INTERNATIONAL STANDARD

ISO 14523

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Photography — Processed photographic materials — Photographic activity test for enclosure materials

Photographie — Matériaux photographiques traités — Essai d'activité photographique pour les matériaux de fermeture

Reference number
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Contents

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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.

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 14523 was prepared by Technical Committee ISO/TC 42, *Photography*.

Annexes A and B of this International Standard are for information only.

Introduction

The use of photographic materials for the storage of records having a long-term value has necessitated the development of International Standards to specify important considerations in this field. Satisfactory long-term storage is dependent upon three factors:

a) suitability of photographic materials;

b) satisfactory photographic processing conditions;

c) recommended storage conditions.

International Standards have been published which specify the material requirements for silver-gelatin type film (ISO 10602), diazo film (ISO 8225), and vesicular film (ISO 9718). Specifications for proper processing are also included in these documents. ISO 3897, ISO 5466 and ISO 6051 specify the storage conditions for photographic plates, films, and paper prints, respectively.

In addition to the storage conditions, the filing materials used are extremely important. Processed photographic materials in archival collections require a high degree of individual packaging to protect them from atmospheric influences, dust, and handling damage, and also to keep them from contaminating each other. For this purpose, a wide variety of paper and plastic materials is commercially available, fabricated into boxes, sleeves, envelopes, folders, mat boards, and interleaving tissues. However, it is absolutely essential that these storage enclosures must not themselves cause harm to the photographic image. For optimum stability, storage enclosures and their components must meet the requirements in ISO 10214 which includes passing the criteria of the photographic activity test.

The photographic activity test described in this International Standard is a predictive test of interactions between the storage enclosure and the photographic image. It can also be used to evaluate possible photographic activity caused by components of enclosures such as adhesives, inks, paints, labels and tape.

Photography — Processed photographic materials — Photographic activity test for enclosure materials

1 Scope

This International Standard specifies the procedure for the photographic activity test.

This International Standard applies to general photographic enclosure materials such as paper, tissue, cardboard, mat board, and plastics.

It also applies to components of photographic enclosure materials such as adhesives, inks, paints, labels and tape.

This International Standard evaluates possible chemical or photographic interactions between enclosures with processed silver-gelatin, colour (dye-gelatin) and diazo images after long-term storage. It does not pertain to important criteria of enclosures such as their inherent chemical stability, physical integrity, and workmanship.

Subclause 8.6 applies to interactions between print albums and both black-and-white and colour (dye-gelatin) images.

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 standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5-2:1991, *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 Definitions

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

3.1
image interaction
measurable density change in the image interactions detector

3.2
mottle
localized non-uniform visual density variation in the image interaction detector

3.3
stain
measurable density increase in the stain detector

4 Test conditions

4.1 Principle

The photographic activity test consists of incubating the enclosure material or its component against the surfaces of two sensitive detectors ([1] in annex B). The photographic density of these detectors shall be measured both before and after incubation and the density changes compared with those obtained when the detectors are incubated against a filter-paper control. Three criteria are used to evaluate an enclosure: its tendencies to cause image interaction, stain, and mottle on the detectors. Specific details for each property are given in clauses 5, 6 and 7. The test conditions described in clauses 4 through 7 pertain to paper, cardboard, mat board, interleaving tissue, and plastic enclosures. Modifications of the photographic activity test for enclosure components or interactions with diazo or colour images are given in clause 8.

4.2 Detectors

Two detectors are used in this test, one for image interactions and one for stain.

The image interaction detector is unprocessed colloidal silver (i.e. Carey Lea Silver) in gelatin on a polyester base[1)].

The stain detector is a conventional non-resin-coated black-and-white photographic paper processed to minimum density (D_{min}) according to the manufacturer's instructions.

