BS ISO 18948:2025

BSI Standards Publication

Imaging materials — Photo books — Test methods for permanence and durability

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Full document details: BS ISO 18948:2025

National foreword

This British Standard is the UK implementation of ISO 18948:2025. It supersedes BS ISO 18948:2018, which is withdrawn.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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Published by BSI Standards Limited 2025

ISBN 978 0 539 34183 6

ICS 37.040.99

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2025.

Amendments/corrigenda issued since publication

Date	Text affected

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International Standard

ISO 18948

Imaging materials — Photo books — Test methods for permanence and durability

Matériaux pour l'image — Albums photos — Méthodes d'essai de permanence et de durabilité

Second edition
2025-02

Reference number
ISO 18948:2025(en)

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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.

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 document 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 ISO/TC 42, *Photography*.

This second edition cancels and replaces the first edition (ISO 18948:2018), of which it constitutes a minor revision.

The changes are as follows:

— two editorial clarifications in Terms and definitions;

— minor punctuation and grammar changes in Clauses 4 and 6;

— consistency of calculation terms in Clause 7;

— minor editorial clarifications in the annexes.

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

Photo books are bound books with printed pages comprised of integrated photos, along with artwork and text, designed by and usually dedicated to a limited group of people.

Like photographic prints, photo books are produced on the widest available spectrum of production, from large run commercial facilities to one-off home kits. Their expected permanence and durability can cover a similarly broad range. Careful consideration should be given to the materials used in the construction of photo books to insure high permanence of the printed images[33] and of the books themselves[34].

Photo books are typically stored in a closed condition, either in a stack or on a book shelf; consequently environmental factors that may adversely affect displayed prints, such as light and ozone, may not be applicable to the preservation of the inside pages of a photo book. The user is cautioned that these factors may become relevant if the photo book is displayed or otherwise exposed to light or other environmental factors for an extended period of time. ISO 18937 (all parts) and ISO 18941 provide guidelines on testing for the effect of light and ozone on photo books.

The test methods included in this document assume that the photo book will be stored and used in environments that may or may not be climate controlled. For this reason, it includes test conditions designed to assess the adverse effects of humidity and temperature that may be outside of recommended long-term and medium-term storage conditions as described in ISO 18920. It also includes test conditions intended to simulate short duration exposure of photo books to the interior of a hot vehicle.

This document contains many specific tests for various binding systems and printing processes. It is not the intention of this document to require that all possible combinations be tested. Testing all combinations of sizes, cover materials, binding options and printing processes is not possible due to the large number of combinations. However, testing representative combinations of materials is encouraged.

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Imaging materials — Photo books — Test methods for permanence and durability

1 Scope

This document specifies test methods to assess the permanence and durability of photo books, including cover and pages.

This document is applicable to photo books which contain reflection colour prints made with colour hardcopy materials of all types, including those from either traditional analogue printing or modern digital printing processes. The same performance test methods apply, regardless of the printing process. Because of the large number of combinations of sizes, cover materials, binding options and printing processes, testing of all possible combinations is not within the scope of this document. Instead, a representative selection of printed pages, cover materials and binding options that are used in the makeup of the photo book are tested.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 527-3, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

ISO 11800:1998, *Information and documentation — Requirements for binding materials and methods used in the manufacture of books*

ISO 18924, *Imaging materials — Test method for Arrhenius-type predictions*

ISO/TR 18931, *Imaging materials — Recommendations for humidity measurement and control*

ISO 18936, *Imaging materials — Processed colour photographs — Methods for measuring thermal stability*

ISO 18937 (all parts), *Imaging materials — Methods for measuring indoor light stability of photographic prints*

ISO 18941:2020, *Imaging materials — Colour reflection prints — Test method for ozone gas fading stability*

ISO 18946, *Imaging materials — Reflection colour photographic prints — Method for testing humidity fastness*

ISO 18949, *Imaging materials — Reflection colour photographic prints — Method for testing stability under low humidity conditions*

ISO 19594, *Graphic technology — Test method for the determination of the binding strength for perfect-bound products — Page-pull test working upwards*

ASTM F904, *Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

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— IEC Electropedia: available at https://www.electropedia.org/

3.1
photo book
bound book with printed pages comprised of integrated personal photos along with artwork and text, designed by and usually dedicated to a limited group of people

3.2
cover
protective covering on the front, back, and spine of a book, including any associated adhesives, binding boards, liners, and laminates

3.3
blister
localized delamination of a multilayer assembly that looks like a bubble

3.4
delamination
separation of a *laminated assembly* (3.8) into its constituent layers, either in whole or in part

3.5
laminate
layer of material that goes over one or both sides of a printed page

Note 1 to entry: Usually the laminate layer provides moisture barrier and abrasion resistance, as well as UV shielding, to add protection to the photo images from physical damage and colour fading.

3.6
laminate
<film> clear polymeric layer applied using thermosetting or pressure-sensitive adhesive to one or both surfaces of a print to improve durability

3.7
laminate
<liquid coating> water-based, solvent-based, or UV-curable liquid protective coating applied to one or both surfaces of a print to improve durability

3.8
laminated assembly
multilayer structure typically comprising a paper support, one or more barrier layers, an imaging layer, and a protective *laminate* (3.5) top layer

Note 1 to entry: Laminated assemblies include films or coatings adhered to the surface of pages or covers, prints adhered back-to-back to each other forming a completed page.

3.9
lay-flat
binding that allows for an uninterrupted image across the binding either by using flexible, hinged pages or by using adhesives to adhere the back of two adjacent pages

3.10
sandwich sample holder
metal fixture intended to hold three components in a flattened, pressed-together position so that airflow to the printed areas of the middle component is restricted as a function of the permeability of the two outer components

Note 1 to entry: This type of sample holder is suitable for sandwich thermal test method written in Annex D.

