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# International Standard



# 6051

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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## Photography — Silver image photographic paper prints for record purposes — Storage conditions

*Photographie — Épreuves sur papier photographique à image argentique pour archivage — Conditions de conservation*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

International Standard ISO 6051 was developed by Technical Committee ISO/TC 42, *Photography*, and was circulated to the member bodies in May 1979.

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It has been approved by the member bodies of the following countries :

Australia	Italy	Spain
Belgium	Japan	United Kingdom
Canada	Korea, Rep. of	USA
Czechoslovakia	Libyan Arab Jamahiriya	USSR
France	Netherlands	
Germany, F.R.	Poland	

No member body expressed disapproval of the document.

# Photography — Silver image photographic paper prints for record purposes — Storage conditions

## 0 Introduction

There is a recognized growing need for information on safeguarding photographic prints having legal, scientific, industrial, or historical value. Prints are susceptible to degradation from many sources. These factors may be divided into two general categories :

- a) internal factors, (for example composition and residual chemicals) which are a function of both manufacture and of the processing conditions;
- b) external factors, (for example temperature, humidity, light, storage materials, gaseous pollutants and handling) which are a function of storage conditions.

Together these two categories determine the practical life of a print. This International Standard is concerned only with the external factors of storage conditions.

Proper preservation, therefore, begins with the use of stable materials and of recommended processing procedures. Even if these criteria are optimized, the prints cannot be properly preserved without adequate storage conditions. The environmental conditions and construction materials specified are known to have an important bearing on the storage of photographs. It is recognized that some users may elect to provide a lower level of protection because the limited value of particular prints does not justify the cost of providing adequate storage facilities. It is, however, the intention of this standard to specify the conditions which will provide long life to the photographic print.

## 1 Scope and field of application

This International Standard specifies storage conditions for processed silver image photographic paper prints intended for record purposes. Such photographic papers have images consisting of silver particles in an organic binder layer. These specifications, while intended for materials that are well processed, should also be of considerable value in prolonging the useful life of photographic paper prints whose processing conditions are unknown, or that have been toned, mounted, retouched or bear markings with materials of uncertain or unknown stability. It is not intended to predict or assign a useful lifetime to the photographic prints stored in accordance with the specifications of this International Standard.

## 2 Definitions

**2.1 silver image photographic paper print** : Paper sheet having a silver image in a photographic layer on a base consisting largely of cellulose fibres. The photographic layer is coated either directly on the paper stock, or on a pigmented layer previously applied to the stock, or on a resin layer previously applied to the stock.

**2.2 open enclosure** : Enclosure which is intended for the physical protection of prints against mechanical damage but is neither light-tight nor air-tight. Such an enclosure may be an album, sleeve, envelope, folder, wrapper, or jacket.

**2.3 sealed enclosure** : Light-tight, impermeable container used to protect one or more prints from outside factors such as reactive gases, and moisture, including relative humidity changes.

## 3 Print enclosures

### 3.1 Classification of enclosures

Enclosures used for long-term storage of sheets or rolls of processed photographic paper prints may be divided into two broad classifications : open enclosures and sealed enclosures.

#### 3.1.1 Open enclosures

The purpose of open enclosures is to exclude dirt, to protect the print against mechanical damage and to facilitate identification and handling. They give limited access to ambient air. Therefore, the conditions of the surrounding air should be within the recommended limits of 6.1, 6.2 and 6.3.

Photographic prints in sheet form may be stored in envelopes of paper or plastic foil, folding cartons or file folders. When in direct contact with the surface of the photographic print, the paper or plastic material used for envelopes, sleeves, jackets, folders, and cartons shall meet as a minimum requirement the specifications given in annex A. Suitable enclosure materials are paper and photographic film support materials such as uncoated polyester (polyethylene terephthalate) and cellulose acetate sheeting with no surface coatings and not more than 15 parts of plasticizer per 100 parts of polymer. Polyethylene should be satisfactory since it is generally inert, unplasticized and has good chemical stability.

