INTERNATIONAL STANDARD

ISO 18908

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Imaging materials — Photographic film — Determination of folding endurance

Matériaux pour l'image — Films photographiques — Détermination de la résistance au pliage

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

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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 18908 was prepared by Technical Committee ISO/TC 42, *Photography.*

This first edition cancels and replaces ISO 8776:1988, of which it constitutes a minor revision.

This International Standard is one of a series of 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 and B of this International Standard are for information only.

Introduction

Photographic film should have sufficient folding endurance to permit satisfactory performance when used in the equipment for which it is intended under the atmospheric conditions likely to be encountered in practice.

Photographic film is essentially a laminate of two or more different materials, generally a plastics support and the photosensitive emulsion. The latter is usually made of image forming chemicals suspended in gelatin or an other polymeric binder.

The folding endurance of photographic film is affected adversely by both reduced temperature and reduced relative humidity. In most applications, folding endurance loss at low relative humidity is encountered more frequently than loss at a low temperature. Moreover, a marked change in film flexibility may occur with only a very small change in relative humidity below a level of about 25 %. This means that folding endurance tests on photographic film should be carried out only in an atmosphere that is accurately controlled with respect to both temperature and relative humidity.

The folding endurance of film is very dependent on the sample thickness decreasing with an increase in thickness of either the base or the emulsion. For this reason, the thickness of the film layers have to be considered when comparing the behaviour of different films. The temperatures and relative humidities to which the film has been subjected between manufacture and testing may also affect the folding endurance even though the sample is reconditioned to a standard temperature and humidity.

Gelatin is generally more brittle than film base, so that photographic film having a gelatin layer on only one side is usually more brittle if bent with the gelatin-side out (that is, gelatin under tension). This can affect the folding endurance, depending on the direction of the first fold.

The folding endurance of photographic film may vary in different directions if the base is oriented more in one direction than another. There is generally no directional effect in the emulsion.

This International Standard covers the MIT folding endurance test in which the film is subjected to a rapid and repeated folding action until it breaks.

Different types of failure occur when film is flexed. Failure may consist of very fine cracks in the emulsion (without a break in the support) which are objectionable when the photograph is viewed. Failure may also consist of cracks in the support or a complete break.

The wedge brittleness test, standardized in ISO 18907 (see [2] in the bibliography), can generally detect the presence of emulsion cracks after a single flex. However, emulsion cracks are not visible during the MIT test. They may occur after relatively few flexes and result in subsequent flexing of only the film base itself with consequent higher folding endurance. For this reason, the MIT fold test may not necessarily be in agreement with ISO 18907. The two tests may also disagree because the apparent brittleness (or lack of flexibility) and fatigue resistance can also be dependent upon the manner in which the photographic film is mechanically treated with respect to both the degree and the speed of straining. There are a number of folding endurance tests in addition to the MIT folding endurance test, as described in ISO 5626 (see [1] in the bibliography). Films may be rated differently according to the different tests.

Imaging materials — Photographic film — Determination of folding endurance

1 Scope

This International Standard specifies a method for determining and quantitatively expressing the folding endurance of photographic film. The method is based on the MIT folding-endurance tester described in annex B. It is an analytical test and is not intended to simulate practical use conditions.

This International Standard is applicable to film with or without a gelatin backing. It may also be applied to either raw or processed film, although the flexibility level of a given film can be quite different after processing.

Equipment similar to that described in this International Standard may be used provided that a correlation has been established between the results obtained using such equipment and the results obtained using the equipment described.

2 Term and definition

For the purposes of this International Standard, the following term and definition applies.

2.1
folding endurance
measure of fatigue resistance after multiple flexing

3 Principle

Folding, backwards and forwards in a standardized manner, of a sample of film subjected to a longitudinal stress until it breaks.

4 Apparatus

4.1 Test chamber

An air-conditioned cabinet or walk-in room shall be used for both conditioning and testing. The temperature shall be controlled to within ± 1 °C. The relative humidity shall be controlled to within ± 1 % at relative humidities below 30 % and to within ± 2 % at higher humidities. The linear air velocity shall be at least 150 mm/s.

If a walk-in conditioned room is used, the air velocity shall be adequate to maintain the conditions specified. The number of personnel permitted in the room during testing shall be limited and precautions taken to prevent the operator's breath reaching the film.

