INTERNATIONAL STANDARD

ISO 18918

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Imaging materials — Processed photographic plates — Storage practices

Matériaux pour image — Plaques photographiques développées — Directives pour l'archivage

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Contents

Foreword

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

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

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 18918 was prepared by Technical Committee ISO/TC 42, *Photography*.

This first edition cancels and replaces the fourth edition of ISO 3897:1997 of which it constitutes a technical revision.

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

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

Introduction

Photographic plates on glass or metal supports have been in existence almost since the beginning of photography. They have become increasingly important as documentary and pictorial reference material in archives, libraries, government, commerce and academia.

The stability and useful life of processed photographic plates depends on their physical and chemical properties, as well as on the conditions under which they are stored and used. This International Standard provides recommendations on proper storage conditions and practices. Although it is difficult to distinguish between the various types of plates covered by the definitions (see 3.7.1 to 3.7.8) with respect to storage life, the recommendations may be applied to all processed photographic plates.

The important storage elements affecting the preservation of processed photographic plates are as follows:

— relative humidity and temperature of the storage environment;

— hazards of fire, water, and light exposure;

— fungal growth and other microorganisms;

— contact with certain chemicals in solid, liquid or gaseous form;

— physical damage.

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

The term “archival” is no longer specified to express longevity or stability in International Standards on image materials, since it has been interpreted to have many meanings, ranging from preserving information “forever”, which is unattainable, to temporary storage of actively used materials.

This International Standard defines two levels of recommended storage conditions: medium-term and extended-term. Medium-term storage conditions can be used to preserve plates for a minimum of 10 years. Extended-term storage conditions will prolong the life of all plates, even those not optimized for permanence.

The space requirements and costs for establishing and operating the two levels of storage conditions (medium-term and extended-term) differ significantly. Furthermore, the specified limits of temperature and relative humidity for both sets of storage conditions may not be realizable due to budgetary constraints, energy considerations, climatic conditions, building construction, etc. However, it must be recognized that temperatures and relative humidities which are higher than the specified conditions will reduce the effectiveness of the storage environment. If such deviation is unavoidable, the environmental conditions closest to the specified limits should be provided. In any event, the best preservation of plates will be attained with extended-term conditions.

The recommendations of this International Standard for processed photographic plates encompass the following:

— storage enclosures, housing and rooms;

— atmospheric and environmental conditions;

— fire protection;

— handling and inspection procedures.

This International Standard does not pertain to means or methods for protecting photographic plates against natural or man-made catastrophes, with the exception of fire and its associated hazards; these are sufficiently common to warrant inclusion of protective measures.

Imaging materials — Processed photographic plates — Storage practices

1 Scope

1.1 This International Standard specifies dark storage conditions, storage facilities, and handling and inspecting procedures for processed photographic plates having integral photographic layers and intended for record purposes.

1.2 This International Standard is applicable to black-and-white, silver-image, gelatin, processed photographic plates as defined in 3.7.7. It is also applicable to medium-term and extended-term storage conditions as defined in 3.6 and 3.2, respectively.

No specific distinction is made, other than the degree of care, between photographic plates for medium-term or extended-term storage. Recommendations for plate storage relate to materials, methods, conditions, and forms of protection applicable specifically to plates defined in 1.1. However, these storage recommendations may also be applied to lacquered and opaque plates, to black-and-white plates altered by dyes or toners, colour plates and other historic photographic plates defined in 3.7.2 to 3.7.8.

1.3 It is not intended to predict or assign a useful lifetime to processed photographic plates stored in accordance with the specifications of this International Standard.

1.4 Recommendations for storage of photographic films are given in ISO 18911 and for storage of processed photographic reflection print material in ISO 18920.

Although there is some variation in recommended storage conditions among these types of photographic materials, recommended temperature and relative humidity ranges do overlap. If all three types of photographic materials are found in one collection or within one storage area, the temperature and relative humidity should be chosen so that all materials are stored within their recommended ranges.

2 Normative references

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO 18902:—[1)], *Imaging materials — Processed films, plates and papers — Filing enclosures and storage containers.*

ISO 18911:—[1)], *Imaging materials — Processed safety photographic films — Storage practices.*

ISO 18920: —[1)], *Imaging materials — Processed reflection prints — Storage practices.*

1) To be published.

3 Terms and definitions

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

3.1
archival medium
recording material that can be expected to retain information forever, so that such information can be retrieved without significant loss when properly stored

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

3.2
extended-term storage conditions
storage conditions suitable for the preservation of recorded information having a permanent value

3.3
fire-protective storage
facility designed to protect records against excessive temperatures, water and other fire-fighting agents, and steam developed by insulation of safes or caused by the extinguishing of fires and collapsing structures

3.4
fire-resistant vault
fire-resistant vaults as defined in appropriate national standards and regulations

NOTE See [1] and [2] in the bibliography.

