INTERNATIONAL STANDARD

ISO 5466

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Photography — Processed safety photographic films — Storage practices

Photographie — 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.

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 fourth edition cancels and replaces the third edition (ISO 5466:1992), which has been technically revised.

Annex A forms an integral part of this International Standard. Annexes B to J are for information only.

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 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. Only safety photographic films are suitable for storage; the specification for safety photographic film is given in ISO 543.

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 used to express longevity or stability in International Standards on imaging materials since it has been interpreted as having many meanings, ranging from the preserving of information "for ever" to the temporary storage of actively used information.

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

b) Photographic processing of the film

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

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 fire, water, light, fungal growth, insects, microbiological attack, contact with certain chemicals in solid, liquid or gaseous form, and physical damage due to handling. Direct contact with other generic types of film can be detrimental to either film.

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 the biological conditions conducive to fungal growth, and on 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 supports and the photographic emulsion[3][4][5]. Cellulose ester base films are more subject to base degradation than polyester base films.

There are two levels of storage conditions

1) medium term,

2) extended term.

Extended-term storage conditions were called “archival” storage conditions in the 1992 issue of this International Standard but this name change was made to remove the term “archival” from International Standards. Medium-term storage can be used for films where the information is to be preserved a minimum of 10 years, while extended-term storage conditions will prolong the life of all films, even those not optimized for permanence. 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 deviations from the specified conditions will reduce the degree of protection offered, and in such cases maintaining a humidity as low as possible will still provide some benefits.

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

In addition to the specifications in this International Standard, good storage practices must consider the filing enclosure. This is covered in ISO 10214.

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Photography — Processed safety photographic films — Storage practices

1 Scope

1.1 This International Standard provides requirements and 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 to extended-term and medium-term storage of photographic film as defined in clause 3.

1.3 It applies 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 A).

1.4 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.

1.5 This International Standard applies only to safety photographic film (see ISO 543). Nitrate base films are hazardous and are not covered by this International Standard[6]. They require special storage considerations[7].

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

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 archival medium: Recording material that can be expected to retain information for ever, 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 material 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 having permanent value.

3.4 fire-protective storage facilities: Facilities designed to protect photographic film against excessive temperatures, water and other fire-fighting agents, and steam developed by the 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 retrievable in a system under extended-term storage conditions.

3.6 LE designation: Rating for the "life expectancy" (see 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 under extended-term storage conditions. For example, LE-100 indicates that information can be retrieved for at least 100 years storage.

3.7 medium-term storage conditions: Storage conditions suitable for the preservation of recorded information for a minimum of ten years.

3.8 open enclosure: Enclosure which is intended for physical protection against mechanical damage, but is neither light-tight nor airtight. Such enclosures may be reels, cores, spools, cassettes, magazines, folders, envelopes, cartons, boxes, sleeves, transparency mounts or aperture cards.

3.9 protective enclosure: Light-tight, impermeable container used for protection from outside factors such as reactive gases and moisture, including relative humidity changes.

3.10 safety photographic film: Film that meets flammability specifications defined in ISO 543.

3.11 storage housing: Physical structure supporting photographic materials and their enclosures.

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

4 Film enclosures

All enclosures used for medium-term and extended-term storage shall meet the requirements of ISO 10214.

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 shall all be wound tightly, but not under extreme tensions. A tension caused by 0,3 N of pullout force for a 35 mm 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 film shall be wound with the emulsion surface on the inside of the roll, as this improves subsequent projection performance[8].

Rolls of photographic film shall be stored, preferably, 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 heat-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 as specified in ISO 10214. 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 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 B). 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 additional protection from high humidity. Metal containers provide the best protection against gases from the environment. However, they may corrode from acidic fumes[1)] from within the container unless they are protected with an overcoat. Alternative materials are polystyrene, polyethylene and polypropylene.

