International Standard 5466

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Photography — Practice for the storage of processed safety photographic film

Photographie — Directives pour l'emmagasinage des films photographiques de sécurité après traitement

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

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Australia	Germany, F. R.	Turkey
Austria	Italy	United Kingdom
Belgium	Japan	USA
Canada	Netherlands	USSR
Czechoslovakia	South Africa, Rep. of	Yugoslavia
Egypt, Arab Rep. of	Spain	
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No member body expressed disapproval of the document.

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Photography — Practice for the storage of processed safety photographic film

0 Introduction

Photographic film is an important documentary and pictorial material. The increasing quantity and value of photographic film records used in libraries, government, commerce, and universities has focused attention on the care of such records to ensure their longest possible life.[1][2]*

This International Standard is concerned with the preservation of processed photographic film records and includes still pictorial, aerial, portrait, X-ray, motion-picture, microfilms, and industrial films. The storage of photographic paper and photographic plates requires different considerations and these are not covered in this document.

The stability of photographic records depends on the physical and chemical nature of the film, its residual thiosulphate level in the case of silver-gelatin films, and the conditions under which the records are processed and stored. The specifications for safety photographic film are described in ISO 543 on definitions, testing and marking of safety film for motion-picture uses. The conditions under which safety photographic film records should be stored are the subject of this International Standard.

The important elements affecting preservation of processed film are humidity and temperature of the air, as well as the hazards of fire, water, light, fungal growth, contact with certain chemicals in solid, liquid or gaseous form, and physical damage. The extent to which humidity, temperature, or variations of both, 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.

Storage conditions for photographic records are of two classes : 1) medium term and 2) optimum. 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. This International Standard applies to processed silver-gelatin photographic films which may be considered archival-record film by ISO specifications, as well as colour, diazo, and vesicular film. Although these latter film types are not currently covered by any ISO specification, excellent keeping experience has been obtained with many of them for as long as 30 years. For optimum preservation of photographic information, archival-record film should be used and it should be stored under optimum storage conditions.

The recommendations of this International Standard pertain to enclosure materials, containers, atmospheric conditions, fire protection, and inspection of stored film as considered necessary for the preservation of film. The 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 steps.

1 Scope and field of application

1.1 This International Standard gives recommendations concerning the storage conditions, storage facilities, handling, and inspection for processed safety photographic films (hereafter referred to as photographic film) in roll, strip, card, or sheet form, regardless of size. All silver-gelatin type films, colour (dye gelatin) films, diazo films, and vesicular films are included.

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.[3][4]

1.3 This International Standard applies to optimum and medium term storage of photographic film as defined in clause 3.

* Numbers in brackets [ ] refer to the references in annex G.

2 References

ISO 543, *Cinematography — Motion-picture safety film — Definition, testing and marking.*

ISO 2803, *Photography — Silver-gelatin type microfilms — Processing and storage for archival purposes.*

ISO 4331, *Photography — Processed photographic film for archival records — Silver-gelatin type on cellulose ester base — Specifications.*

ISO 4332, *Photography — Processed photographic film for archival records — Silver-gelatin type on poly(ethylene terephthalate) base — Specifications.*

3 Definitions

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

3.2 archival-record film : A photographic film composed and treated so that under optimum storage conditions it is suitable for the preservation of records having permanent value. Films suitable for archival records are specified in ISO 4331 and ISO 4332.

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

3.4 optimum storage : Those conditions suitable for the preservation of photographic film having permanent value. Optimum storage conditions will prolong the useful life of both archival and non-archival record films.

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

3.6 insulated record containers : Containers as defined in appropriate national standards and regulations.[1)]

3.7 fire-resistive vaults : Vaults as defined in appropriate national standards and regulations.[2)]

3.8 film enclosure : For the purposes of this International Standard, any item in close or direct contact with the film, such as reels, cores, spools, cassettes, magazines, cans, folders, envelopes, cartons, sleeves, transparency mounts and aperture cards.

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 stored in roll form. Rolls should be wound tightly but not under extreme tensions. Rolls greater than 20 cm in diameter, mounted on cores, should be stored with the core axis vertical, unless the core itself is carried on a horizontal spindle which prevents the lower part of the film from supporting the load of the core.

The materials used for the cores or reels shall be non-corrodible, such as suitable plastic or non-ferrous metals. The use of steel for reels is permissible provided that the reels are well protected by lacquer, enamel, tinning, plating, or some other corrosion-resistant finish. Plastics and lacquers which might give off reactive fumes, peroxides, or exudations during storage shall not be used (see annex D).

