
**Imaging materials — Processed safety
photographic films — Storage practices**

*Matériaux pour image — Films photographiques de sécurité traités —
Techniques d'archivage*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member 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 shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 18911 was prepared by Technical Committee ISO/TC 42, *Photography*.

This first edition cancels and replaces the fourth edition of ISO 5466:1996, of which it constitutes a technical revision.

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This International Standard is one of a series of International Standards dealing with the physical properties and stability of imaging materials. To facilitate identification of these International Standards, they are assigned a number within the block from 18900 to 18999 (see annex A).

Annexes A to K of this International Standard are for information only.

Introduction

The value of records used in archives, museums, libraries, government, commerce and universities has focused attention on the care of these records to ensure their longest possible life (see [1, 2, 3] in the bibliography). Photographic film is an important documentary and pictorial material, and there is a recognized need for information on safeguarding photographic film having legal, scientific, industrial, artistic or historical value.

Films are susceptible to degradation from many sources. These factors may be divided into three general categories as follows.

a) Nature of the photographic film

The stability of photographic film records depends on the physical and chemical nature of the film. The specification for safety photographic film which is suitable for storage is described in ISO 18906.

For preservation purposes, processed photographic films are classified according to their life expectancy or LE designation. These are specified in the appropriate International Standards. The term "archival" is no longer specified to express longevity or stability in International Standards on imaging materials, since it has been interpreted to have many meanings that range from "preserving information forever," which is unattainable, to "temporary storage of actively used information."

For optimum preservation of photographic information, a high LE film should be used, and it should be stored under extended-term storage conditions. A film material suitable for preservation is silver-gelatin type film on polyester base that meets the requirements of ISO 10602. However, this International Standard also applies to processed colour, diazo (ISO 8225), vesicular (ISO 9718) and thermally processed silver (ISO 18919) films. Although these film types may not have as high an LE designation, excellent keeping properties have been obtained with many of them.

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b) Photographic processing of the film

For black-and-white silver-gelatin type film, ISO 10602 specifies a maximum residual thiosulfate level for different LE classifications and a residual silver compounds level.

For diazo film, ISO 8225 specifies a proper development test. ISO 9718, for vesicular film, includes both a proper development test and a residual diazonium salt test.

c) Storage conditions

The conditions under which safety photographic film records should be stored are extremely important for the preservation of film and are the subject of this International Standard (see ISO 18906). The same environmental conditions are recommended for nitrate-base films, but they shall be stored in a separate storage area having suitable fire protection safeguards (see [4] in the bibliography).

The important elements affecting preservation of processed film are humidity, temperature and air pollutants, as well as the hazards of fire, water, light, fungal growth, insects, microbiological attack, contact with certain chemicals in solid, liquid or gaseous form, and physical damage. Direct contact with other generic types of film can be detrimental to either film.

The extent to which humidity, temperature, and atmospheric contaminants or variations thereof can be permitted to reach beyond recommended limits without producing adverse effects will depend upon the duration of exposure, the biological conditions conducive to fungal growth, and the accessibility of this atmosphere to the emulsion and support surfaces. Exposure to high temperatures, and in particular to high humidities, can lead to degradation of the film support and the photographic emulsion (see [5, 6, 7] in the bibliography). Cellulose ester base films are more subject to base degradation than polyester base films.

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There are two levels of storage conditions: medium-term and extended-term. Medium-term storage can be used for films where the information is to be preserved for a minimum of 10 years, while extended-term storage conditions can extend the useful life of a majority of freshly processed films to 500 years. However, extended-term storage conditions will prolong the life of all films, independent of age, type or processing conditions. The storage protection provided by each level will differ in degree, as will the cost of providing and maintaining the storage facility.

Immediate availability of space and cost may need to be considered when selecting storage conditions. It is recognized that many facilities may not be able to obtain the low humidity and low temperature levels specified in this International Standard because of energy considerations, climate conditions or building construction. Such deviation from the specified conditions will reduce the degree of protection offered, and in such cases maintaining a humidity and temperature as low as possible will still provide some benefits.

This International Standard is not designed to provide protection against natural or man-made catastrophes, with the exception of fire and associated hazards which are sufficiently common to warrant inclusion of protection measures.

In addition to the recommendations in this International Standard, good storage practices must consider the filing enclosure. These are covered in ISO 18902.

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Imaging materials — Processed safety photographic films — Storage practices

1 Scope

This International Standard provides recommendations concerning the storage conditions, storage facilities, handling and inspection for all processed safety photographic films (hereafter referred to as photographic film) in roll, strip, aperture-card or sheet format, regardless of size.

This International Standard is applicable to extended-term and medium-term storage of photographic film as defined in clause 3.

It is applicable to photographic film records intended as storage copies, which should not be in frequent use. It does not apply to “work” or “use” copies (see annex B).