4.1.2 Extended-term storage enclosures

For extended-term storage, the requirements of 4.1.1 shall be met. The materials used for reels, cores and containers shall meet the requirements of ISO 10214. 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 given in ISO 10214. Films on reels may be confined by tucking the film end between the roll and flange. Pressure-sensitive tape, if needed for the enclosure, shall be free from peroxide and pass the photographic activity test given in ISO 10214. Pressure-sensitive tape shall not be used in contact with the film.

Films may have possible interactions with other films which are of a different generic type (e.g. diazo and silver-gelatin), as well as with magnetic tapes and optical disks. Films of a different generic type shall not be wound on 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).

4.2 Film in sheet and slide form

4.2.1 Medium-term storage enclosures

Film in sheet form shall be stored in envelopes of paper or plastic foil, folding cartons, boxes, file folders, aperture cards or film strip jackets. Photographic slides shall be stored in cardboard, metal or plastic boxes. Colour, diazo and heat-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 lower ones. 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 given in ISO 10214. Suitable plastic enclosure materials are uncoated polyester (polyethylene terephthalate), high-density polyethylene and polypropylene. Glassine envelopes and chlorinated, nitrated or highly plasticized sheeting shall be avoided.

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 without humidity control. 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.

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

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 image layer.

Any film which is not essentially free from acid release[1)] shall be stored in plastic envelopes.

4.2.2 Extended-term storage enclosures

For extended-term storage, the requirements of 4.2.1 shall be met.

Photographic quality gelatin and many polyvinyl acetate and cellulose acetate adhesives are suitable for use with paper. Pressure-sensitive (permanently tacky) adhesives shall meet the specifications of ISO 10214.

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

5 Storage housing

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

The finish on housing materials shall be durable and shall not contribute any deleterious effects to stored photographic film. Adverse effects can be produced by finishes containing chlorinated or highly plasticized resins, or by freshly painted or lacquered surfaces. Freshly painted cabinets shall not be used for 3 months, as they can give off peroxides and contaminants.

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 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 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 dewpoint of the air. Provisions shall be made against damage to the film by water from floods, leaks, sprinklers, etc., and from steam released during a fire from masonry walls. Storage rooms or vaults should be located above basement levels where possible. A special storage room separated from the work areas will generally not be required for film records of medium-term interest, 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. Films showing any sign of chemical degradation 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 that is 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 annex C).

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

7 Environmental conditions

7.1 Humidity and temperature limits (see annexes D and E)

7.1.1 Medium-term storage environment

The average relative humidity of a medium-term storage environment shall not exceed 50 %. Ideally, the maximum temperature for extended periods shall not exceed 25 °C, and a temperature below 21 °C is preferable (see table 1). The peak temperature for short periods shall not exceed 32 °C.

Short-term cycling of temperature shall be avoided. Cycling of relative humidity shall not be greater than ± 10 % over a 24-h period. Protection may be increased by storing film at low temperature and low relative humidity.

Table 1 — Maximum temperatures and relative humidity range for storage

Sensitive layer	Medium-term storage		Extended-term storage[1]	
	Maximum temperature °C	Relative humidity range[2] %	Maximum temperature °C	Relative humidity range[2][3] %
Silver-gelatin Thermally processed silver Vesicular Electrophotographic Photoplastic Diazo	25	20 to 50	21 15 10	20 to 30 20 to 40 20 to 50
Colour	25	20 to 50	2 – 3 – 10	20 to 30 20 to 40 20 to 50

1) Formerly known as "archival storage"; see Introduction.
2) The moisture content of the film to be stored shall not be greater than film in moisture equilibrium with these relative humidities.
3) See annex G for storage of historic still photographic records.

7.1.2 Extended-term storage environment

7.1.2.1 Recommended environment for black-and-white films

The rate of most chemical reactions, such as the degradation of film base and the fading of chromogenic dyes, is lowered with decreasing temperature and decreasing relative humidity. Consequently, life expectancy is increased as either storage temperature or storage humidity is lowered. Moreover, a lower storage temperature can compensate for a higher humidity to provide the same life expectancy (see annex F). For this reason, several relative humidity-temperature combinations can be used for an extended-term storage environment as specified in table 1. Higher relative humidity ranges can be employed if the average temperature is reduced, but the maximum relative humidity shall not exceed 50 %. Cycling of relative humidity shall be no greater than ± 5 % over a 24-h period.