Materials which should be avoided include glassine envelopes<sup>(1)</sup>, highly plasticized sheetings, formaldehyde based plastics, chlorinated and nitrated plastics, plastics that may contain or form peroxides, and rubber (for example rubber bands). Acrylics may contain harmful catalysts and, therefore, should be avoided. Enclosures shall be fabricated so that no seam can contact the image area of an enclosed print.

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

### 3.1.2 Sealed enclosures

Sealed enclosures and containers or cans are impermeable to gases and vapours and must be used where gaseous impurities and changes in relative humidity lie outside the recommended limits. Materials of construction should be inert and impermeable. It is recommended that anodized aluminium, stainless steel, or steel with a baked enamel finish be used. Containers or cans with threaded twist-on lids and polyolefin gaskets are suitable. Rubber gaskets should not be used.

Telescoping lids may be used, but the joint shall be sealed by two wraps of pressure sensitive adhesive tape having low permeability, high stability and no deleterious ingredients (see 3.1.1). If tape is used, retaping of joints every two years is recommended.

A heat-sealable envelope consisting of 12 µm aluminium foil extrusion coated with clear polyethylene on the inside and laminated to a suitable paper sheet on the outside may also be used as a sealed enclosure. Precautions should be taken in handling these envelopes so that they are not punctured.

When photographic prints are sealed in impermeable sealed enclosures, the prints must first be conditioned to the correct storage temperature and relative humidity.

## 4 Storage housing

Photographic prints should be stored in closed housings such as drawer-type cabinets, or on shelves and racks enclosed by doors. Alternatively, open shelves and racks may be used if the prints are in either open or sealed enclosures. Caution should be exercised in storing paper prints whose processing conditions are unknown or which have been treated or marked with materials of unknown stability. Intermixing of such prints with unaltered prints known to have been subjected to good processing should be avoided.

The storage housing materials should be noncombustible and noncorrosive such as anodized aluminium, stainless steel, or steel with a baked-on enamel finish. Wood, board made from bonded wood shavings or sawdust, cardboard and other natural materials should be avoided because of their combustible nature and the possibility of producing active fading agents on ageing.

The finish on housing materials should be durable and not contribute deleterious effects to the stored photographic

paper. Adverse effects may be produced by finishes containing chlorinated or highly plasticized resins, or by freshly painted or lacquered surfaces.

When air-conditioned individually, storage housings shall be arranged to permit interior circulation of air to all shelves and drawers holding print enclosures to allow uniform humidity conditions. Storage housings located in rooms conditioned in accordance with 6.1 shall be provided with ventilation openings permitting access of air to the interior. Such openings shall not interfere with requirements for fire-protective storage or water and dust protection.

## 5 Storage rooms

The walls of the storage rooms shall be designed to prevent condensation of moisture on interior surfaces and within walls, especially during periods of low exterior temperatures. Provision shall be made for protection against physical damage of prints by fire, mechanical force, or by water from floods, leaks, sprinklers, etc. Good housekeeping is essential. Cabinets, drawers, and shelves for storing prints shall be in air-conditioned rooms, or vaults.

It is recommended that storage rooms include an area for the inspection of prints. The inspection area should be maintained at the same temperature and humidity as the storage room, to avoid curling or distortion.

The value of photographic prints which are to be kept for long periods of time makes it advisable to provide a storage room or vault separate from temporary storage facilities, offices, or work areas. It should be located as far as possible from an urban or industrial area where contaminants (see 6.3.1 and 6.3.2) may be present in harmful concentrations.

Storage rooms have been constructed in caves and mines and have proven very satisfactory when accepted requirements for the environmental conditions (see 6.1 and 6.2) and air purity (see 6.3) are met.

## 6 Environmental conditions

### 6.1 Humidity

The optimum limits for relative humidity of the surrounding air are 30 to 50 % but frequent cycling between these extremes shall be avoided. Relative humidities above 60 % shall be avoided. High moisture content of the air is conducive to mould growth which can completely destroy the image in time; and also the higher the moisture level, the greater is the effect of residual chemicals. A relative humidity lower than 30 % will minimize chemical deterioration, but can cause emulsion brittleness and print curl in the material being stored. These latter effects may, however, be partially reversed by reconditioning at the proper humidity level.