This International Standard, while intended for materials that are properly processed, should also be of considerable value in prolonging the useful life of photographic film whose processing conditions are unknown, or that have been toned, retouched, or have markings with materials of uncertain or unknown stability.

This International Standard is applicable only to safety photographic film (see ISO 18906). Nitrate-base films are hazardous (see [8] in the bibliography) and are not covered by this International Standard. They require special storage considerations (see [4] in the bibliography), but the environmental conditions specified in this International Standard are applicable. <https://standards.iteh.ai/catalog/standards/sist/46655d79-4c5d-4000-98fc-b88447264165/iso-18911-2000>

The storage of photographic prints and photographic plates requires different considerations. They are not covered in this International Standard, but are described respectively in ISO 18920 and ISO 18918.

2 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 18906:—¹⁾, *Imaging materials — Photographic films — Specifications for safety film*.

ISO 8225:1995, *Photography — Ammonia-processed diazo photographic film — Specifications for stability*.

ISO 9718:1995, *Photography — Processed vesicular photographic film — Specifications for stability*.

ISO 10602:1995, *Photography — Processed silver-gelatin type black-and-white film — Specifications for stability*.

ISO 18915:—¹⁾, *Imaging materials — Methods for the evaluation of the effectiveness of chemical conversion of silver images against oxidation*.

1) To be published.

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ISO 14523:1999, *Photography — Processed photographic materials — Photographic activity test for enclosure materials*.

ISO 18902:2000, *Imaging materials — Processed photographic films, plates and papers — Filing enclosures and storage containers*.

ISO 18919:1999, *Imaging materials — Thermally processed silver microfilm — Specifications for stability*.

3 Terms and definitions

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

3.1 archival medium

recording material that can be expected to retain information forever, so that such information can be retrieved without significant loss when properly stored

NOTE There is, however, no such material and it is not a term to be used in International Standards or system specifications.

3.2 duplicate

reproduction of a master, retaining the same polarity and size

3.3 extended-term storage conditions

storage conditions suitable for the preservation of recorded information on the majority of freshly and properly processed photographic films for 500 years

3.4 fire-protective storage

facility designed to protect records against excessive temperatures, water and other fire-fighting agents, and steam developed by insulation of safes or caused by the extinguishing of fires and collapsing structures

3.5 life expectancy LE

length of time that information is predicted to be acceptable in a system at 21 °C and 50 % RH

3.6 LE designation

rating for the **life expectancy** (3.5) of recording materials and associated retrieval systems

NOTE The number following the LE symbol is a prediction of the minimum life expectancy in years for which information can be retrieved without significant loss when stored at 21 °C and 50 % RH, e.g., LE-100 indicates that information can be retrieved after at least 100 years storage.

3.7 macroenvironment

atmospheric conditions (temperature, relative humidity and pollutants) in a large area in which records are kept

3.8 medium-term storage conditions

storage conditions suitable for the preservation of recorded information for a minimum of 10 years

3.9 microenvironment

atmospheric conditions (temperature, relative humidity and pollutants) inside a storage enclosure in which records are kept

3.10**open enclosure**

enclosure that is intended for physical protection against mechanical damage, but is neither light-tight nor airtight

NOTE Such enclosures may be reels, cores, spools, cassettes, magazines, folders, envelopes, cartons, boxes, sleeves, transparency mounts or aperture cards.

3.11**protective enclosures**

impermeable sealed containers, that may also have to be opaque, used for protection from outside factors such as reactive gases and moisture, including changes in relative humidity, and from light for certain kinds of products

NOTE Such enclosures may be taped cans and sealed envelopes.

3.12**safety photographic film**

film that meets the flammability specifications defined in ISO 18906

3.13**storage housing**

physical structure supporting materials and their enclosures

NOTE It may consist of drawers, racks, shelves or cabinets.

4 Film enclosures

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4.1 Requirements

All enclosures used for medium-term and ~~extended-term storage~~ shall meet the requirements of ISO 18902.

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4.2 Film in roll format**4.2.1 Medium-term storage enclosures**

Aerial film, microfilm, motion-picture film, and some portrait films are wound on reels or cores and stored in roll form. The rolls shall all be wound tightly, but not under extreme tensions. A tension caused by 0,3 N of pull-out force for a 35 mm film width is recommended. Rolls greater than 150 m in length shall be stored so that the radius of the roll is in the horizontal position and the film is supported on its edges. Rolls less than 150 m in length may also be stored with the radius of the roll in the vertical position, if the core itself is supported by a horizontal spindle inserted into the cores so as to avoid pressure on the bottom of the roll. However, if such rolls are on reels or spools which have flanges, a spindle is not required since the flanges support the weight of the roll.