For any facility, it is impossible to specify what the exact relative humidity and temperature of storage should be, since it depends upon the value of the film, the past storage history, the length of time the film is to be kept, the size of the vault, the cost of various options, and the climatic conditions where the facility is to be located. The cost/protection ratio has to be determined by the individual facility. Another very important factor is the exact mix of photographic objects in the collection; i.e. whether photographic prints and plates are included and whether the materials are new or old. Low relative humidities can cause excessive strain on the emulsion and result in high curl of single-weight photographic prints. Low humidities can also cause serious problems with older historic records (see annex G). The environmental conditions chosen shall fall within the guidelines given in table 1.

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

Very low humidity conditions may 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.

7.1.2.2 Recommended environment for colour films

The storage temperature for colour films shall be 2 °C or below[9][10]. This can be provided by a storage room controlled at the desired temperature and at the recommended relative humidity.

An alternative procedure is to condition the film to the recommended relative humidity at room temperature, place it in hermetically sealed or taped containers, and then put it in cold storage[11]. Roll films in cans and sheet films should have good moisture protection if placed within two heat-sealed foil bags. The double-bag technique reduces the possibility of air leakage. The use of such bags improves moisture protection but does not guarantee it. This procedure has the advantage of good keeping conditions and makes possible 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.

The user should balance the capital and operating cost of cold storage vaults or deep-freeze units with the labour and material cost of bagging film.

7.1.2.3 Moisture-conditioning time

While temperature equilibrium readily occurs, it must be recognized that moisture equilibration takes considerably longer. The time required for a package of film to reach moisture equilibrium with its environment depends on several factors:

— the moisture permeability of the storage container;

— the volume and packing density of the film within the container;

— the type of film and enclosure materials;

— the temperature at which the moisture-conditioning occurs; and

— the difference between the initial and the final moisture content.

These factors can produce a prolonged conditioning period, and the effectiveness of the storage vault may be compromised if the conditioning is expected to take place in storage.

For example, freely separated sheet films will condition at room temperature within hours, whereas films at sub-zero temperature will require a dramatic increase in conditioning time. Depending on the circumstances, film conditioning procedures may be necessary prior to placing materials in storage. This can be accomplished for sheet films by allowing free access of air to the film surfaces for a 24-h period. If sheet film is placed in the storage environment in stacks, longer conditioning times are required, but eventually moisture equilibration is achieved. Moisture equilibration for roll films takes much longer. The conditioning time can be decreased if the rolls have access to the air or are in moisture-permeable enclosures. However, rolls in closed metal containers will come to moisture equilibrium within several months[10] at room temperature. Roll film may be dried by keeping it for 2 or 3 weeks in a taped container with a suitable quantity of activated silica gel, molecular sieve, or other inert humidity-controlling substances.

If the relative humidity requirements of the storage environment are chosen to match those of the use environment, moisture-conditioning procedures can be reduced or eliminated. Matching the relative humidity levels between use and storage has the added advantage of reducing physical stress on the film caused by relative humidity cycling between storage and use. Unmatched humidity levels will have a strong influence on the time required to reach moisture equilibrium.

7.1.2.4 Warm-up time

Storage temperatures significantly below room temperature will require some warm-up time before the film can be used, in order to prevent absorption or condensation of moisture on cold film surfaces. The warm-up procedure requires that an adequate vapour barrier be wrapped around the film contents during the warm-up period. Adequate time must be provided to allow the total volume of film to approach room temperature (see annex E). The warm-up time can vary between 1 h and 1 day, depending on the package size, degree of insulation and temperature differential.