3.5
insulated record containers (Class 150)
insulated record containers (Class 150) as defined in appropriate national standards and regulations

NOTE See [3] and [4] in the bibliography.

3.6
medium-term storage conditions
storage conditions suitable for the preservation of recorded information for a minimum of 10 years

3.7
photographic layer
sensitive coating that yields an image after exposure to radiant flux

NOTE Exposure is usually followed by processing to generate the image.

3.7.1
photographic plate
material consisting of one or more radiation-sensitive layers coated on a rigid support, such as glass or metal, that yields a visible image

3.7.2
albumen plate
glass sheet bearing a silver halide/albumen layer which yields a visible image after exposure and processing

3.7.3
ambrotype plate
glass plate collodion positive, i.e., a glass sheet bearing a thin silver halide/cellulose nitrate layer which yields a visible image after exposure and processing

NOTE The processed negative silver image appears as a positive when backed by a dark field.

3.7.4
collodion plate
collodion wet or dry plate
glass sheet bearing a thin silver halide/cellulose nitrate layer which yields a visible image after exposure and processing

3.7.5
colour screen plate
glass sheet bearing a colour screen consisting of dyed elements in contact with a silver halide/gelatin layer which yields a visible image after exposure and processing

3.7.6
ferrotype plate
tintype
enamelled iron sheet bearing a thin silver halide/cellulose nitrate layer which yields a visible image after exposure and processing

NOTE This is not to be confused with a thin metal sheet with a glossy surface upon which high-glass photographic prints are dried.

3.7.7
gelatin plate
gelatin dry plate
glass sheet bearing a silver halide/gelatin layer which yields a visible image after exposure and processing

3.7.8
lantern slide
glass sheet bearing a silver halide/gelatin layer which yields a visible image after exposure and processing

NOTE The image layer of lantern-slide plates is usually protected with a cover glass, bound on all edges with adhesive tape, as this type of plate is viewed by projection. Albumen and colour-screen plates are also found as lantern slides.

3.8
storage container
box or can used to store plates

3.9
storage enclosure
any item in close or direct contact with recording material such as folders, envelopes, sleeves, albums and mats

3.10
storage housing
physical structure that supports materials and their enclosures

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

4 Photographic-plate housings: Storage enclosures and containers

Processed photographic plates require protection against all types of physical damage such as scratches, abrasion, fingerprints, breakage, etc. Filing enclosures and containers provide physical protection that minimizes or prevents such damage. Processed photographic film and prints shall not be stored within the same enclosure or container as photographic plates. Different types of photographic plates shall not be stored together within the same enclosure or container, but instead shall be segregated by type (see definitions 3.7.2 to 3.7.8).

Enclosures and containers shall be designed to permit vertical storage of plates, resting on one long edge. Plates shall not be stored in a flat or horizontal position since those on the bottom may be put under excessive pressure. Plates made from 19th century glass are especially vulnerable to stress-related fractures when stored horizontally, since such glass usually is not flat.

If unprotected plates are stored in contact, they shall be oriented with the emulsion side against the back side, not emulsion against emulsion. However, unprotected plates with very fine-grain images should never be stored in contact, but in grooved, multiple-plate containers of the type described in 4.2.

For maximum storage life, processed photographic plates shall be in a clean condition before they are placed in storage.

4.1 Individual enclosures

All enclosures used for medium-term and extended-term storage shall meet the requirements of ISO 18902 and ISO 14523. This includes enclosures that are in direct contact or in close proximity to the photographic plates.

Processed photographic plates may be stored in envelopes or sleeves, file folders, folding cartons, boxes, or albums made from paper or plastic which meet the requirements of ISO 18902 and ISO 14523. Individual plates should be placed in suitable individual envelopes (seamed or seamless types), sleeves or folders (see annex B) to exclude dirt, to protect the plates against mechanical damage, and to facilitate identification and handling.

Suitable plastic enclosure materials are uncoated polyester (polyethylene terephthalate), polystyrene, polyethylene and polypropylene. Other plastics may be satisfactory, but there has been no extended experience with such materials. Glassine envelopes and chlorinated, nitrated, or highly plasticized sheeting shall be avoided. Specifically, cellulose nitrate and polyvinyl chloride are not acceptable.