Rolls of photographic film should be stored, preferably, in closed containers to provide protection against dirt and physical damage. Colour and diazo films shall be stored in closed, opaque containers or be otherwise protected from light exposure. Suitable containers are those with telescoping, slip-type, or threaded twist-on lids. The materials used shall meet the same requirements as those for cores and reels. Closed containers are not necessarily airtight and may give limited access to ambient air. Therefore if they are used, the humidity of the ambient air must not exceed the recommended limits.

Sealed containers 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 containers are not recommended for microfilm because of the danger of microscopic blemishes (see annex F). Suitable containers are closed containers with friction-type or threaded, twist-on lids having and incorporated seal. 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 should be replaced.

Any film which is not essentially free from gas release[3)] shall be stored in separate storage housings (see clause 5). Polystyrene or polyethylene containers are preferable to cardboard or metal containers for such films.

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

1) Example : Class 150 of UL72-1971[5].

2) Example : Publication NFPA No. 232, 1970[6].

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

4.1.2 Optimum storage enclosures

For optimum storage, the requirements of 4.1.1 must be met. Plastic materials used for reels or cores must not be highly plasticized and must be free of peroxides. 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 annex A. Films on reels may be confined by tucking the film end between the roll and flange.

Pressure-sensitive tape, if used, shall be free of peroxides and shall not be used in contact with the film.

Films may have possible interactions with other films which are of a different generic type (for example, diazo and silver-gelatin). Films of different generic type should not be wound in the same rolls or stored in the same containers.

Closed containers are required unless the photographic film is protected from dirt and damage by the storage housings (see clause 5). Containers should be of non-corrodible material such as anodized aluminium, stainless steel, or plastics which are peroxide-free and not highly plasticized.

Periodic inspection should 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 could cause the lower ones being stored under high pressure.

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 annex A. Suitable plastic enclosure materials are photographic film support materials such as uncoated polyester (polyethylene terephthalate) and cellulose acetate. Other plastics may be satisfactory but there has been no extended experience with such materials. Glassine envelopes[7] and chlorinated, nitrated, or highly plasticized sheeting should be avoided.

Sealed 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 sealed foil bags can provide this protection.

The adhesive used for seams and joints shall also meet the requirements of the photographic activity test described in annex A. The filing enclosure shall be constructed so that the 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 acid release[1] shall be stored in plastic envelopes and in separate storage housings (see clause 5).

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

4.2.2 Optimum storage enclosures

For optimum storage the requirements of 4.2.1 must be met. Enclosure construction should preclude the use of hygroscopic glues, pressure-sensitive permanently tacky adhesives and those based on naturally occuring rubbers and, in fact, all adhesives if possible. Photographic quality gelatin and many polyvinyl acetate and cellulose acetate adhesives are suitable for use with paper.

Films may have possible interactions with other films which are of a different generic type (for example, diazo and silver-gelatin). Film of different generic types should not be interfiled or be in physical contact.

Periodic inspection should 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. Alternatively, open shelves and racks may be used if the film is in closed containers. The storage housing materials should be non-combustible and non-corrodible, such as anodized aluminium, stainless steel, or steel with baked-on non-plasticized synthetic resin lacquer. Because of their combustible nature and the possibility of producing active fading agents on ageing, wood, pressboard, hardboard, particle-board, and other such materials shall be avoided.

The finish on housing materials should be durable and not contribute deleterious effects to the stored photographic film. Adverse effects may be produced by finishes containing chlorinated or highly plasticized resins, or by freshly painted or lacquered surfaces.

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

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

permitting access of air to the interior. Such openings shall not interfere with requirements for fire-protective 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 may be cooled below the dew point of the air. Provisions shall be made against damage ~~of film~~ by water from floods, leaks, sprinklers, etc. A special storage room separate from the work areas for film records of short-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 shall be stored in separate storage rooms.

6.2 Optimum storage rooms

The value of photographic film kept for archival purposes makes it advisable to provide a storage room or vault separate 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 E).

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 for silver-gelatin film on polyester base it shall not be lower than 30 %. Ideally, a maximum temperature for extended periods should not exceed 25 °C (77 °F), and a temperature below 20 °C (68 °F) is preferable. Peak temperature for short time periods shall not exceed 32 °C (90 °F). For colour film, a storage temperature not exceeding 10 °C (50 °F) is recommended for proper protection. Cycling of humidity or temperature should be avoided. Protection may be increased by storing at low temperature and low relative humidity.

7.1.2 Optimum storage environment

The relative humidity range for optimum storage varies with the product type according to the table.

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.