7.2 Environmental control requirements

Proper environmental control is necessary for maintaining humidity and temperature within the limits specified, particularly for extended-term storage where the requirements are more stringent than for medium-term storage. Slightly positive air pressure shall be maintained within the storage room or vault. Environmental control 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[2]. They shall also follow recommendations for fire-resistive file rooms contained in appropriate national standards and regulations[3]. Masonry or concrete walls may release steam from internally bonded water when heated in a fire. A vapour barrier is required for such vaults, or sealed containers shall be used.

Automatic control systems are recommended, and they shall be checked frequently enough to determine that the humidity limits specified in table 1 are not being exceeded. A reliable hygrometer, such as a sling psychrometer, can be used for this purpose. Where air-conditioning is not practical, high humidities may be lowered by electrical refrigeration-type dehumidifiers controlled with a hygrostat. Inert desiccants, such as chemically pure silica gel, may be used provided 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 specified in 7.1.

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 specified 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 C)

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 storage. These mechanical filters are preferably a dry-media type having an arrestance rating of not less than 85 %, as determined by tests contained in appropriate national standards and regulations[4]. Filters shall be of a non-combustible type, meeting the construction requirements of appropriate national standards and regulations[5].

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

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2) For example, see references [12] and [27].

3) For example, see references [13] and [28].

4) For example, see the stain test of reference [14], and also reference [29].

5) For example, see the Class 1 construction of reference [15], and also reference [29].

Gaseous impurities such as sulfur dioxide, hydrogen sulfide, peroxides, ozone, acid fumes, ammonia and nitrogen oxides can cause deterioration of the film base or image degradation in some films (see annex H). They can be removed from the air by suitable washers or absorbers. An extended-term storage film vault should be located as far as possible from an urban or industrial area, where contaminants can be present in harmful concentrations. Storage of film in sealed containers in accordance with clause 4 will afford adequate protection against outside pollutants.

Since paint fumes may be a source of oxidizing contaminants, film shall be removed from either an extended-term or medium-term storage area for a 3-month 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[16]. Therefore, film shall not be stored with nitrate-base films, either in the same room or in rooms connected by ventilation ducts.

7.4 Light

Normally, film is kept under dark conditions. This is recommended practice, as light can be detrimental to some images.

8 Fire-protective storage (see annex I)

During heating for 4 h at 150 °C 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 does. Many enclosure materials will melt or become badly distorted at this temperature.

This melting or distortion shall not cause damage to the film or prevent it from being removed from the enclosure. The materials used in reels or cores shall be neither 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[6]. If fire-resistive vaults are used, they shall be constructed in accordance with recommendations contained in appropriate standards and regulations[3], with particular care for protection from steam.

When the quantity of film is not too great, insulated record containers conforming to appropriate national standards and regulations may be used. They shall not exceed an interior temperature of 65 °C and an interior relative humidity of 85 % when given a fire exposure test from 1 h to 4 h depending on the classification of the record container. 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 of film records shall be placed in another storage area.

9 Film identification, handling and inspection

9.1 Identification

Processed film is frequently identified by non-photographic means such as ink, crayon, felt marking pens or pressure-sensitive labels. Such identification materials shall pass the photographic activity test as described in ISO 10214, when tested with the identification area incubated in contact with the test detectors.

6) For example, see Class 150 of reference [17], and also reference [30].

9.2 Handling

Proper handling of film is important. Some types of film are used frequently, generating damage and imposing critical handling and filing requirements.

NOTE — Gelatin emulsion layers can be physically scratched; vesicular images are sensitive to pressure damage causing bubble collapse.

Good housekeeping and cleanliness are essential. Films shall be handled by their edges, and the wearing of thin cotton or nylon gloves by the handlers is good practice.

9.3 Inspection

A number of different representative samples of film shall be inspected at 2-year intervals. If deviations from recommended temperature and relative humidity ranges have occurred, inspection shall be made at more frequent intervals. A sampling plan established in advance shall be used, and a different lot should be inspected each time. Deterioration of either film or enclosure materials shall be noted. Recommended practices have been established by national standardizing bodies for film inspection[18].