A suitable non-resin-coated paper is premium-grade print material having a relatively thick emulsion layer. (A warm-tone paper base shall not be used.) The paper shall be processed without development, using a fix, wash, hypo-clearing agent, and wash stages. A satisfactory fix solution is 240 g of sodium thiosulfate pentahydrate and 15 g of anhydrous sodium sulfite added to 1 litre of water at 50 °C. The hypo-clearing agent shall be 5 g of anhydrous sodium sulfite and 26 g of sodium hydrogen sulfite per litre of water. It is recommended that the final washing be for 0,5 h with good agitation. This will avoid uneven leaching of brightener.

NOTE Longer wash times may cause physical distortion. The uniformity of the fluorescent brightener can be checked by examination using a UV lamp.

4.3 Incubation

Sandwiches of the detectors and enclosure material shall be subjected to an accelerated ageing test of 70 °C ± 1 °C and 86 % ± 3 % relative humidity for 15 days. Exposure to these temperature and humidity conditions may be provided by means of a conditioned air cabinet that provides 70 °C ± 1 °C and 86 % ± 3 % relative humidity.

NOTE 1 To minimize moisture condensation when placing the sandwiches in the oven, the sandwiches may be put in the oven when the latter is at room temperature and low humidity. The oven can then be brought to the incubation conditions.

Alternatively, these temperature and humidity conditions can be obtained readily by storing the sandwiches in a desiccator jar that is placed in a forced-air circulating oven at 70 °C. The 86 % relative humidity can be obtained by keeping a saturated solution of barium chloride in water [2, 3], at the bottom of the jar[2)]. Care shall be exercised so that the saturated solution contains an excess of undissolved crystals at 70 °C. The surface area of the solution should be as large as practical.

NOTE 2 Test results obtained in a desiccator are less precise than those obtained in a humidity chamber. This is believed to be due to the absence of circulating air in the former.

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1) The sensitivity of the colloidal silver detector is dependent upon the silver grain size and the degree of hardness. To ensure test sensitivity and reliability, the colloidal silver detector can be obtained from either the Image Permanence Institute, Rochester Institute of Technology, 70 Lomb Memorial Dr., Rochester, NY 14623-5604, USA; Agfa-Gevaert AG, Sparte Bild-Foto, D-51301, Leverkusen, Germany or equivalent.

2) The relative humidity is based on the nominal vapour pressure of the salt solution, but the relative humidity tolerance cannot be specified.

The sandwiches shall not be humidity-conditioned prior to incubation[3]. The sandwiches shall be pulled apart after they are removed from the desiccator or humidity chamber. Failure to do so may result in the adhering of adjacent layers and detectors.

4.4 Measurement

Status A blue diffuse density of the detector strips shall be measured both before and after incubation at four locations for each strip. The after-incubation measurements shall be made at the same location as the before-incubation measurements. The use of a template can aid in establishing the measurement location. Measurements shall not be made at the edges of the strip. Densities shall be measured on a densitometer having spectral conformance to ISO 5-3, and geometric conformance to ISO 5-2 and ISO 5-4. Transmission density shall be determined on the colloidal silver detector and reflection density on the photographic paper stain detector.

5 Image interaction test

5.1 Procedure

A stack of two image interaction test sandwiches shall be made of the enclosure material and the colloidal silver image-interaction detector. A sandwich shall be constructed so that the emulsion side of each image interaction detector strip faces a filter-paper separator as shown in figure 1. These two sandwiches shall consist of two strips of the image interaction detector, two strips of the enclosure material, two strips of a filter-paper separator[4], and two pieces of glass. The glass shall be clean and shall be discarded if there are any signs of corrosion. The enclosure materials and detectors in the sandwich shall be under a pressure of 500 Pa (includes the weight of glass), which can be obtained by adding weights to the sandwich surface. The enclosure material, filter-paper separators, detectors and glass shall be cut into strips having the same dimension, being at least 100 mm × 20 mm. Sandwich construction is facilitated by using a specimen jig (see figure 2) to hold the materials in place.

Two control sandwiches shall also be made using filter paper[5] instead of the enclosure material.

Within any single evaluation, the detector (and the filter paper) shall be from the same batch of material.