The adhesive used for seams and joints shall also meet the requirements of ISO 18902 and ISO 14523. The filing enclosure shall be constructed so that the seam or joint will be at the edge of the enclosure and not in contact with the image layer. Adhesives that are suitable for use with paper include photographic-quality gelatin, some acrylic and polyvinyl acetate adhesives, pure starch paste, and methyl cellulose.

4.2 Multiple-plate containers

Container materials should be metal, plastic or paperboard, and meet the specifications defined in ISO 18902 and ISO 14523. The storage container materials shall be non-corrodible. Materials made of wood, pressed-board, hardboard, particle-board, and other natural materials shall be avoided because they can contain oxidizing materials which can attack the silver image (see annex C). Finishes on metal containers shall meet the criteria listed in clause 5 for metal storage housings.

There are two types of multiple-plate containers, both of which are available in commonly used plate dimensions:

— standard document-storage containers for vertical storage of plates filed in contact with each other or a spacer material;

— containers having grooved, parallel tracks for holding the plates apart in fixed, vertical positions.

The first type of container shall be designed to permit and maintain vertical plate storage on one long edge, as well as allowing insertion and removal of plates without damage. This requires that the inner dimensions of the container are only slightly larger than the plate size and that the strength and rigidity of the container are commensurate with the weight of a full complement of plates. Rigid paperboard inserts or filler pieces meeting the requirements of ISO 18902 and ISO 14523 can be used to ensure that plates are kept upright and to prevent them from rubbing against each other.

The second type of container shall be used when it is necessary to avoid plate-to-plate contact, as in the case of plates having a very fine-grain image or when plates are not protected by either individual enclosures or a cover glass. Such containers normally are lined on the bottom and sides of the interior with inserts that have parallel grooves. The grooves have a U- or V-type cross-section to restrict contact at the extreme edges of the plates while holding the plates vertical.

5 Storage housings

Processed photographic plates should be stored in closable storage housings such as vertical filing drawers or cabinets, in storage cabinets with tightly fitting doors, or inside closed containers on open shelves. Storage housings for photographic plates should be designed to bear a heavy weight load. Plates or plate containers should be placed so that their weight is centred on the shelving or inside the drawer, thus minimizing the tendency of the shelving or cabinets to topple over due to uneven weight distribution. Storage housings may be bolted to floors and wall studs as an added precaution to secure against the danger of tipping over.

The materials used in the fabrication of storage housings should be non-combustible, non-corrosive, and chemically inert, for example, anodized aluminium, stainless steel, or steel finished with a non-plasticized synthetic resin-powder coating. Wood, pressed-board, particle-board, plywood, and other such materials shall be avoided because of their combustible nature and the possibility of their producing active deteriorating agents as they age.

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

When air that is temperature- and humidity-conditioned is supplied to storage housings, adequate interior air circulation shall be provided to all shelves and drawers holding plates or their containers, to ensure proper and uniform temperature and relative humidity conditions. Storage housings located in rooms that are properly air-conditioned in accordance with 7.2 shall be vented to permit adequate air circulation within the interior of the housing. Such openings shall not interfere with the requirements for fire-protective storage or water protection.

Photographic reflection prints and film may be stored within the same storage area as processed photographic plates, but not in the same enclosure or storage container. Magnetic tapes and optical disks shall not be stored within the same storage area or housing as photographic plates due to possible deleterious effects of off-gassing during storage.

5.1 Drawer cabinets

Structurally reinforced, modified office-type filing cabinets with drawers are suitable for storing individual photographic plates when the following handling precautions are observed:

— care is taken to avoid uneven weight distribution and potential toppling of the cabinet when the upper drawers are opened all the way;

— drawers are opened and closed slowly and smoothly to avoid jostling the plates inside.

The drawers should be flat-bottomed and the vertical height of the drawer should be slightly larger than the vertical dimension of the plates. Drawers should be fitted with rigid vertical dividers that are the same height as the plates. Dividers should be fixed at appropriate intervals, for example, 2,5 cm to 5 cm and not more than 10 cm. In addition to supporting the plates, the dividers minimize movement of plates during retrieval and filing and relieve pressure on plates located at the end of rows.

Plates should be grouped by size and shall be filed vertically in the drawers, in one or more parallel rows depending on the plate size. Rows should be divided by suitable partitions. If drawers are not fitted with rigid dividers, containers can be used as a means of grouping plates within compartments in order to minimize jostling, and as an aid to organization and filing.

Structurally reinforced drawer-type cabinets are also recommended for storing plate containers as described in 4.2. Containers should be filed in a single layer, i.e., not stacked on each other. Care should be taken to ensure that containers do not tip over when other containers are removed during use.