There may by physical changes in the film (e.g. curl, distortion, brittleness, adhesion failure), visual changes in the film (fading, microblemishes, colour change) or changes in the enclosure material (embrittlement, discoloration). The cause of the problem shall be determined and corrective action taken.

If film has been stored at a temperature below the dewpoint of the atmosphere where inspection is to take place, the film in its enclosure shall first be warmed up, before opening, to a temperature within a few degrees of that of the inspection room. The time required for warm-up increases with the volume of the film and the temperature difference (see annex E).

Annex A
(normative)

Distinction between storage copies and work copies

The distinction between photographic film records which are intended for storage and those intended for use has not always been clear. Work (or use) copies are the predominant photographic records found in libraries or record centres. Their value lies in their being available for ready reference. However, as a result of this use, they are subjected to dirt, abrasion, fingerprints, contamination with foreign materials, and exposure to excessive light and temperatures. Such use copies may become moisture conditioned to the conditions of the working area, which may be quite different from the storage area where they are filed in the library. In fact, physical distortions of work copies can occur if they are not reconditioned to the moisture conditions of the library storage area. It is evident that use copies of photographic records are not suitable for long-term preservation.

Where there is a need for extended storage of film records, duplicates should be prepared and they should be kept in a collection area separate from the one in which work copies are stored. Storage copies should meet the appropriate ISO requirements for the photographic material and should be stored according to the recommendations of this International Standard. Storage records will occasionally be looked at, otherwise the need for keeping these records is pointless. However, the use of storage copies shall be infrequent. If the film is expected to be handled more than 10 times during its lifetime, work copies should be printed from the storage copies.

Annex B
(informative)

Advantages and disadvantages of protective (sealed) enclosures

Recommended enclosures are very dependent upon the specific conditions of storage. Sealed containers which are impervious to moisture and gases, such as taped metal cans or heat-sealed metallic envelopes, provide protection of the film from high humidities and pollutant gases in the storage environment. Metal cans also offer physical protection from handling damage, dirt and dust, allow easier stacking, and provide some protection from water and fire damage. However, it has been established that decomposing triacetate film base will degrade faster in such a closed environment. A closed environment confines acetic acid (formed by the decomposition) and catalyses further degradation. Cardboard boxes or paper envelopes offer advantages by absorbing acetic acid vapours, thereby slowing down the degradation reaction. However, they offer only limited protection from outside humidity or pollutants, and little or no protection from fire and water. These materials can become brittle if the pH of the enclosures drops below 4 as a result of acid absorption. All cardboard and paper enclosures should meet the requirements of ISO 10214.

The film archivist must make a qualitative evaluation of the potential risks to the collection. If humidity, pollutants, dirt, water or fire are major concerns, sealed enclosures should be used. However, if the film collection contains acetate base film that has shown some signs of deterioration, such as an acetic acid or vinegar odour, then film should be stored in an open environment or in an enclosure which can absorb vapours. If decomposing film is stored in an open environment, consideration must also be given to any effect of acetic acid vapours on other film stored in the same room. This will depend upon the air change-over in the storage room, the proximity of other collections, and the type of enclosure used.

Annex C
(informative)

Air-entrained and gaseous impurities

When dust and other air-entrained solid particles are deposited on photographic film, they can interfere with legibility and produce scratches. Reactive types of dust can cause fading or staining of the image layer. Gaseous impurities such as sulfur compounds, ozone, peroxides, ammonia, paint fumes and other active compounds may cause deterioration of the base and a chemical degradation of the photographic image. The most frequently encountered impurity, especially in urban and industrial atmospheres, is sulfur dioxide, and small concentrations are likely to produce detrimental effects. Hydrogen sulfide is not a common impurity, but is a very active one even at low concentrations; it can occur in air washers containing decomposed biological slime. Oxidizing gases, such as peroxides, are responsible for the local oxidation of image silver in fine grain images[19][20], causing formation of minute deposits of coloured colloidal silver.

