

INTERNATIONAL STANDARD

ISO 5466

Third edition
1992-12-15

Photography — Processed safety photographic films — Storage practices

*Photographie — Films photographiques de sécurité traités — Directives
pour l'archivage*

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ISO 5466:1992

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Reference number
ISO 5466:1992(E)

Foreword

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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.

International Standard ISO 5466 was prepared by Technical Committee ISO/TC 42, *Photography*.

This third edition cancels and replaces the second edition (ISO 5466:1986), of which it constitutes a technical revision.

Annexes A, B, C, D, E, F and G of this International Standard are for information only.

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Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Introduction

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

Films are susceptible to degradation from many sources. These factors can be divided into three general categories:

a) Nature of the photographic film

The stability of photographic film records depends on the physical and chemical nature of the film. Only safety photographic films are suitable for storage, the specification for safety photographic film being described in ISO 543.

For preservation purposes, film can be given three classifications:

1) ISO 5466:1992
medium-term;

2) long-term, and

3) archival.

The best film material for preservation is silver-gelatin type film which meets the requirements of ISO 10602 for archival film.

This International Standard also applies to processed colour, diazo (see ISO 8225) and vesicular (see ISO 9718) films. Although these film types are not archival, they can be medium-term or long-term and excellent keeping experience has been obtained with many of them.

For optimum preservation of photographic information, archival film should be used and it should be stored under archival storage conditions.

b) Photographic processing of the film

For silver-gelatin type archival film, ISO 10602 specifies a maximum residual thiosulfate level and a maximum residual silver compounds level.

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

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.

The important elements affecting preservation of processed film are humidity, temperature and pollutants of the air, as well as the hazards of water, light, fungal growth, insects, microbiological attack, contact with certain chemicals in solid, liquid or gaseous form, and physical damage.

The extent to which humidity, temperature, atmospheric contaminants or variations thereof can be permitted to reach beyond recommended limits without producing adverse effects will depend upon the duration of exposure, on biological conditions conducive to fungal growth, and on the accessibility of this atmosphere to the film surfaces.

Exposure to high temperatures and more particularly to high humidities can lead to degradation of the film supports and the photographic emulsion [3] [4] [5]. Cellulose ester base films are more subject to base degradation than polyester base films.

The recommendations of this International Standard also pertain to fire protection, and inspection. This International Standard does not give recommendations concerning 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.

Storage conditions for photographic records are of two classes:

- 1) medium-term; and
- 2) archival.

[ISO 5466:1992](#)

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The storage protection provided by each class will differ in degree because of the cost of providing storage facilities, desired record life and frequency of record use. Storage conditions may be chosen within specified limits representing a satisfactory compromise between degree of protection required and practical considerations of immediate availability.

In addition to the specifications in this International Standard, good storage practices should consider the filing enclosure. These are covered in ISO 10214.

Photography — Processed safety photographic films — Storage practices

1 Scope

1.1 This International Standard gives 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 form, regardless of size.

1.2 This International Standard applies only to safety photographic film (see ISO 543). Nitrate base films are hazardous and unstable and are not covered by this International Standard [6] [7].

1.3 The storage of photographic paper and photographic plates requires different considerations and these are not covered in this International Standard but are covered in ISO 6051 and ISO 3897, respectively.

1.4 This International Standard applies to archival and medium-term storage of photographic film as defined in clause 3.

1.5 This International Standard applies to photographic film records intended as storage copies, which should not be in frequent use. This International Standard does not apply to “work” or “use” copies (see annex A).

1.6 This International Standard, while intended for materials that are well 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. It is not intended to predict or assign a useful lifetime to photographic film stored in accordance with the specifications of this International Standard.

2 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 543:1990, *Photography — Photographic films — Specifications for safety film*.

ISO 10214:1991, *Photography — Processed photographic materials — Filing enclosures for storage*.

3 Definitions

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

3.1 safety photographic film: Film meeting the specifications as defined in ISO 543.

3.2 medium-term film: A photographic film which is suitable for the preservation of records for a minimum of 10 years under “medium-term” storage conditions, providing the original images are of suitable quality.

3.3 long-term film: A photographic film which is suitable for the preservation of records for a minimum of 100 years under “archival” storage conditions, providing the original images are of suitable quality.