Motion-picture prints shall be wound with the emulsion surface on the inside of the roll, as this improves subsequent projection performance (see [9] in the bibliography).

Rolls of photographic film shall be stored in closed containers to provide protection against dirt and physical damage, unless the film is protected by the storage housing (see clause 5).

Colour, diazo and thermally-processed silver films shall be stored in closed, opaque enclosures or be otherwise protected from light exposure. Suitable enclosures are containers with telescoping, slip-type, or threaded twist-on lids. The materials used shall meet the same requirements as those for cores and reels. Closed enclosures are not necessarily airtight and may provide limited access to ambient air. Therefore, if they are used, the humidity of the ambient air shall not exceed the recommended limits.

Protective enclosures made from impermeable materials shall be used, where needed, to maintain the humidity limits of the film (see clause 7), to protect against gaseous impurities in the atmosphere, or when low-temperature storage is used without humidity control (see annex C). Suitable enclosures are closed containers with friction-type

or threaded, twist-on lids having an incorporated seal. Rubber gaskets shall not be used. Cans within heat-sealed foil bags also provide protection from high humidity.

Metal containers provide the best protection against gases from the environment. However, they may corrode from acidic fumes²⁾ from within the container unless they are protected with an overcoat. Alternative materials are polystyrene, polyethylene and polypropylene.

4.2.2 Extended-term storage enclosures

For extended-term storage, the requirements of 4.2.1 shall be met. The materials used for reels, cores, and containers shall meet the requirements of ISO 18902 and ISO 14523. Rubber bands shall not be used for confining film on reels or cores. If paper bands are used, the paper shall meet, as a minimum requirement, the specifications described in ISO 18902 and ISO 14523. Films on reels may be confined by tucking the film end between the roll and the flange. Pressure-sensitive tape, if needed for the enclosure, shall be free from peroxide and pass the photographic activity test specified in ISO 14523. Pressure-sensitive tape shall not be used in contact with the film.

Films may have possible interactions with other films that are of a different generic type (for example, diazo and silver-gelatin), as well as with magnetic tapes and optical disks. Films of a different generic type shall not be wound in the same rolls or stored in the same enclosures. Closed containers are required, unless the photographic film is protected from dirt and damage by the storage housing (see clause 5).

4.3 Film in sheet and slide format

4.3.1 Medium-term storage enclosures

Film in sheet form may be stored in envelopes of paper or plastic foil, folding cartons, boxes, file folders, aperture cards, or film strip jackets. Photographic slides may be stored in cardboard, metal or plastic boxes. Colour, diazo, and thermally-processed silver films shall be stored in opaque envelopes or folders, or otherwise protected from light exposure. Films should not be stacked, as this could cause excessive pressure on the lowermost sheets. When in direct contact with the surface of the photographic film, the paper or plastic material used for envelopes, sleeves, jackets, folders, boxes and cartons shall meet, as a minimum requirement, the specifications described in ISO 18902 and ISO 14523.

Suitable plastic enclosure materials are uncoated polyester (polyethylene terephthalate), polystyrene, polyethylene and polypropylene. Glassine envelopes and chlorinated, nitrated or highly plasticized sheeting shall be avoided. Specifically, cellulose nitrate and polyvinyl chloride are not acceptable.

Protective enclosures shall be used, where needed, to maintain humidity within the limits recommended for the specific film type (see clause 7), to protect against gaseous impurities in the atmosphere, or when low-temperature storage is used without humidity control. Heat-sealable envelopes, consisting of aluminum foil extrusion coated with clear polyethylene on the inside and laminated to a suitable paper sheet on the outside, have been successfully used as sealed enclosures. Precautions should be taken in handling these envelopes, so that they are not punctured. To provide greater protection against pinholes, a double bagging technique is recommended.

The adhesive used for seams and joints shall also meet the requirements of ISO 18902 and ISO 14523. The filing enclosure shall be constructed so that any seam or joint will be at the edge of the enclosure and not in contact with the image layer.

Any film that is actively releasing acidic fumes²⁾ shall be stored in plastic or acid-neutralizing envelopes.

2) Some vesicular films give off acidic fumes that may interact with silver, diazo or dye-gelatin type films. Decomposing acetate-base films release acetic acid, which further catalyses base degradation.

4.3.2 Extended-term storage enclosures

For extended-term storage, the requirements of 4.3.1 shall be met except that film shall not be stored in cardboard enclosures.

Photographic-quality gelatin, modified and photographically inert starch, some acrylic and polyvinyl acetate adhesives and methyl cellulose are suitable for use with paper storage enclosures. Pressure-sensitive (permanently tacky) adhesives shall meet the specifications of ISO 18902 and ISO 14523.

Films may have possible interactions with other films that are of a different generic type (for example, diazo and silver-gelatin), as well as with magnetic tapes and optical disks. Films of different generic types shall not be interfiled or be in physical contact.