Suitable means for removal of gaseous impurities are available, such as air washers operating with treated water for elimination of sulfur dioxide, and activated carbon for the absorption of sulfur dioxide and hydrogen sulfide[21]. These require consistent control and, in the case of activated carbon, expert processing.

Annex D
(informative)

Humidity during storage

Humidity appreciably beyond the limits specified in this International Standard can have a very deleterious effect on photographic film. Relative humidities above 60 % and below 20 % should be avoided.

Prolonged exposure to conditions above 60 % relative humidity will tend to damage or destroy the gelatin emulsion layer due to growth of fungus, and will eventually cause softening and sticking of the emulsion. High humidity exposure will also accelerate any effect of residual processing chemicals (e.g. thiosulfate) on the stability of silver images and will impair the stability of dye images. High relative humidities can accelerate degradation of the film base.

Storage at low humidities not only avoids fungal growth, but reduces the rate of chemical degradation. Recent investigations [5][22] have shown markedly improved base and emulsion stability when the storage humidity is reduced below 50 % relative humidity. When the relative humidity is lowered to 20 %, useful life can be increased by a factor of 4 to 10, depending upon the property measured. Consistent exposure to humidity below 15 % relative humidity can also produce a temporary brittleness in gelatin emulsion film, but flexibility can be restored by conditioning the film to 30 % relative humidity or higher. Film records should be handled carefully while in low relative humidity storage to avoid unnecessary flexing. Film having a low moisture content is apt to develop static charges causing attraction of dust particles, but this difficulty may be avoided by appropriate discharging during handling and printing. Low relative humidity exposure can also result in high film curl, which may produce permanent film deformation in sheet film and "spoking" in motion-picture film. It may also exacerbate existing physical problems, such as emulsion flaking or delamination.

Annex E
(informative)

Temperature during storage

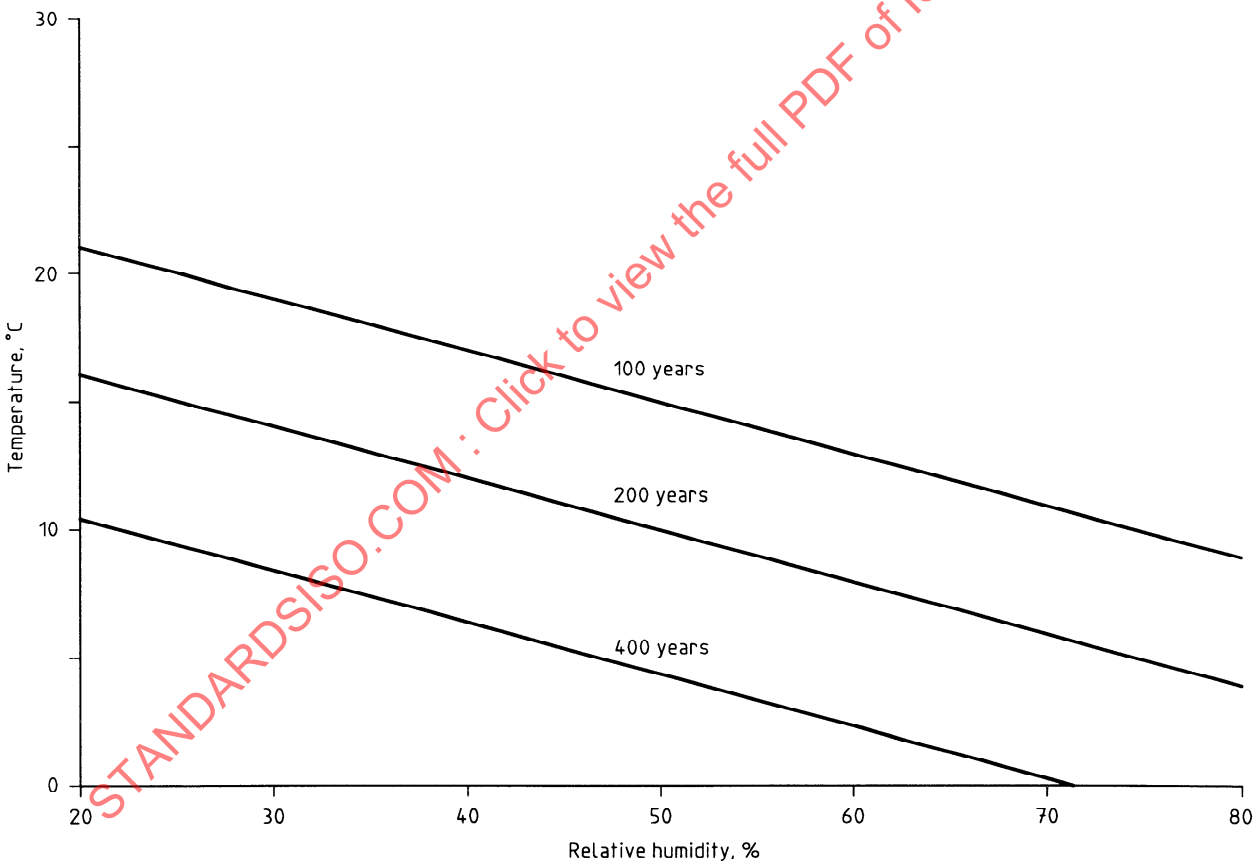
Continuous temperatures above approximately 40 °C can permanently reduce the pliability of some film bases, and can accelerate fading of dye images and vesicular images. While gelatin film becomes brittle at low temperatures (below 0 °C), flexibility is restored upon return to room temperature. Films should be handled carefully when in low temperature storage to avoid undue flexing. Storage temperatures below the dewpoint of the air may produce condensation of moisture upon film surfaces, unless the container and contents are brought above the dewpoint temperature before removal of the film. The required warm-up time may vary from 1 h to 1 day, depending on the size and type of the package and the temperature differential.

