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Imaging materials — Processed imaging materials — Photographic activity test for enclosure materials

Matériaux pour l'image — Matériaux pour l'image traités — Essai d'activité photographique pour les matériaux de fermeture

Reference number
ISO 18916:2007(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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18916 was prepared by Technical Committee ISO/TC 42, *Photography*.

This first edition cancels and replaces ISO 14523:1999, which has been technically revised.

This corrected version incorporates corrections to 4.2.2 and 4.2.3, which in this corrected version have been combined into 4.2.2 because there is only one stain detector required for testing, not two.

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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. The important elements affecting the useful life of imaging materials are as follows:

a) humidity and temperature of the storage environment;

b) hazards of fire, water, and light exposure;

c) fungal growth;

d) contact with certain chemicals in solid, liquid or gaseous form;

e) physical damage;

f) proper processing;

g) enclosures and containers in contact with the imaging material.

International Standards have been published which specify the material requirements for silver-gelatin type film (ISO 18901), diazo film (ISO 18905), and vesicular film (ISO 18912). Specifications for proper processing are also included in these documents. ISO 18918, ISO 18911, and ISO 18920 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 albums, boxes, sleeves, envelopes, folders, mat boards, and interleaving tissues. However, it is absolutely essential that these storage enclosures not cause harm to the photographic image. For optimum stability, it is necessary that storage enclosures and their components meet the requirements in ISO 18902, 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.

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Imaging materials — Processed imaging materials — Photographic activity test for enclosure materials

1 Scope

This International Standard specifies the procedure for the photographic activity and dye coupler reactivity tests.

This International Standard is applicable to general photographic enclosure materials such as paper, tissue, cardboard, mat board and plastics. It is also applicable to components of photographic enclosure materials such as adhesives, inks, paints, labels, and tape.

This International Standard evaluates possible chemical interactions between enclosures with processed silver-gelatin, colour (dye-gelatin), inkjet prints made with dye-based and pigment-based inks, thermal dye diffusion transfer ("dye sub") prints, digitally printed dye-diffusion-transfer prints, liquid- and dry-toner xerographic prints, liquid-toner electrostatic prints, and diazo images after long-term storage. It does not pertain to harmful physical interactions such as blocking (sticking together), dye bleed, adhesive migration, or plasticizer exudation. It does not pertain to important criteria of enclosures such as their inherent chemical stability, physical integrity, and workmanship. Passing the photographic activity test (PAT) does not indicate that a material is archival. This term has no clear definition and is not used in this standard. Photo-safe, storage enclosures and their components are covered in ISO 18902, which includes passing the criteria of the photographic activity test.

If a particular brand of commercially made enclosure materials is found to be safe for long-term storage purposes, there is no assurance that subsequent batches will contain the same ingredients of the same purity, chemical inertness, concentrations, or sound and sturdy construction. For this reason, materials are tested annually or upon each formulation or supplier change. For materials which are manufactured in a variety of colours, such as papers and inks, each colour is evaluated and reported separately.

For enclosures intended for use with any of the above imaging processes, only the black-and-white PAT described in Clauses 4 to 7 are applicable. The dye coupler reactivity test is optional as the results are valid only for the specific colour print product being investigated. Different colour print products can have different staining sensitivities.

For enclosures intended for use with diazo images, only the diazo PAT described in 8.5 is applicable.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5-2:2001, *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*

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3 Terms and definitions

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

3.1
image interaction
measurable density change in the image interaction

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

3.3
stain
measurable density increase in the stain detector

3.4
blocking
sticking together of similar or dissimilar materials in physical contact

4 Test conditions

4.1 Principle

The photographic activity test applies to processed silver-gelatin, colour (dye-gelatin), inkjet prints made with dye-based and pigment-based inks, thermal dye diffusion transfer ("dye sub") prints, digitally printed dye-diffusion-transfer prints, liquid- and dry-toner xerographic prints, liquid-toner electrostatic prints, and diazo images. The test consists of incubating the enclosure material or its component against the surfaces of two sensitive detectors [1]. The photographic density of these detectors is 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, i.e. its tendencies to cause image interaction, stain, and mottle on the detectors. Specific details for each property are given in Clauses 5 to 7. The test conditions described in Clauses 4 to 7 pertain to paper and plastic enclosures. Modifications of the photographic activity test for enclosure components or interactions with diazo images or the residual dye couplers in colour photographic prints are given in Clause 8.

4.2 Apparatus and materials

4.2.1 Image interaction detector, consisting of unprocessed colloidal silver (i.e. Carey Lea silver) in gelatin on a polyester base [1)].