5.2 Shelving and cabinets

Multiple-plate containers may also be stored on open-sided shelving or racks, or in door-type cabinets equipped with shelving or racks. The spacing between shelves should allow safe retrieval and filing of containers. Containers should be filed in a single layer, i.e., not stacked on each other, with the plates oriented vertically. The shelves should be divided by partitions, arranged to accommodate several containers, in order to keep the containers upright during retrieval and refiling. Care should be taken to ensure that containers do not tip over when other containers are removed during use.

Door-type cabinets with shelving may be used for storing individual plates. Shelves should be fitted with rigid vertical dividers that are the same height as the plates. Dividers should be fixed at appropriate intervals, for example, 2,5 cm to 5 cm and not more than 10 cm. In addition to supporting the plates, the dividers minimize movement of plates during retrieval and filing and relieve pressure on plates located at the end of rows. Plates should be grouped by size and filed vertically.

6 Storage rooms

6.1 Medium-term storage rooms

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

Provisions shall be made against damage of photographic plates by water from floods, leaks, sprinklers, and from the steam released from masonry walls during a fire. A special storage room separated from the work areas for plate records of medium-term interest generally will not be required, provided that the conditions recommended in 7.2 are maintained.

6.2 Extended-term storage rooms

For extended-term storage, the requirements specified in 6.1 shall be met. The value of processed photographic plates kept for long-term purposes makes it advisable to provide a storage room or vault separate from medium-term storage facilities, temporary storage facilities, offices or work areas.

7 Environmental conditions

7.1 Introduction

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

7.2 Temperature and humidity specifications for storage (see annexes D, E and F)

Table 1 — Maximum temperatures and average relative humidity ranges for storage

Process	Medium-term storage		Extended-term storage [a]	
	Maximum temperature [b] °C	Relative-humidity range [b] %	Maximum temperature [c] °C	Relative-humidity range [c] %
B and W silver	25	20-50 [c)]	18	30-40 [c)]

[a] Formerly known as “archival storage”; see the introduction. For storage of historic still-photographic records, see annex F.

[b] For medium-term storage, the cycling of temperature and relative humidity (RH) shall be no greater than ± 5 °C or ± 10 % RH respectively over a 24 h period. The moisture content in plates shall not be greater than the moisture equilibrium with these relative humidities.

[c] For extended-term storage, a set temperature and relative-humidity level should be chosen. The cycling of temperature and relative humidity shall be no greater than ± 2 °C or ± 5 % RH, respectively, over a 24 h period. The moisture content in plates shall not be greater than the moisture equilibrium with these relative humidities.

The rates of degradation of photographic plate materials and the potential for physical problems due to storage at low temperature and/or low relative humidity with photographic plate materials are currently not well-known. Glass decomposition rates are very moisture dependent at relative humidities above 40 %. However, prolonged exposure to very low relative humidity may promote contraction or distortion of the photographic layer and potential lifting or frilling (delamination at the edge) from the plates. Gelatin dry-plate emulsion layers having low moisture content tend to develop electrostatic charges, causing attraction of dust which can lead to abrasion.

7.2.1 Medium-term storage environment

The maximum temperature for medium-term storage shall not exceed 25 °C, and a temperature below 20 °C is preferable (see Table 1). Some temperature fluctuation is allowable as long as the relative humidity stays within the specified limits. Cycling of temperature shall not be greater than ± 5 °C over a 24 h period.

The relative humidity of a medium-term storage environment shall not exceed 50 %. Cycling of relative humidity shall be no greater than ± 10 % over a 24 h period. Storing plates at the lowest relative humidity in this range, i.e. 20 % to 30 %, may exacerbate existing physical damage such as flaking or delamination by causing the emulsion layer to contract as moisture is extracted from the emulsion (see annexes D and F).

7.2.2 Extended-term storage environment

The maximum temperature for extended-term storage shall not exceed 18 °C (see Table 1). Some temperature fluctuation is allowable as long as the relative humidity stays within the specified limits. Cycling of temperature shall not be greater than ± 2 °C over a 24 h period.

The relative humidity of an extended-term storage environment shall be a set point within the recommended relative humidity range of 30 % to 40 %. Cycling of relative humidity shall be no greater than ± 5 % over a 24 h period (see annexes D and F).

When processed photographic plates are handled infrequently, stability may be increased by conditioning and storing the plates in equilibrium with air at the lower end of the recommended relative humidity range. This may be accomplished by conditioning plates in a suitable conditioning cabinet before placing them in sealed containers or storage housings. If plates are accessed and used at a relative humidity above 40 %, they should be reconditioned to the storage relative humidity before they are returned to sealed containers or storage housings.

