INTERNATIONAL STANDARD

ISO 18922

First edition
2003-05-01

Imaging materials — Processed photographic films — Methods for determining scratch resistance

Matériaux pour image — Films photographiques développés — Méthodes de détermination de la résistance à la rayure

Reference number
ISO 18922:2003(E)

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Published in Switzerland

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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 18922 was prepared by Technical Committee ISO/TC 42, *Photography*.

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 18 900 to 18 999 (see Annex A).

Introduction

Processed photographic film should have sufficient scratch or abrasion resistance to permit satisfactory performance when it is used in equipment for which it is intended and under conditions likely to be encountered. Treatments to enhance the scratch resistance of film are commercially available. Test methods are needed to evaluate the effectiveness of such treatments, as well as to rate the inherent scratch resistance of photographic film.

Scratch resistance is a complex and abstruse characteristic. Processed photographic film is subjected to several varieties of scratch, such as those caused by grit particles or by cinching in rolls. Since each variety has a different physical mechanism, scratch resistance of film is not an absolute, singular property. One film may be rated superior to another in one test, while the opposite ranking may be found in another test. There is not a scratch or abrasion test capable of ranking a variety of film types as they would behave under different practical conditions. The test methods described in this document yield results that correlate rather successfully with practical use in some applications, but not in all.

The scratch resistance of photographic film is affected by relative humidity, processing conditions and surface friction. This means that scratch tests on photographic film are to be carried out in a controlled atmosphere with proper processing and without touching of the film surface or other handling that might unintentionally lubricate the surface. In some cases, such as lacquered or freshly processed film, the scratch resistance may change with age. Lubrication generally increases the scratch resistance of a film surface. Lubrication can be detected by the method described in ISO 18904.

Both the emulsion layer and the base side of processed photographic film are susceptible to scratching or abrasion. However, many film-handling machines are designed to protect the emulsion side as much as possible, so that the base side takes the brunt of the wear. The test methods given in this document are applicable to both sides of the film.

Scratch resistance greatly depends upon the geometry of the stylus used in the test. Styli that are nominally the same may differ widely in scratch characteristics. For this reason, the methods described in this International Standard are good for material comparisons using a single stylus point. However, agreement of scratch levels obtained with different equipment may be poor.

Unprocessed photographic emulsions generally exhibit photographic scratch or abrasion sensitivity (made visible by development) at lower levels than those where physical scratch is apparent. Method A (see Clause 3) can be used to determine photographic abrasion sensitivity, if desired; the test should be performed in the dark, and the specimen should then be processed.

Imaging materials — Processed photographic films — Methods for determining scratch resistance

1 Scope

This International Standard is applicable to evaluating the scratch resistance of dry, processed photographic film. It specifies two test methods for evaluating the scratch resistance on either the emulsion or the base side. The two test methods usually give comparable results. It provides empirical laboratory tests made under controlled conditions, but does not necessarily predict the actual scratch resistance of a film in any particular commercial machine.

Method A (see Clause 3) gives a measure of the minimum load requirement to produce a scratch, requires less elaborate evaluation equipment and is less stringent in its requirements of the optical condition of the specimens. Method B (see Clause 4) provides a measurement of haze produced by various stylus loads, is a more complete measure of scratch characteristics of a material and is the preferred method.

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.

ANSI/ASTM D1003-95, *Test method for haze and luminous transmittance of transparent plastics*

3 Method A

3.1 Apparatus

The apparatus shall consist of a specimen holder that will hold the specimen flat on a smooth glass plate. The specimen holder should permit smooth, linear, horizontal travel of the specimen for a distance of at least 20 mm without sidewise motion, and the holder may be either manually operated or power driven.

A spherical sapphire stylus of either 0,050 mm or 0,075 mm radius shall be used[1)]. It shall be mounted at the end of a pivoted arm, so that it can be lowered onto the specimen and thereby scribe a line on it when the specimen holder travels along under the stylus. The stylus shall make perpendicular contact with the specimen.