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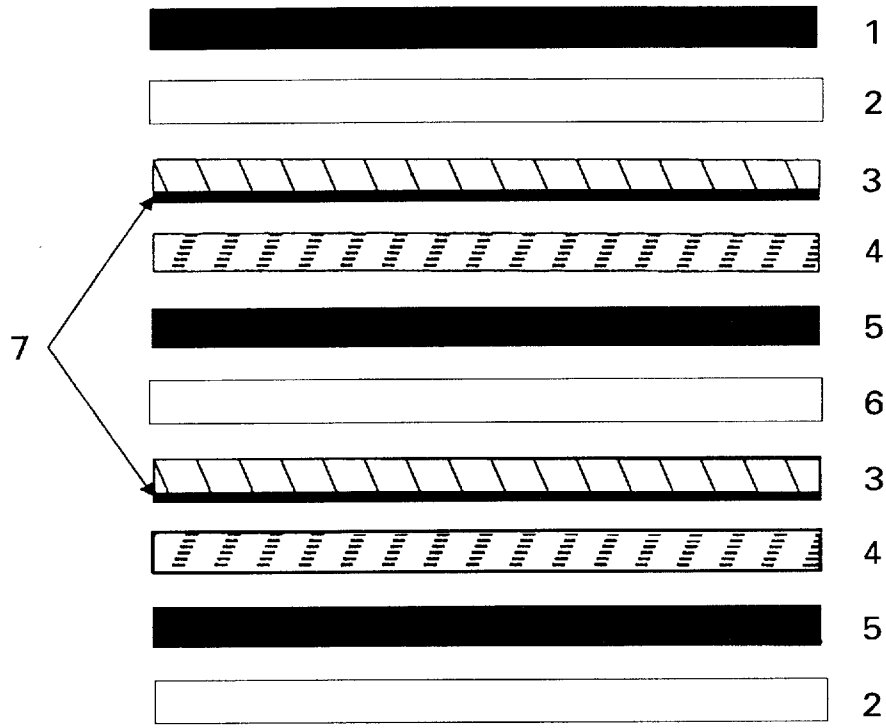
3) Humidity conditioning is not necessary as the 15 day incubation time and narrow specimen size allow moisture equilibration to be reached.

4) The filter-paper separator is used to prevent any physical interactions between smooth impermeable enclosures and the detector, as well as any fibre transfer, enclosure sticking, ink transfer or adhesive sticking to the detector surface.

5) Whatman Number 1 filter paper has proven suitable.



Key

1 Weight to provide 500 Pa (including glass)
2 Glass
3 Image interaction or stain detector
4 Filter-paper separator
5 Enclosure material
6 Uncoated polyester [1)]
7 Colloidal silver or D_{min} silver-gelatin layer

1) Required as an impermeable separator between sandwiches for the stain test only. For the image interaction test, the polyester base of the detector acts as an impermeable separator between sandwiches.