Table — Recommended relative humidity range

Sensitive layer	Base type	Recommended relative humidity range %
Microfilm		
Silver-gelatin	Cellulose ester	15 to 40
Silver-gelatin	Poly(ethylene terephthalate)	30 to 40
General		
Silver-gelatin	Cellulose ester	15 to 50
Silver-gelatin	Poly(ethylene terephthalate)	30 to 50
Colour	Cellulose ester	15 to 30
Colour	Poly(ethylene terephthalate)	25 to 30
Diazo	Cellulose ester Poly(ethylene terephthalate)	15 to 30
Vesicular	Poly(ethylene terephthalate)	15 to 50

When inactivity of an archival film permits, protection may be increased by conditioning and sealing the film (see 4.1.2) 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 hanging film sheets in such a cabinet. A conditioning time of 20 min is suitable. Individual rolls of film may be conditioned to the recommended storage humidity by keeping them in the recommended atmosphere 3 days for 16 mm film and 1 week for 35 mm film. Small quantities of roll film may be dried by keeping for two or three weeks in desiccator without forced air circulation and with a suitable quantity of activated silica gel. They should then be transferred quickly to cans and sealed. Very low humidity conditions may produce brittleness of 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, to restore flexibility. After use, reconditioning to the recommended humidity is required before replacement in sealed containers.

Temperatures shall not exceed 20 °C (68 °F) and added protection may be obtained for all films by low temperature storage. A storage temperature of 2 °C (35 °F) or below is strongly recommended for colour film.[8][9] Two methods may be used :

a) *The film may be conditioned to the recommended* relative humidity, placed in hermetically sealed containers, and then placed in below freezing storage. Taped cans within heat sealed foil bags may provide good moisture protection for roll films, while sheet films may 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.

b) An alternative procedure is the use of a storage room controlled at 2 °C (35 °F) and at the recommended relative humidity. This eliminates the requirement of sealed containers but does require an expensive installation.

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 may be necessary for maintaining humidity and temperature within the limits specified particulary for optimum 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 regulations.[1] They shall also follow recommendations for fire-resistive file rooms contained in appropriate national standards and regulations.[2]

Automatic control systems are recommended and they shall be checked frequently. Where air conditioning is not practical, high humidities may be lowered by electrical refrigeration-type dehumidifiers, controlled with a hygrostat. Dehumidifiers using desiccants should not be used; with circulating air they create a danger of fine dust particles getting on the film (see 7.3). Dehumidification may 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 are encountered with active files. If humidification is required, a controlled humidifer should be used. Water trays or saturated chemical solutions should not be used because of the serious danger of over-humidification.

7.3 Air purity (see annex D)

Solid particles, which may abrade film or react with the image, shall be removed by mechanical filters from air supplied to housings or rooms used for archival storage. These mechanical filters are preferably of dry media type having an arrestance rating of not less than 85 % as determined by tests contained in appropriate national standards and regulations.[3] Filters shall be of non-combustible type, meeting the construction requirements of appropriate national standards and regulations.[4]

Gaseous impurties such as sulphur dioxide, hydrogen sulphide, peroxides, ozone, acidic fumes, ammonia and nitrogen oxides cause deterioration of the film base or degradation of the image in some films. They can be removed from the air by suitable washers or absorbers. An optimum storage film vault should be located as far possible from an urban or industrial area where contaminants may be present in harmful concentrations. Where practical, storage of film in sealed containers in accordance with 4.1.1 will afford adequate protection.

As paint fumes may be a source of oxidizing contaminants, film should be removed from either an optimum or medium-term storage area for a two-week period when the area is freshly painted. Gases given off by decomposing nitrate base film will damage or destroy the image on safety film records stored in the same area[13] Therefore, film shall not be stored with nitrate base films, either in the same room or in rooms connected by ventilating ducts.

8 Fire-protective storage (see annex E)

After heating for 4 h at 150 °C (302 °F) in the package that is to be stored, enclosure materials for fire-resistant storage shall not ignite or release more reactive fumes than the film itself. Many enclosure materials will melt or become badly distorted at this temperature. However, this melting or distortion shall not cause damage to the film or prevent it from being removed from the enclosure. The materials used in rolls or cores shall neither be more flammable nor more decomposable than the film which is stored on them.

For protection against fire and associated hazards, the film shall be placed in closed containers in either fire-resistive vaults or insulated record containers. If fire-resistive vaults are used, they shall be constructed in accordance with recommendations contained in appropriate national standards and regulations.[2]

When the quantity of film is not too great, insulated record containers conforming to appropriate national standards and regulations[5] may be used. They will not exceed an interior temperature of 66 °C (150 °F) and an interior relative humidity of 85 % when given a fire exposure test from 1 to 4 h depending on the classification. Insulated record containers shall be situated on a ground supported floor if the building is not fire resistant.