5 Storage housings

Photographic film should be stored in closable housings, such as drawers or cabinets, or on shelves and racks enclosed by tightly fitting doors in order to provide protection from dust and dirt. Alternatively, open shelves and racks may be used if the film is in closed containers. The storage housing materials shall be non-corrosive as described in ISO 18902. They shall also be non-combustible and chemically inert. Wood, pressed-board, particle-board, plywood and other such materials shall be avoided due to their combustible nature and the possibility of producing active deteriorating agents as they age.

The finish on storage housing materials shall be durable and should not contain substances that can have a deleterious effect on stored photographic film. Adverse effects may be produced by finishes containing chlorinated or highly plasticized resins, or by solvents off-gassing from freshly applied finishes. Paints used on cabinets may give off peroxides, solvents and other contaminants for up to three months after being applied. Metal housing materials that have been powder coated (a solvent-free finish process in which electrostatically applied resin particles are fused by heat) or cabinets made from stainless steel or anodized aluminum are recommended.

When air-conditioned individually, storage housings shall be arranged to permit interior circulation of air to all shelves and drawers holding film containers so as to provide uniform humidity conditions. Storage housings, located in rooms conditioned in accordance with 7.1, shall be provided with ventilation openings that permit access of air to the interior. Such openings shall not interfere with the requirements for fire-protective storage or water protection.

Films and other materials that release acidic fumes, magnetic tapes and optical disks shall not be stored in the same storage housing as other photographic products.

6 Storage rooms

6.1 Medium-term storage rooms

Rooms and areas used for film storage should be located in the same area as rooms containing provisions for inspection and viewing of the film. Good housekeeping is essential. Walls and enclosed air-conditioned spaces shall be designed to prevent condensation of moisture on interior surfaces and within walls, especially during periods of low exterior temperatures when the walls can be cooled below the dew-point of the air.

Provisions shall be made against damage of film by water from floods, leaks, sprinklers, and from the steam released from masonry walls during a fire. Storage rooms or vaults should be located above basement levels where possible. A special storage room separated from the work areas, for film records of medium-term interest, generally will not be required, provided that the conditions recommended in 7.1.2 are maintained.

Films that are not essentially free from release of acidic fumes, such as some vesicular films, shall be stored in separate storage rooms. Films showing any sign of chemical degradation, such as the presence of acidic fumes, shall be stored in a separate storage room having a separate circulating-air system.

6.2 Extended-term storage rooms

For extended-term storage, the requirements of 6.1 shall be met.

The value of photographic film kept for long-term purposes makes it advisable to provide a storage room or vault separate from medium-term storage facilities, temporary storage facilities, offices or work areas. Storage rooms for films that are not essentially free from acid release shall have a separate circulating-air system (see annex D).

Storage rooms have been constructed in caves and mines and have proven very satisfactory when requirements are met for environmental conditions (see 7.1) and air purity (see 7.3).

7 Environmental conditions

7.1 Temperature and humidity specifications for storage (see annexes E, F and G)

7.1.1 Recommended temperature and relative humidity

The recommended temperature and relative humidity conditions given in Table 1 shall be maintained either within individual storage housings or within storage rooms containing such housings.

Table 1 — Maximum temperatures and relative humidity ranges for extended-term storage

Image	Base	Maximum temperature ^{a, b} °C	Relative humidity range ^{a, c} %
Black-and-white silver-gelatin ^d (see ISO 10602)	Cellulose esters ^e	2	20-50
		5	20-40
		7	20-30
Black-and-white silver-gelatin ^d (see ISO 10602) Thermally or processed silver (see ISO 18919) Vesicular (see ISO 9718) Silver dye bleach	Polyester	21	20-50
Colour (chromogenic)	Cellulose esters ^e	- 10	20-50
		- 3	20-40
Diazo (see ISO 8225)	Polyester	2	20-30

^a See annex H for storage of historic still photographic records.
^b Cycling of temperature shall not be greater than ± 2 °C over a 24 h period.
^c Cycling of relative humidity shall not be greater than ± 5 % RH over a 24 h period.
^d If there is concern about the possibility of silver image oxidation due to atmospheric contaminants, poor quality enclosures, and/or excessively high temperature and humidity levels, a post-process chemical conversion treatment can be used to provide added protection (see ISO 18915).
^e This includes cellulose triacetate, cellulose acetate butyrate, and cellulose acetate propionate.

7.1.2 Medium-term storage environment

The average relative humidity (RH) of a medium-term storage environment shall not exceed 50 % RH, and the maximum relative humidity shall not exceed 60 % RH. Ideally, the maximum temperature for extended periods should not exceed 25 °C, and a temperature below 21 °C is preferable. The peak temperature for short time periods shall not exceed 32 °C.