Figure 1 — A stack of two image interaction or stain test sandwiches

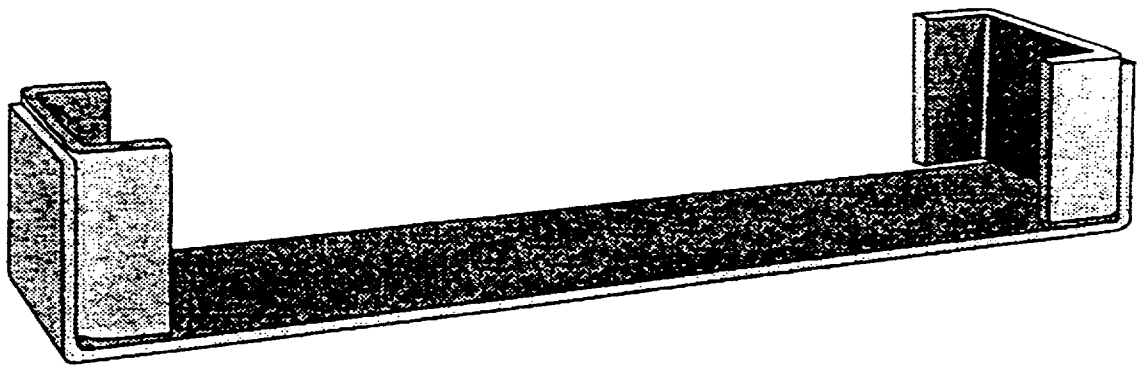


Figure 2 — Specimen jig to hold sandwiches

5.2 Criteria

Image interaction of the colloidal silver detector shall be calculated by subtracting the final Status A blue diffuse transmission density from the initial blue density for each of the four locations on each of the two image interaction detector strips. The before-and-after incubation measurements shall be made at the same location. The mean image interaction and the standard deviation shall be calculated from these eight density changes. The mean and the standard deviation of the image interaction values produced by the filter-paper controls shall also be calculated.

Any fibre pickoff from the filter-paper separators or filter-paper controls onto the detector shall be removed by gentle rubbing. Fibres that are not removed shall be ignored in the evaluation.

The density change of the detector in contact with the enclosure material shall be calculated as a percentage of the change shown by the detector in contact with the filter-paper control using the following formula:

$$X = \frac{\Delta D_e - \Delta D_f}{\Delta D_f} \times 100$$

where

X is the image interaction difference, expressed as a percentage;

ΔD_e is the density change of the enclosure detector;

ΔD_f is the density change of the filter-paper control detector.

The enclosure material shall not produce a percent image interaction difference in the colloidal silver fade detectors greater than ± 20 % for the control.

NOTE A large percent image interaction difference indicates a chemical effect of the enclosure (see annex A).

6 Stain test

6.1 Procedure

A stack of two stain test sandwiches shall be made of the enclosure materials and the D_{min} processed photographic paper stain detector. A sandwich shall be constructed so that the emulsion side of each stain-detector strip faces a filter-paper separator as shown in figure 1. These two sandwiches shall consist of two strips of the stain detector, two strips of the enclosure material, two strips of filter-paper separator, one strip of uncoated polyester and two pieces of glass. The uncoated polyester strip shall be used as shown in figure 1 to act as an impermeable separator between sandwiches within the stack.

The enclosure materials and detectors in the sandwich shall be under a pressure of 500 Pa (including the weight of the glass), which can be obtained by adding weights to the sandwich surface. The enclosure material, detectors and glass shall be cut into strips having the same dimension, being at least 100 mm × 20 mm. Sandwich construction is facilitated by using a specimen jig to hold the materials in place.

Two control sandwiches shall also be made using filter paper[6] instead of the enclosure material.

Within any single evaluation, the detector (and the filter paper) shall be from the same batch of material.

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6) Whatman Number 1 filter paper has proven suitable.

6.2 Criteria

Stain shall be calculated by subtracting the initial Status A blue reflection density from the final blue reflection density for each of the four locations on each of the two stain detector strips. The before- and after-incubation measurements shall be made at the same location. The mean stain and the standard deviation shall be calculated from these eight density changes. The mean and the standard deviation of the stain values produced by the filter-paper controls shall also be calculated.

The enclosure material shall not produce a mean stain in the photographic paper stain detector that is greater than the mean stain produced by the filter-paper controls plus 0,08 density units.

7 Mottle test

7.1 Procedure

Evaluation for mottling shall be made by evaluating the colloidal silver image-interaction detector after incubation as described in 4.3 and 5.1.

7.2 Criteria

The image interaction detector shall also be evaluated visually for the presence of mottling. This shall be done by transmitted light using a light table or transparency viewer. The enclosure material shall not produce easily recognizable mottling.

8 Specific procedures

8.1 General

The test conditions described in clauses 5, 6, and 7 pertain to general enclosure materials such as paper, cardboard, mat board, interleaving tissue, and plastic sheeting. Modifications to this procedure are required for specific materials and applications.

