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DEPARTMENT OF ADMINISTRATION

MADISON 2



BUREAU OF MANAGEMENT  
DIRECTOR - WALLACE LEMON

March 30, 1962

PRI

Mr. James J. Burke  
Revisor of Statutes  
321 NE, State Capitol  
Madison, Wisconsin

Dear Mr. Burke:

Under Section 277.025 of the Wisconsin Statutes, I enclose reference copies of standards for film used for permanent photographic records and the processing and development of such film as listed under the March 1962 Wisconsin Administrative Register No. 75, rule relating to permanent records, Subsection (3).

Sincerely yours,

A handwritten signature in cursive script, reading "Maynard J. Brichford".

Maynard J. Brichford  
Executive Secretary  
COMMITTEE ON PUBLIC RECORDS

enclosure

**ASA**  
*Reg. U. S. Pat. Off.*  
**PHI.28-1957**  
Revision of  
Z38.3.2-1945  
UDC 771.531 (093.2)

American Standard Specifications for  
**Photographic Films for Permanent Records**

Sponsor

**PHOTOGRAPHIC STANDARDS BOARD**

Approved November 27, 1957

**AMERICAN STANDARDS ASSOCIATION**  
INCORPORATED

# American Standard

*Registered United States Patent Office*

An American Standard implies a consensus of those substantially concerned with its scope and provisions. The consensus principle extends to the initiation of work under the procedure of the Association, to the method of work to be followed, and to the final approval of the standard.

An American Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American Standard does not in any respect preclude any party who has approved of the standard from manufacturing, selling, or using products, processes, or procedures not conforming to the standard.

An American Standard defines a product, process, or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, quality, rating, certification, testing, and the service for which designed.

*American Standards are subject to periodic review. They are reaffirmed or revised to meet changing economic conditions and technological progress. Users of American Standards are cautioned to secure the latest editions.*

Producers of goods made in conformity with an American Standard are encouraged to state on their own responsibility, in advertising, promotion material, or on tags or labels, that the goods are produced in conformity with particular American Standards. The inclusion in such advertising and promotion media, or on tags or labels, of information concerning the characteristics covered by the standard to define its scope is also encouraged.

*Published by*

**American Standards Association**

Incorporated

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## Foreword

(This Foreword is not a part of American Standard Specifications for Photographic Films for Permanent Records, PH1.28-1957.)

The past two decades have seen great advances in the use of photographic films for the preservation of records. Considerable interest is also being shown in the safekeeping of pictorial records having legal, scientific, industrial, or historical value. The preservation of film records of national, state, and municipal governments throughout the country, and by banks, insurance companies, and other enterprises was stimulated by a recognition of the economies in storage space, organization, accessibility, and the ease of reproduction that results from the use of film records.

During the early development period of the art of microcopying documents it was customary to use 35mm nitrate motion-picture film, a material that is flammable and likely to deteriorate in storage.\* For some years, however, films specifically designed for microcopying purposes have been in wide use. They have special photographic qualities and are, without exception, produced on safety film base, usually of the cellulose ester type.

The useful life of safety cellulose ester-type films is conjectural, since actual experience with the material extends back only about 45 years. Experience with the material during that time and the results of accelerated aging tests and other studies predict, however, that the material is capable of enduring as long as rag paper stock under normal storage conditions. This fact was recognized by the 76th Congress of the United States, which passed, in 1940, Public—No. 788, a bill permitting the destruction of certain kinds of original records of the Government after they had been copied on record film meeting the requirements of the National Bureau of Standards. The present American Standard is based on these requirements.

This document is a revision of the original standard, Z38.3.2-1945, which was developed by ASA Sectional Committee Z38 on Photography. The principal changes are the substitution of the MIT Fold Test for the Pfund Test because of availability and convenience of the instruments; new flexibility limits to take care of films of various thicknesses; omission of the pH test which is not applicable to cellulose triacetate; revision of the viscosity test to cover cellulose triacetate; revision of the limits for residual thiosulfate for films of different grain size and films with coatings on both sides of the base; and specification of the image to be selected for thiosulfate analysis and restriction of the time in which the analysis may be performed.

This standard is only one of many American Standards covering the various aspects of the subject of still photography. At the present time there are five committees working on the various standardization problems in the field, and they are responsible not only for the development of new standards, but for revisions of old standards as well. These committees are constantly on the alert for new developments in the art, and periodically review all approved photographic standards with a view to reaffirmation, revision, or withdrawal.

Suggestions for improvement, based upon experience gained in the use of these specifications, will always be welcome. They should be sent to the American Standards Association, Incorporated, 10 East 40th St., New York 16, N. Y.

It was in 1938 that standardization work in the field of still photography was first initiated under the procedures of the American Standards Association. The committee which was organized to carry on this work was designated as the ASA Sectional Committee on Standardization in the Field of Photography, Z38. This committee continued in operation for over ten years, under the sponsorship of the Optical Society of America, and was responsible for the development of well over a hundred American Standards in the photographic field.

In 1950, it became apparent that it was not feasible for one committee to handle such a large assignment, and on November 30, 1950, ASA Committee Z38 was disbanded and four new committees were organized to replace it. On June 25, 1953, a fifth committee was also organized.