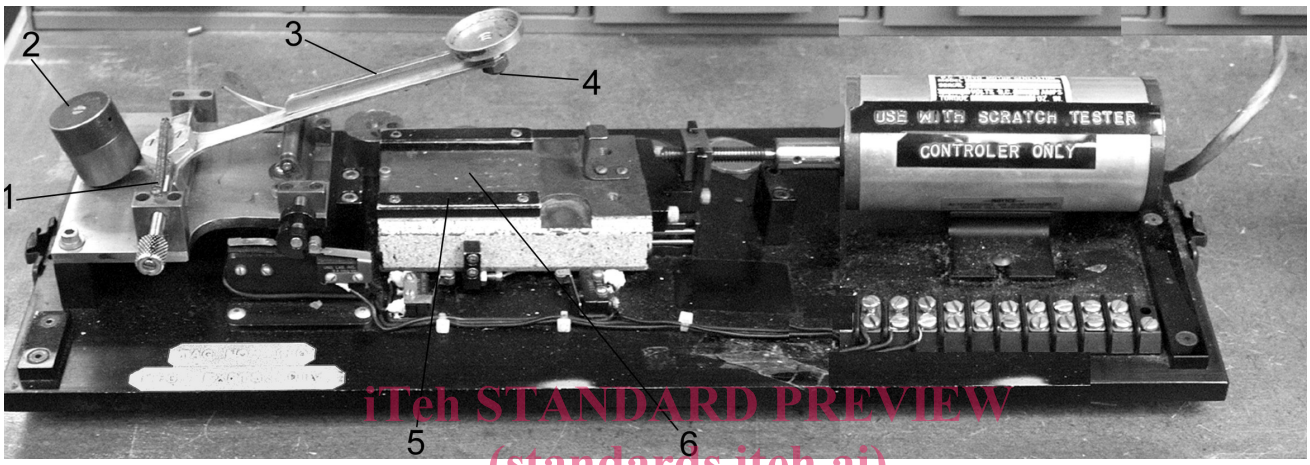
The stylus arm may be pivoted on a threaded hinge with a knurled knob or other provision for positioning the stylus laterally so that many parallel scribe lines can be made on the same specimen. Alternatively, the specimen holder can be provided with lateral positioning and a simple pivot used on the stylus arm.

1) Sapphire styli generally give results that usually reflect trade experience. They may be obtained from the following sources: Stanton, Inc., 101 Sunnyside Blvd., Plainview, NY 11803, USA; Carbide Probes, Inc., 1328 Research Park Dr., Dayton, OH 45432, USA; Sinto Kagaku, Co., Ltd., Nukui 2-16-30, Nerina, Tokyo 176, Japan. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these suppliers. Diamond styli have the advantage of greater durability, but because of their different friction properties they are frequently less sensitive to differences between materials.

The stylus arm shall be counterbalanced so that it produces no load on the stylus. The weights shall be designed so that, when used singly or in combination, the centre of gravity of the mass will be positioned directly over the stylus. Preferably, this should provide for automatic, accurate positioning. These weights should range from 1 g to 100 g, but are not necessarily limited to this range.

An example of a scratch test instrument is shown in Figure 1. Figure 2 shows a mechanical drawing of the same apparatus. Exact dimensions are not critical, except with respect to the stylus.

NOTE The test apparatus for mushiness, described in ISO 18914, may be adapted for this test which is constructed so that the load is continuously increased as the stylus arm is drawn across the specimen. However, it is not as satisfactory since only a single point, rather than a line, is obtained at each load level.



Key

1	hinge
2	knob
3	pivoted arm
4	stylus
5	specimen holder
6	aperture

Figure 1 — Spherical stylus scratch tester

3.2 Specimen preparation

Film specimens should preferably be processed so that there is no significant optical density. Film exposed with an image that contains some clear areas is also usable. Film shall be processed in the normal manner for the specific product, except where the effect of processing variables is being investigated.

