INTERNATIONAL STANDARD

ISO 18912

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Imaging materials — Processed vesicular photographic film — Specifications for stability

Matériaux pour l'image — Film photographique vésiculaire traité — Spécifications relatives à la stabilité

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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.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18912 was prepared by Technical Committee ISO/TC 42, *Photography*.

ISO 18912 cancels and replaces the second edition of ISO 9718:1995, of which it constitutes a technical 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).

Annexes A to G of this International Standard are for information only.

Introduction

Since 1930, great advances have been made in the use of photographic films for the preservation of records. The preservation of records on film by national, state and municipal governments, by banks, insurance companies, industry and other enterprises has been stimulated by recognition of the resultant economies in storage space, organization, accessibility and ease of reproduction. The safe-keeping of pictorial film records having legal, scientific, industrial, medical, historical, military or other values has also become increasingly important.

The use of film for records having long-term values necessitated the development of International Standards to specify the characteristics of film suitable for this purpose. ISO 18901 specifies the requirements for silver-gelatin films which are suitable for storage. This International Standard (for vesicular film) and ISO 18905 (for diazo film) give the requirements for photographic duplicate films suitable for storage.

The term “archival film” has been discontinued and the new concept of “life expectancy” is introduced. Film life is classified by the LE or life expectancy rating as defined in this International Standard. For example, LE-100 represents film with a life expectancy of 100 years when stored at 21 °C and 50 % RH.

Criteria for properties of LE-10 and LE-100 vesicular films are based upon the dark-ageing stability of D_{min} processed areas. Different dark-incubation tests are specified for LE-10 and LE-100 films. All other properties and processing requirements for medium and long-term vesicular films are identical.

In addition to tests to ensure that the density of D_{min} areas does not increase to unacceptable levels during storage, a test is also specified on high-density areas. This is to guard against the possibility of vesicle (or bubble) collapse during storage. This test has to be carried out at temperatures below the softening point of the image binder, as tests above this temperature have no practical meaning (see [1], [2] in the bibliography). However, to give confidence of acceptable image stability, the permissible density change was set as low as possible, in line with the measurement error of the densitometer. Both LE-10 and LE-100 vesicular films shall meet the same requirement.

It is recognized that vesicular images may show density changes after exposure to light. However, this International Standard covers only films used as storage copies, not as work copies (as defined in annex B). The light-fading requirements specified in this International Standard ensure satisfactory behaviour for storage copies that are not intended to be subjected to frequent light exposure.

In addition to the characterization of films with respect to their expected storage life, vesicular films are also separated into two classes (A and B) which are dependent upon their intended use. Class A films are those which retain density in both the visual and actinic region (printing) after storage. Such films can be viewed directly or reprinted onto ultraviolet (UV)-sensitive materials. However, some vesicular films are not intended to be reprinted onto UV-sensitive materials and require only visual capabilities after storage. Such films are designated as Class B films. Obviously, both Class A and Class B films can fall into the LE-10 and LE-100 categories. The requirements for Class A and Class B films are identical, with the exception of image-stability tests after dark-ageing and after light-fading.

Everyone concerned with the preservation of records on photographic film should realize that specifying the chemical and physical characteristics of the material does not, by itself, assure satisfactory behaviour. It is also essential to provide the correct storage temperature and humidity, as well as protection from the hazards of fire, water, light and certain atmospheric pollutants. Conditions for the storage of record films are specified in ISO 18902 and ISO 18911.

Imaging materials — Processed vesicular photographic film — Specifications for stability

1 Scope

This International Standard establishes specifications for the stability of polyester-base safety film which has a heat-processed vesicular photographic image formed by nitrogen bubbles. It is applicable only to vesicular photographic film intended and used as LE-10 and LE-100 storage copies, which shall be stored in accordance with ISO 18902 and ISO 18911.

This document characterizes only the inherent keeping behaviour of the film. However, the suitability of a film record after extended storage depends on both the inherent ageing characteristics of the film and the original image quality. The latter is discussed in annex C.

This International Standard is applicable to photographic film in which the image layer is a discrete layer attached to a transparent support, and it applies to roll film and sheet film.

This International Standard is not applicable to vesicular film records intended and used as “work” or “use” copies as discussed in annex B.

The effects of heat and pressure are discussed in annex D and those of high humidity in annex E.

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 5-2:2001, *Photography — Density measurements — Part 2: Geometric conditions for transmission density*

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

ISO 527-3:1995, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

ISO 18902:2001, *Imaging materials — Processed photographic films, plates and papers — Filing enclosures and storage containers*

ISO 18906:2000, *Imaging materials — Photographic films — Specifications for safety film*

ISO 18907:2000, *Imaging materials — Photographic films and papers — Wedge test for brittleness*

ISO 18911:2000, *Imaging materials — Processed safety photographic films — Storage practices*

3 Terms and definitions

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

3.1
archival medium
recording material that can be expected to retain information forever so such information can be retrieved without significant loss when properly stored

NOTE There is, however, no such material and it is not a term to be used in International Standards or system specifications.