3.4 archival film: A photographic film which is suitable for the preservation of records having permanent value under archival storage conditions.¹⁾

1) Films suitable for archival records are specified in ISO 10602.

3.5 medium-term storage: Those storage conditions suitable for ensuring a minimum useful life of 10 years for medium-term films.

3.6 archival storage: Those storage conditions suitable for the preservation of photographic film having permanent value.

NOTES

1 Archival storage conditions will prolong the useful life of both archival and non-archival films.

2 The term "archival" as used in photography and defined as in this International Standard is frequently being misapplied in related fields of imaging. ISO/TC 42 will therefore replace the term "archival storage" with "extended-term storage" or specify a "life expectancy (LE)" classification in future editions of its standards.

3.7 fire-protection storage: Facilities designed to protect photographic film against excessive temperatures, water and other fire-fighting agents, steam developed by insulation of safes, and collapsing structures.

3.8 insulated record container: Container as defined in appropriate national standards and regulations.²⁾

3.9 fire-resistant vault: Vault as defined in appropriate national standards and regulations.³⁾

3.10 open enclosure: Enclosure which is intended for physical protection against mechanical damage but is neither lighttight nor airtight.

Reels, cores, spools, cassettes, magazines, folders, envelopes, cartons, sleeves, transparency mounts and aperture cards are examples of open enclosures.

3.11 protective enclosure: Lighttight, impermeable container used for protection from outside factors such as reactive gases and moisture, including relative humidity changes.

Taped cans and sealed envelopes are examples of protective enclosures.

4 Film enclosures

4.1 Film in roll form

4.1.1 Medium-term storage enclosures

Aerial film, microfilm, motion-picture film and some portrait films are wound on reels or cores and

2) Example: Class 150 of UL 72 [8].

3) Example: NFPA 232 [9].

4) Some vesicular films give off acidic fumes which can interact with silver, diazo or dye-gelatin type films.

stored in roll form. Rolls shall all be wound tightly but not under extreme tensions. A tension of 0,3 N for a 35 mm width is recommended. Rolls, mounted on cores, shall be stored with the core axis vertical. If it is necessary to store rolls less than 20 cm in diameter with the core axis horizontal, the roll shall be supported so that the lower part of the roll does not support the weight of the roll.

Motion picture film shall be wound with the emulsion surface on the inside of the roll as this improves subsequent projection performance [10].

Rolls of photographic film should be preferably 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 and diazo 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 give 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 humidity limits of the film (see clause 7), to protect against gaseous impurities in the atmosphere or when low-temperature storage is used. Cardboard enclosures are not recommended for microfilm because of the danger of their producing microscopic blemishes (see annex F). Suitable enclosures are closed containers with friction-type or threaded, twist-on lids having an incorporated seal. Rubber gaskets shall not be used. Flip-top, hinged or telescoping lids can be used, but the joint shall be sealed by several wraps of pressure-sensitive adhesive tape having low gas permeability. Taped cans within heat-sealed foil bags provide additional protection from high humidity. If tape is used, routine retaping of joints every 2 years is recommended; in any case, if the tape seal is observably deficient in integrity, it shall be replaced.

Any film which is not essentially free from gas release⁴⁾ shall be stored in separate storage rooms (see clause 6). Polystyrene, polypropylene or polyethylene enclosures are preferable to cardboard or metal enclosures for such films.

For maximum storage life, photographic film shall be in a clean condition before being placed in storage.

4.1.2 Archival storage enclosures

For archival storage, the requirements of 4.1.1 shall be met. The materials used for reels, cores and containers shall meet the requirements for ISO 10214. They shall be non-corrodible and peroxide-free. Rubber bands or pressure sensitive tape 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 10214. Films on reels may be confined by tucking the film end between the roll and flange.

Films can have interactions with other films which are of a different generic type (for example, diazo and silver-gelatin), with magnetic tapes and with optical disks. Films of different generic type shall not be wound in the same rolls or stored in the same enclosures. Magnetic tapes and optical disks should not be stored in the same storage housing.

Closed containers are required unless the photographic film is protected from dirt and damage by the storage housing (see clause 5).

Periodic inspection shall be made as outlined in 9.2.