4.2.2 Stain detector, consisting of a conventional non-resin-coated premium-grade black-and-white photographic paper having a relatively thick emulsion layer, processed to minimum density (D_{min}) according to the manufacturer's instructions. (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.

4.2.3 Fix solution, consisting of 240 g of sodium thiosulfate pentahydrate and 15 g of anhydrous sodium sulfite added to 1 l of water at 50 °C.

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 the Image Permanence Institute, Rochester Institute of Technology, 70 Lomb Memorial Dr., Rochester, NY 14623-5604, USA, or equivalent. 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.

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4.2.4 Hypo-clearing agent, consisting of 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 can cause physical distortion. The uniformity of the fluorescent brightener can be checked by examination using a UV lamp.

4.3 Incubation

Subject sandwiches of the detectors and enclosure material to an accelerated ageing test of 70 °C ± 1 °C and 86 % RH ± 3 % RH 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 % RH ± 3 % RH relative humidity.

To minimize moisture condensation when placing the sandwiches in the oven, put the sandwiches in the oven when it is at 70 °C ± 1 °C and 40 % RH ± 3 % RH. After the samples have equilibrated to test temperature (approximately one hour) the humidity can then be brought to 86 % RH ± 3 % RH.

Pull the sandwiches apart immediately after they are removed from the humidity chamber. Failure to do so may result in the adhering of adjacent layers and detectors.

4.4 Measurement

Measure the Status A blue diffuse density of the detector strips both before and after incubation at four locations for each strip. Make the after-incubation measurements at approximately the same locations as the before-incubation measurements. Measurements shall not be made at the edges of the strip. After incubation of highly mottled or unevenly stained samples, it may be necessary to take density readings at different locations on the same detector than the readings taken before incubation to ensure the reacted areas on the detector are measured. Use a densitometer having spectral conformance to ISO 5-3, and geometric conformance to ISO 5-2 and ISO 5-4 for the measurements. Determine the transmission density on the colloidal silver detector and reflection density on the photographic paper stain detector.

5 Image interaction test

5.1 Procedure

Make a stack of two image interaction test sandwiches of the enclosure material and the colloidal silver image interaction detector. Construct a sandwich 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 (see Note), and two pieces of glass. The glass shall be clean and shall be discarded if there are any signs of corrosion. Apply a pressure of 500 Pa to the enclosure materials and detectors in the sandwich (including the mass of glass), which can be obtained by adding weight pieces to the sandwich surface. Cut the enclosure material, filter paper separators, detectors and glass into strips having the same dimension, being at least 30 mm × 20 mm. Sandwich construction is facilitated by using a specimen jig (see Figure 2) to hold the materials in place.

NOTE 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.

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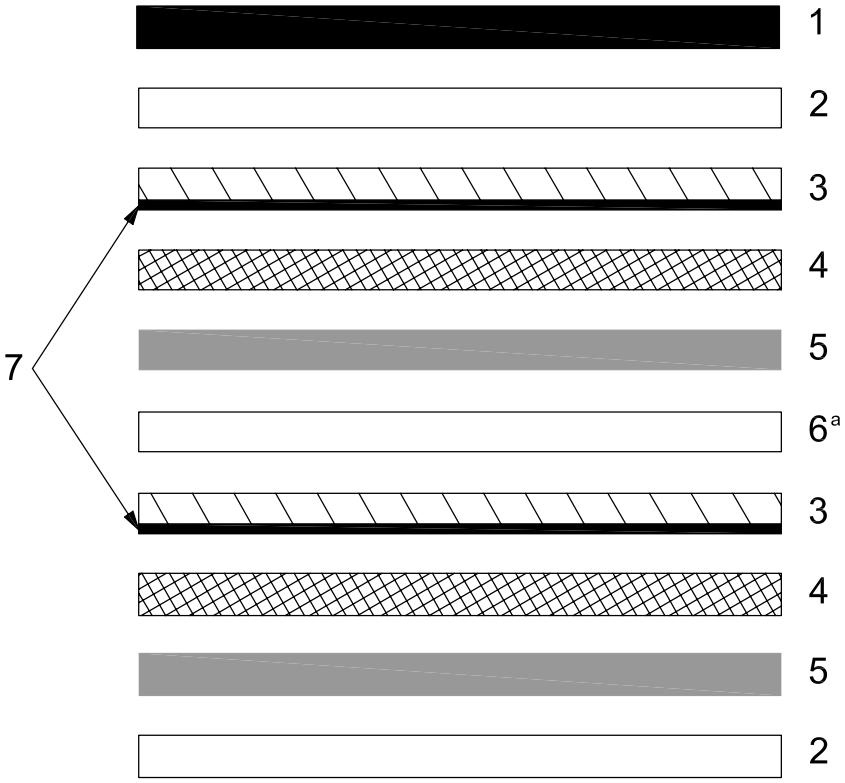
Make two control sandwiches using filter paper [2)] instead of the enclosure material.

