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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION
R 421

METHOD FOR INDICATING THE STABILITY OF THE IMAGES OF PROCESSED BLACK-AND-WHITE FILMS, PLATES AND PAPERS

1st EDITION
March 1965

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BRIEF HISTORY

The ISO Recommendation R 421, *Method for Indicating the Stability of the Images of Processed Black-and-White Films, Plates and Papers*, was drawn up by Technical Committee ISO/TC 42, *Photography*, the Secretariat of which is held by the American Standards Association, Inc. (ASA).

Work on this question by the Technical Committee began in 1956 and led, in 1958, to the adoption of a Draft ISO Recommendation.

In August 1961, this Draft ISO Recommendation (No. 396) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Belgium
Brazil
Canada
Chile
France
Germany
Italy
Japan
Netherlands
New Zealand
Romania
Sweden
Switzerland
United Kingdom
U.S.A.
U.S.S.R.

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in March 1965, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 421 March 1965

METHOD FOR INDICATING THE STABILITY OF THE IMAGES OF PROCESSED BLACK-AND-WHITE FILMS, PLATES AND PAPERS

1. SCOPE

1.1 General scope

This ISO Recommendation specifies test methods for indicating the relative stability of the images of processed films, plates and papers, as conditioned by the internal factors resulting from processing. It applies only to processed photographic materials containing silver particles in an organic colloid layer, and not to dye images, tinted, toned or intensified photographs.

1.2 Purpose of the three test methods

The scope of the three test methods given is as follows:

Test	Effect
Test for effect of thiosulphate (hyposulphite) (see clause 3.1)	Fading or darkening due to chemical reaction of residues of thiosulphate or other treating agents
Test for light stability (see clause 3.2)	Darkening due to action of light on residual silver compounds
Test for effect of silver compounds (see clause 3.3)	Discoloration due to chemical action on residual silver compounds.

Appropriate criteria are given for archival and non-archival cases respectively. All three tests are necessary to characterize image stability, but any one test may be useful for a particular purpose.

NOTE.—The qualitative criteria for archival and non-archival cases given in the methods of this ISO Recommendation are not specifications *per se* for materials tested in the respective cases.

2. GENERAL

2.1 Factors affecting stability

Deterioration of the image of processed photographic materials is controlled by factors which may be classified as internal and external.

2.1.1 *Internal factors.* The internal factors determine the stability and are the subject of the test methods. They include the state of division of the silver, the form of the image (for example, narrow lines or small spots of low density in a field of high density, or the converse), and a group of factors governed by the processing treatment, the presence of protective substances, the content of uncombined fixing or " stabilizing " agents, such as the thiosulphates, the acidity and the residual silver compounds in the processed material. Instability of the base or other layers may be an internal factor in so far as decomposition in any of them may yield products which stain or attack any part of the image.

2.1.2 *External factors.* Some of the most common external factors are the conditions of temperature and humidity, the intensity and quality of light, or other radiation to which the photographic material is exposed, the presence of active gases in the atmosphere and the time of exposure to any of these.

The durability of the photographic record when subjected to weathering, biological attack or mechanical wear is not within the scope of this ISO Recommendation.

2.2 Purpose of test

The test methods are intended to evaluate the internal factors by subjecting representative samples of the processed materials to some of the external factors in a severe but controlled degree.

2.3 Effect according to type of process: fixing or " stabilizing "

Following completion of photographic development, the photographic material is subjected either to fixing and washing or to a so-called " stabilizing " treatment to impart the required resistance to darkening, discoloration and fading during subsequent use or storage.

2.3.1 When the fixing and washing process is employed, the object is to convert the unused silver salt to a soluble complex which, along with the fixing chemicals, will then be removed by thorough washing, so as to assure a relatively high degree of stability.

2.3.2 In contrast, the " stabilizing " processes usually consist of bathing the developed material in a solution containing, for example, thiosulphate, thiourea or thiocyanate, to convert the unused silver salt to a comparatively stable chemical complex. In some of these processes, half or more of the silver compounds are removed from the photographic material. Drying follows, either without any intermediary washing or, at the most, with a superficial rinse. Generally speaking, the degree of stability attainable by " stabilization " is less in one respect or another than that attainable with the more usually employed fixing and washing processes.

2.4 Effect of excess thiosulphate or tetrathionate

The possible extent of fading which results from reactions involving thiosulphate and image silver, with the consequent conversion of the latter to silver sulphide, is dependent, among other things, upon the relative quantities of metallic silver and excess thiosulphate, and the state of subdivision of the silver. Conversion to silver sulphide does not necessarily render the image useless, unless legibility, image detail or aesthetic quality is too much impaired. The amount of such fading or discoloration allowable in a negative or print will depend somewhat upon the use for which the material is intended. Thus a slight discoloration may be seriously objectionable in pictorial matter, especially if it is uneven, while extensive sulphiding of a line image may be inconsequential, if legibility is not lost.