The ASA Sectional Committee on Photographic Films, Plates, and Papers, PH1, which developed this

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\*The manufacture of nitrate motion-picture film was discontinued in the United States about 1951, although appreciable quantities remain in storage. The manufacture of other types of nitrate film has also been discontinued in the United States.

standard, is one of the five photographic committees. It is sponsored by the Photographic Standards Board and has the following scope:

Standards for the physical and chemical characteristics and the packaging of photographic films, plates, and papers.

In addition to participating in the national standardization program, the PH1 Committee is also concerned with the work being carried on by the ASA as Secretariat for Technical Committee 42 on Photography of the International Organization for Standardization (ISO). The ISO is a federation of the national standardizing bodies in the principal industrial countries of the world. It is the successor organization to the International Federation of National Standardizing Associations (ISA).

The ASA Sectional Committee on Photographic Films, Plates, and Papers, PH1, consisted of the following personnel at the time action was taken on American Standard PH1.28-1957.

VICTOR J. MOYES, *Chairman*  
 C. H. JORDAN, *Vice-Chairman*  
 PAUL ARNOLD, *Secretary*

<i>Organization Represented</i>	<i>Name of Representative</i>
American Society of Photogrammetry .....	FRANCIS E. WASHER
AnSCO .....	PAUL ARNOLD
Bell & Howell Company .....	ROBERT O. BIELING
Canadian Standards Association ( <i>Liaison</i> ) .....	P. D. CARMAN
Department of the Air Force ( <i>Liaison</i> ) .....	JACK C. LEWIS
Department of the Army, Signal Corps ( <i>Liaison</i> ) .....	FRED W. BUYS CAPT. FREDERICK B. PLUNKETT FRANK SMITH IRVING BAUMAN ( <i>Alt</i> )
Department of Defense ( <i>Liaison</i> ) .....	WILLIAM S. HUTCHINSON
Department of the Navy ( <i>Liaison</i> ) .....	LCDR PAUL S. RUNDALL
E. I. du Pont de Nemours & Company .....	R. F. BROWN W. H. VINTON ( <i>Alt</i> )
Eastman Kodak Company .....	VICTOR J. MOYES JOHN G. MULDER ( <i>Alt</i> )
The Haloid Company .....	JAMES C. GRIFFIN
Kilborn Photo Paper, Inc ( <i>Liaison</i> ) .....	C. H. JORDAN
Master Photo Dealers' & Finishers' Association .....	R. J. WILKINSON A. A. BARBER ( <i>Alt</i> )
National Bureau of Standards .....	RAYMOND DAVIS
Photographic Society of America .....	R. G. BOWIE DAVID B. EISENDRATH, JR
Remington Rand Inc .....	P. SAVERCOOL A. HEY ( <i>Alt</i> )
Society of Photographic Engineers .....	(representation vacant)
Underwriters' Laboratories, Inc .....	A. F. MATSON

The members of the ASA Subcommittee on Characteristics of Films, Plates, and Papers (Other Than Dimensions), PH1-3, directly responsible for the development of American Standard PH1.28-1957, are as follows:

J. M. CALHOUN, *Chairman*  
 IRA B. CURRENT, *Secretary*

R. O. BIELING  
 RAYMOND DAVIS  
 JACK C. LEWIS  
 A. F. MATSON

LCDR PAUL S. RUNDALL  
 W. R. SANER  
 ROBERT P. SMITH  
 A. J. STABB (*Alt*)

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# American Standard Specifications for Photographic Films for Permanent Records

## 1. Scope

**1.1** This standard is concerned with both raw stock for permanent record films and with the processed films ready for storage. The standard is not restricted to microfilms but applies equally well to motion-picture films, roll films, and sheet films.

**1.2** This standard applies only to safety cellulose ester-type films having gelatin-silver halide emulsions\* developed in ordinary processing solutions to produce what is normally called a black-and-white photographic image. Silver halide layers that produce colored images by means of their chemical composition or treatment in processing are excluded. Likewise excluded are black-and-white silver halide images that have been chemically altered by treatments such as toning, reduction, or intensification.

## 2. Definitions

**2.1 Permanent Record Film.** Permanent record film is a photographic material so composed and treated that the image and support will have maximum keeping quality under ordinary room storage conditions.

**2.2 Raw Stock.** Raw stock is sensitized photographic material that has not undergone the process of development.

**2.3 Film Base.** The film base is the support for the photographic layer or photographic film with the light sensitive layer or layers and any non-curl backing layer removed.

**2.4 Safety Cellulose Ester-Type Base.** Safety cellulose ester-type film base is film base composed mainly of cellulose esters of acetic, propionic, or butyric acids.

**2.5 Photographic Layer.** The photographic layer is the light sensitive medium capable of producing an image by means of the photographic process; specifically a gelatin-silver halide emulsion layer.

\*If photographic films made from materials of other chemical types become commercially available and research or experience demonstrates that they are suitable for permanent record use, either this standard will have to be modified accordingly or a separate applicable standard prepared.

**2.6 Non-Curl Backing Layer.** A non-curl backing layer is a layer usually made of gelatin, applied to the side of the film base opposite that of the photographic layer for the purpose of preventing curl. It is comparable to the photographic layer in thickness and is not removed in processing. (Antihalation layers removed in processing are excluded from this definition.)