The useful life of the support and image layers of photographic plates, as well as that of all other types of photographs, can be enhanced by storage at low temperature.

There are two types of "cold-storage systems": one in which the room or vault is cooled without relative-humidity control, and one in which the temperature and relative humidity are regulated and controlled to set conditions. The first is a less expensive installation than the second, but requires that photographic materials be sealed in vapour- and moisture-proof foil bags prior to being placed in the low-temperature storage conditions. However, glass plates cannot be sealed easily in foil bags without puncturing the bag or physically endangering the plate during the procedure. Furthermore, foil bags prevent the plates from resting properly on their edges in a vertical position during storage. Therefore, low-temperature storage areas for use with photographic plates ideally should have regulated and controlled relative humidity and temperature so that the use of foil bags is not necessary. However, containers may be sealed inside bags to avoid problems associated with sealing individual plates inside enclosures.

Before opening containers that are moved from low-temperature storage into work areas, they shall be allowed to equilibrate with the higher room temperature in order to prevent moisture condensation on the surfaces of the enclosed photographs. This requires longer warm-up times with photographic plates than with films or papers, because the heat capacity of glass is larger than that of other photographic supports.

The benefit of low-temperature storage is reduced dramatically when plates are taken out frequently and/or for extended periods of time into higher temperature environments.

Due to the fragility of glass plates, it is recommended that a reference copy be made and handling of the original be kept to a minimum.

7.3 Environmental conditioning requirements

Properly controlled air-conditioning may be necessary for maintaining relative humidity and temperature within the limits specified, particularly for extended-term storage where the requirements are more stringent than those 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 recommendations contained in appropriate national standards and regulations ([5, 6] in the bibliography). They shall also follow recommendations for fire-resistant file rooms contained in appropriate national standards and regulations ([1, 2] in the bibliography). 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 else sealed containers shall be used.

Automatic control systems are recommended and they shall be checked frequently with a reliable hygrometer that has been properly calibrated. Where air-conditioning is not practical, high humidities may be lowered by electrical refrigeration-type dehumidifiers and controlled with a humidistat set at the desired humidity level. Desiccants, such as chemically pure silica gel, may be used provided they are enclosed within units equipped with filters (see 7.4) capable of removing dust particles 0,3 µm in size and larger, and are controlled to maintain the relative humidity specified in 7.2. Dehumidification may be required in storage areas such as basements and caves. Because of their location, these areas 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 7.2 or if processed photographic plates in active files suffer physical damage, such as flaking or delamination of the image layer from the base, due to increased brittleness or dryness at lower relative humidities. If humidification is required, a controlled humidifier should be used. Water trays or saturated chemical solutions should not be used because of the serious danger of over-humidification.

7.4 **Air purity** (see annex G)

Solid particles, that may abrade photographic plates or react with the image, shall be removed by mechanical filters from air supplied to housings or rooms used for extended-term storage. These mechanical filters should preferably be of the dry-media type having an arrestance rating of not less than 85 %, as determined by tests contained in appropriate national standards and regulations ([7, 8] in the bibliography). Filters shall be of a non-combustible type, meeting the construction requirements of appropriate national standards and regulations ([8, 9] in the bibliography).

Gaseous impurities such as sulfur dioxide, hydrogen sulfide, peroxides, ozone, ammonia, acidic fumes, and nitrogen oxides cause deterioration of the plate base or degradation of the emulsion and the image in some plates. They can be removed from the air by suitable washers or absorbers. Where practical, storage of processed photographic plates in sealed enclosures, containers, and storage housings in accordance with clauses 4 and 5 will afford adequate protection.

Since paint fumes may be a source of oxidizing contaminants, photographic plates should be removed from either an extended-term or medium-term storage area for a 3 month period when the area is freshly painted.

8 Fire-protective storage (see annex H)

Enclosure materials for fire-resistant storage shall be sufficiently fire-resistant that they will not ignite or develop reactive fumes after heating for 4 h at 150 °C in the package that is to be stored. Many enclosure materials will melt or become badly distorted at this temperature. Enclosures shall not be used that deform or melt to the extent that the photographic contents cannot be removed from the enclosure or are themselves permanently deformed.

For protection against fire and associated hazards, processed photographic plates shall be placed in closed containers in either fire-resistant vaults or insulated record containers (Class 150) ([3, 4] in the bibliography). If fire-resistant vaults are used, they shall be constructed in accordance with the recommendations contained in appropriate national standards and regulations ([1, 2] in the bibliography) with particular care being taken for protection from steam.

