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STANDARD

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**Photography — Processed photographic
plates — Storage practices**

iTeh *Photographie — Plaques photographiques développées — Directives
pour l'archivage*
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Foreword

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

International Standard ISO 3897 was prepared by Technical Committee ISO/TC 42, *Photography*.

This third edition cancels and replaces the second edition (ISO 3897:1986), of which it constitutes a technical revision.

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Introduction

Photographic plates on glass or metal supports have been in existence almost since the beginning of photography. Plates made many years ago and now stored in archives or other collections are invaluable and eminently worthy of preservation. Present-day usage of photographic plates dictates many special requirements, which may give them appreciable value.

There are many factors which may contribute to the deterioration of photographic plates. These factors can be divided into three general categories:

a) Nature of the photographic plate

The stability of photographic-plate records depends on the physical and chemical nature of the material. Some obsolete types of photographic plate still exist and require preservation in archives, museums, and other collections. These plates are covered by the recommendations in this International Standard. The permanent-record nature of some types of photographic plate has been established by many years of storage (over 100 years in many instances). However, it is difficult to distinguish between various types of plate covered by the definitions (see clause 3), with respect to storage life. Nothing in the practices described should be construed as a recommendation for mixing the various types in storage. Although the same recommendations apply to plates of both short-term and long-term interest, much greater care should be taken to obtain maximum protection for plates of long-term interest.

b) Photographic processing of the plate

The importance of processing procedures to the preservation of plates should be emphasized. Plates should be thoroughly fixed and washed after development to ensure the required image stability and to remove unused silver halide and chemicals used during processing. Residual thiosulfate in processed images should be low for long-term stability. Although this has not been specified for plates in any International Standard, ISO 10602 may be used as a guideline for archival storage of photographic plates. Residual thiosulfate may be determined according to ISO 417. The drying process plays an essential role in avoidance of emulsion layer shrinkage, water spots and distortion.

c) Storage conditions

The conditions under which photographic plates should be stored are extremely important for the preservation of plates and are the subject of this International Standard.

The important elements affecting preservation of processed plates are humidity, temperature and pollutants of the air, as well as the

hazards of water, light, fungal growth, insects, microbiological attack, contact with certain chemicals in solid, liquid or gaseous form, and physical damage.

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

The recommendations of this International Standard also pertain to fire protection, plate handling and inspection. This International Standard does not give recommendations concerning protection against natural or man-made catastrophes with the exception of fire and associated hazards which are sufficiently common to warrant inclusion of protective measures.

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

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Photography — Processed photographic plates — Storage practices

1 Scope

1.1 This International Standard gives recommendations for the storage conditions, storage facilities, handling and inspection of processed photographic plates.

1.2 This International Standard defines terms and recommends practices for the storage of black-and-white, silver-image, photographic plates having integral photographic layers and intended for record purposes.

No specific distinction is made, other than the degree of care, between plates for medium-term or archival storage.

Recommendations for plate storage relate to materials, methods, conditions, and forms of protection applicable specifically to plates defined in 3.3. However, the storage recommendations may also be applied to colour plates, to black-and-white plates altered by dyes or toners, and to the plates defined in 3.4, 3.5, 3.6, 3.7 and 3.8.

1.3 The storage of photographic film and paper requires different considerations and these are not covered in this International Standard but are covered in ISO 5466 and ISO 6051, respectively.

1.4 Although not covered by this International Standard, lacquered and opaqued plates will have their useful life prolonged under the storage conditions recommended. However, they should not be stored with non-lacquered or non-opaqued plates.

1.5 This International Standard, while intended for materials that are well processed, should also be of considerable value in prolonging the useful life of photographic plates whose processing conditions

are unknown, that have been toned or retouched, or bear markings with materials of uncertain or unknown stability. It is not intended to predict or assign a useful lifetime to photographic plates stored in accordance with the specifications of this International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 417:—¹⁾, *Photography — Determination of residual thiosulfate and other related chemicals in processed photographic materials — Methods using iodine-amylose, methylene blue and silver sulfide.*

ISO 1974:1990, *Paper — Determination of tearing resistance (Elmendorf method).*

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

ISO 10602:1992²⁾, *Photography — Processed silver-gelatin type black-and-white film — Specifications for stability.*

3 Definitions

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

1) To be published. (Revision of ISO 417:1977)

2) To be published.

