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International Standard 3897

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Photography — Processed photographic plates — Storage practices

Photographie — Plaques photographiques développées — Directives pour l'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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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

This second edition cancels and replaces the first edition (ISO 3897-1976) of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Photography — Processed photographic plates — Storage practices

0 Introduction

Photographic plates 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 may 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. Most of 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 shall 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 is emphasized, even though the glass support is inert and is not a factor in chemical stability. Plates require thorough fixing and washing after development to ensure the required image stability, to remove chemicals used during processing, and to avoid the possible formation of microscopic blemishes. Residual thiosulfate in processed images shall be low for long-term stability. Although this has not been specified in any International Standard, ISO 4331 and ISO 4332 may be used as guidelines for archival record film. Residual thiosulfate may be determined according to ISO 417. The drying process plays an essential role in avoidance of shrinkage of the emulsion layer, water spots and distortion.

c) Storage conditions.

The conditions under which photographic plates should be stored are extremely important for the preservation of plates.

The important elements affecting preservation of processed plates are humidity and temperature 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, or variations of both, can be permitted to reach beyond recommended limits without producing adverse effects will depend upon the duration of exposure, on biological conditions conducive to fungal growth, and on the accessibility of this atmosphere to the plate surfaces.

The recommendations of this International Standard also pertain to enclosure materials, containers, fire protection, and inspection. This International Standard is not designed to provide protection against natural or man-made catastrophes, with the exception of fire and associated hazards which are sufficiently common to warrant inclusion of appropriate protective measures.

It is recognized that some users may elect to provide a lesser degree of protection than that recommended because of the limited value of the plates, in terms of their end use, compared with the cost of providing storage facilities. However, the need for the protection of plates from the hazards of fire, water, and physical damage is obvious.

1 Scope and field of application

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

1.2 This International Standard defines terms and recommends practices for 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 short-term storage, medium-term storage or optimum 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, in a broader sense, 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 and 3.7.

1.3 Although not included in 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.

1.4 This International Standard, while intended for materials that are well processed, should also be of considerable value in prolonging the useful life of photographic plates whose processing conditions are unknown, or that have been toned, 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 References

ISO 417, *Photography — Determination of thiosulphate and other residual chemicals in processed photographic films, plates and papers — Methylene blue photometric method and silver sulphide densitometric method.*

ISO 1974, *Paper — Determination of tearing resistance.*

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

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

ISO 5466, *Photography — Processed safety photographic film — Storage practices.* [1]

ISO 6051, *Photography — Processed photographic paper prints — Storage practices.*

3 Definitions

3.1 photographic plate : A photographic layer on "soda-lime-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; 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 plate on which the processed silver image appears as a positive when backed by a dark field.

3.6 ferrotype plate : 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.

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

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

NOTE — Optimum storage conditions will prolong the useful life of plates, whether or not they have had optimum or non-optimum processing.

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

3.12 insulated record containers : Containers as defined in appropriate national standards and regulations.[2]

3.13 fire-resistive vaults : Vaults as defined in appropriate national standards and regulations.[3]

3.14 open enclosure : Enclosure which is intended for the physical protection against mechanical damage, but is neither light-tight nor air-tight.

Such enclosures may be folders, envelopes, cartons, sleeves and transparency mounts.

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

Such enclosures may be sealed envelopes.

1) At present at the stage of draft.

2) Example : Class 150 of UL 72-1977.[2]

3) Example : Publication NFPA No. 232-1981.[3]

4 Composition of enclosure materials

4.1 General

The enclosure material shall be free from acidic, oxidizing and reducing agents which may be released slowly with time and cause image instability. For example, ageing blemishes in processed images may be caused by chemicals evolved from enclosure materials[1]. Likewise, the presence of acid in paper that is in contact with photographic materials can cause degradation.

The enclosure itself shall be chemically stable. Otherwise, the decomposition products might be harmful to the photographic material, and dirt or dust might be produced that could scratch or become embedded in the image surface. Cellulose nitrate and glassine sheeting are examples of unsatisfactory enclosure materials because of their own instability[4] [5].

The physical surface of the enclosure material is also important. A very smooth glossy surface can result in sticking or ferrotyping of the image surface. A slightly rough or matt surface is recommended for the filling enclosure, but a rough surface can produce abrasion problems.

The enclosure material and the photographic material to be stored shall each meet the requirements of the photographic activity test as described in 11.1. This incubation test determines whether there is a chemical interaction between the particular components of the package. The adhesive used for seams and joints shall also meet this requirement.

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

4.2 Paper

The paper shall be made from rag, bleached sulfite, or bleached kraft pulp with an alpha-cellulose content greater than 87 % (m/m)[6]. It shall be free from such highly lignified fibres as ground wood, as determined by the phloroglucinol spot test.

