

International Standard



4332

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Photography — Processed photographic black-and-white film for archival records — Silver-gelatin type on poly(ethylene terephthalate) base — Specifications

Photographie — Film photographique noir et blanc traité pour la conservation d'archives — Type gélatino-argentique sur support en polyéthylène téréphtalate — Spécifications

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4332 was prepared by Technical Committee ISO/TC 42, *Photography*.

This second edition cancels and replaces the first edition (ISO 4332-1977), of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Photography — Processed photographic black-and-white film for archival records — Silver-gelatin type on poly(ethylene terephthalate) base — Specifications

0 Introduction

Since 1930, great advances have been made in the use of photographic films for the preservation of records. The preservation of film records by governments, banks, insurance companies, industry and other enterprises has been stimulated by a recognition of the economies in storage space, organization, accessibility, and ease of reproduction that result from the use of film records.

During the early development period of the art of copying documents, 35 mm nitrate motion-picture film was sometimes used. This material is highly flammable and deteriorates rapidly under unfavourable storage conditions. Nitrate film is not acceptable for any archival record use. The manufacture of nitrate film declined after World War II and was discontinued in most countries in the 1950s.

For many years, the only films suitable for archival storage were made on some type of cellulose ester base. An ISO specification for archival photographic film on this base has been drawn up (see ISO 4331). In 1956, a synthetic polymer film base belonging to the polyester class was introduced. This particular polyester is known chemically as poly(ethylene terephthalate). It has several advantages over cellulose ester base, including superior mechanical properties and dimensional stability. Practical experience with this polyester film is considerably shorter than that with cellulose ester film. However, experience to date and accelerated ageing tests indicate that this film support is just as stable, if not more so, than safety cellulose ester base. This International Standard for archival film on poly(ethylene terephthalate) base parallels ISO 4331 for cellulose ester base.

This International Standard is intended to eliminate possible hazards to permanence attributable to the chemical or physical characteristics of the processed film. Some of these characteristics are the responsibility of the film manufacturer, some of the film processor, and some are influenced by both. However, specifying the chemical and physical characteristics of the material does not, by itself, ensure satisfactory archival behaviour. It is essential to provide proper storage temperature and humidity and protection from the hazards of fire, water, fungus and certain atmospheric pollutants. Archival record films shall be stored under the conditions prescribed in ISO 5466.

1 Scope and field of application

1.1 This International Standard establishes the specifications for safety poly(ethylene terephthalate) type films having silver-gelatin type emulsions processed to produce a stable black-and-white photographic image.

1.2 It is applicable to silver images produced by negative and full reversal processing¹⁾, positive working films and gold toning. It does not, however, apply to other silver images that have been chemically altered by treatments such as toning, reduction, or intensification.

This International Standard does not apply to colour films, films fixed in other than thiosulfate solutions^[3], and silver images produced by dry or thermal processing, diffusion transfer and halide reversal processing.

1.3 This International Standard is applicable to microfilm, motion-picture film, roll film and sheet film intended for archival record films.

1.4 Lacquers have been applied to processed film for fungus and scratch protection without any known detrimental effect on permanence. However, because of the wide variety of possible materials, lacquered film is not within the scope of this International Standard.

2 References

ISO 417, *Photography — Determination of thiosulphate and other residual chemicals in processed photographic films, plates and papers — Methylene blue photometric method and silver sulphide densitometric method.*

ISO 543, *Cinematography — Motion-picture safety film — Definition, testing and marking.*

ISO 1184, *Plastics — Determination of tensile properties of films.*

ISO 4331, *Photography — Processed photographic black-and-white film for archival records — Silver-gelatin type on cellulose ester base — Specifications.*

1) Full reversal processing includes a final fix and wash after the second development step.

ISO 5466, *Photography — Processed safety photographic film — Storage practices.*

ISO 7830, *Photography — Safety photographic films other than motion-picture films — Material specifications.*

3 Definitions

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

3.1 archival record film : A photographic film composed and treated so that under optimum storage conditions it is suitable for the preservation of records having permanent value.

3.2 film base : The plastic support for the emulsion and backing layers.

3.3 safety poly(ethylene terephthalate) base : A film base composed mainly of a polymer of ethylene glycol and terephthalic acid.

3.4 emulsion layer : The silver-gelatin image layer of the processed film.

3.5 non-curl backing layer : A layer, usually made of gelatin, applied to the side of the film base opposite that of the emulsion layer for the purpose of preventing curl. It is comparable to the emulsion layer in thickness and is not removed in processing.

NOTE — Antihalation or other layers removed in processing are excluded from this definition.

3.6 mushiness; wet penetration strength : A term used to indicate the wet strength of emulsion and backing layers. It is the minimum force on a stylus required to penetrate the emulsion surface. A high mushiness value denotes a high wet strength.

4 Physical requirements controlled by the film manufacturer

4.1 Film base type

The base used for archival record film shall be of safety poly(ethylene terephthalate) type and can be identified by the method specified in 7.1.¹⁾

4.2 Viscosity retention

The relative viscosity of a solution of film base obtained from processed film shall not show a loss which exceeds 5 % as the

result of accelerated ageing of the processed film. The accelerated ageing shall be accomplished as specified in 7.2 and the viscosity determined as specified in 7.3.

