BS ISO 18936:2020

BSI Standards Publication

Imaging materials — Processed colour photographs — Methods for measuring thermal stability

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National foreword

This British Standard is the UK implementation of ISO 18936:2020. It supersedes BS ISO 18936:2012, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CPW/42, Photography.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 42, *Photography*.

This second edition cancels and replaces the first edition (ISO 18936:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the test methods for environmental stress factors have been changed to align with ISO 18944;

— the calculations and computations section has been removed as they are now contained in ISO 18944;

— Annex A has been removed as the method for interpolation is now contained in ISO 18944:2018, Annex B;

— the usage and reporting requirements have been updated to ensure consistency within the documents of the ISO 189## family.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document covers the methods and procedures for measuring the long-term, dark storage stability (thermal stability) of colour photographs.

Today, the majority of photographs are made with colour dyes and pigments. The length of time that such photographs are to be kept can vary from a few days to many hundreds of years, and the importance of image stability can be correspondingly small or great. Often the ultimate use of a particular photograph may not be known at the outset. Knowledge of the useful life of colour photographs is important to many users, especially since stability requirements often vary depending upon the application. For museums, archives and others responsible for the care of colour photographic materials, an understanding of the behaviour of these materials under various storage and display conditions is essential if they are to be preserved in good condition for long periods of time.

Any change in density, contrast or stain, whether due to colourant fading, changes in colourant morphology or discolouration of residual substances will change the appearance of the photograph.

The most damaging change tends to be contrast balance distortions brought about by differential fading of the three image colourants. These manifest themselves as shifts in colour balance from highlights to shadows that are especially noticeable in a scale of neutrals, for example a shift from magenta to green due to fading of the photograph's magenta image colourant, or from yellow to blue or cyan to red due to fading of the yellow or cyan colourant.

The second most consequential change is that caused by an increase in stain. The result may simply be a discolouration of the $D_{\min}$ areas (unexposed processed media or unprinted substrate) or a change in the $D_{\min}$ colour balance.

Cyan, magenta, yellow, and sometimes black, red, green and blue colourants that are dispersed in transparent binder layers, or absorbed onto special receiver layers coated onto transparent or white opaque supports, form the images of most modern colour photographs. Colour photographic images typically fade during storage and display; they will usually also change in colour balance because the image colourants seldom fade at the same rate. In addition, a yellowish (or occasionally another colour) stain may form and physical degradation may occur, such as embrittlement and cracking of the support and image layers. The rate of fading and staining is governed principally by the intrinsic stability of the colour photographic material and by the conditions under which the photograph is stored and displayed. The quality of chemical processing or post-processing is another important factor. Post-processing treatments and, in the case of digitally generated photographs, post-production treatments, such as application of lacquers, plastic laminates and retouching colours, also may affect the stability of colour materials.

The three main factors that influence storage behaviour or dark stability are the temperature and relative humidity (RH) of the air that has access to the photograph, as well as atmospheric pollutants to which the photograph is exposed. High temperature, particularly in combination with high relative humidity, will accelerate the chemical reactions that can lead to degradation of one or more of the image colourants. Low-temperature, low-humidity storage, on the other hand, can greatly prolong the life of photographic colour images for typical materials. Other potential causes of image degradation are microorganisms and insects.

Most modern photographs degrade too slowly under normal room conditions to permit evaluation of their dark storage stability within reasonable periods. However, it is possible to assess the probable, long-term changes of some photographs under low and moderate storage conditions with accelerated, high-temperature tests, because recognizable losses in image quality under high temperatures are apt to be generated also under milder temperatures, if at a slower pace. The effects of relative humidity on thermal degradation can also be evaluated with Arrhenius tests conducted at two or more humidity levels.

Long-term changes in image density, colour balance and stain level can be reasonably estimated only when good correlation has been confirmed between accelerated tests and actual conditions of use.

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Density changes induced by the test conditions and measured during and after incubations include those in the support and in the various auxiliary layers that may be in a particular product. With most materials, however, the major changes occur in the image-bearing layer. An exception to this is found in some inkjet papers where the inks are thermally stable and substrate yellowing is the failure mode (see Reference [9]).

The tests for predicting the stability of colour photographic images in dark storage are based on an adaptation of the Arrhenius method described by Bard et al. (see References [2] and [3]) and earlier references by Arrhenius, Steiger and others (see References [4], [5] and [6]). Although this method is derived from well understood and proven theoretical precepts of chemistry, the validity of its application to predicting changes of photographic images rests on empirical confirmation. Although many chromogenic-type colour products yield image fading and staining data in both accelerated and non-accelerated dark ageing tests that are in agreement with the Arrhenius relationship, some other types of products do not. For example, integral-type instant colour print materials often exhibit atypical staining at elevated temperatures. The treatment of some chromogenic materials at temperatures above 80 °C and 60 % RH may cause the loss of incorporated high-boiling solvents and abnormal image degradation. The dyes of silver dye-bleach images deaggregate at combinations of very high temperature and high relative humidity, causing abnormal changes in colour balance and saturation (see Reference [7]). In general, photographic materials tend to undergo dramatic changes above 60 % RH (especially at the high temperatures used in accelerated tests) owing to changes in the physical properties of gelatine and other binder materials. Lower maximum relative humidity may need to be tested for some of the more humidity-sensitive inkjet materials because of phase changes such as melting point or glass transition temperature.

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