The rate at which the actual chemical conversion takes place varies widely, not only with the factors mentioned above, the form of the image, the presence of protective material, the acidity or alkalinity and the relative quantities of free thiosulphate and sulphite, but also with temperature and humidity. It is impossible to assign a definite figure for the expected life of a given sample of processed material on the basis of any one factor, such as free thiosulphate content. However, the relative stability of the image can be indicated from the results of empirical accelerated tests on samples of typical image matter.

Methods for determining the thiosulphate in processed photographic film and papers respectively are given in ISO Recommendation R 417, *Method for determining thiosulphate and tetrathionate in processed black-and-white photographic film, plates and papers*. The method of Part II of this ISO Recommendation also determines tetrathionate (for example, sodium tetrathionate ($Na_2S_4O_6$)), which may result from mild oxidation of thiosulphate and which, during storage, can effect conversion of the silver image to silver sulphide in a manner analogous to soluble thiosulphate.

2.5 Effect of other fixing or " stabilizing " agents

Fading effects may be produced when the silver grains are attacked by a residual excess of other fixing or " stabilizing " agents. Depending on the agent employed, the silver compound formed in the fading process may be the sulphide, as previously discussed, or some other compound which effects a change in colour or loss in density. The influence of the other internal and external factors is of similar significance with the above-mentioned agents. Considerations governing the choice of test material and the criteria for evaluating image impairment are as mentioned in clause 2.4.

2.6 Effect of residual silver compounds

The residual silver compounds are primarily responsible for the over-all staining of processed photographic materials often encountered under conditions of high temperature and humidity or on exposure to actinic light or to other radiation which causes the light-sensitive substance to darken or " print-out ". The presence of labile sulphur (active with respect to silver) either in the atmosphere or as the product of decomposition of sulphur compounds in the photographic material will also cause the conversion of these silver compounds to silver sulphide, even when the temperature and humidity are not extreme.

3. TEST METHODS

3.1 Test for effect of thiosulphate and other residual chemicals

Representative samples * of the processed photographic materials to be tested, chosen to include typical image matter (see clause 2.1), are perforated at one end and suspended from a glass rod support in a closed (but not sealed) all-glass container low in form. Contact of the samples with each other or the container walls should be avoided. The atmosphere within the container should be maintained at 37.8 ± 0.3 °C (100 ± 0.5 °F) and 94 ± 4.0 per cent relative humidity. A relative humidity of approximately 96 per cent can be attained by keeping in the bottom of the container a generous amount of a saturated water solution of potassium sulphate in contact with an excess of the solid salt (K_2SO_4). Grades designated as " technical " or " purified " may be used. Alternatively, exposure to these conditions of temperature and humidity may be provided by means of air-conditioning cabinets or rooms in which the samples are similarly suspended to keep them separated from each other and shielded from contamination.

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* While a single specimen may be tested, the selection of truly representative samples will entail the use of an adequate sampling procedure.

If no noticeable change of image colour or density or staining of the clear areas has occurred after 30 days' incubation under these conditions, the material should be reported as satisfactorily stable for archival purposes, with respect to the internal factors resulting from processing. Comparison should be made with an adjacent portion of the sample which has been given the following special processing treatment and incubated with the test sample.

3.1.1 *Treatment of sample for comparison.* Prepare comparison sample or samples

(1) using the particular class of material concerned, preferably from the same lot;

(2) exposing, developing and treating for the time considered good practice for the material.

Fix successively for 5 min in duplicate fresh fixing baths containing 240 g of crystalline sodium thiosulphate per litre. Wash paper prints 30 min and film or plates for 1 hour in running water which is flowing at a rate equivalent to that needed to fill the vessel (tray, dish or tank) once every 5 min. Air-dry the film and plate samples at this stage.

For images on paper supports, follow the 30 min wash by bathing for 5 min in the following hypo eliminator:

Hypo eliminator

Water	300 ml
Hydrogen peroxide (3 per cent solution)	500 ml
Ammonia solution *	100 ml
Potassium bromide	1 g
Water to make in total	1 litre

Caution: Prepare the solution immediately before use and keep in an open container during use. Do not store the mixed solution in a stoppered bottle, or the gas evolved may break the bottle.

Remove the prints directly to a 1 per cent solution of sodium sulphite and treat them for 2 min. Finally, wash in fresh running water for 10 min before drying.

In the preparation of comparison samples, the temperature of all baths including the wash water should be 20 ± 1.7 °C (68 ± 3 °F).

3.1.2 For non-archival purposes, exposure to the prescribed conditions of incubation for 10 days will suffice, and the results should be reported in terms of non-archival use.

The 10-day exposure also may be used when judgment is based on the non-archival criterion of retention of legibility instead of the absence of noticeable change, and the legibility criterion should be mentioned, if it is used. In this case, comparison may be made with an adjacent portion of the sample which has been retained at no higher than 23.9 °C (75 °F) and 40 per cent relative humidity.**

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* Prepared by adding 1 part of concentrated ammonia (28 per cent) to 9 parts of water.

** Indoor conditions during winter will usually be found adequate. Suitable storage can also be provided by sealing the sample with an ample quantity of activated silica gel in a container which is kept in a refrigerator.