4.3 Safety requirements

The polyester film shall comply with the requirements of the safety film specified in ISO 543 and ISO 7830.

4.4 Free acidity and acidity increase

The film shall not have a free acidity greater than the equivalent of 1,0 ml of 0,1 mol/l sodium hydroxide solution per gram of film when measured as specified in 7.4. The volume of 0,1 mol/l sodium hydroxide solution equivalent to the free acidity of the processed film shall not increase by more than 0,5 ml over its original value after accelerated ageing as specified in 7.2.

4.5 Layer adhesion

4.5.1 Tape-stripping adhesion

The processed film shall not show any removal of the emulsion layer or backing layer when tested as specified in 7.5.

4.5.2 Humidity-cycling adhesion

The emulsion layer or backing layer of the processed film shall not show separation or cracking which would impair its intended use, when tested as specified in 7.6. (See annex D.)

5 Physical properties controlled by the film manufacturer and by the processor

5.1 Tensile properties and tensile properties loss

The film samples shall be processed and dried under the conditions used for the film records. Processed film shall have a tensile strength and elongation at break as specified in line 1 of table 1 when tested as specified in 7.7. The loss in tensile properties after accelerated ageing, as specified in 7.2, shall not exceed the percentage specified in line 2 of table 1.

5.2 Mushiness loss

The processed film shall not show a loss in the mushiness value of the emulsion and backing layer which exceeds the percentage specified in table 2 as the result of accelerated ageing of the processed film. The mushiness value shall be determined as specified in 7.8 and the accelerated ageing shall be carried out as specified in 7.2.

1) Poly(ethylene terephthalate) base films are characterized by excellent dimensional stability. The humidity and thermal coefficients of expansion are approximately 30 to 50 % those of a comparable thickness film on cellulose ester base. Size change due to room temperature ageing is generally less than 0,05 % after 3 years.

Table 1 — Limits for tensile properties and tensile properties loss

Characteristic	Tensile strength at break	Elongation at break
1 Unheated film minimum permissible tensile properties	138 MPa*	75 %
2 Film after accelerated ageing maximum permissible loss in tensile properties	10 %	10 %

* 1 MPa = 10^6 N/m²

Table 2 — Limits for mushiness value loss after accelerated ageing

Characteristic	Original mushiness value	
	< 0,5 N	> 0,5 N
Maximum permissible mushiness value loss*	50 %	25 %

* The increase in the limits with decrease in original mushiness level is necessary because the test is not sufficiently accurate to distinguish small differences.

5.3 Blocking

Processed film shall show no evidence of blocking (sticking), delamination or surface damage when tested as specified in 7.9. A slight sticking of the film samples which does not result in physical damage or a change in the gloss of the surface shall be acceptable.

5.4 Image stability

The film shall show no degradation which would impair the film for its intended use, when tested as specified in 7.10.

6 Properties controlled by the processor

These characteristics are determined by the processing conditions (see annex A).

6.1 Thiosulfate concentration

The thiosulfate concentration in processed films depends on processing conditions. Washing aids containing oxidizing agents such as peroxides or hypochlorites shall not be used. Processed film shall not contain a greater concentration of residual thiosulfate calculated as thiosulfate ion, $S_2O_3^{2-}$, than that specified in table 3, when determined by the test method specified in ISO 4171^[8].

The analysis for thiosulfate shall be made on a film sample from a clear area and shall be made within 2 weeks after processing (see annex B). The test method does not measure any change in the sample between the time of processing and the time of analysis but is used to judge the keeping properties of the film following the time of the test.

Table 3 — Limits for thiosulfate concentration

Classification of films	Maximum permissible concentration of thiosulfate ion, $S_2O_3^{2-}$ g/m ²
Fine-grain copying, duplicating, and printing films	0,007
Medium-grain continuous-tone camera films and coarse-grain X-ray films	0,02

Films having a photographic layer on both sides of the base, or films having a photographic layer on one side and a non-curl backing layer on the reverse side, are permitted the specified concentration of residual thiosulfate on each side of the film.

Films are classified according to two broad classes of graininess in table 3. If the graininess of the film is not known, a sample of the exposed and processed film should be examined under a comparison microscope at X 20 magnification or greater, along with samples whose classifications according to graininess are known and classified accordingly. Any film which cannot be classified definitely according to graininess shall be considered as fine grain, with the lower limit of thiosulfate concentration of table 3 applying.

6.2 Residual silver compounds

The area treated with sodium sulfide shall show no more than a barely perceptible tint when tested as described in 7.11.

7 Test methods

7.1 Identification of film base

All emulsion and backing layers shall be removed from a specimen of the unknown film, either by scraping or by the use of an enzyme solution. All sub-layers shall then be removed by scraping. Base material shall then be prepared by scuffing the surface with a suitable tool to produce a very fine powder. This powder shall be mixed in a mortar with about 100 times its mass of potassium bromide previously ground to about 75 μ m. A strip or pellet shall be prepared as described in the literature^[1]. An infra-red absorption curve shall be obtained from this pellet by means of an infra-red absorption spectrophotometer. The identity of the unknown base can be established by comparison with curves for known polymers^[11].