8.2 Adhesives, inks and paints

Adhesives, inks and paints shall be tested by applying these materials to filter paper (see figure 3). After the adhesive, ink, or paint is dried, this surface of the filter paper shall be placed in contact with a filter-paper separator[7] which shall be adjacent to the detector.

Adhesives, inks, and paints shall be applied to the filter paper with approximately the same coverage as used in the finished enclosure[8]. These materials shall be allowed to dry for 48 h prior to assembling the test sandwiches.

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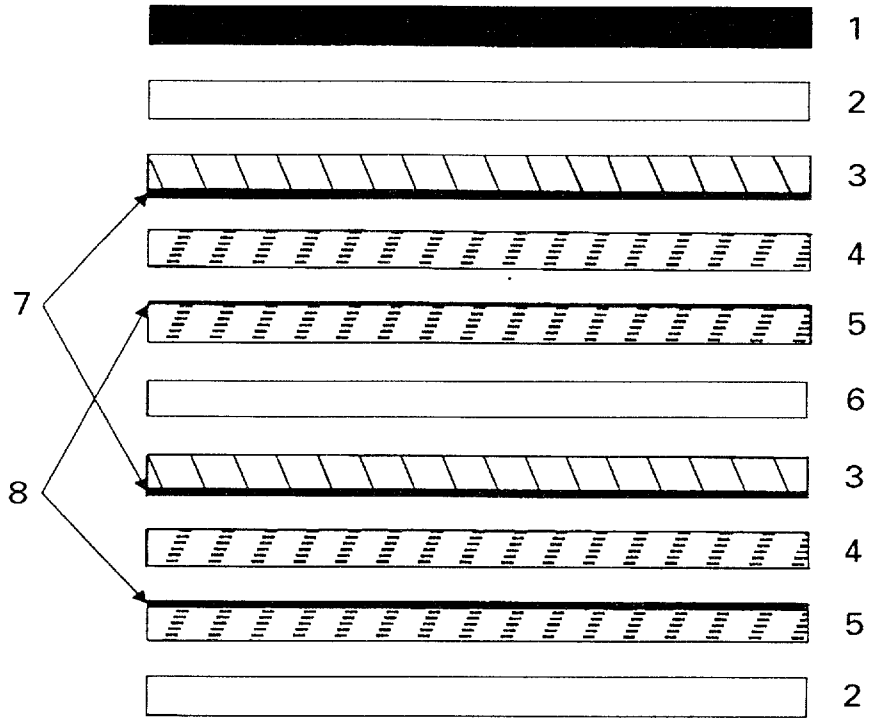
7) The filter-paper separator is used to prevent any physical interactions between smooth impermeable enclosures and the detector, as well as any fibre transfer, enclosure sticking, ink transfer or adhesive sticking to the detector surface.

8) The manufacturer's recommendations should be followed, if available.



Key

1 Weight to provide 500 Pa (including glass)
2 Glass
3 Image interaction or stain detector
4 Filter-paper separator
5 Filter paper
6 Uncoated polyester [1)]
7 Colloidal silver or D_{min} silver-gelatin layer
8 Adhesive, ink or paint layer

1) Required as an impermeable separator between sandwiches for the stain test only. For the image interaction test, the polyester base of the detector acts as an impermeable separator between sandwiches.