## 3. Raw Stock Requirements

**3.1 Base.** The base used for permanent record film shall contain not over 0.15 percent nitrogen combined as cellulose nitrate, as determined by the method described in American Standard Specifications for Safety Photographic Film, PH1.25-1956, or the latest revision thereof approved by the American Standards Association, Incorporated.

**3.2 Base Plus Photographic Layer.** The film shall meet the requirement for ignition time and rapidity of burning specified in American Standard Specifications for Safety Photographic Film, PH1.25-1956, or the latest revision thereof.

**3.3 Photographic Layer.** Gelatin-silver halide emulsions shall be used for permanent records and shall be suitable for development as original negatives, as positive prints from negatives, or as direct positives. Photographic materials producing final images composed of dyes shall not be used for permanent record films.

## 4. Processed Film Requirements

### 4.1 Base

**4.1.1 Viscosity Retention.** The relative viscosity of a solution of film base obtained from processed film which has been heated for 72 hours at  $100 \pm 2$  C ( $212 \pm 4$  F) and the relative viscosity of a solution of film base obtained from unheated processed film shall not differ by more than 5 percent when measured according to 5.1.

### 4.2 Processed Film Samples

**4.2.1 Flexibility and Flexibility Loss on Aging.** The film samples shall be processed and dried under the conditions used for the film records.\*

\*Film can be made brittle by drying at too high a temperature.

One-half of the processed film samples shall be heated in an oven for 72 hours at  $100 \pm 2$  C ( $212 \pm 4$  F) as specified in 5.2. Both unheated and heated specimens shall be conditioned and tested for folding endurance as specified in 5.3. The unheated film shall withstand the number of double MIT folds specified in line 1 of Table 1. The loss in folding endurance after heating shall not exceed the percentages specified in line 2 of Table 1.\*

\*The increase in the limits for percent loss in number of folds after heating with increase in film thickness is not intended to permit greater deterioration of the thicker film, but is necessary because the test is not sufficiently accurate when the level of folds is low.

### 4.3 Photographic Layer

**4.3.1 Color of Image.** A developer or a process of development designed to produce a colored image shall not be employed. Stained or toned images shall not be accepted for permanent record use.

**4.3.2 Residual Thiosulfate Content.** After processing, the film shall not contain more thiosulfate as anhydrous sodium thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) than specified in Table 2, when determined by the test method described in American Standard Method of Determining the Thiosulfate Content of Processed Photographic Film, PH4.8-1953, or the latest revision thereof approved by the American Standards

**Table 1**  
**Limits for Flexibility and Flexibility Loss on Aging**

Total Film Thickness	Under 0.13mm (0.005 in.)	0.13-0.18mm (0.005-0.007 in.)	Over 0.18mm (0.007 in.)
1. Unheated Film Minimum average number of double MIT folds	20	10	4
2. Heated Film Maximum average loss in number of folds compared with unheated film	25%	35%	50%

**Table 2**  
**Limits for Residual Thiosulfate**

Classification of Films According to Grain Size of Developed Image	Maximum Thiosulfate as Anhydrous Sodium Thiosulfate (Each Side of Film)		
	Micrograms per sq cm	Micrograms per sq in.	Milligrams per sq in.
Class 1 Fine grain copying, duplicating, and printing films (includes ordinary microfilms)*	0.8	5	0.005
Class 2 Medium grain continuous tone camera films (negative and reversal) and coarse grain x-ray films	3	20	0.02

\*For films having finer grain structure than those types covered by Class 1 (that is, high resolution films), it is desirable to have a residual thiosulfate content less than 0.8 micrograms per square centimeter (sq cm) (0.005 milligrams per square inch). This can be accomplished by at least one of two alternatives: (1) additional washing to give a residual thiosulfate content of 0.5 micrograms per sq cm (0.003 milligrams per square inch) or less, or (2) use of a suitable washing aid.



Association, Incorporated. The analysis for thiosulfate shall be made on a film sample from a representative image area\* and shall be made within 24 hours after processing. (See Appendix A.)

Films having photographic layers 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 amount of residual thiosulfate in each side of the film.

The classification of films according to grain size given in Table 2 will usually be obvious where the name and type of film, as described by the manufacturer, are known. Where the type of film is not known, a sample of the exposed and processed film should be examined under a comparison microscope at 20 times magnification or greater, along with samples whose classifications according to grain size are known, and classified accordingly. Any film which cannot be classified definitely according to grain size as indicated in the table shall be considered as Class 1. (See Appendix A.)

## 5. Test Methods

**5.1 Test for Relative Viscosity.** Four specimens of processed film having the same average silver density and weighing 1.000 gram each shall be cut from the sample. Two of the specimens shall be heated in air at  $100 \pm 2$  C ( $212 \pm 4$  F) for 72 hours. Each of the specimens shall be immersed in approximately 95 milliliters (ml) of reagent grade acetone in a 100-ml volumetric flask, if the film base is known to be acetone soluble. If not, a mixture of methylene chloride, 90 percent, and methanol, 10 percent by weight, shall be substituted. Solution of the base may be effected by repeated shakings for one to two hours or by allowing it to stand overnight.