### 6.2 Temperature

Probably the most important aspect of temperature is its effect on relative humidity, since a temperature variation may take it beyond the acceptable range. Photographic papers shall not be

stored above 30 °C for a prolonged period. This high temperature will accelerate the reactions that degrade the image. A temperature in the range 15 to 25 °C is acceptable but daily cycling greater than 4 °C shall be avoided, by thermostatic means, if necessary.

### 6.3 Air entrained impurities (annex B)

#### 6.3.1 Solid impurities

Dust and other airborne solid particles may interfere with legibility and provide a potential abrasion risk when deposited on photographic paper. Reactive dust may in addition, cause fading or staining of the emulsion.

Solid particles shall be removed by mechanical filters from air supplied to housings or rooms used for long-term storage. These are preferably of a dry media type having an arrestance rating of not less than 85 % as determined by tests contained in appropriate national standards and regulations.<sup>[2]</sup> Filters shall be of a noncombustible type, meeting the construction requirements of appropriate national standards and regulations<sup>[3]</sup>.

#### 6.3.2 Gaseous impurities

The most frequently encountered gaseous impurities, especially in industrial and urban atmosphere, are nitrogen oxides, sulphur dioxide, hydrogen sulphide and ozone. These will react with the silver in the emulsion and thereby fade the image. They may also cause staining and decomposition of the base material. The peroxides released by bleached wood, glues, and varnishes that may be used in manufacture of storage cabinets can cause substantial fading of the image. Photographic prints shall not be stored in the same area as cellulose nitrate based photographic film.

Great care should be taken to eliminate these gaseous impurities from the long-term storage environment because even very small concentrations may cause extreme damage. Suitable means for removal of gaseous impurities are available, such as air washers operating with treated water for elimination of sulphur dioxide, and activated charcoal for the adsorption of sulphur dioxide and hydrogen sulphide.<sup>[4]</sup> These require consistent control and, in the case of activated charcoal, proper recycling.

### 6.4 Light

Exposure to direct sunlight may lead to deterioration especially in poorly processed prints. Staining and fading may result. Light sources containing high levels of ultraviolet radiation should be avoided. Tungsten lights and ultraviolet-free fluorescent lamps are recommended for periodic examination when required.

### 6.5 Air conditioning requirements

Properly controlled air conditioning may be necessary for maintaining humidity and temperature within the limits specified

particularly for long-term storage where the requirements are more stringent than for short-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.<sup>[5]</sup> <sup>[6]</sup> They shall also follow recommendations for fire-resistive file rooms in appropriate national standards and regulations.<sup>[6]</sup> Automatic control systems are recommended and they shall be checked frequently with a reliable hygrometer, such as a sling psychrometer.

Where air-conditioning is not practical, high humidities may be lowered by electrical refrigeration-type dehumidifiers, controlled with a humidistat set at the desired humidity level. Dehumidifiers using desiccants should not be used as, with circulating air, they create a danger of fine dust particles, abrasive or reactive, settling on the print (see 6.3). Dehumidification may be required in storage areas such as basements and caves. Owing to their location, they 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 6.1 or if physical troubles are encountered with active files. If humidification is required, a controlled humidifier should be used. Water trays of saturated chemical solutions should not be used because of the serious danger of over-humidification.

## 7 Print handling and inspection

### 7.1 Handling

Well-planned filing systems and proper handling of photographic prints are important. Many classes of prints are viewed frequently and, to avoid damage, critical handling and filing requirements must be imposed. After each use, prints should be inspected for damage or other signs of deterioration. Good housekeeping and cleanliness are essential. Prints should be handled by their edges, and the wearing of thin cotton gloves by the handler is good practice. Worn enclosures should be replaced.

### 7.2 Inspection

Monitoring and inspection of stored prints are important. Infrequently-used prints and inactive files 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 random sampling plan established in advance should be used and a different lot should be inspected each time. If signs of deterioration are noted, corrective action should be taken. Indications that the filing materials are deteriorating should be noted and preventative measures should be carried out. The atmosphere in the area used to inspect prints and to seal the enclosures should be within the limits specified in 6.1 and 6.2.