3.1 photographic plate: A photographic layer on "soda-line-silica" sheet glass, except for the type of plate defined in 3.6.

3.2 photographic layer: A light-sensitive coating containing silver halide which yields a visible image after exposure and processing.

3.3 (gelatin) dry plate: A glass sheet with a silver halide/gelatin coating which has been exposed and processed to form a silver image.

3.4 wet or dry collodion plate; wet or dry plate: A glass sheet bearing a thin silver halide/cellulose nitrate layer which has been exposed and processed to form a silver image.

3.5 ambrotype plate: A type of wet collodion glass plate on which the processed silver image appears as a positive when backed by a dark field.

3.6 ferrotype plate³⁾; tintype: An enamelled iron sheet bearing a thin silver halide/cellulose nitrate layer which has been exposed and processed to form a silver image and which appears in positive form.

3.7 colour screen plate: A glass sheet bearing a colour screen consisting of dyed elements in contact with a positive silver image.

3.8 albumen plate: A glass sheet bearing a silver halide/albumen layer which has been exposed and processed to form a silver image.

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

3.10 archival storage: Those storage conditions suitable for the preservation of photographic materials having permanent value.

NOTES

1 Archival storage conditions will prolong the useful life of plates, whether or not they have had optimum processing.

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

3.11 fire-protection storage: Facilities designed to protect photographic materials against excessive

3) Not to be confused with a thin metal sheet with a glossy surface upon which high-gloss photographic prints are dried.

4) Example: Class 150 of UL 72 [1].

5) Example: NFPA 232 [2].

temperatures, water and other fire-fighting agents, steam developed by insulation of safes, and collapsing structures.

3.12 insulated record container: Container as defined in appropriate national standards and regulations.⁴⁾

3.13 fire-resistant vault: Vault as defined in appropriate national standards and regulations.⁵⁾

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

Folders, envelopes, cartons, sleeves, transparency mounts, and jackets are examples of protective enclosures.

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

Sealed envelopes (see A.2.4) are examples of protective enclosures.

4 Plate enclosures

4.1 Classification of enclosures

Plates require protection against all types of physical damage such as breakage, scratches, abrasion, fingerprints, etc. Enclosures for storage of processed photographic plates may be divided into two classifications: individual enclosures and multiple-plate containers. Storage arrangements are dependent on the physical dimensions of the plate.

4.2 Individual enclosures

Individual plates (except fine-grain plates and small size plates) should be placed in suitable individual envelopes, sleeves or folders (see annex A) to exclude dirt, to protect the plates against mechanical damage and to facilitate identification and handling. It is important to avoid any contact with the image surface of small plates (for example up to 10 cm x 15 cm) and fine-grain types, which should preferably be stored in a multiple-plate container of the type recommended in 4.3.

Plates may be stored in envelopes of paper or paper/foil/plastic laminates, folding cartons or file folders. When in direct contact with the surface of the photographic plate, the paper or plastic enclosure material shall meet, as a minimum require-

ment, the specifications described in ISO 10214. Sealed enclosures shall be used where needed to maintain humidity within the specified limits (see clause 7), to protect against gaseous impurities in the atmosphere, or when low-temperature storage is used. Heat sealable envelopes consisting of aluminium foil extrusion coated with clear polyethylene on the inside and laminated to a suitable paper sheet on the outside have been successfully used as sealed enclosures. To provide greater protection against pinholes, a double-bagging technique is recommended. Precautions shall be taken in handling these envelopes so that they are not punctured. Enclosures shall not create excessive pressure on the plate surface. Marks can originate from improperly located seams or wrinkles. 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 surface. Examples of dimensions and construction of filing enclosures are given in annex A.

Enclosure design shall permit storage of the plate on edge (i.e. in a vertical plane with one edge parallel to the horizontal). Plates shall not be stored in a flat or horizontal position as this could cause excessive pressure on the lower ones. It should be noted that 19th century glass is usually not flat and horizontal storage of such materials can cause stress-related fractures. Plates shall not be stored or handled with plate emulsion surfaces in contact.

For optimum storage life, photographic plates shall be in a clean condition before being placed in storage. Periodic inspection should be made as described in 9.2.