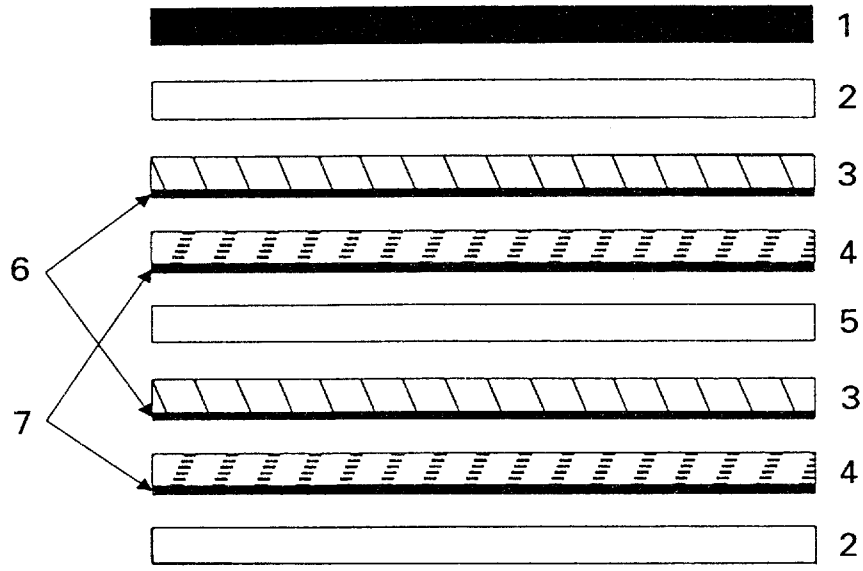
Figure 3 — A stack of two image interaction or stain test sandwiches for adhesives, inks or paints

8.3 Labels and tape

Labels and tape shall be tested by applying those materials to filter paper. Both the adhesive and carrier surfaces shall be tested.

The adhesive surface shall be tested as described in clauses 5, 6 and 7 and as illustrated in figure 4. A filter-paper separator shall not be used since the filter-paper support for the label or tape acts as a separator.

The carrier surface (with any printing) shall also be tested as described in clauses 5, 6 and 7. A filter-paper separator shall be used, as illustrated in figure 5.

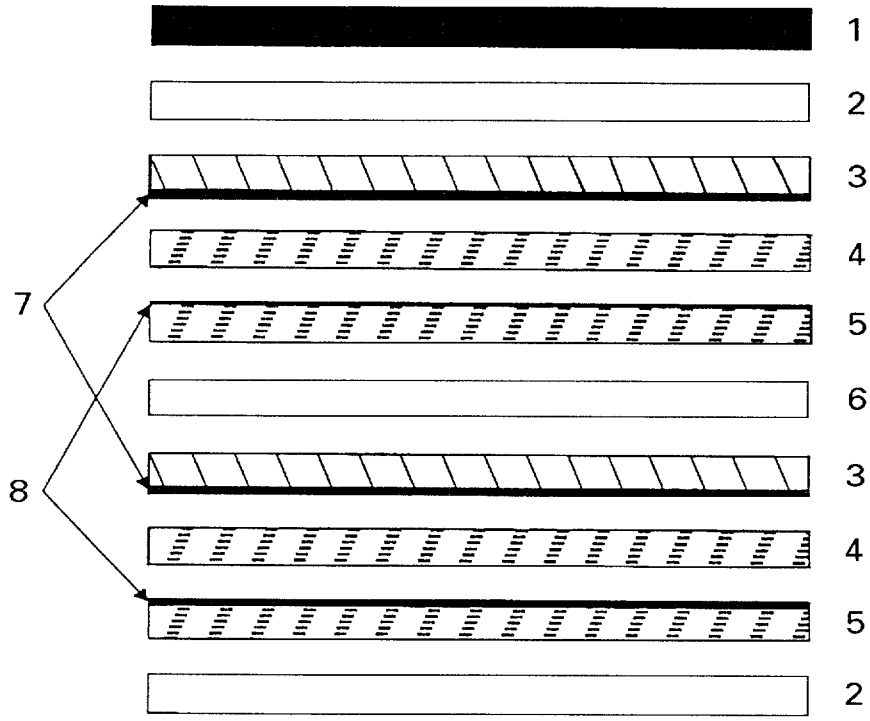


Key

1 Weight to provide 500 Pa (including glass)
2 Glass
3 Image interaction or stain detector
4 Filter paper
5 Uncoated polyester [1)]
6 Colloidal silver or D_{min} silver-gelatin layer
7 Label or tape on filter paper

1) Required as an impermeable separator between sandwiches for the stain test only. For the image interaction test, the polyester base of the detector acts as an impermeable separator between sandwiches.