An important aspect of temperature is its effect on the relative humidity of the storage area. A fall in temperature can raise the relative humidity if the storage area is not humidity controlled. This may cause conditions beyond the range of recommended humidities for proper storage. In this case, sealed containers should be used.

Annex F
(informative)

Temperature/relative humidity relationship

Degradation of photographic film is caused by chemical reactions, whose rates are lowered with decreasing temperature and decreasing relative humidity. Consequently, the useful life of film can be increased by lowering either the storage temperature or storage humidity. Moreover, a lower storage temperature can compensate for a higher humidity to obtain the same life expectancy. This is illustrated in figure F.1 for the acidity increase caused by degradation of cellulose triacetate base [22]. Similar behaviour exists for the degradation of polyester base and the fading rates of chromogenic dyes. These relationships permit several temperature/relative humidity combinations to be acceptable for extended-term storage conditions as specified in table 1. This gives the storage vault designer a range of options.



NOTE — Curves are based on accelerated tests on freshly processed films.

Figure F.1 — Temperature/relative humidity relationship for cellulose triacetate film to attain a fixed acidity level

Annex G
(informative)

Historic still photographic records

In facilities where historic photographic records are stored, care should be exercised when choosing the relative humidity level, so that items in poor condition (those with flaking, delaminating emulsion or film curl) are not physically stressed by low relative humidities in the range of 20 % to 30 %. If historic film record copies in poor condition are stored in low relative humidity vaults, they should be monitored for damage. Cycling between low relative humidity storage areas and higher relative humidity use areas can exacerbate existing problems.

Since low temperature and/or low relative humidity storage can cause brittleness, which makes the emulsion and film layers more susceptible to physical damage during handling, all historic film records, especially those in poor conditions, should be handled carefully when in low temperature and/or low relative humidity storage to avoid unnecessary flexing. Flexing or rough handling may damage embrittled film in addition to potentially exacerbating physical problems, such as delaminating and flaking emulsions.

Copies should be made for items which require frequent use. This is important since the benefits of increased chemical stability of the film base and colour dyes gained by low humidity or low temperature storage are quickly mitigated by frequent cycling and prolonged removal to higher humidities and temperatures.