4.3 Multiple-plate containers

Multiple-plate containers shall be used where it is necessary to avoid plate-to-plate contact. They are preferable for storing fine-grain types of plates or groups of plates and serve as transfer boxes for handling plates from storage to working area.

Container materials should preferably be metal or plastic as described in ISO 10214. Cardboard or wooden containers should be avoided because they can contain oxidizing materials which can attack the silver image (see annex C).

Two categories of multiple-plate containers are:

- a) containers for a large number (for example 12 to 36) of small or fine-grain plates without individual enclosures;
- b) containers for a small number (for example 4 to 12) of large plates with individual enclosures.

4.3.1 Containers for small plates and fine-grain types

Small plates up to 10 cm × 15 cm in size and fine-grain plates shall be stored in closed rectangular containers. Each container shall be fitted with grooved inserts which separate the plates from each other and support them vertically. No supporting material shall be in contact with major areas of plate surfaces. The cross-section of the grooves shall have the form of a "U" or "V" and contact shall be at the extreme edge of the plate. Depending on plate size and thickness, 12 to 36 grooves are suitable.

4.3.2 Containers for large plates

Large plates in individual enclosures may be stored in multiple-plate boxes designed to accommodate from 4 to 12 plates, depending on plate size and thickness. Box dimensions shall permit the plate to be on edge when placed in storage. Boxes of this type are suitable for plates in the size range 13 cm × 18 cm to 30 cm × 40 cm or larger. The mass of the contents shall control the quantity. The inside dimensions (length and height of the box) shall be only slightly larger than the length and width of the individual enclosure.

5 Storage housings

Plates should be segregated carefully by type, as defined in 3.3, 3.4, 3.5, 3.6, 3.7 and 3.8 and stored in a well-separated storage housing to avoid interactions among various types which might produce adverse effects if mixing were to occur. It is particularly important to segregate collodion plates, ambrotype plates and ferrotype plates since they contain cellulose nitrate. Cellulose nitrate is unstable and releases oxides of nitrogen [3] which can attack the silver image on adjacent plates.

Plate dimensions will normally control the choice of housings, but the mass of the plates should also be considered.

The storage housing materials shall be non-corrodible as described in ISO 10214. They shall also be non-combustible. Because of their combustible nature and the possibility of producing active fading agents on ageing, materials made of wood, pressed-board, hardboard, particle-board and other natural materials shall be avoided.

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

When air-conditioned individually, storage housings shall be arranged to permit interior circulation of air to all shelves and drawers to allow uniform humidity conditions. Storage housings located in rooms conditioned in accordance with 7.1 shall be provided with ventilation openings permitting access of air to the interior. Such openings shall not affect accordance with requirements for fire-protection storage (see clause 8) or water protection.

Storage housing is of two types:

- type 1: Cabinets for plates in individual enclosures;
- type 2: Cabinets, shelves or racks for plates in multiple-plate containers or for large plates.

NOTE 3 Type 2 housing is preferable for enclosures larger than 30 cm x 40 cm.

5.1 Type 1 housings

Individual enclosures should be stored in drawer-type cabinets. Modified office-type drawer filing cabinets are suitable. Enclosures shall be filed with the plates vertically in the drawers, in one or more horizontal rows depending on the plate size. The drawers should be flat-bottomed and the vertical height of the drawer should correspond to the vertical dimension of the enclosure. Enclosures should be grouped by size and the drawer height should preclude filing more than one vertical row of enclosures.

The drawers should be divided by suitable partitions between horizontal rows. The rows should be subdivided at appropriate intervals (for example 10 cm to 15 cm) to keep rows of individual enclosures upright, relieving pressure on the end enclosures in the row.

Drawer-type cabinets are also recommended for storing small-plate containers as described in 4.3.1. Small-plate containers should be filed in a single layer with the plates vertical.

5.2 Type 2 housings

Other multiple-plate containers should be stored on open-sided shelving or racks, or in door-type cabinets equipped with shelving or racks. The containers should be oriented so that the plates are stored vertically on edge, with the longer dimension horizontal.

The shelves should be divided by partitions, arranged to accommodate several containers, to keep the containers upright. The spacing between shelves should prevent storing more than one vertical row of containers on each shelf.

Door-type cabinets with shelving may be used for storing small-plate containers as described in 4.3.1. Containers should be stored in a single layer with the plates vertical.