When the quantity of photographic plates is not too great, insulated record containers (Class 150) conforming to appropriate national standards and regulations may be used. An interior temperature of 66 °C and an interior relative humidity of 85 % shall not be exceeded when the record containers are subjected to a fire-exposure test lasting from 1 h to 4 h, depending on their 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 of processed photographic plates should be placed in another storage area.

9 Photographic plate identification, handling and inspection (see annexes C, F and I)

9.1 Identification

Processed photographic plates are frequently inscribed with identification marks using non-photographic means such as ink, felt marking pens, or pressure-sensitive labels. Such identification materials shall pass the photographic activity test as described in ISO 14523.

9.2 Handling

Proper handling of processed photographic plates is important. If plates are used frequently, this generates damage and necessitates the imposition of critical handling and filing requirements. Good housekeeping and cleanliness are essential. Plates shall be handled by their edges and be properly supported during use. Handlers shall wear thin, clean, cotton, nylon or plastic gloves. Plates shall not be stacked on top of each other as stress fractures and breakage may occur due to the weight of glass on plates that are not perfectly flat.

9.3 Inspection

An adequate number of properly selected lot samples of processed photographic plates should be inspected at 2 to 3 year intervals. If deviations from recommended temperature and relative-humidity ranges have occurred, inspection shall be made at more frequent intervals. A random-sampling plan established in advance of the inspection shall be used.

If signs of deterioration of either plates or enclosure materials are noted, corrective action shall be taken; such as improving humidity and temperature controls or replacing poor-quality storage enclosures and containers. A record of the inspection results shall be maintained to monitor changes in the appearance of plates. Periodic reinspection shall be performed to ensure that corrective actions are effective.

Care shall be taken during the inspection to prevent abrasion, since photographic layers can be physically scratched. Changes to note during the inspection include:

— physical changes in the plates (breakage, emulsion cracking or scratches, adhesion failure, etc.);

— visual changes in the plates (fading, microblemishes, colour change);

— changes in the enclosure materials (embrittlement, discolouration).

If possible, the cause of the problem should be determined and eliminated.

Annex A
(informative)

Numbering system for related International Standard

The current numbering system for TC 42 documents dealing with the physical properties and stability of imaging materials is confusing since the five digit numbers that are used are not in any consecutive order. To facilitate remembering the numbers, ISO has set aside a block of numbers from 18900 to 18999 and all revisions and new International Standards will be given a number within this block. The last three digits will be identical to the current ANSI/PIMA numbers of published documents. This will be advantageous to the technical experts from Germany, Japan, United Kingdom, and the USA who have prepared the standard and who are familiar with the ANSI/PIMA numbers.

As the present International Standards are revised and published, their new numbers will be as given in Table A.1:

Current ISO number	Title	New ISO Number
10602	Photography — Processed silver-gelatin type black-and-white film — Specifications for stability	18901
10214	Photography — Processed photographic materials — Filing enclosures for storage	18902
6221	Photography — Films and papers — Determination of dimensional change	18903
5769	Photography — Processed films — Method for determining lubrication	18904
8225	Photography — Ammonia-processed diazo photographic film — Specifications for stability	18905
543	Photography — Photographic films — Specifications for safety film	18906
6077	Photography — Photographic films and papers — Wedge test for brittleness	18907
8776	Photography — Photographic film — Determination of folding endurance	18908
10977	Photography — Processed photographic colour films and paper prints — Methods for measuring image stability	18909
4330	Photography — Determination of the curl of photographic film and paper	18910
5466	Photography — Processed safety photographic films — Storage practices	18911
9718	Photography — Processed vesicular photographic film — Specifications for stability	18912
12206	Photography — Methods for the evaluation of the effectiveness of chemical conversion of silver images against oxidation	18915
14523	Photography — Processed photographic materials — Photographic activity test for enclosure materials	18916
417	Photography — Determination of residual thiosulfate and other related chemicals in processed photographic materials — Methods using iodine-amylose, methylene blue and silver sulfide	18917
3897	Photography — Processed photographic plates — Storage practices	18918
14806	Photography — Thermally processed silver (TPS) microfilm — Specifications for stability	18919
6051	Photography — Processed reflection prints — Storage practices	18920
DIS 15524	Photography — Polyester-base magnetic tape — Storage practices	18923
DIS 15640	Photography — Imaging materials — Test method for Arrhenius-type predictions	18924

Annex B
(informative)

Photographic filing enclosures for plates

B.1 General

Filing enclosures and storage materials for photographic plates, as described in this annex and clause 4, include all the designs mentioned in ISO 18902. However, dimensions of seamed envelopes and sleeves used for plates must accommodate the plate thickness. Enclosures for processed photographic plates up to and including 20 cm × 25 cm should be about 1 cm larger in both length and width than the nominal size of the plate for which they are intended. All enclosures for plates greater than 20 cm × 25 cm should be about 2 cm larger in both length and width than the nominal size of the plate for which they are intended.

