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Imaging materials — Methods for the evaluation of the effectiveness of chemical conversion of silver images against oxidation

Matériaux pour image — Méthodes d'évaluation de l'efficacité de la conversion chimique des images argentiques contre l'oxydation

Reference number
ISO 18915:2000(E)

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Foreword

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

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 18915 was prepared by Technical Committee ISO/TC 42, *Photography*.

This first edition cancels and replaces ISO 12206:1995, of which it constitutes a minor revision.

This International Standard is one of a series of International 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 – 18999 (see annex A).

Annex D forms a normative part of this International Standard. Annexes A, B and C are for information only.

Introduction

Silver-gelatin photographs have been used extensively for recording and preserving information of lasting value in all fields of human activity. The long-term stability of these records has become of increasing concern in recent years, because image and support degradation have been found with accelerating frequency in photographic collections and archives.

ISO has published documents on various aspects of the stability and preservation of black-and-white silver-gelatin photographic materials. ISO 18901:—[1] *Imaging materials — Processed silver-gelatin type black-and-white film — Specifications for stability*, provides test methods and criteria for the physical properties, permissible residual processing chemicals, and the image quality of films. ISO 18911:2000, *Imaging materials — Processed safety photographic films — Storage practices*, deals with the conditions required for maintaining and preserving the integrity of photographic films during storage. ISO 18902—[2], *Imaging materials — Processed photographic films, plates and papers — Filing enclosures and storage containers*, pertains to the materials used in contact with stored photographic materials.

If photographic film meets the material and processing specifications of ISO 18901 and is stored in accordance with ISO 18902 and ISO 18911, excellent stability will be obtained. Similarly, photographic paper prints should be stored in accordance with ISO 18920:2000, *Imaging materials — Processed photographic reflection prints — Storage practices*, and processed photographic plates in accordance with ISO 18918:2000, *Imaging materials — Processed photographic plates — Storage practices.*

However, in practical situations it is not always possible to control the storage conditions, particularly with respect to contaminants.

Atmospheric pollutants such as peroxides, sulfur dioxide, ozone and nitrogen dioxide are very detrimental to silver images (see [1] in the bibliography). Such environmental pollutants are of increasing concern in our industrial society. They can cause oxidation of the silver with consequent silver migration. This results in image fading, silver mirroring and redox blemishes (see [2] and [3] in the bibliography). Oxidizing agents that diffuse out of enclosure materials cause similar defects.

Recent studies have shown that silver images can be made resistant to oxidizing pollutants by chemically treating the silver to form silver sulfide (see [4] in the bibliography) or silver selenide (see [5] in the bibliography), or by substitution of the silver by gold (see [6] in the bibliography). Such treatments are recommended when it is not possible to ensure the absence of contaminants, or when the importance of the image justifies the added expense.

This International Standard is an adjunct to the processing requirements and describes methods for evaluating the effectiveness of various treatments which impart greater stability to silver images.

1) To be published. (Revision of ISO 10602:1995)

2) To be published. (Revision of ISO 10214:1991)

Imaging materials — Methods for the evaluation of the effectiveness of chemical conversion of silver images against oxidation

1 Scope

1.1 This International Standard describes methods for evaluating the effectiveness of chemical conversion treatments intended to increase the resistance of wet-processed silver images to oxidation. The treatment may be applied as part of the original processing, or it may be a post-processing treatment.

This International Standard does not recommend general or specific treatments for silver images. Likewise, treatment temperature, times and replenishment rates are outside the scope of this International Standard. Factors to be considered in a stabilizing treatment are discussed in informative annex B.

Two test methods are described: the "dichromate bleach test" and the "hydrogen peroxide incubation test" (see [7] in the bibliography). The significance of each is discussed in informative annex C.

1.2 This International Standard is applicable to silver-gelatin images coated on supports of either plastic, paper or glass.

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 5-2:—[3)], *Photography — Density measurements — Part 2: Geometric conditions for transmission density*.

ISO 5-3:1995, *Photography — Density measurements — Part 3: Spectral conditions*.

ISO 5-4:1995, *Photography — Density measurements — Part 4: Geometric conditions for reflection density*.

3 Terms and definitions

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

3.1
treated silver images
silver images that have been given a specific treatment, either during or after processing, to increase their stability

3) To be published. (Revision of ISO 5-2:1991)

3.2
toned silver images
silver images that have been given a specific treatment, either during or after processing, to modify their colour

4 Dichromate bleach test

4.1 Principle

This test consists of dissolving the treated silver image and measuring the retained density. This retained density is proportional to the silver that has been chemically converted to a non-bleachable compound, or has been substituted by a non-bleachable element.