For paper in direct contact with black-and-white photographic material, the pH (cold extraction)[7] shall be between 7,5 and 9,5. The pH shall be close to 7,0 when in direct contact with other types of photographic plates. The alkali reserve shall be at least 2 % (m/m), as determined by the alkali reserve test described in 11.2[8]. The alkali reserve shall be accomplished by the incorporation of an alkaline earth carbonate.

A minimum of sizing chemicals shall be used, the amount being dictated by the requirements of the end use (enclosure, overwraps, interleaving, etc.).

Neutral or alkaline sizing chemicals shall be employed.

The material shall essentially be free from particles of metal. Surface fibres that might offset on to photographic layers should not be present. The paper shall not contain waxes, plasticizers, or other ingredients that may transfer to the photographic material during storage. Glassine envelopes[4] shall not be used. The paper shall meet the physical tests required for the particular application; these include stability[9], folding endurance[10] and tear resistance (see ISO 1974).

Where high-humidity conditions favourable to fungus growth may occur, the user should provide controlled conditions of lower humidity. This will eliminate the need for a fungicide treatment. Where it is not possible to provide lower humidity storage, the paper used for the enclosure should be relatively non-porous and treated with a fungicide. The effectiveness of such a fungus-resistant treatment should be determined[11]. Additive treatments for fungus protection should be used with extreme caution. There may be long-term effects of the fungicide with respect to its efficiency and safety, as well as an interaction with the photographic material.

4.3 Plastic

Photographic film support materials such as uncoated polyester (polyethylene terephthalate) and uncoated cellulose acetate are suitable plastic enclosure materials. Uncoated polyethylene has been found suitable as it is generally inert, unplasticized, and has good chemical stability. Other plastics may be satisfactory, but there has been no long-term experience with such materials.

Chlorinated or nitrated sheeting shall not be used, and cellulose nitrate in particular shall be avoided. Polyurethane foam shall not be used.

Highly-plasticized sheetings or coatings shall not be employed as this might result in either sticking or ferrotyping of the image surface. Plastics of unknown quality containing residual solvents or plasticizers are suspect because such solvents may escape and have a harmful effect on the photographic image. The plastic materials shall be free of peroxides.

The plastic shall meet the physical tests required for the particular application. These include folding endurance[10], tear resistance[12] and tensile strength[13].

4.4 Metal

Metals shall be non-corrodible such as anodized aluminium or stainless steel. The use of steel is permissible provided the surface is well protected by lacquer, enamel, tinning, plating or some other corrosion-resistant finish. Lacquer which might give off reactive fumes, peroxides or exudations during storage shall not be used (see annex C).

Cabinets painted with oil base paints shall not be used for 3 months as they may give off peroxides.

4.5 Adhesive

If an adhesive is used, it shall have no harmful effect on the photographic image or enclosure when tested by the photographic activity test described in 11.1. Some photographic images can be damaged by adhesives incorporating impurities such as sulfur, iron, copper or other ingredients that might react with image silver or gelatin. Pressure-sensitive adhesives and ether-linked products shall be avoided. If a particular brand of commercially-made adhesive is found to be safe for long-term storage purposes, there is no assurance that subsequent batches will contain ingredients of the same purity.

Rubber-based products such as rubber cement shall not be used. Not only might they contain harmful solvents or plasticizers, but they might be compounded with photographically-damaging sulfur, usually as a vulcanizer, accelerator, or stabilizer. Even some "low-desensitizing" or "sulfur-free" rubbers contain sulfur.

Photographic quality gelatin and many polyvinyl acetate and cellulose ester adhesives are suitable for use with paper enclosures. Heat sealing or mechanical sealing should be used when possible.

4.6 Printing inks

The printing ink shall have no harmful effect on the photographic image when tested by the photographic activity test described in 11.1. Printing inks have been known to cause microscopic spots in fine-grain silver microfilm[15]; consequently, there shall be no printed matter on the inside of the filing enclosure. The ink used for imprinting the outside of filing enclosures shall not bleed, spread, or transfer, nor shall it be a source of products that attack the plates or the enclosure itself.

5 Plate enclosures

5.1 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.

5.2 Individual enclosures

Individual plates (except fine-grain plates and small size plates) should be placed in suitable individual envelopes, sleeves, or folders 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 × 15 cm) and fine-grain types, which should preferably be stored in a multiple-plate container of the type recommended in 5.3.

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 requirement, the specifications described in 4.2 and 4.3. Sealed enclosures shall be used where needed to maintain humidity within the specified limits (see clause 8), to protect against gaseous impurities in the atmosphere, or when low-temperature storage is used. Heat-sealable envelopes consisting of aluminium foil extrusion coated with clear polyethylene on the inside and laminated to a suitable paper sheet on the outside have been successfully used as sealed enclosures. Precautions shall be taken in handling these envelopes so that they are not punctured. Enclosures shall not create excessive pressure on the plate surface. Marks may 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. 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 10.2.