4.2 Film in sheet and slide form

4.2.1 Medium-term storage enclosures

Film in sheet form may be stored in envelopes of paper or plastic foil, folding cartons, file folders, aperture cards or in film strip jackets. Photographic slides may be stored in cardboard, metal or plastic boxes. Colour or diazo films shall be stored in opaque envelopes or folders or otherwise protected from light exposure. Films should not be stacked as this can cause excessive pressure on the lower ones.

When in direct contact with the surface of the photographic film, the paper or plastic material used for envelopes, sleeves, jackets, folders and cartons shall meet as a minimum requirement the specifications described in ISO 10214.

Protective enclosures shall be used where needed to maintain humidity within the limits of the film (see clause 7), to protect against gaseous impurities in the atmosphere, or when low-temperature storage is used. Heat-sealable envelopes consisting of aluminium 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 10214. 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 film surface.

Any film which is not essentially free from gas release⁴⁾ shall be stored in plastic envelopes and in separate storage rooms (see clause 5).

For maximum storage life, photographic film shall be in a clean condition before being placed in storage.

4.2.2 Archival storage enclosures

For archival storage, the requirements of 4.2.1 shall be met.

Films can have possible interactions with other films which are of a different generic type (for example, diazo and silver-gelatin), with magnetic tapes and with optical disks. Films of different generic types shall not be interfiled or be in physical contact. Magnetic tapes and optical disks should not be stored in the same storage housing.

Periodic inspection shall be made as outlined in 9.2.

5 Storage housing

Photographic film should be stored in closed housings such as drawers, or on shelves and racks enclosed by doors 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-corrodible as described in ISO 10214. They shall also be non-combustible. Because of their combustible nature and the possibility of producing active fading agents on ageing, materials made of wood, pressed-board, hardboard, particle-board and other natural materials shall be avoided.

The finish on housing materials shall be durable and shall not contribute deleterious effects to the stored photographic film. Adverse effects can be produced by finishes containing chlorinated or highly-plasticized resins, or by freshly-painted or lacquered surfaces. Cabinets painted with oil-base paints shall not be used for 3 months as they can give off peroxides.

When air-conditioned individually, storage housings shall be arranged to permit interior circulation of air to all shelves and drawers holding film containers to allow uniform humidity conditions. Storage housings located in rooms conditioned in accordance with 7.1 shall be provided with ventilation openings permitting access of air to the interior. Such openings shall not affect accordance with re-

quirements for fire-protection storage or water protection.

Films which are not essentially free from release of acidic fumes 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 associated with rooms allowing facilities for inspection and viewing of the film. Good housekeeping is essential. Walls and enclosures of 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, etc. 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 will generally not be required, provided that conditions as recommended in 7.1.1 are maintained. Films which are not essentially free from release of acidic fumes, such as some vesicular films, shall be stored in separate storage rooms.

6.2 Archival storage rooms

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

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

7 Environmental conditions

7.1 Humidity and temperature limits (see annexes B and C)

7.1.1 Medium-term storage environment

The relative humidity shall not exceed 60 % and the recommended range varies with the product type as given in table 1. The maximum temperature for black-and-white films for extended periods shall not exceed 25 °C and a temperature below 20 °C is preferable. Peak temperature for short time periods

shall not exceed 32 °C. For colour film, a storage temperature not exceeding 10 °C is recommended for proper protection. Cycling of humidity or temperature should be avoided. Protection can be increased by storing at low temperature and low relative humidity.

7.1.2 Archival storage environment

The relative humidity range for archival storage varies with the product type as given in table 1.

When several film types are to be stored within the same storage area, the recommended relative humidity is 30 %. Short-term cycling of humidity should be avoided.

When inactivity of an archival film permits, protection can be increased by conditioning and sealing the film (see 4.1.1 and 4.2.1) in equilibrium with air at the lower end of the recommended relative humidity range. This may be accomplished by running roll film, as a single strand, through a suitable conditioning cabinet, or by hanging film sheets in such a cabinet. A conditioning time of 20 min is suitable. Individual rolls of film can be conditioned to the recommended storage humidity by keeping them in the recommended atmosphere for 3 days for 16 mm film and for 1 week for 35 mm film. Small quantities of roll films can be dried by keeping them for 2 or 3 weeks in a desiccator with a suitable quantity of activated silica gel. They should then be transferred quickly to cans or bags and sealed. Very low humidity conditions can produce brittleness or curl in films having a gelatin emulsion, by extraction of moisture from the emulsion. In such cases, it is good practice to recondition the film to a higher humidity prior to use. After use, reconditioning to the recommended humidity is required before replacement in sealed containers.