Figure 4 — A stack of two image interaction or stain test sandwiches for labels and tape — adhesive side



Key

1 Weight to provide 500 Pa (including glass)
2 Glass
3 Image interaction or stain detector
4 Filter-paper separator
5 Filter paper
6 Uncoated polyester [1)]
7 Colloidal silver or D_{min} silver-gelatin layer
8 Label or tape on filter paper

1) Required as an impermeable separator between sandwiches for the stain test only. For the image interaction test, the polyester base of the detector acts as an impermeable separator between sandwiches.

Figure 5 — A stack of two image interaction or stain test sandwiches for labels and tape — carrier side

8.4 Chromogenic photographic images

8.4.1 Detectors

The two detectors described in 4.2 shall be used. A second stain detector shall be a processed D_{min} specimen of the reflection chromogenic print material of interest.

NOTE This test is very product-specific. It cannot be assumed that all types of chromogenic images will react similarly to an enclosure.

8.4.2 Incubation

The black-and-white stain and colloidal silver image-interaction detectors shall be incubated as discussed in 4.3 and clauses 5 and 6. The chromogenic stain detectors shall be incubated for 15 days at 60 °C ± 1 °C and 86 % ± 3 % relative humidity[9]. The procedure and salt solution to obtain this condition are given in 4.3. The sandwiches shall be constructed as shown in figure 1.

8.4.3 Measurement

The black-and-white stain and colloidal silver image-interaction detectors shall be evaluated as described in 4.4. Measurements on the chromogenic stain detector shall be made with a densitometer using red, green, and blue Status A filters. Eight measurements shall be made for each colour, resulting in 24 in total for the chromogenic stain detector.

8.4.4 Criteria

The colloidal silver detector and the detectors for stain and mottle shall pass the criteria given in 5.2, 6.2 and 7.2.

8.5 Diazo images

8.5.1 Detectors

The colloidal silver image-interaction detector described in 4.2 shall be used. However, the stain detector is not required since staining is not a problem with diazo films. A second image interaction detector shall be processed samples of the diazo material of interest with a visual diffuse density of 1,0 ± 2,0.

8.5.2 Incubation

The colloidal silver and the diazo image-interaction detectors shall be incubated for 15 days at 70 °C ± 1 °C and 86 % ± 3 % relative humidity, as described in 4.3. The sandwiches shall be constructed as shown in figure 1.

8.5.3 Measurement

Status A blue diffuse density of the colloidal silver image-interaction detector shall be measured as described in 4.4. Visual diffuse density of the diazo image-interaction detector shall be measured.

8.5.4 Criteria

The detectors shall meet the criteria for image interaction as described in 5.2 and for mottle, as described in 7.2.

Many diazo detectors show a density change of less than 0,5 when incubated against the filter-paper control. In such cases, the acceptable density difference from the filter-paper control shall not be greater than 0,10.

The enclosure material shall not produce easily recognizable discolouration, mottle, or deposition on the diazo detector greater than that found with the filter-paper control when evaluated visually using both transmitted and reflected light.

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9) The lower incubation temperature for the chromogenic detectors is to reduce the level of staining that may occur at 70 °C by the chromogenic images themselves. These could mask the effects of the enclosure.

8.6 Colour print albums[10)]

8.6.1 Detector

The two detectors described in 4.2 shall be used. A second detector shall be a processed D_{min} specimen of the reflection chromogenic print material of interest.

NOTE This test is very product-specific. It cannot be assumed that all types of chromogenic images will react similarly to an enclosure.

8.6.2 Incubation

The black-and-white stain detector and the colloidal silver image-interaction detector shall be tested against both the plastic cover sheet and the backing page of the album. Incubation shall be for 15 days at 60 °C ± 1 °C and 86 % ± 3 % relative humidity, as described in 4.3. The controls for these detectors shall be filter paper against the emulsion surface, incubated under the same conditions.