4.2 Reagents

4.2.1 Bleach solution

A bleach solution shall be prepared by dissolving 90 g of anhydrous potassium dichromate in 1 litre of water. Subsequently, 96 ml of concentrated sulfuric acid shall be slowly added with constant stirring.

WARNING — Avoid contact with the eyes, skin, and clothing. Wash thoroughly after handling. In case of contact, flush eyes and skin with water. Obtain medical attention immediately.

Take care to dispose of dichromate bleach solution in accordance with national and local regulations for hazardous waste disposal.

4.2.2 Clearing solution

The clearing solution shall be prepared by dissolving 100 g of sodium sulfite in 1 litre of water.

4.3 Specimen preparation

Six uniform-density patches shall be prepared on the treated silver material with densities (D) ranging in approximately equal increments from 0,1 above D_{min} to D_{max}.

The exact size of the patches is not critical, provided they cover the aperture of the densitometer and are easy to handle.

4.4 Procedure

Measure the treated silver image on the six uniform-density patches and on the D_{min} for status A blue density. Densities shall be measured on a densitometer having spectral conformance to ISO 5-3. The densitometer shall have geometric conformance to ISO 5-2 for photographic films and plates, and geometric conformance to ISO 5-4 for photographic papers.

Then immerse the specimen in the bleach solution (4.2.1) for 30 s at (20 ± 5) °C, rinse it in water for 2 s, and clear for 30 s in the clearing solution (4.2.2). Then rinse the specimen in water, dry it and remeasure the status A blue density.

4.5 Calculation

The percent density retention is calculated by dividing the blue density after bleaching by the original blue density (after treatment, but before bleaching) and multiplying by 100. Make this calculation for all six uniform-density patches.

With some photographic materials, particularly photographic paper prints, bleaching can cause an increase in the D_{min}. The percent density retention shall be corrected for any D_{min} increase, as shown in normative annex D.

4.6 Significance

The retained density is an approximation of the percentage of silver image that has been converted into substances which are not affected by oxidants or pollutants. A treatment that results in 65 % density retention or more after bleaching for all six density patches is considered a stable image.

NOTE This density retention value is based on the fact that since two-thirds of the image will not be affected by oxidants, there would be no loss of information. Treatments that result in a lower percent density retention may also be very stable, depending upon the image density and type of chemical conversion.

5 Hydrogen peroxide incubation test

5.1 Principle

This test consists of exposing the treated silver images to hydrogen peroxide vapour and measuring the resultant change in density. A small change in density represents an image that is resistant to peroxides.

5.2 Reagents

5.2.1 Hydrogen peroxide, reagent grade, 2 % (*m/m*) solution, freshly prepared from a 30 % stock solution.

WARNING — Hydrogen peroxide is very corrosive. Caution should be used in handling hydrogen peroxide solutions. The stock solutions should be kept refrigerated in vertical vented bottles and kept away from combustibles. Gloves and protective clothing should be worn.

Take care to dispose of hydrogen peroxide solutions according to national and local waste disposal regulations.

5.2.2 Potassium chloride, saturated solution.

5.2.3 Potassium chloride, dry solid.

5.3 Apparatus

5.3.1 Glass desiccator jar, having a nominal inside diameter of 150 mm and a capacity of 2 litres.

5.3.2 Ground plastic desiccator lid[4], fitted with a fan.

The fan motor is attached to the top surface of the desiccator lid with the shaft going through the lid to the fan mounted on the inside surface. There shall be four fan blades, each approximately 25 mm in length. The fan shall rotate at approximately 2 000 r/min.