6 Storage rooms

The value of photographic plates kept for long-term or archival purposes makes it advisable to provide a storage room or vault separate from temporary storage facilities, offices or work areas. Good housekeeping is essential. Walls and enclosures of air-conditioned spaces shall be designed to prevent condensation of moisture on interior surfaces and within walls, especially during periods of low exterior temperatures when the walls can be cooled below the dew point of the air. Provisions shall be made against damage by water from floods, leaks, sprinklers, etc. Storage rooms or vaults should be located above basement levels, where possible.

Storage rooms have been constructed in caves and mines and have proven very satisfactory when accepted requirements for the environmental conditions (see 7.1 and 7.2) and air purity (see 7.4) are met.

7 Environmental conditions

The humidity and temperature of the air in contact with plates and the presence of air-entrained solid or gaseous impurities are important external factors affecting plate permanence. For long-term inactive storage, maintenance of the humidity and temperature near the minimum of the given range in each instance is preferable.

7.1 Humidity limits (see annex B)

The relative humidity in the storage area should be maintained at all times between 20 % and 50 %, preferably below 40 %.

Prolonged exposure to relative humidity above 60 % will promote damage or destruction of the emulsion layer on gelatin dry plates due to mould growth. Such conditions will eventually cause the emulsion layer to stick to filing enclosures or other contact surfaces.

Prolonged exposure to very low relative humidity may promote shrinkage or distortion of the image layer and potential lifting or frilling (delamination at the edge) of the photographic layer on gelatin dry plates and wet collodion plates. Dry-plate emulsion layers having low moisture content tend to develop electrostatic charges, causing attraction of dust particles.

7.2 Temperature limits (see annex C)

Temperatures shall not exceed 20 °C and added protection can be obtained for all plates by low-temperature storage. An important aspect of temperature is its effect on relative humidity. Caution should be exercised as relative humidity tends to increase as temperature decreases. High temperatures in storage should be avoided because consistent exposure to dry heat promotes shrinkage or distortion of the photographic layer.

A storage temperature of 2 °C or below is strongly recommended for colour plates by analogy with the behaviour of colour film [4] [5]. Two methods may be used.

- a) The plate may be conditioned to the recommended relative humidity at room temperature, placed in two heat-sealed foil bags and then placed in storage below 2 °C. The use of such bags improves moisture protection, but does not guarantee it. This procedure has the advantage of excellent keeping conditions and the use of reasonably-priced deep-freeze units. It is essential to limit the volume of free air in the sealed bag as much as possible.
- b) An alternative procedure is to use a storage room controlled at 2 °C and at the recommended relative humidity. This eliminates the requirement of sealed bags but does require an expensive installation. Low relative humidity is difficult and expensive to maintain at low temperatures.

The bag should be allowed to warm up to room temperature prior to opening to avoid moisture condensation on the plates (see annex C). The warm-up time can amount to several hours because of the heat capacity of glass plates. Cycling of temperature should be avoided.

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

7.3 Air-conditioning requirements

Properly controlled air-conditioning can be necessary for maintaining humidity and temperature within the limits specified for optimum 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

6) Example: NFPA 90A [6].

7) Example: Stain test of ASHRAE Standard 52-68 [7].

8) Example: Class 1 construction of UL 900 [8].

storage vault shall be constructed and maintained on the basis of the recommendations contained in appropriate national standards and regulations⁶⁾. They shall also follow recommendations for fire-resistant file rooms contained in appropriate national standards and regulations⁵⁾.

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

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

7.4 Air purity (see annex D)

Solid particles, which can abrade the surface or react with the image, shall be removed by mechanical filters from air supplied to housings or rooms used for storage. These mechanical filters should be preferably of dry-media type having an arrestance rating of not less than 85 % as determined by tests contained in appropriate national standards and regulations⁷⁾. Filters shall be of the non-combustible type, meeting the construction requirements of appropriate national standards and regulations⁸⁾.

Gaseous impurities such as sulfur dioxide, hydrogen sulfide, peroxides, ozone, acidic fumes, ammonia and nitrogen oxides can cause degradation of the image in some plates. They can be removed from the air by suitable washers or absorbers. An archival storage vault should be located as far as possible from an urban or industrial area where contaminants can be present in harmful concentrations. Where practical, storage of plates in sealed containers will afford adequate protection.