3.2
blocking
sticking together of similar or dissimilar materials in physical contact

3.3
Class A films
films which are usable both visually and for printing onto ultraviolet-sensitive materials

3.4
Class B films
films which are usable visually, but do not have any density requirements for printing onto ultraviolet-sensitive materials

3.5
density
〈optical〉 degree of light absorption, reflection or scattering characteristics of a photographic image, expressed as the logarithm to the base 10 of the ratio of incident radiant flux to the transmitted, reflected or scattered flux

NOTE See ISO 5-3.

3.5.1
printing density
optical density in which the incident radiant flux has the same spectral energy distribution as the printer light source and the transmitted density is evaluated by a receiver having the same spectral response as the print material

3.5.2
projection density
optical density of a processed photographic image in which the angular distributions of the incident and transmitted radiant flux are equal and specified

NOTE For microfilm applications, the angular distribution is a nominal half-angle of 6,4°, which corresponds to an f-number of f/4,5 and simulates a microfilm reader.

3.5.3
visual density
optical density of a processed photographic image in which the incident radiant flux has a spectral energy distribution as defined in ISO 5-3, and the transmitted or reflected flux is evaluated by the human eye or by a receiver having the same spectral receiver as the human eye

3.6
emulsion layer(s)
image or image-forming layers(s) of photographic films, papers and plates

3.7
extended-term storage conditions
storage conditions suitable for the preservation of recorded information having permanent value

3.8
film base
plastic support for the emulsion and backing layers

3.9
LE designation
rating for the “life expectancy” of recording materials and associated retrieval systems

NOTE The number following the LE symbol is a prediction of the minimum life expectancy in years for which information can be retrieved without significant loss when stored at 21 °C and 50 % RH, e.g. LE-100 indicates that information can be retrieved after at least 100 years storage.

3.10
life expectancy
LE
length of time that information is predicted to be acceptable in a system after dark storage at 23 °C and 50 % RH

3.11
medium-term storage conditions
storage conditions suitable for the preservation of recorded information for a minimum of 10 years

3.12
polyester base
base for recording materials composed mainly of a polymer of ethylene glycol and terephthalic acid (also referred to as polyethylene terephthalate), or a polymer of ethylene glycol and 2,6 naphthalene dicarboxylic acid (also referred to as polyethylene naphthalate)

3.13
poly(ethylene terephthalate) base
polyester base for recording materials composed mainly of a polymer of ethylene glycol and terephthalic acid

3.14
safety photographic film
photographic film which passes the ignition-time test and the burning-time test specified in ISO 18906

4 Film base requirements

The base used for record films, as specified in this International Standard, shall be of a safety polyester type and can be identified by the method described in 8.1.

Films can have a maximum LE rating of 500.

5 Processed film requirements

5.1 Safety film

Film shall meet the requirements specified in ISO 18906.

5.2 Tensile properties and loss in tensile properties

Film specimens shall be processed and dried under the conditions used for the film records.

Processed films shall be tested for tensile properties as described in 8.3 and shall have a tensile stress and elongation at break as specified in Table 1 (unheated film). The loss in tensile properties after accelerated ageing as described in 8.2 shall not exceed the percentage specified in Table 1 (heated film).

Table 1 — Limits for tensile properties and loss in tensile properties on accelerated ageing of polyester-base film

Film type	Tensile stress at break	Elongation at break
Unheated film		
Minimum permissible tensile properties	140 MPa	75 %
Heated film		
Maximum permissible loss in tensile properties compared with unheated film	15 %	30 %
NOTE 1 MPa = 10^6 N/m^2		

6 Requirements for the emulsion and backing layers of processed film

6.1 Layer adhesion

6.1.1 Tape-stripping adhesion

Processed film shall not show any removal of the emulsion layer or backing layer when tested as described in 8.4.

6.1.2 Humidity-cycling adhesion

The emulsion layer or backing layer of the processed film shall not show separation or cracking that can impair its intended use when tested as described in 8.5

6.2 Blocking

Processed film shall show no evidence of blocking (sticking), delamination or surface damage when tested as described in 8.6. A slight sticking of the film specimens that does not result in physical damage or a change in gloss of the surface shall be acceptable.

6.3 Binder stability

Processed film shall not exceed a 1 mm increase in brittleness after accelerated ageing as specified in 8.2. Brittleness shall be determined at 50 % RH and shall be tested in accordance with ISO 18907.

Films shall be tested preferably in low-density areas.

6.4 Thermal sticking

Processed film shall show no evidence of blocking (sticking), delamination or surface damage at high temperature when tested before and after accelerated ageing as described in 8.2.

Thermal sticking shall be tested as specified in 8.7. A slight sticking of film to glass that does not result in physical damage shall be acceptable.