After solution of the film base is complete and the nonsupport layers have settled to the bottom, the flasks shall be immersed in a water bath maintained at  $25 \pm 0.1$  C ( $77 \pm 0.2$  F). When a temperature equilibrium has been reached and the volume of the solution adjusted to 100 ml, a portion shall be transferred to an Ostwald pipette immersed in a constant temperature bath at the same temperature. The pipette chosen should have a flow time between 20 and 100 seconds for the solution to be tested. The volume taken should be sufficient to half fill the lower bulb of the pipette. The time of flow of the solution through the capillary of the pipette shall be measured to the

\*Additional exposures required for test purposes can be made at the end of the roll in the case of microfilm or motion-picture film.

nearest  $\frac{1}{5}$  of a second. The time of flow shall also be measured for the same volume of the pure solvent. Not less than three readings should be made for each portion and the results averaged. The relative viscosity shall be calculated as the ratio of the time of flow of the solution to the time of flow of the solvent.

Duplicate determinations shall be made on both the original and heat-treated film sample and the duplicates should agree within  $\frac{5}{10}$  of a second.

**5.2 Test for Effect of Heating on Folding Endurance.** The effect of heating on the folding endurance of the processed film shall be determined in a manner similar to that described in American Society for Testing Materials Standard D776-46. The test specimens shall consist of strips 15 to 16 millimeters (0.59 to 0.63 inch) wide and at least 14 centimeters (5.5 inches) long. Ten strips shall be used for the heat test and an equal number for the unheated control. Films already in 16mm form may be tested in this width; other films shall be cut to the width specified using a sharp tool which does not nick the edges of the specimen. Where the size of film permits, an equal number of test specimens shall be cut from both the lengthwise and widthwise directions of the film and tested. The specimens to be heated and the control specimens shall be cut alternately and contiguous to each other.

The test specimens to be heated shall be suspended in the oven in such a way that the air of the oven has free access to each strip, and the strips are not in contact with any part of the oven. The specimens shall be heated under the conditions specified in 4.2.1. The oven shall be kept closed and no other materials shall be in the oven during the heating period. The heated and unheated test specimens shall be conditioned side-by-side and tested alternately in the MIT folding machine as specified in 5.3.

Film strips which curl appreciably when freely suspended in the oven during heating may give abnormally low fold values. If the film strips after heating are appreciably curled, and if the percent loss in number of folds exceeds the limits specified in 4.2.1, another set of film strips shall be retested in the following manner: The film strips shall be fastened snugly, emulsion side out, by clamping the two ends together around a glass or metal cylinder, approximately 3 inches in diameter, before placing in the oven. This procedure prevents the development of high curl in the oven and gives more reliable fold values.

**5.3 Test for Folding Endurance.** The folding

endurance of both unheated and heated film specimens shall be determined by means of the MIT folding tester as specified in American Society for Testing Materials Standard D643-43, Method B. The test specimens shall be prepared as described in 5.2 and shall be measured for thickness with a suitable micrometer to within 0.005mm (0.0002 inch). All specimens shall be conditioned at 21 to 24 C (70 to 75 F) at  $50 \pm 2$  percent relative humidity for 24 hours and then tested in the MIT folding machine at a tension of 1.0 kilogram. Perforated 16mm specimens shall be positioned in the jaws of the MIT machine so that the fold is made midway between successive perforations. The folding endurance of the film is the average number of double folds required to sever the specimens and automatically stop the machine. The results for films tested in both the lengthwise and widthwise directions shall be reported separately for the two directions.

### Applicable Specifications

- PH1.25-1956 American Standard Specifications for Safety Photographic Film
  - PH4.8-1953 American Standard Method of Determining the Thiosulfate Content of Processed Photographic Film
  - PH4.12-1954 American Standard Method for Indicating the Stability of the Images of Processed Black-and-White Films, Plates, and Papers
  - ASTM D643-43 Standard Methods of Test for Folding Endurance of Paper
  - ASTM D776-46 Standard Method of Test for Effect of Heating on Folding Endurance of Paper
- Copies of American Standards can be obtained from the American Standards Association, Incorporated, 70 East Forty-fifth Street, New York 17, N. Y. Copies of ASTM standards can be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

## Appendices

(These Appendices are not a part of American Standard Specifications for Photographic Films for Permanent Records, PH1.28-1957, but are included to facilitate its use.)

### Appendix A

#### The Effect of Residual Thiosulfate on the Developed Silver Image

The chemical reaction between residual thiosulfate and the grains of metallic silver constituting the image in developed photographic film results in discoloration and fading of the image, and this increases in seriousness the smaller the state of subdivision of the metallic silver in the image (hereinafter referred to as "grain size"). It would be logical to specify the permissible residual thiosulfate as a continuous function of grain size. However, an exact measure of the grain size range in a film is not necessary for the purpose of this standard.