Within any single evaluation, use the same batch of materials for the detectors as well as for the filter paper for both the sample and the controls.



Key

1 weight piece to provide 500 Pa (including top glass)
2 glass
3 image interaction or stain detector
4 filter paper separator
5 enclosure material
6 uncoated polyester
7 colloidal silver of D_{min} silver-gelatin layer

[a] 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

2) Whatman Number 1 filter paper has proven suitable. 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.

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Figure 2 — Specimen jig to hold sandwiches

5.2 Calculation

Calculate the image interaction of the colloidal silver detector 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. Calculate the mean image interaction from these eight density changes. Also calculate the mean of the image interaction values produced by the filter paper controls.

Ignore any fibre pickoff from the filter paper separators or filter paper controls on the detector in the evaluation.

Calculate the density change of the detector in contact with the enclosure material as a percentage of the change shown by the detector in contact with the filter paper control using the following equation:

$$X = \frac{\Delta D_{\mathrm{e}} - \Delta D_{\mathrm{f}}}{\Delta D_{\mathrm{f}}} \times 100$$

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.

5.3 Requirements

The enclosure material shall not produce a percentage image interaction effect in the colloidal silver fade detectors greater than a relative difference of more than $\pm$ 20 % compared to 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

Make a stack of two stain test sandwiches of the enclosure materials and the D_{min} processed photographic paper stain detector. Construct a sandwich 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. Use the uncoated polyester strip as shown in Figure 1 to act as an impermeable separator between sandwiches within the stack.

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Make two control sandwiches using filter paper [3)] instead of the enclosure material.

Within any single evaluation, use the same batch of materials for the detectors as well as for the filter paper for both the sample and the controls.

6.2 Calculation

Calculate the stain 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. Calculate the mean stain from these eight density changes. Also calculate the mean of the stain values produced by the filter paper controls.

6.3 Requirements

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

Determine the mottling on the colloidal silver image interaction detector for samples subjected to the incubation and image interaction test described in 4.3 and 5.1. Perform a visual evaluation of the image interaction detector at a distance of approximately 50 cm for the presence of mottling by transmitting light using a light table or other even light source.

7.2 Requirements

The enclosure material shall not produce *easily recognizable* mottling (see Annex B).

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

Test adhesives, inks, and paints by applying these materials to filter paper (see Figure 3). After the adhesive, ink, or paint is dried, place this surface of the filter paper in contact with a filter paper separator (see Note) which shall be adjacent to the detector.

NOTE 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.

3) Whatman Number 1 filter paper has proven suitable. 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.

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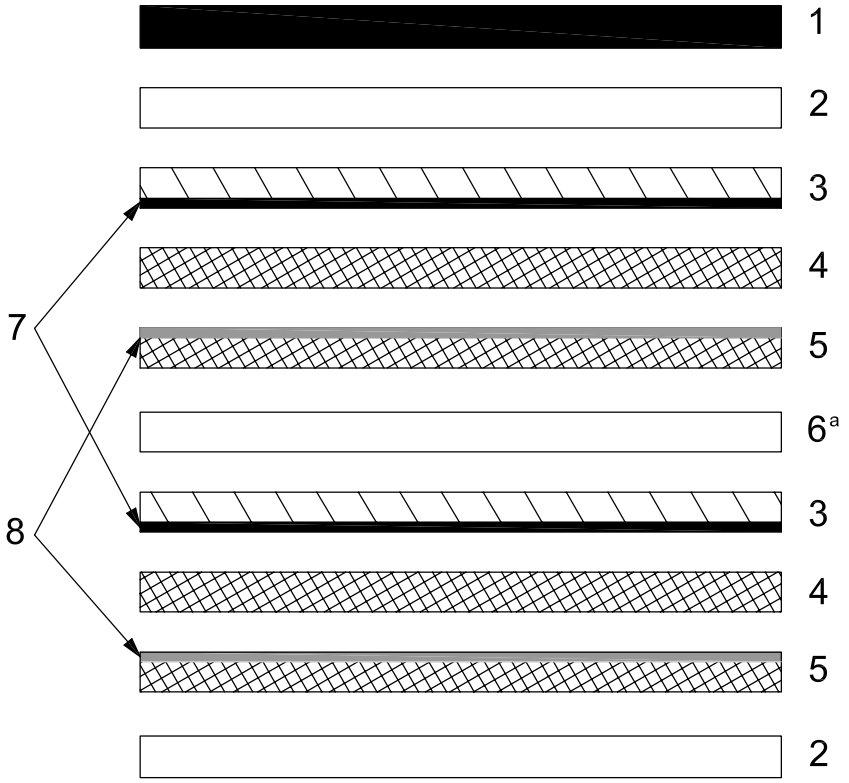
Apply adhesives, inks, and paints to the filter paper according to the manufacturer's published recommendations using the final dispensing mechanism and using approximately the same coverage as intended in the final application. Pen inks should be applied in non-overlapping lines. Allow these materials to dry for 48 h prior to assembling the test sandwiches.