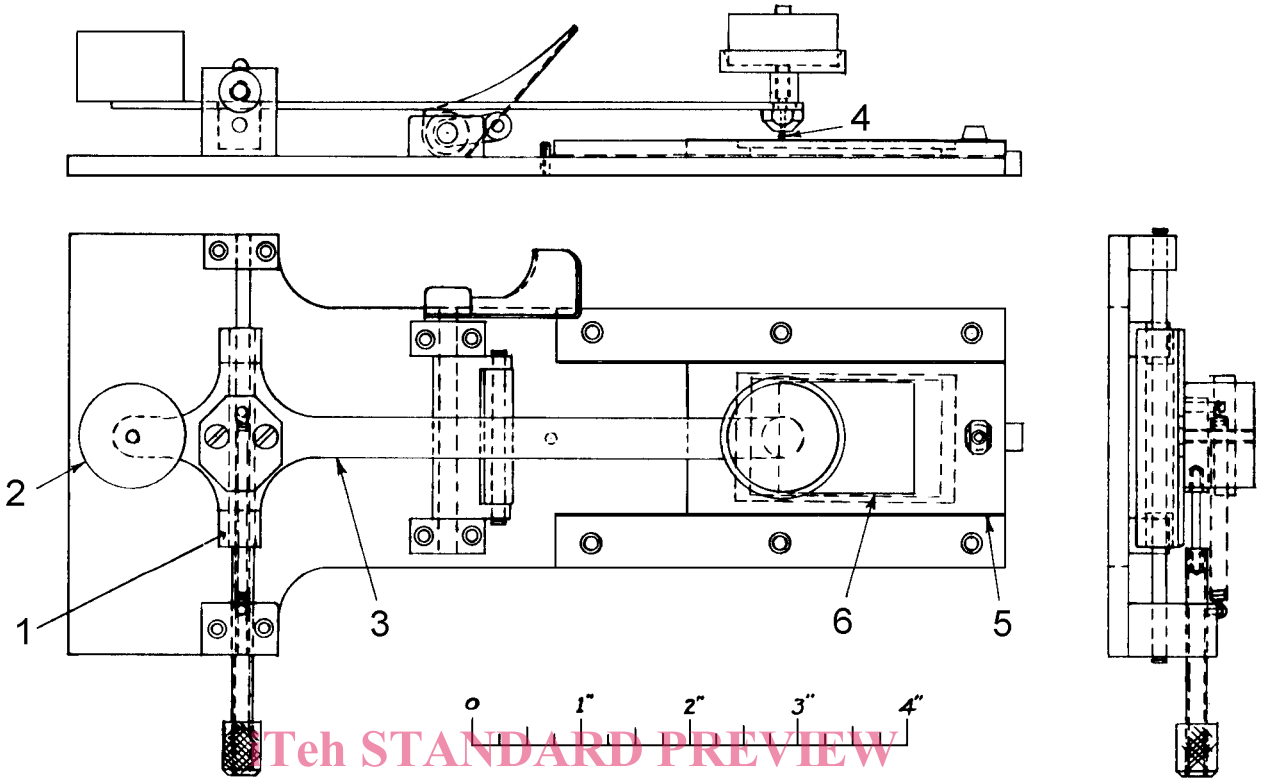
NOTE Some optical density, up to 0,7, can be tolerated with only a minor effect on the results. However, it is best to avoid density entirely when possible.

Care shall be taken in handling specimens to avoid fingerprints. Use of “medicated” cotton gloves, or any other practice that might contaminate the film surface shall be avoided.

Film shall be conditioned in individual strip format for at least 2 h at the relative humidity (RH) at which the test will be conducted. During the conditioning operation, there shall be no handling of the test surface.

3.3 Procedure

A temperature of 23 °C and a relative humidity of 50 % are suggested test conditions. However, other relative humidities, such as 15 % RH and 70 % RH, may prove useful.



Key

1 hinge
2 knob
3 pivoted arm
4 stylus
5 specimen holder
6 aperture

Figure 2 — Construction of spherical stylus scratch tester

The scratch test shall be performed as follows:

— the film specimen is placed in the specimen holder, and the stylus is laterally positioned toward one side of the specimen;

— a 1 g weight is then positioned above the stylus, and the specimen holder is drawn forward with the stylus riding in contact with the surface of the specimen. A speed of 10 mm/s to 50 mm/s/s is desirable;

— two scratch lines, at least 20 mm long, are made at each load, spaced approximately 1 mm apart. The line pairs may be separated by a 3 mm spacing or more. A set of triple lines may be used occasionally to index the lines according to the load;

— after each line is made, the stylus shall be cleaned of any residual particles from the film surface. This can be accomplished by gently rotating the stylus into the grainy surface of soft balsa wood.

NOTE The effect of lubricant carry-over on the stylus after testing a lubricated specimen is usually negligible. The rate of scratching is unimportant within the range that can reasonably be obtained manually.

The load range may be varied to suit the material being tested. A recommended set of loads in grams for this test is 1 g, 2 g, 4 g, 6 g, 8 g, 10 g, 15 g, 20 g, 25 g, 30 g, 35 g, 40 g, 50 g, 60 g, 70 g, 80 g, 90 g, and 100 g. This range may be extended if required. A preliminary spot check of specific specimens may be used to determine the approximate load level required so that only the appropriate portion of the load range need be tried.