## Annex A

### Enclosure materials

#### A.1 General material requirements

When photographic prints are stored in enclosures, the chemical inertness and physical characteristics of the enclosure are as important as the properties of the print itself.<sup>[1]</sup> There are several important criteria for a satisfactory enclosure :

a) The material should be free of acids and peroxides which may be released slowly with time and cause image instability or chemical decomposition of the print. For example, the presence of acid in the enclosure paper can cause degradation of the print with which it is in contact.

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

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

c) There must not be any chemical interaction between the particular components of the storage package. This is the purpose of the photographic activity test described in A.2.3.

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

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

#### A.2 Paper requirements

A satisfactory paper enclosure material should be made from rag, bleached sulphite, or bleached kraft pulp with an alpha cellulose content of greater than 87 % and be free from highly lignified fibres such as ground wood. A minimum of sizing chemicals should be used, the amount being dictated by the

requirements of the end-use (filing enclosures, overwraps, interleaving, etc.). Sizing chemicals should be free of unsaturated organic compounds and those containing active chemical groups. The paper should be essentially free from particles of metal or metal compounds. Surface fibres which might offset onto photographic layers should not be present. The paper should not contain waxes, plasticizers, or other ingredients which will transfer to the photographic material during the photographic activity test described in A.2.3.

#### A.2.1 Chemical tests

The paper should be given the following tests. Where International Standards are not available, suitable national standards should be used. References given below serve only as examples.

a) Microscopic analysis of fibres and phloroglucinol spot test for absence of ground wood.

b) Analysis for percent alpha cellulose, which is to be greater than 87 %.<sup>1)</sup>

c) Determination of pH by cold extraction which is to fall within the range of 7 to 9.5.<sup>2)</sup>

#### A.2.2 Physical tests

The paper shall be subjected to physical tests as needed, such as for folding endurance, for tear resistance<sup>3)</sup>, etc. The limits for test values are determined by the grammage<sup>4)</sup> and end-use of the paper.

#### A.2.3 Photographic activity test

The enclosure paper and a representative sample of the processed photographic print to be stored shall be placed in close contact. The sandwich shall be subjected to an accelerated ageing test of  $50 \pm 1$  °C and  $86 \pm 2$  % relative humidity for 30 d. No other materials shall be in the same environment as the test materials during this heating period. At the end of this test, no visual pattern shall be transferred from the enclosure material to the photographic print 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 during the incubation to serve as a control.

1) This may be determined in accordance with appropriate national standards such as TAPPI Standard T-429 os-69 (1969), *Alpha-cellulose in paper*; Technical Association of the Pulp and Paper Industry, 1 Dunwoody Park, Atlanta, Georgia 30341, USA; French standard NF T 12-001, *Cellulose — Dosage des alpha, beta, gamma celluloses*;

2) This may be determined in accordance with appropriate national standards such as TAPPI Standard T-509 su-68 (1968), *Hydrogen ion concentration (pH) of paper extracts — Cold extraction method*; French standard NF Q 03-005, *Détermination du pH du papier*;

3) ISO 1974, *Paper and board — Determination of tensile strength*.

4) ISO 536, *Paper and board — Determination of grammage*.

## Annex B

### Air-entrained and gaseous impurities

When dust and other air-entrained solid particles are deposited on photographic prints, 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 sulphur compounds, peroxides, paint fumes, and other active compounds may cause deterioration of the base and a chemical degradation of the photographic image. The most frequently encountered impurity, especially in urban and industrial atmospheres, is sulphur dioxide and small concentrations are likely to produce detrimental effects. Hydrogen sulphide is not

a common impurity but a very active one even at low concentrations; it can occur in air washers containing decomposed biological slime.

Suitable means for removal of gaseous impurities are available, such as air washers operating with treated water for elimination of sulphur dioxide, and activated charcoal for the adsorption of sulphur dioxide and hydrogen sulphide. These require consistent control and, in the case of activated carbon, expert servicing.

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