Tests have shown that the fading of silver images caused by residual thiosulfate in the film is accelerated greatly under conditions of elevated humidity and temperature, so that the ultimate degree of image impairment can be approximated in a matter of days. The limits for residual thiosulfate specified in this standard have been selected on the basis of safe

levels under such adverse storage conditions, even though permanent record films should always be stored under favorable conditions. The criterion for determining the safe levels has been a thiosulfate concentration sufficiently low to cause no visible image impairment when subjected to a moist incubation test similar to that specified in American Standard Method for Indicating the Stability of the Images of Processed Black-and-White Films, Plates, and Papers, PH4.12-1954, or the latest revision thereof approved by the American Standards Association, Incorporated, except that the test conditions used were 30 days at 48.9 C (120 F) and 90 percent relative humidity instead of 37.8 C (100 F) and 94 percent relative humidity.

The residual thiosulfate content of some processed photographic films, as determined by the American Standard Method for Determining the Thiosulfate Content of Processed Photographic Film, PH4.8-1953, is higher at high silver densities than at low densities, and decreases with the age of the film after processing, particularly during the first few weeks. Therefore, it is necessary to analyze a sample from a rep-

representative image area within a specified time after processing.

The amount of hypo retained in a processed film is dependent to a considerable degree on the pH of the fixing bath employed. Acid hardening fixing baths at pH values below 5.0 condition the gelatin in the emulsion so that thiosulfate ion ( $S_2O_3^{--}$ ) is retained more rigidly than is the case when the pH of the bath is above 5.0. The use of either ammonia in the wash water or a salt solution in the washing cycle releases thiosulfate retained following the use of acid hardening fixing baths. On the other hand, a higher pH fixing bath should be used with caution because the gelatin is not hardened effectively above a pH value of approximately 5.5 and pH control may be necessary.

The degree of image fading which might be tolerated in a permanent record film depends upon the kind of record. For some records, retention of legibility is the sole consideration; whereas for other types of records even a slight amount of staining, particularly if nonuniform, would be unacceptable. Although any accelerated aging test of necessity involves some element of uncertainty, it is believed

that the criterion used in this standard provides a sufficient margin of safety for an indefinite period of time under normal storage conditions.

## Appendix B

### The Effect of Residual Silver Compounds on the Developed Silver Image

Residual silver compounds are primarily responsible for the over-all staining of processed photographic materials, as described in American Standard Method for Indicating the Stability of the Images of Processed Black-and-White Films, Plates, and Papers, PH4.12-1954, or the latest revision thereof. At the present state of knowledge it is not possible to specify a safe maximum for residual silver compounds for permanent record films in quantitative terms. However, if the film is completely fixed and washed thoroughly enough to meet the limits for residual thiosulfate specified in Table 2, it is believed that the concentration of residual silver compounds will be satisfactorily low. This can be confirmed qualitatively by means of the test method given in PH4.12-1954, or the latest revision thereof.

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(This Bibliography is not a part of American Standard Specifications for Photographic Films for Permanent Records, PH1.28-1957.)

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American Standard Method for Determining the  
**Thiosulfate Content of**  
Processed Black-and-White  
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# Foreword

(This Foreword is not a part of American Standard Method for Determining the Thiosulfate Content of Processed Black-and-White Photographic Film and Plates, PH4.8-1958.)

The American Standard PH4.8-1958 is one of a series of American Standards covering many aspects of the subject of still photography. At the present time there are five committees working on the various standardization problems in the field and they are responsible not only for the development of new standards, but for revisions of old standards as well. These committees are constantly on the alert for new developments in the art and periodically review all approved photographic standards with a view to reaffirmation, revision, or withdrawal.

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In 1950, it became apparent that it was not feasible for one committee to handle such a large assignment, and, on November 30, 1950, ASA Committee Z38 was disbanded and four new committees were organized to replace it. A fifth committee was organized in 1953. The ASA Sectional Committee on Photographic Processing, PH4, which developed this standard, is one of the five committees.

The scope for the PH4 Committee is as follows:

Standards for photographic processing supplies, equipment, and procedures.

In addition to participating in the national standardization program, the PH4 Committee is also concerned with the work being carried on by the ASA as Secretariat for Technical Committee 42 on Photography of the International Organization for Standardization (ISO). The ISO is a federation of the national standardizing bodies in the principal industrial countries of the world. It is the successor organization to the International Federation of National Standardizing Associations (ISA), which was organized in 1926, whose work was suspended due to World War II. When work was resumed, the ISA was reorganized and redesignated as the ISO.

The following organizations, with the personnel listed below, comprise the ASA Sectional Committee on Photographic Processing, PH4, which was responsible for the development of this standard.

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# American Standard Method for Determining the Thiosulfate Content of Processed Black-and-White Photographic Film and Plates\*

## General

Determination of the amount of thiosulfate in a processed film or plate is of interest in connection with studies of rate, efficiency, and effectiveness of washing, and in connection with the problems of image stability with respect to storage.†

The method described in this standard is reasonably accurate and very sensitive to thiosulfate. It is not at all sensitive to sulfite, bisulfite, or thionates such as tetrathionates.

The effectiveness of this test diminishes with elapsed time after the films or plates are processed. Residual thiosulfate decomposes fairly rapidly into substances which are not detected by this test but which may still cause image deterioration. For this reason it is prescribed that this test must be performed within 24 hours after completion of the processing steps.

For black-and-white films and plates processed more than twenty-four hours prior to testing, the American Standard Method for Indicating the Stability of the Images of Processed Black-and-White Films, Plates and Papers, PH4.12-1954, may be used to indicate the image fading tendency.