Key

1 weight to provide 500 Pa (including top glass)
2 glass
3 image interaction or stain detector
4 filter paper separator
5 filter paper
6 uncoated polyester
7 colloidal silver or D_{min} silver-gelatin layer
8 adhesive, ink or paint layer

[a] 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

Test labels and tape by applying these materials to filter paper. Test both the adhesive and carrier surfaces. Place the double-sided tapes and transfer adhesives between two strips of filter paper. If doubled-sided tapes have different adhesives on each side, then evaluate and report each side separately.

Test the adhesive as described in Clauses 5 to 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.

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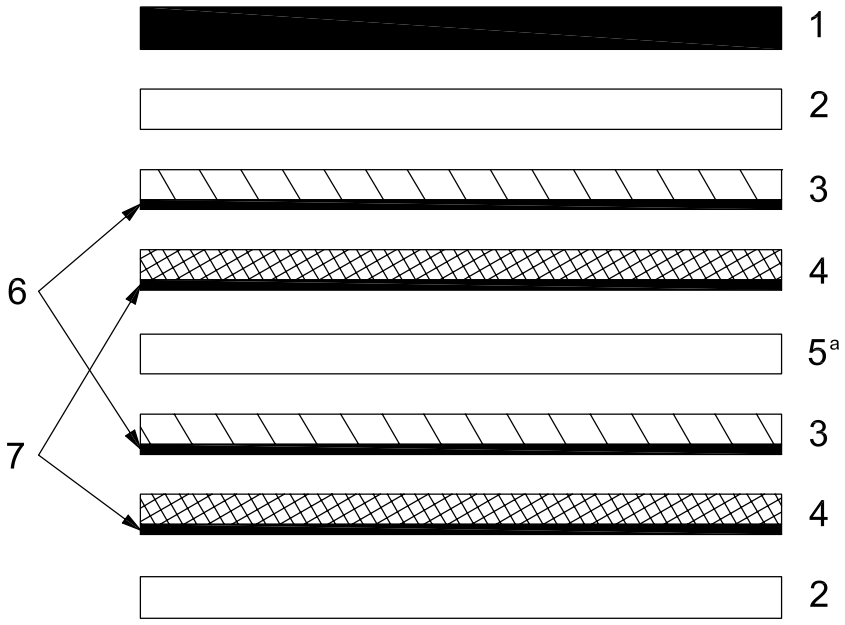
Also test the carrier surface (with any printing) as described in Clauses 5 to 7. Use a filter paper separator as illustrated in Figure 5.



Key

1 weight to provide 500 Pa (including top glass)
2 glass
3 image interaction or stain detector
4 filter paper
5 uncoated polyester
6 colloidal silver or D_{min} silver-gelatin layer
7 label or tape on filter paper

[a] 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)