5.3 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 (see 4.4) or plastic (see 4.3). Cardboard or wooden containers should be avoided because they may contain oxidizing materials which may 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.

5.3.1 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.

5.3.2 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 plates 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.

6 Storage housings

Plates should be segregated carefully by type, as defined in 3.3, 3.4, 3.5 and 3.6, 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 fer-

rotype plates since they contain cellulose nitrate. Cellulose nitrate is unstable and releases oxides of nitrogen[5] which can attack the silver image on adjacent plates.

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

The storage housing materials shall be non-corrodible as described in 4.4. 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 not deleterious to the stored photographic plate. Adverse effects may be produced by finishes containing chlorinated or highly-plasticized resins, or by freshly-painted or lacquered surfaces.

When air-conditioned individually, storage housings shall be arranged to permit interior circulation of air to all shelves and drawers to allow uniform humidity conditions. Storage housings located in rooms conditioned in accordance with 8.1 shall be provided with ventilation openings permitting access of air to the interior. Such openings shall not interfere with requirements for fire-protective storage (see clause 9) or water protection.

Storage housing should be of two types

— type 1 : Housing — Cabinets for plates in individual enclosures;

— type 2 : Housing — Cabinets, shelves, or racks for plates in multiple-plate containers or for large plates.

6.1 Type 1 housing

Individual enclosures should be stored in drawer-type cabinets. Modifications of 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 to 15 cm) to keep rows of individual enclosures upright, relieving pressure on the end enclosures in the row. (Type 2 housing is preferable for enclosures larger than 30 cm × 40 cm.)

Drawer-type cabinets are also recommended for storing small-plate containers as described in 5.3.1. Small-plate containers should be filed in a single layer with the plates vertical.

6.2 Type 2 housing

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 5.3.1. Containers should be stored in a single layer with the plates vertical.

7 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 may be cooled below the due 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 8.1 and 8.2) and air purity (see 8.4) are met.

8 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 nearer the minimum of the range given in each instance is preferable.

8.1 Humidity limits

The relative humidity in the storage area should be maintained at all times between 15 % and 50 %, preferably below 40 %.

Prolonged exposure to relative humidity above 60 % will promote damage or destruction of the emulsion layer on gelating dry-plates due to mould growth. Such conditions eventually will 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 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 attaction of dust particles.

8.2 Temperature limits

Temperatures shall not exceed 20 °C and added protection may be obtained for all plates by low-temperature storage. A most important aspect of temperature is its effect on relative humidity, which may be brought outside the recommended limits. 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 balance of colour film.[15][16] Two methods may be used.

a) The plate may be conditioned to the recommended relative humidity, placed in two heat-sealed foil bags, and then placed in below 2 °C storage. 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 the use of a storage room controlled at 2 °C and at the recommended relative humidity. This eliminates the requirement for sealed bags, but does require an expensive installation.

The bag should be allowed to warm up to room temperature prior to opening, to avoid moisture condensation on the plates. The warm-up time may 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.

8.3 Air-conditioning requirements

Properly controlled air-conditioning may be necessary for maintaining humidity and temperature within the limits specified. Slightly positive air pressure should be maintained within the storage room or vault. Air-conditioning installations, and automatic fire-control dampers in ducts carrying air to or from the storage vault, shall be constructed and maintained on the basis of the recommendations contained in appropriate national standards and regulations.1) They shall also follow recommendations for fire-resistant file rooms contained in appropriate national standards and regulations.2)

Automatic control systems are recommended and they shall be checked frequently. Where air-conditioning is not practical, high humidities may be lowered by electrical refrigeration-type dehumidifiers, controlled with a hygrostat. 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 prescribed in 8.1. Dehumidification may 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 8.1 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.

8.4 Air purity (see annex D)

Solid particles, which may abrade 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 regulations.3) Filters shall be of the non-combustible type, meeting the construction requirements of appropriate national standards and regulations.4)

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 optimum storage vault should be located as far as possible from an urban or industrial area where contaminants may be present in harmful concentrations. Where practical, storage of plates in sealed containers in accordance with clause 5 will afford adequate protection.

As paint fumes may be a source of oxidizing contaminants, plates shall be removed from a storage area for a 3 month period when the area is freshly painted.

Gases given off by decomposing nitrate-base film may damage or destroy a photographic image stored in the same area.[5] Therefore, plates shall not be stored with nitrate-base films, either in the same room or in rooms connected by ventilating ducts.