The method of this standard is not intended for use with color films, but experience indicates that it may have some applicability.

## 1. Scope

**1.1** This standard provides a method for determining quantitatively the thiosulfate content of freshly processed black-and-white photographic films and plates, and is intended for use in the control or evaluation of processing.

## 2. Method

**2.1 Outline of the Test.** The test depends upon the production of a degree of turbidity or opalescence

\*See also American Standard Method for Determining Residual Thiosulfate and Tetrathionate in Processed Photographic Papers, Z38.8.25-1950, or the latest revision thereof approved by the American Standards Association, Incorporated.

†See also American Standard Specifications for Photographic Films for Permanent Records, PH1.28-1957, or the latest revision thereof approved by the American Standards Association, Incorporated.

in the test solution which is related to the amount of thiosulfate present in the sample. A measured area of the sample is immersed for a sufficient time in a given volume of the test solution. At essentially the same time as the sample is immersed, comparison solutions are prepared by adding known quantities of thiosulfate solution of specified concentration to the required volumes of test solution. When thiosulfate is present, a precipitate is formed which rises to the upper part of the test solution. After standing undisturbed for a given period of time, the tubes are agitated to distribute the precipitates uniformly. The turbidity of the sample tube is compared with the turbidity of the comparison tubes and matching turbidities are found. Since the quantity of thiosulfate in any comparison solution is known, the amount in the sample is thus quantitatively determined.

**2.2 Sensitivity.** The lower limit of sensitivity of the test is 0.001 mg of anhydrous sodium thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) per 10 ml of test solution. The test will therefore indicate down to this quantity in 1 square inch (sq in.) [6.45 square centimeter (sq cm)] of film or plate. The approximate reproducibility is as shown in Table 1.

**2.3 Test Solution.** Prepare the following test solution from chemicals meeting recommended specifications for Reagent Chemicals of the American Chemical Society, current edition.

Test Solution for Thiosulfate	
Distilled water (20 C-50 C):	750.0 ml
Potassium bromide:	25.0 grams
Mercuric chloride:	25.0 grams
Distilled water to make:	1.0 liter

### CAUTION: POISONOUS SOLUTION!

Allow the solution to stand overnight before use. Keep in a glass-stoppered bottle away from strong daylight or excessive heat. If a precipitate forms, the solution should be decanted or filtered. A completely clear solution is required for use.

**2.4 Thiosulfate Solutions for Preparing Comparison Solutions.** Weigh  $1.570 \pm 0.010$  grams of crystalline sodium thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ ), conforming to the recommended specifications for Re-

Table 1

**Volumes of Sodium Thiosulfate Solutions Required to Give  
Varying Degrees of Turbidity for Comparison**

[For 1-sq-in. (6.45-sq-cm) Film or Plate Samples and 10 ml of Test Solutions for Thiosulfate]

Thiosulfate Solution to Be Added (ml)	Concentration of Thiosulfate Solution to Be Used	Content of Thiosulfate As Anhydrous Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )		
		Micrograms per sq cm	Micrograms per sq in.	Milligrams per sq in. (6.45 sq cm)
—	—	Zero	Zero	Zero
0.1	1:40,000	0.4 ± 0.16	2.5 ± 1.0	0.0025 ± 0.001
0.1	1:20,000	0.8 ± 0.2	5.0 ± 1.0	0.005 ± 0.001
0.2	1:20,000	1.6 ± 0.4	10.0 ± 2.0	0.01 ± 0.002
0.1	1:5,000	3.1 ± 0.8	20.0 ± 5.0	0.02 ± 0.005
0.2	1:5,000	6.2 ± 1.6	40.0 ± 10.0	0.04 ± 0.010
0.1	1:1,000	16.0 ± 4.0	100.0 ± 25.0	0.1 ± 0.025
0.2	1:1,000	31.0 ± 8.0	200.0 ± 50.0	0.2 ± 0.050

Values for thiosulfate content between any two shown in the last three columns can be obtained by the use of volumes intermediate to those shown in the first column or by employing thiosulfate solutions of concentrations intermediate to those given in the second column.

agent Chemicals of the American Chemical Society, current edition. Dissolve in about 750 milliliters (ml) of distilled water at room temperature, then add distilled water to make one liter and mix well. This is equivalent to a 1:1,000 solution of anhydrous sodium thiosulfate. Remove a 200-ml portion of this 1:1,000 solution and dilute with distilled water to 1,000 ml to make a 1:5,000 solution and, similarly, dilute a 50-ml portion to 1,000 ml to make a 1:20,000 solution. Dilute 500 ml of the 1:20,000 solution to 1,000 ml to make a 1:40,000 solution. For accurate work, volumes should be measured with pipettes and volumetric flasks. The 1:1,000 solution may be used for five or six days and must be kept in a glass-stoppered bottle. The more dilute thiosulfate solutions shall be prepared within two hours of use.

## 2.5 Test Procedure

**2.5.1 Test Tubes.** Select for uniformity and clarity a number of glass vials or test tubes approximately 18 millimeters (mm) by 150mm so that a 10-ml volume of solution gives essentially the same height in each. Ordinarily, to determine an unknown thiosulfate content, eight tubes are required for the comparison solutions with an additional tube for each sample tested.