Seamless envelopes, i.e., those constructed with either three or four flaps which fold up to enclose the plate inside, are preferable for extended-term storage of photographic plates, especially those with damaged (flaking, cracking) emulsion layers. Seamless envelopes can be exactly sized to the plate dimensions and can be removed without abrading the surface of the plate.

B.2 Enclosures for cracked or broken plates

Cracked or broken plates may be:

— wrapped in soft tissue and interleaved with rigid paperboard;

— sandwiched between two additional glass plates or pieces of rigid paperboard, then placed in an envelope;

— placed in a custom-built paperboard mat enclosure which allows fragments to be separated from each other with small paperboard spacers to prevent abrasion and chipping.

Housed broken plates should then be stored horizontally in shallow containers. All materials should comply with ISO 18902.

Annex C
(informative)

Silver-image degradation

Processed black-and-white silver images are susceptible to discoloration (microspots, mirroring or yellowing) when stored under adverse storage conditions or in unsuitable enclosures. The deterioration is caused by local oxidation of the image silver, resulting in ionic silver which is mobile. This mobile silver can migrate from its original site and be subsequently reduced to metallic silver and redeposited in a new location. When the silver is redeposited on the surface of the image layer it results in a silver mirror. This appears as a metallic sheen when viewed by low-angle reflected light. When migration is confined to a localized area, this defect can appear as small reddish spots or microblemishes. Yellowing can be an overall or localized discolouration.

Possible oxidizing agents that cause this degradation are aerial oxygen, whose action is accelerated by moisture, and atmospheric contaminants such as peroxides, ozone, sulfur dioxide, hydrogen sulfide, or others that occur in industrial atmospheres. Peroxides may be present in most woods and may also be formed as a result of the ageing of paper inserts and cardboard containers commonly used in storing plates. In closed containers, various methods may be used to remove atmospheric pollutants using materials such as molecular sieves, chemical scavengers, and suitable corrosion inhibitors.

Processing and storage conditions play an important role in the development of discolouration or blemishes. Storage in cool, dry air that is free of oxidizing gases or vapours is usually an effective method of arresting or retarding the formation of discolouration or blemishes. Chemical conversion of the silver image provides excellent resistance to oxidizing gases ([10] in the bibliography).

Annex D
(informative)

Humidity during storage

Relative humidity appreciably beyond the limits specified in this International Standard can have a very deleterious effect on processed photographic plates. The extremes of both low and high humidity should be avoided.

Prolonged exposure to conditions above 60 % relative humidity will tend to damage or destroy the gelatin emulsion layers due to the growth of fungus, and will eventually cause the emulsion to stick to other surfaces such as storage enclosures. Exposure to high humidity will also accelerate any effects of excess residual silver halide and 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 plate base.

Storage at low humidity not only inhibits fungal growth, but also reduces the rate of chemical degradation. Recent investigations have shown markedly improved emulsion stability when the storage humidity is reduced below 50 % relative humidity. However, low relative-humidity exposure can result in high emulsion contraction which may produce cracking or delamination. Also, low relative humidities can cause emulsion brittleness which makes plates more susceptible to physical damage, such as cracking during handling, and can exacerbate existing physical problems such as flaking or delamination.

Annex E
(informative)

Temperature during storage

Continuous storage temperatures above approximately 40 °C may permanently embrittle and deteriorate emulsion layers of processed photographic plates and may accelerate the fading of dye images. Consistent exposure to dry heat promotes contraction or distortion of the photographic layer.

Although gelatin emulsion layers become more brittle at low temperatures (below 0 °C), flexibility is restored upon return to room temperature. Brittle emulsion layers on photographic plates are susceptible to physical damage, such as cracking and delamination during handling; therefore, plates should be handled carefully at lower temperatures.

Storage temperatures which are below the dew-point of the air in the area for use may cause moisture condensation upon plate surfaces, unless the container and contents are brought above the dew-point temperature before removal of the plates. The required warm-up time might amount to several hours, depending on the size of the packaged plates, the relative humidity, and the temperature differential.

An important aspect of temperature is its effect on relative humidity. Low-storage temperatures may 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 such a case, sealed containers should be used.

Annex F
(informative)

Historic records for photographic plates

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, frilling, or delaminating emulsions) are not physically stressed by low relative humidities in the range of 20 % to 30 %. Cycling between areas with low relative humidity and areas with higher relative humidity can exacerbate existing problems.