Temperatures for black-and-white films shall not exceed 21 °C and added protection can be obtained for all films by low-temperature storage. The storage temperature for colour films shall be 2 °C or below [11][12]. Two methods may be used.

- a) The film may be conditioned to the recommended relative humidity at room temperature, placed in hermetically sealed containers and then placed in cold storage [13]. Taped cans within heat-sealed foil bags can provide good moisture protection for roll films, while sheet films can be placed within two heat-sealed bags. The use of such bags improves moisture protection but does not guarantee it. This procedure has the advantage of excellent keeping conditions and the use of reasonably-priced deep-freeze units. It is essential to limit as much as possible the volume of free air in the sealed film container.

Table 1 — Recommended relative humidity and temperature conditions for storage

Sensitive layer	Base type	Medium-term storage		Archival storage	
		Relative humidity range %	Maximum temperature °C	Relative humidity range %	Maximum temperature °C
Microfilm					
Silver-gelatin	Cellulose ester	15 to 60	25	15 to 40	21
Silver-gelatin	Polyester	30 to 60	25	30 to 40	21
Heat processed silver	Polyester	15 to 60	25	15 to 50	21
General					
Silver-gelatin	Cellulose ester	15 to 60	25	15 to 50	21
Silver-gelatin	Polyester	30 to 60	25	30 to 50	21
Colour	Cellulose ester	15 to 30	10	15 to 30	2
Colour	Polyester	25 to 30	10	25 to 30	2
Diazo	Cellulose ester	15 to 50	25	15 to 30	21
Diazo	Polyester	15 to 50	25	15 to 30	21
Vesicular	Polyester	15 to 60	25	15 to 50	21
Electrophotographic	Polyester	15 to 60	25	15 to 50	21
Photoplastic	Polyester	15 to 60	25	15 to 50	21

b) An alternative procedure is to use a storage room controlled at 2 °C and at the recommended relative humidity. This eliminates the requirement of sealed containers but does require an expensive installation. Low relative humidity is difficult and expensive to maintain at low temperatures.

The container should be allowed to warm up to room temperature prior to opening to avoid moisture condensation on the film (see annex C). Cycling of temperature should be avoided.

The recommended humidity and temperature conditions may be maintained either within individual storage housings or within storage rooms containing such housings.

7.2 Air-conditioning requirements

Properly controlled air-conditioning can be necessary for maintaining humidity and temperature within the limits specified, particularly for archival storage where the requirements are more stringent than for medium-term storage. Slightly positive air pressure should be maintained within the storage room or vault.

Air-conditioning installations and automatic fire control dampers in ducts carrying air to or from the storage vault shall be constructed and maintained on the basis of the recommendations contained in appropriate national standards and regulations⁵⁾. They shall also follow recommendations for fire-

resistant file rooms contained in appropriate national standards and regulations⁶⁾.

Automatic control systems are recommended and they shall be checked frequently. Where air-conditioning is not practical, high humidities can be lowered by electrical refrigeration-type dehumidifiers, controlled with a hygrostat. Inert desiccants, such as chemically-pure silica gel, may be used provided that the dehumidifier is equipped with filters capable of removing dust particles down to 0,3 µm in size and is controlled to maintain the relative humidity prescribed in 7.1. Dehumidification can be required in storage areas such as basements and caves that have inherently low temperatures and frequently exceed the upper humidity limit.

Humidification is necessary if the prevailing relative humidity is less than that recommended in 7.1 or if physical troubles such as curl or brittleness are encountered with active files. If humidification is required, a controlled humidifier shall be used. Water trays or saturated chemical solutions shall not be used because of the serious danger of over-humidification.

7.3 Air purity (see annex D)

Solid particles, which can abrade film or react with the image, shall be removed by mechanical filters from air supplied to housings or rooms used for storage. These mechanical filters are preferably of the dry-media type having an arrestance rating of not less than 85 % as determined by tests conducted in appropriate national standards and regulations⁶⁾.

5) Example: NFPA 90A [14].

6) Example: Stain test of ASHRAE Standard 52-68 [15].