8.5 Light

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

9 Fire-protective storage (see annex E)

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 plate itself does. Many enclosure materials will melt or become badly distorted at this temperature. However, this melting or distortion shall not cause damage to the plate or prevent it from being removed from the enclosure.

For protection against fire and associated hazards, the plates shall be placed in closed containers in either fire-resistant vaults or insulated record containers. If fire-resistant vaults are used,

1) Example : Publication NFPA No. 90A-1981.[17]

2) Example : Publication NFPA No. 232-1981.[3]

3) Example : «Stain test» of ASHRAE Standard 52-68.[18]

4) Example : Class 1 construction of UL900-1971.[19]

they shall be constructed in accordance with recommendations contained in appropriate standards and regulations.[1)]

When the quantity of plates is not too great, insulated record containers conforming to appropriate national standards and regulations[2)] 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 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 should be placed in another storage area.

10 Plate handling and inspection

10.1 Handling

Proper handling of plates is important. Some plates may be used frequently, generating damage and imposing critical handling and filing requirements. Good housekeeping and cleanliness are essential.

Plates should be handled by their edges and the wearing of clean, thin cotton gloves by the handlers is recommended since fingermarks should be prevented. Dust should be avoided so that the plates do not become scratched and worn enclosures should be replaced.

10.2 Inspection

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

There may be physical changes in the plates (image cracking, adhesion failure, etc.), visual changes in the plates (fading, microblemishes, colour change) or changes in the enclosure materials (embrittlement, discolouration). The cause of the problem should be determined and corrective action taken.

Cracked or broken plates may be wrapped in soft tissue complying with clause 4, or may be sandwiched between two additional glass plates.

If plates have been stored at a temperature below the dew point of the atmosphere where the inspection is to take place, the plate in its enclosure shall first be allowed to warm-up, before opening, to a temperature within a few degrees of that of the inspection room. The time required for heating increases with the volume of the material and the temperature difference.

11 Test methods

11.1 Photographic activity test

The enclosure material and a representative sample of the processed photographic material to be stored shall be placed in close contact. Two such sandwiches shall be subjected to an accelerated aging test, i.e. exposed to a temperature of 50 ± 2 °C and a relative humidity of 86 % for 30 days. No other materials shall be in the same environment as the test materials during this period. At the end of this test, no visual pattern shall be transferred from the enclosure material to the photographic material nor shall the image of the latter be affected. Any image change may be readily determined by having one-half of the photographic image against a piece of filter paper, having a pH between 7,0 and 7,7 during the incubation to serve as a control. Alternatively, paper conforming to the requirements of 4.2 may also be used. Some types of photographic images may undergo a colour or density change due to the incubation conditions. The changes produced by contact with the enclosure material shall be no greater than that produced by the plate in contact with a filter paper control.

These temperature and humidity conditions can be readily obtained by storing the materials in a glass desiccator jar that can be placed in a forced-air circulating oven at 50 °C. The 86 % relative humidity can be obtained by keeping a saturated solution of potassium nitrate in water[20] at the bottom of the jar[3)]. Care shall be exercised so that the saturated solution contains an excess of undissolved crystals at 50 °C. The undissolved crystals shall be completely covered by a layer of saturated salt solution, and the surface area of the solution should be as large as practicable. The jar and salt solution shall be at a temperature of 50 °C for at least 20 h prior to use to ensure adequate equilibrium. Good circulation of air in the desiccator should be accomplished, and this is most easily done by a built-in fan.

Alternatively, exposure to these temperature and humidity conditions may be provided by means of a conditioning air cabinet.

11.2 Alkali reserve test for paper

The paper enclosure material shall be conditioned to 23 ± 1°C and 50 ± 2 % relative humidity. A specimen of approximately 2,5 g shall be weighed to the nearest 0,01 g. It shall then be dispersed in 275 ml of distilled water to form a slurry. The pH shall be measured[7]. A sufficient volume of 0,1 $c(H^+)$ = 0,1 mol/l acid shall be pipetted into the slurry to lower the pH to 3,0. A blank with 275 ml of distilled water shall be prepared, and the same volume of 0,1 $c(H^+)$ = 0,1 mol/l acid as was used with the sample shall be pipetted into the blank. The sample and the blank solutions shall be boiled gently for about 1 min to expel carbon dioxide. After the sample and the blank solutions have cooled to room temperature, they shall each be back titrated with a 0,1 $c(NaOH)$ = 0,1 mol/l standard volumetric sodium hydroxide solution to a pH of 7,0.

1) Example : Publication NFPA No. 232-1981.[3]

2) Example : Class 150 of UL 72-1977.[2]

3) The relative humidity is based on the nominal vapour pressure of the salt solution but the tolerances of this relative humidity cannot be specified.