Storage at low temperature and/or low relative humidity can embrittle the emulsion or image layers, making them more susceptible to physical damage during handling. Rough handling may exacerbate physical problems, such as flaking or cracking emulsions. Because of this, all historic photographic plates, especially those in poor condition, should be handled carefully when in storage at low temperature and/or low relative humidity.

Copies should be made for items that require frequent or extended use. This is especially true since the benefits of increased chemical stability of photographic materials gained by storage at low temperature or low relative humidity are quickly mitigated by frequent cycling and prolonged removal to higher temperatures and humidities.

Annex G
(informative)

Air-entrained and gaseous impurities

When dust and other air-entrained solid particles are deposited on photographic plates, they may interfere with legibility and produce scratches. Reactive types of dust may cause fading or staining of the image layer. Gaseous impurities such as sulfur compounds, ozone, peroxides, ammonia, paint fumes, solvent vapours, and other active compounds may cause deterioration of the base and a chemical degradation of the photographic image.

The most frequently encountered impurities, especially in urban and industrial atmospheres, are car exhaust fumes, nitrogen oxides, sulfur dioxide and ozone; small concentrations of these pollutants are likely to produce detrimental effects on photographic materials. Hydrogen sulfide is a compound that is very reactive with photographic silver images, even at low concentrations; it can occur in air conditioners or washers containing decomposed biological slime. Oxidizing gases, such as peroxides, are responsible for the local oxidation of image silver in fine-grain plates, which causes the formation of minute deposits of coloured colloidal silver and contributes to silver mirroring.

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

Annex H
(informative)

Fire protection

Damage to photographic plates by high temperatures can occur even if the plates are not destroyed by fire. Although silver-gelatin images can withstand temperatures as high as 150 °C for several hours without significant loss in image quality, colour images may show some fading or change in colour balance. In addition to image loss, plates may stick to or block to adjacent plates or suffer emulsion cracking and delamination as a result of exposure to high temperature.

Steam generation and the resultant cooling effect is a design characteristic for the insulation of certain types of fire-resistant safes, insulated record containers, and vault doors. Plates should be protected against steam; otherwise, sticking, gelatin-emulsion melting, and severe distortion will result. For this reason, insulated record containers (Class 150) designed to seal the contents against steam are recommended (see clause 8).

For very critical records and for greater fire protection, it is recommended that duplicate copies be stored in another location.

Annex I
(informative)

Distinction between storage (record) copies and work (reference) copies

The distinction between processed photographic plates that are intended for storage and those intended for use has not always been clear. Work or reference copies, or copies for use, are the predominant photographic copies found in archives, record centres, libraries and museum collections. Their value lies in their being available for ready reference. However, as a result of this use, they are subjected to physical damage such as breakage, fractures, abrasions, fingerprints, contamination with foreign materials, and exposure to excessive light and temperatures. Such work 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 fact, physical imperfections such as flaking or delamination of the emulsion layer can occur in work copies if they are not reconditioned to the moisture conditions of the storage area. It is evident that work copies are not suitable for long-term preservation; they should not be considered as storage (record) copies.

Where there is a need for extended storage of processed photographic plates having a permanent value, duplicates should be prepared for reference use. These duplicates should be kept in a collection area separate from the one in which the original storage or record copies are stored. Original storage copies should meet the appropriate ISO requirements for the photographic material used and should be stored according to the recommendations of the appropriate International Standard. Original storage copies will occasionally be looked at, otherwise the need for keeping these records is pointless. However, the use of storage copies should be infrequent.

Due to the fragility of glass plates, duplicates or work copies should be produced for use. Plates which have fractures or flaking emulsions should be duplicated immediately since even one use may exacerbate the existing damage.

Bibliography

[1] ANSI/NFPA 232-1995, *Protection of records.*[2)]

[2] Japanese Ordinance No. 306, *Regulation on fire-hazard materials under Fire Protection Law.*[3)]

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2) Available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269-9101, USA.

3) Available from the Center for Governmental Issues Services, Building No. 2 of Ohtemachi – Godo-Chosha Governmental Offices, Chiyoda-ku, Ohtemachi 1-3-2, Tokyo 100, Japan.

4) Available from the Underwriters' Laboratories, Inc., 333 Pfingsten Rd., Northbrook, IL 60062, USA.

5) Available from the Japanese Standards Association, Minato-ku, Okasaka 4-1-24, Tokyo 107, Japan.

6) Available from the American Society of Heating, Refrigeration, and Air Conditioning Engineers, 1791 Tullie Circle, NE, Atlanta, GA 30329, USA.

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