4.2 Test apparatus

The MIT folding-endurance tester (see Figure 1) shall hold the sample in a vertical position under a predetermined tension between two clamps. The upper clamp is stationary and the lower clamp oscillates through an angle of

135° ± 5° to both the right and left of the vertical position. This oscillation is at a frequency of 175 cycles ± 25 cycles, or double folds, per minute.

Each of the two folding surfaces, over which the sample is bent in the lower jaw, has a radius of curvature of 0,38 mm ± 0,03 mm. The machine is provided with a counter to register the total number of double folds required to break the sample. The parts of the apparatus are described in more detail in annex B.

5 Sampling

5.1 Preparation of samples

Film samples shall be cut in an atmosphere of approximately 23 °C and 50 % relative humidity.

NOTE If the samples are cut at low relative humidities, it may be difficult to obtain smooth edges. Handling under these conditions can also cause emulsion cracking which will affect the subsequent folding endurance. Exposure to high relative humidities can permanently alter the subsequent brittleness behaviour of the film

The sample cutter shall be of a precision type and shall be kept sharp so that the sample edges are smooth and free of nicks. Rubber gloves shall be worn by the operator when handling the samples, both in their preparation and testing.

NOTE Rubber gloves are specified in order to avoid moisture transfer from the operator to the sample.

5.2 Selection of samples

A set of at least 10 samples shall be prepared for each test. Where the film size permits, one set of samples should be cut in the machine direction and a second set in the transverse (cross) direction. If the film has a discrete backing layer, a separate set of samples shall be cut in at least one of the two principal directions to enable the film to be tested with both the emulsion-side and the reverse-side in tension on the first fold.

NOTE In the MIT folding-endurance tester, the same film can give different results depending on the direction of the first fold.

5.3 Size of samples

Standard film samples shall be 120 mm long and 15 mm to 16 mm wide.

6 Conditioning and test conditions

6.1 Conditioning of samples

Samples shall be conditioned in the test chamber (4.1) until practical moisture equilibrium has been reached. This may be determined by weighing the samples at regular intervals and determining the time at which further conditioning does not appreciably change the weight. In many instances this time will be in the vicinity of 4 h, but actual times will vary due to access of the conditioning air and the type and thickness of the material. The conditioning time should not exceed 24 h.

Film shall be held in racks permitting free circulation of air around the samples.

6.2 Test conditions

The recommended relative humidity for testing shall be 15 % when the contribution of an emulsion or backing gelatin layer to folding endurance is of interest. A relative humidity of 50 % is more useful for evaluating the contribution of the support.

NOTE The folding endurance of polyethylene terephthalate (polyester) base films is so high that an MIT folding endurance test is impracticable.

The standard temperature for testing shall be 23 °C. However, other temperatures may be used where the effect of temperature is to be investigated.

Film samples shall not be removed from the conditioning atmosphere for testing except at temperatures of 0 °C or below. For testing film at 0 °C or below, samples shall be conditioned at the desired relative humidity at 23 °C, sealed in small taped cans, cooled long enough to reach the test temperature, and then removed, one at a time, for testing.

NOTE Direct control of relative humidity at temperatures of 0 °C or below is impracticable, but once photographic film is conditioned, the rate of gain or loss of moisture is much lower at low temperatures.

7 Procedure

Level the test apparatus (4.2) and turn the oscillating folding head so that the sample slot is vertical. Place the film sample in the machine so that the emulsion is in tension on the first fold (see the note in 6.2). The direction in which the lower clamp starts to rotate can be regulated by manually turning the knurled flywheel on the drive shaft in the same direction as the instrument operates. If the film has a discrete backing layer, two tests shall be run, one with the emulsion under tension on the first fold and one with the backing under tension on the first fold. Adjust the tension on the sample to 9,81 N. Read the number of folds from the counter when the sample breaks.

Perforated film may be tested by positioning the sample in the jaws so that the fold is made between successive perforations.

8 Interpretation of results

For films approximately 0,15 mm thick, an average MIT folding-endurance value of 20 or more double folds indicates a reasonably acceptable film at the conditions under which the test was made. A value of 3 or less denotes a very brittle or fatigue-prone film. These ranges differ for films which are either thicker or thinner. An average difference between two films of less than 3 MIT double folds is not believed to be significant.

If the adhesion between the emulsion (or backing) and the support is weak, separation may occur during the folding test at the bending area. This may be determined by testing additional samples and stopping the machine prior to sample breakage to permit visual inspection. When this happens, the test is not valid.