For the best fire protection, duplicate copies should be placed in another storage area.

1) Example : Publication NFPA No. 90A, 1967.[10].

2) Example : Publication NFPA No. 232, 1970.[6]

3) Example : Stain test of ASHRAE Standard 52-68.[11]

4) Example : Class 1 construction of UL 900-1971.[12]

5) Example : Class 150 of UL 72-1971.[5]

9 Film handling and inspection

9.1 Handling

Proper handling of film is important. Many types of film may be used frequently, generating damage and imposing critical handling and filing requirements. Good housekeeping and cleanliness are essential. Films should be handled by their edges and wearing of thin cotton gloves by the handlers is good practice.

9.2 Inspection

A number of selected lot samples of film should be inspected at two-year intervals. If deviations from recommended temperature and relative humidity ranges have occured, inspection should be made at more frequent intervals. A random sampling plan established in advance should be used and a different lot should be inspected each time. Deterioration of either film or enclosure materials shall be noted.

These may be physical changes in the film (curl, distortion, brittleness, adhesion failure, etc.), visual changes in the film (fading, microblemishes) or changes in the enclosure material (embrittlement, discolouration). The cause of the problem should be determined and corrective action taken.

If film has been stored at a temperature below the dew point of the atmosphere where inspection is to take place, the film in its enclosure ~~must~~ first be allowed to warm up, before opening, to a temperature a few degrees above that of the inspection room. The time required for heating with the volume of the film and the temperature difference (see annex C).

Annex A

Enclosure materials

A.1 When photographic film is stored in enclosures, the chemical inertness and physical characterisitcs of the enclosure can be as important as the properties of the film itself.[7] There are several important criteria for a satisfactory enclosure :

a) The material should be free of acids and peroxides which may be released slowly with time and cause image instability or chemical decomposition of the film. For example, ageing blemishes in processed microfilm may be influenced by chemicals evolved from paper storage cartons.[14][15] Likewise, the presence of acid in paper can cause degradation of film with which it is in contact.

b) The enclosure itself should be chemically stable. Otherwise, the decomposition products might be harmful to the film, the film could lose its physical protection, and dirt or dust may be produced which could scratch or become embedded in the image surface.

Cellulose nitrate and glassine sheeting are examples of unsatisfactory enclosure materials because of their own instability. Periodic inspection of storage facilities is recommended to verify stability of the enclosure materials.

c) There must not be any chemical interaction between the particular components of the film package. This is the purpose of the photographic activity test described below.

d) The physical surface of the enclosure material should be satisfactory. For example, a very smooth glossy surface or a highly plasticized plastic (such as plasticized polyvinyl chloride) can result in either sticking or ferrotyping of the image surface. A slightly rough or matte surface of the filing enclosure is recommended but a very rough surface can produce abrasion problems.

A.2 One of the most common enclosure materials is paper and this should meet the four requirements in A.2.1 to A.2.4.

A.2.1 General material requirements

A satisfactory paper enclosure material should have the following requirements. The paper should be made from rag, bleached sulphite, or bleached kraft pulp with an alpha-cellulose content of greater than 87 % and be free from highly lignified fibres such as ground wood. A minimum of sizing chemicals should be used, the amount being dictated by the requirements of the end use (filing enclosures, overwraps, interleaving, etc.). Sizing chemicals should be saturated organic compounds. The material essentially should be free from particles of metal or metal compounds. Surface fibres which might offset onto photographic layers should not be present. The paper should not contain waxes, plasticizers, or other ingredients which will transfer to the photographic material during the photographic activity test described in A.2.4.

A.2.2 Chemical requirements

The paper should be given the following tests. Where International Standards are not available, suitable national standards should be used.

A.2.2.1 Microscopic analysis of fibres and phloroglucinol spot test for absence of ground wood.

A.2.2.2 Analysis for alpha-cellulose content, which is to be greater than 87 %.[16]

A.2.2.3 Determination of pH by cold extraction, which is to fall within the range 6,5 to 7,5.[17]

A.2.3 Physical tests

Suitable physical tests are folding endurance and tear resistance.[18].

A.2.4 Photographic activity test

The paper and a suitably prepared photographic test sample are to be subjected to an accelerated ageing test by incubation at 50 ± 1 °C and 70 to 75 % relative humidity for 10 days. At the end of this test, no visual pattern shall be transferred from the paper to the photographic film, nor shall the image of the film be affected. The latter may be determined more readily by having one-half of the photographic image against a piece of inert filter paper during the incubation to serve as a control.