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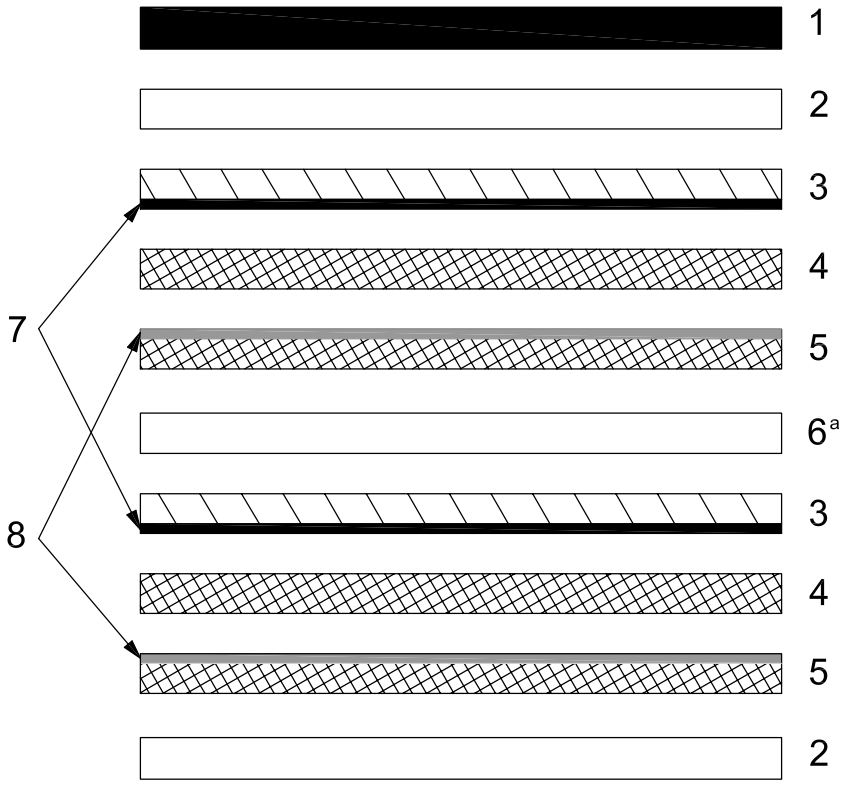

Key

1 weight to provide 500 Pa (including top glass)
2 glass
3 image interaction or stain detector
4 filter paper separator
5 filter paper
6 uncoated polyester
7 colloidal silver or D_{min} silver-gelatin layer
8 label or tape on filter paper

[a] 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 Dye coupler reactivity test

8.4.1 Detectors

The dye coupler reactivity 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 dye couplers will react similarly to an enclosure.

8.4.2 Incubation

Incubate the dye coupler reactivity detectors for 15 days at 60 °C ± 1 °C and 86 % RH ± 3 % RH (see Note) in accordance with the procedure given in 4.3. Construct the sandwiches as shown in Figure 1.

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

8.4.3 Measurement

Use a densitometer using red, green, and blue Status A filters to make measurements on the dye coupler reactivity detector. Make eight measurements for each colour, making a total of 24 measurements for the dye coupler reactivity detector.

8.4.4 Requirements

The dye coupler reactivity detector shall pass the criteria given in 6.3.

8.5 Diazo images

8.5.1 Detectors

The image interaction detector shall be processed samples of the diazo material of interest with a visual diffuse density of 1,0 ± 0,2. The stain detector is not required since staining is not a problem with diazo films.

8.5.2 Incubation

Incubate the diazo image interaction detectors for 15 days at 70 °C ± 1 °C and 86 % RH ± 3 % RH, as described in 4.3. Construct the sandwiches as shown in Figure 1.

8.5.3 Measurement

Measure the visual diffuse density of the diazo image interaction detector.

8.5.4 Requirements

The detectors shall meet the requirements for image interaction as specified in 5.3 and for mottle as specified 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.

9 Test report

The test report shall contain the following information:

a) a reference to this International Standard, ISO 18916:2007;

b) all enclosure material identification;

c) the test date;

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

e) the percent image interaction difference from the filter paper control;

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

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

h) whether the enclosure material passes the mottle test;

i) 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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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] 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 [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 and 86 % RH, 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 5.3).

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.

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Annex B
(informative)

Description of mottling

Mottling is defined as localized, non-uniform visual density variation in the image interaction detectors. It is determined by holding up the detectors at arm's length to an even light source. If easily recognizable areas of light and dark are observed on the detectors, then the material is considered to have failed the mottling portion of the photographic activity test.

Mottling can and does appear in many forms. The following are only a few examples and should not be viewed as the only possible manifestations of mottling:

— blotchy areas of light and dark;

— random small to large dark spots;

— embedded filter paper fibres that have turned brown (embedded fibres which have not discoloured shall be ignored);

— pin holes in the gelatin;

— patterns that match features of the material being tested (such as glue lines on a magnetic album page).

Very light examples of mottling may be visible upon close scrutiny of the detectors, but not easily recognizable when held at arm's length to an even light source. Such detectors should not be considered mottled. Holding detectors above a white sheet of paper as opposed to up to an even light source exaggerates mottling effects as light needs to travel through the detector twice. This method should not be used.

Sometimes there may be mottling on one detector but not on the second in the same material test. If the mottling on the one detector is severe, the test should be repeated. If there are only one or two small spots on one detector, the spots may be assumed to be defects in the detector or contamination introduced in the test preparation process.

Mottling is a qualitative assessment. It is therefore dependent on the visual acuity of the evaluator, as well as their experience with the test method. Ultimately, it is up to the evaluator to judge whether the material passes or fails mottling.

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