**2.5.2 Preparation of Film or Plate Sample.** Accurately cut a 1-sq-in. (6.45-sq-cm) ( $\pm 5$  percent) sample of film or plate from a representative image area (see Appendix). Place the sample in one of the

tubes in a manner which allows free access of test solution to both sides of the film or plate. This sample shall be taken from a film or plate which has been processed within the preceding 24 hours.

**2.5.3 Performance of the Test.** Into each film or plate sample tube and the eight comparison tubes introduce 10 ml of the perfectly clear test solution (prepared as in 2.3).<sup>\*</sup> Introduce into the comparison tubes the respective volumes, indicated in Table 1, of 1:1,000, 1:5,000, 1:20,000, and 1:40,000 sodium thiosulfate solution (prepared as in 2.4), using either a 1-ml measuring pipette having 0.1 ml division marks or an automatic pipette suitable for dispensing 0.1-ml quantities accurately. The thiosulfate solutions shall be delivered directly into the test solution, employing equipment and technique which prevent retention of drops on the tip of the pipette or the wall of the tube. The volume of thiosulfate solution added to 10 ml of test solution shall not exceed 0.2 ml. One of the eight tubes shall be free of thiosulfate in order to serve as a blank.

Allow the film or plate sample and the comparison tubes to stand without agitation for 15 minutes. Then agitate to distribute uniformly any precipitate which may have formed. (NOTE: If considerable thiosulfate is present, 5 minutes instead of 15 minutes may be permitted to elapse before the samples are agitated

<sup>\*</sup>An automatic pipette is desirable for dispensing this poisonous solution. The equipment chosen should deliver precisely the same quantity each time.

and examined.) Remove the film or plate before evaluation.

**2.5.4 Evaluation of Turbidity.** Compare the turbidity or opalescence in the solutions by viewing toward a black (or dark) background, with the test tubes uniformly illuminated from the side opposite to that of the observer, and with the illumination source elevated or depressed from the line of sight 30 to 90 degrees. A preferable light source for direct visual comparison consists of a daylight-type fluorescent lamp fitted with an opaque shield or placed in an illuminator housing to prevent direct light from reaching the observer.\* (See Figs. A1, A2, and A3 in Appendix for suggested illuminators.) Light from a bright sky also may be used. After obtaining a match of turbidity or opalescence, the corresponding quantities of sodium thiosulfate in micrograms per square centimeter, micrograms per square inch, and milligrams per square inch of the film or plate sample are found by reference to Table 1. The eight comparison solutions specified in Table 1 are sufficient for most purposes, but, for determination of intermediate quantities in a given range, other comparison

\*For readings made by instrumental methods, such as in photoelectric instruments, the use of a mercury vapor lamp in a housing is permitted as an alternative light source.

solutions can be prepared as suggested in the note following Table 1, or the size of the film or plate sample can be changed.

**2.5.5 Films or Plates with Layers on Both Sides.** Values for thiosulfate content as taken from Table 1 will be divided by two for films or plates having (1) image layers on both sides, or (2) an image layer on one side and a similar non-image layer on the reverse side.

**2.5.6 Film or Plate Sample Size When Excessive Thiosulfate Content Is Found.** Determination of thiosulfate content in excess of that provided for in Table 1 is seldom of interest. However, films or plates having such higher content can be tested by using 0.1 sq in. (0.65 sq cm)\* instead of 1 sq in. (6.45 sq cm). The corresponding thiosulfate content will then be ten times that of a given value shown in Table 1. Comparison solutions containing greater quantities of thiosulfate than the maximum shown in Table 1 should not be used, since the turbidity differences gradually diminish with addition of thiosulfate above the maximum quantity shown.

\*An 0.1-square-inch film sample is obtained conveniently by taking two circular punchings 0.25 inch in diameter.

## Appendix

(This Appendix is for informative purposes and is not to be considered a part of American Standard Method for Determining the Thiosulfate Content of Processed Black-and-White Photographic Film and Plates, PH4.8-1958.)

### Effect of Density of Sample

Careful users of the method given in this standard have observed that at low thiosulfate content more thiosulfate is sometimes indicated by the test when the samples are taken from areas of high silver density as compared with low density. For most purposes, the effect is insignificant unless the density is greater than 2.0 in more than 25 percent of the area. In order to avoid possible error from this source, it is prescribed in 2.5.2 that the sample of film or plate for test be taken from a representative image area. Thus the sample should not include any greater or lesser area of high or low density than is normal for the type of subject matter.