7 Image stability requirements

7.1 Proper development

Processed film shall not show a projection density decrease greater than 20 % when tested as specified in 9.2.

7.2 Residual diazonium-salt test

Processed film shall not show a printing density decrease greater than 0,1 when tested as specified in 9.3.

7.3 Light-fading

Low-density and high-density patches of processed film shall be tested in a light-exposure apparatus as described in 9.4.2.

After testing, patches with low-printing and low-projection densities shall have a density of 0,7 or less. The difference between densities for patches with high and low-printing densities shall be 0,8 or greater and that between patches with high and low-projection densities shall be 1,4 or greater (see Table 2).

These density requirements shall apply to both projection and printing densities for Class A films and to projection densities only for Class B films (see annex E). The same density requirements shall apply for both LE-10 and LE-100 films.

Table 2 — Limits for the change in image density after the light-fading test

Vesicular density levels	Printing density	Projection density
Original		
Low density	$< 0,4$	$< 0,4$
High density – low density	$> 0,8$	$> 1,4$
Final		
Low density	$\leqslant 0,7$	$\leqslant 0,7$
High density – low density	$\geqslant 0,8$	$\geqslant 1,4$

7.4 Dark-ageing of minimum-density area

Minimum-density patches of processed film shall be incubated as specified in 9.5 using the two conditions specified for either LE-10 or LE-100 films. After incubation under each of the two conditions, the density patches with low-printing and low-projection densities shall have a density of 0,6 or less.

These density requirements shall apply to both projection and printing densities for Class A films and to projection density only for Class B films.

7.5 Dark-ageing of vesicular image

A density patch having a projection density of 2,0 shall be incubated as specified in 9.6. After incubation, the projection density shall not show a density change greater than $\pm$ 0,03.

This density requirement shall apply for both LE-10 and LE-100 films.

8 Test methods

8.1 Identification of film base

Remove all emulsion and backing layers from a specimen of the unknown film by scraping and then remove all sublayers by scraping.

Prepare a specimen of the base material by scuffing the surface with a suitable tool such as a razor blade. The general procedure is to move the scuffing device back and forth over the specimen manually while exerting a very slight pressure. This removes the top layer of the base as a very fine dust. Carefully brush this into a mortar.

Mix the specimen with about 100 times its mass of potassium bromide, previously ground to about 75 µm. Prepare a strip or pellet as described in [3] in the bibliography.

Obtain an infrared (IR) absorption curve from the prepared strip or pellet by means of an infrared absorption spectrometer. By comparing the IR absorption curve for the unknown with curves for known polymers, the identity of the unknown can be established (see [4] in the bibliography).

8.2 Accelerated-ageing conditions

Processed film shall be subjected to accelerated-ageing conditions to meet the requirements for a loss in tensile properties, binder stability and thermal sticking.

Test specimens shall be conditioned at (23 ± 1) °C and (50 ± 2) % RH for at least 15 h. After conditioning, place the specimens in a moisture-proof envelope and heat-seal the envelope.

NOTE 1 A suitable moisture-proof envelope is a metal-foil bag that is coated on the inside with polyethylene for heat-sealing.

To prevent sticking between adjacent specimens, it may be necessary to interleave them with polytetrafluoroethylene or uncoated polyester. Ensure a high ratio of film to air volume by squeezing out excess air prior to heat-sealing. Use a separate envelope for each film specimen. Double bagging is recommended to reduce any effects of pinholes in the envelopes. Heat the envelopes in an oven for 72 h at (100 ± 2) °C.

NOTE 2 Incubation is accomplished in a closed environment to prevent escape of any acid that may be produced during incubation. Such acid may catalyse further film-base degradation.

An alternative method of incubating the specimens in a closed environment is by placing them in 25 mm borosilicate-glass tubes (see [5] in the bibliography). Each tube shall have two flanged sections separated by a gasket to provide a moisture seal and shall be held together by a metal clamp.

NOTE 3 A suitable inert gasket can be made from polytetrafluoroethylene.

Sufficient film specimens shall be used to provide a high ratio of film to air volume.

NOTE 4 In the text, specimens subjected to these accelerated-ageing conditions are designated “heated film”. Comparison specimens kept at room conditions are designated “unheated film”.

8.3 Tensile-property test for processed film

8.3.1 Specimen preparation

Processed film already in 16 mm format may be tested in this width. In the case of perforated 16 mm film, specimens shall be cut from the area between the perforations. Film in other sizes shall be cut into sections 15 mm to 16 mm wide and at least 150 mm long, using a sharp tool that does not nick the edges of the specimen.

Five specimens are required for unheated film and five specimens for heated film. The specimens to be heated and the control specimens shall be cut alternately and contiguously from a single piece of film.

The thickness of each specimen shall be measured with a suitable gauge to the nearest 0,002 mm and the width to the nearest 0,1 mm.

8.3.2 Accelerated ageing

Five specimens shall be subjected to accelerated ageing as described in 8.2.