The chromogenic stain detectors shall be placed in a portion of the album page under study, duplicating its use configuration. Incubation shall be for 15 days at 70 °C ± 1 °C[11)] and 86 % ± 3 % relative humidity. The filter-paper control shall be tested against the emulsion surface and incubated under the same conditions.

8.6.3 Measurement

The detectors shall be measured for density changes as described in 4.4 and 8.4.3.

8.6.4 Criteria

The detectors shall pass the criteria for image interaction and stain given in 5.2 and 6.2.

9 Test report

The test report shall contain the following information:

a) a reference to this International Standard;

b) enclosure material identification;

c) whether the enclosure material passes or fails the image interaction test;

d) the percent image interaction difference from the filter-paper control;

e) whether the enclosure material passes or fails the stain test;

f) the mean stain in the stain detector caused by the enclosure material and by the filter-paper control;

g) whether the enclosure material passes the mottle test;

h) if detectors, in addition to the colloidal silver image interaction and the paper stain detectors, were used in the image interaction, stain and mottle results.

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10) The photographic activity tests in the subclauses 8.2 to 8.5 evaluate the sensitivity of enclosures or their components but do not simulate the practical interactions between print albums and chromogenic prints. This subclause is intended to duplicate the latter situation.

11) The lower incubation temperature for the chromogenic detectors is to reduce the level of staining that may occur at 70 °C by the chromogenic images themselves. These could mask the effects of the enclosure.

Annex A
(informative)

Colloidal silver image-interaction detector

For accurate detection of potential image degradation, the most important attribute of a detector is the microstructure of its silver image. The size, shape, and spacing of the individual silver particles determine, to a great extent, how susceptible the detector is to density change. Those silver materials that show the greatest change in response to the incubation conditions are likely to be the best detectors of image attack. Incubation tests ([1] in annex B) have shown that the most sensitive material to this incubation was colloidal (Carey Lea) silver in gelatin on a polyester film base. Coatings of this type were described in 1972 by Edith Weyde of Agfa-Gevaert [4].

Colloidal silver coatings showed large density changes when incubated in contact with known harmful materials. In addition to overall density changes, they also became mottled in the presence of reactive substances. These materials were found to be much more sensitive to image interaction and mottle than conventional silver images. Consequently, colloidal silver is very suitable as an image interaction detector in the photographic activity test where maximum sensitivity is desired.

When colloidal silver is incubated at 70 °C 86 % r.h., some of the visible metallic silver is oxidized to invisible ionic silver. This generally results in a density decrease. Moreover, when colloidal silver is incubated in the presence of oxidizing agents, increased oxidation and consequently a greater density decrease is obtained. Therefore, if colloidal silver incubated in contact with an enclosure material shows a greater density decrease than when incubated in contact with a filter-paper control, it indicates the presence of oxidizing agents in the enclosure; that is, after incubation, the detector density with the enclosure is less than the detector density with the filter-paper control. This is reflected in a positive value for the percent image interaction difference (see 5.2).

However, incubation in the photographic activity test can also cause an increase in density of the colloidal silver detector. This may reflect reduction of any ionic silver that is present. Alternatively, it can also reflect oxidation since the density can either increase or decrease depending upon the size of the original colloidal silver particles [5].

In either case, a density change caused by the enclosure which is significantly greater than that found with filter paper indicates an objectionable degree of chemical activity of the former.

Annex B
(informative)

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[6] ISO 3897:1997, *Photography — Processed photographic plates — Storage practices.*

[7] ISO 5466:1996, *Photography — Processed safety photographic films — Storage practices.*

[8] ISO 6051:1997, *Photography — Processed reflection prints — Storage practices.*

[9] ISO 8225:1995, *Photography — Ammonia-processed diazo photographic film — Specifications for stability.*

[10] ISO 9718:1995, *Photography — Processed vesicular photographic film — Specifications for stability.*

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

[12] ISO 10602:1995, *Photography — Processed silver-gelatin type black-and-white film — Specifications for stability.*

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