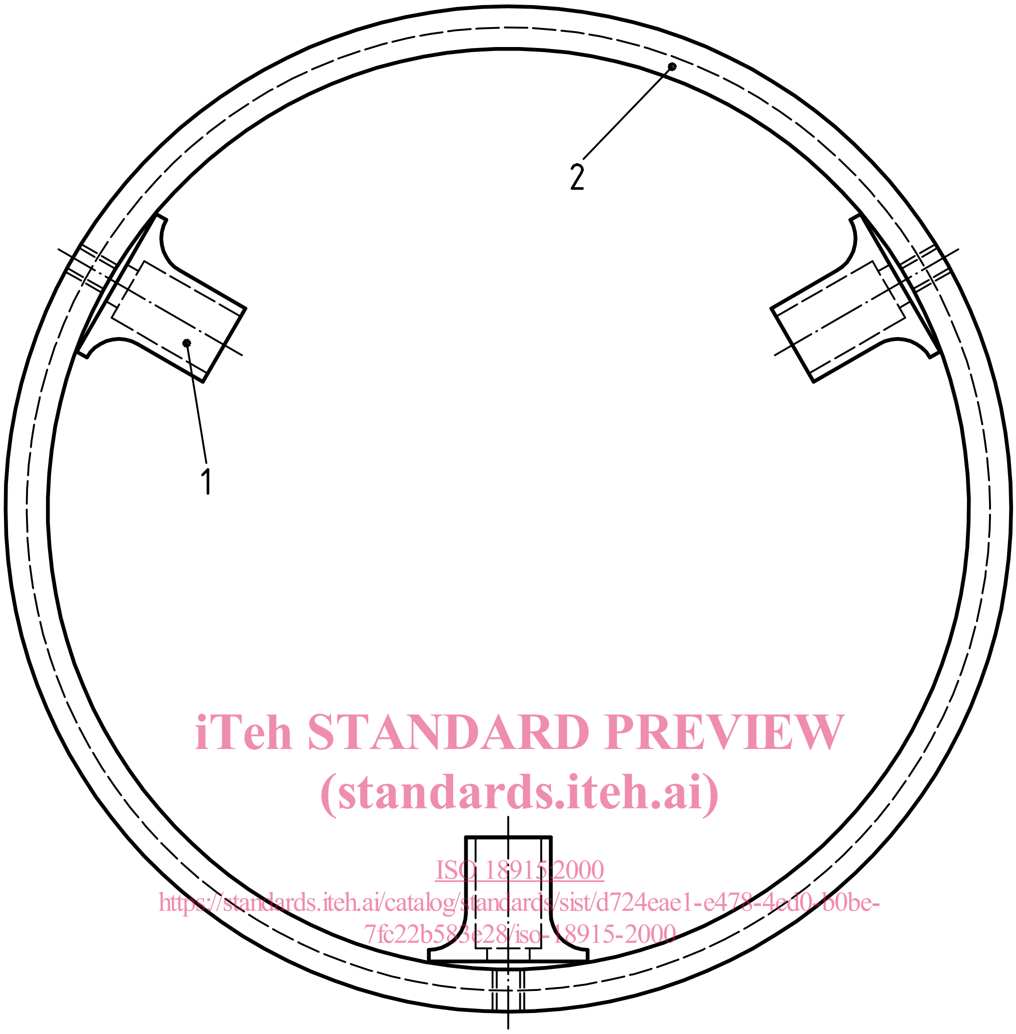
5.3.3 Plastic collar[4], that shall fit snugly inside the desiccator on which the specimens are mounted.

The collar shall be roughly 80 mm in height with an inside diameter of 135 mm and a wall thickness of approximately 7 mm. The collar shall be fitted with three baffles, each approximately 80 mm in length, 20 mm in depth, and 25 mm in width.

NOTE The baffles serve to provide more turbulent air movement and ensure uniform distribution of the hydrogen peroxide vapour. They may be constructed of a hydrogen-peroxide-resistant plastic, such as polycarbonate.

4) Poly(methyl metachrylate) has proven to be an acceptable plastic.

A drawing of the collar and baffles is shown in Figure 1.



Key

1 Baffle

2 Collar

Figure 1 — Drawing of collar and baffles

5.3.4 Perforated porcelain plate, of diameter 140 mm, which fits over the desiccator well.

5.3.5 Petri dish, of capacity 60 ml which fits into the desiccator well and holds a saturated salt solution to regulate the relative humidity.

5.3.6 Circular pad, approximately 40 mm in diameter, made of 0,3 mm chromatography paper or filter paper, with a water flowrate of 100 mm to 150 mm per 30 min, which is wired to the upper side of the perforated porcelain plate with stainless steel wire.

NOTE 1 A suitable chromatography paper is Whatman No. 3 mm CHR paper. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

NOTE 2 The flowrate refers to the capillary rise of water when the paper is partially immersed in water.

5.3.7 Oven, fan-assisted, capable of being maintained at 50 °C ± 2 °C.

The components of the desiccator jar used to expose the test specimens to hydrogen peroxide vapour are given in Figure 2 and the assembled apparatus is shown in Figure 3.

Figure 2 — Desiccator jar components

Figure 3 — Assembled desiccator jar