate a reflective layer for the readout beam.

A.2.2 On-axis/off-axis holograms

On- and off-axis holograms differ in viewing angle. On-axis holograms are illuminated by the readout beam perpendicularly incident to the hologram (incident angle 90°). Off-axis holograms are illuminated by the readout beam under an incident angle differing from 90°. Both methods are depicted in Figure A.3



a) On-axis arrangement

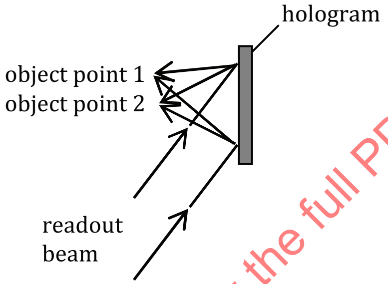


b) Off-axis arrangement

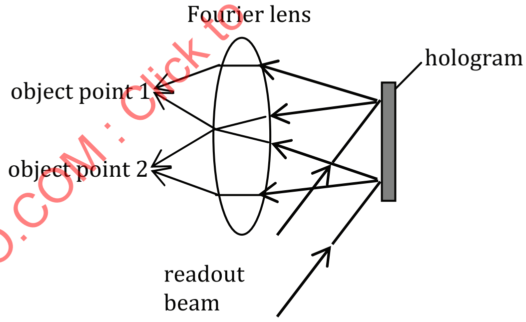
Figure A.3 — On-axis and off-axis arrangements

A.2.3 Fresnel holograms/Fourier holograms

The characteristic of a Fresnel hologram is that the reconstructed object points are located at a finite distance from the hologram. For Fourier holograms the reconstructed object points are located at infinity, so the collimated beams are focused by a Fourier lens to get an image of the recorded object Figure A.4



a) Fresnel hologram



b) Fourier hologram

Figure A.4 — Fresnel and Fourier holograms

A.2.4 Amplitude/phase holograms

Any photo-induced effect is the result of a change in the complex index of refraction

$$\tilde{n} = n - i\kappa$$

where n is the index of refraction and κ the absorption index,