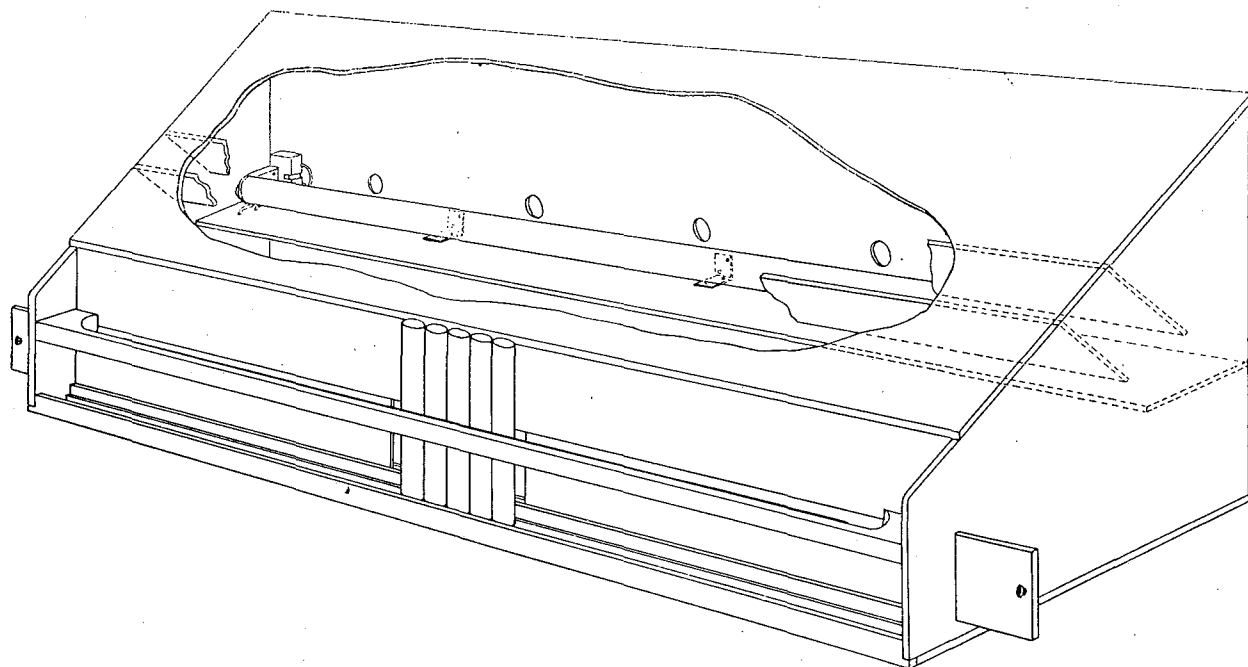


Fig. A1  
Viewing Box

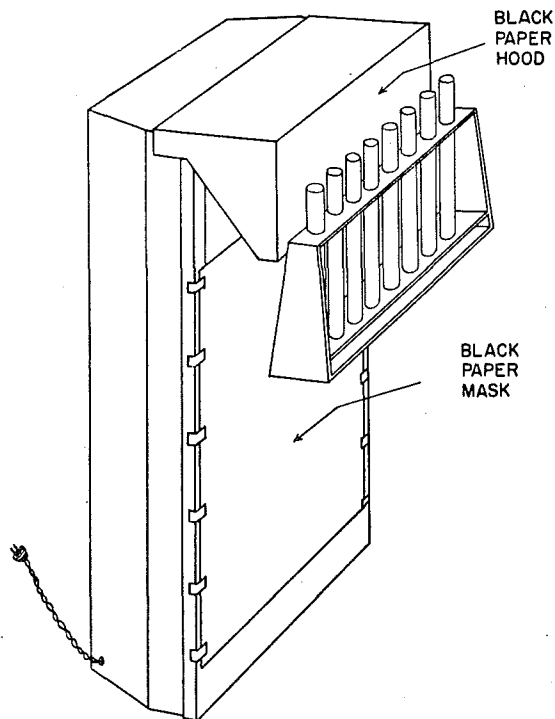


Fig. A2

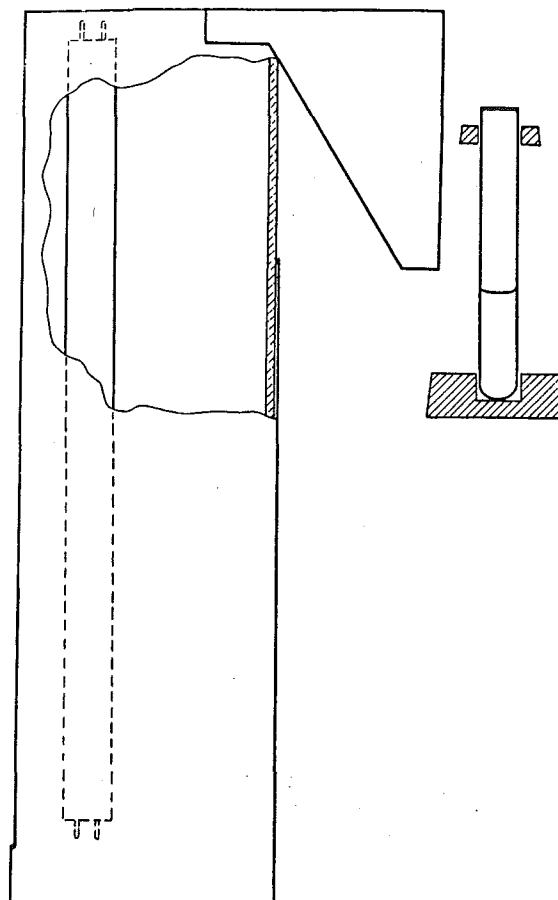


Fig. A3

**Method of Adapting an Ordinary 14- × 17-Inch X-ray Illuminator for Use As Viewing Light Source**

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