3.11
sample sandwich thermal test method
thermal stability test method that complies with ISO 18936 except that the *sandwich sample holder* (3.10) is used in place of the free hanging sample holding method

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3.12
blocking
undesired adhesion between sheets of printed material that occurs under moderate pressure, high temperature, or high humidity, while in storage or in use that leads to undesirable effects such as *delamination* (3.4), paper splitting, tearing, ferrotyping, colourant transfer, or edge deformation

3.13
sticking
temporary adhesion of prints in a stack or pages in a *photo book* (3.1) but without physical damage when adjacent prints or pages are separated

3.14
ferrotyping
changes in surface gloss resulting from intimate contact with another surface, often associated with high humidity

Note 1 to entry: The term ferrotyping is derived from a historical term associated with silver halide photography. It is a process used to produce a very high gloss surface on a gelatine silver halide print in which a damp print is placed in contact with a highly polished surface, such as chromium-plated steel, and dried under conditions of elevated temperature and pressure.

3.15
bleeding
lateral migration of colourant

3.16
colourant transfer
transfer of colourant from one sheet to the other sheet, when both sheets are placed in direct contact

3.17
cumulative exposure
the aggregated total exposure of a test sample to a series of exposures to a specific condition (e.g., light intensity) over a specific duration.

Note 1 to entry: For example, receiving five separate exposures to a light intensity of 10 klx for 24 hours each, would have a cumulative exposure of 1 200 klx-h (5 x 10 x 24)

3.18
curling
physical deformation of a page, a cover, a stack of prints or a bound *photo book* (3.1) resulting in departure from physical flatness with the tendency to curve into a concave or convex shape

3.19
wrinkling
physical deformation of a page or a cover of a *photo book* (3.1) resulting in departure from physical flatness with the tendency to make furrows, crinkles, folds, ridges or creases

3.20
warp
distortion of the front and/or back covers of a bound book, so that the covers do not lie flat against the book block

3.21
book block
text block, including the endpapers and other materials added by the binder, before casing in

3.22
waviness
physical deformation of a page or a cover of a *photo book* (3.1) resulting in departure from physical flatness with the tendency to curve alternately in opposite directions, resembling or suggesting waves

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3.23
cockle
planar distortion in flat materials, especially paper or vellum, that is characterized by puckering, waves, or rippling

3.24
edge fluting
wave-shaped deformation along the edges of cut sheets and can be caused by an expansion of the edge of the material, which is exposed to greater variations in temperature and humidity than the centre

4 Image permanence tests for covers and pages

4.1 General

Although the individual pages of most photo books are not typically exposed to light and pollutants in the ambient environment for long periods of time, it is useful to know how stable the printed pages are if the book were to be left open to the environment for extended periods of time. Therefore, the tests described in this clause are intended to be carried out on individual printed sheets or pages of a photo book. In addition, these tests are also intended for photo book covers. Different use profiles are addressed in specification documents.

Thermal stability, light stability, ozone resistance and humidity resistance of printed sheets and covers may be evaluated according to the test methods given in ISO 18936, ISO 18937 (all parts), ISO 18941, and ISO 18946, respectively.

Light stability and ozone resistance, as measured according to ISO 18937 (all parts) and ISO 18941 will reflect the performance that can be expected for a cover that contains pictures or for the underlying printed sheets, if a cover has a window opening that shows the first page, or if the book is displayed or otherwise left in an open state for long periods of time. However the most important issue regarding image permanence of photo books is generally dark storage.

NOTE Information regarding physical abrasion testing is provided in Annex B.

4.2 Sample preparation

The samples shall consist of the parts of a photo book, including pages, liner and end sheets, and covers, separated into individual page size components. Printable components, including a printable cover — if applicable — shall be printed with a test target. These parts are then bound in the same process (time and machine settings) as the book for which the test is intended. At least two replicate samples are recommended. Alternatively, test specimens shall be cut off from the book. For general testing purposes, users of this document are free to choose whatever target patches and starting densities they feel are appropriate for their testing needs. An example of such a target is included in ISO 18944 along with requirements and recommendations for sample preparation. Applicable International Standard(s) for specification of print life may require the use of specific targets. If a protective lamination film or varnish coating is applied to the photo book, either on the book cover or in its inner sheets, the same protective film or varnish coating shall be applied on the test samples. The photo book components shall be conditioned at 23 °C and 50 % RH for 24 h prior to testing.

NOTE Be aware that different starting densities of the test prints may yield different test results in terms of fading rate. Once a test sample density is chosen, it is important to be consistent across all test samples for comparison. If testing is being done according to a standard that uses specific starting densities it is important that those densities be adhered to.

At least two replicate samples of each photo book component part are required, both printed and unprinted. Replicates of each photo book component part shall be located in different regions of the respective test chambers (light, ozone, etc.).

The measurement and sample holding conditions and measurement procedures given in ISO 18936 shall be followed. In particular, care shall be taken to use consistent ambient light levels and hold times in each

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iteration of the sample holding and measurement process. Density shall be measured for printed patch areas, and colorimetric values shall be measured in the D_{min} (minimum density) patch areas of the printable components and in the centre, of each unprinted component. Density and colorimetric values from the replicate samples shall be averaged before calculations are performed.

4.3 Thermal stability during long-term dark storage

4.3.1 General

Long term stability shall be evaluated in accordance with ISO 18936, the test method, and ISO 18924, the Arrhenius analysis. It should be noted that the test results of the short term high temperature test may not correspond to the long term stability.

4.3.2 Procedures

The sealed bag method, as detailed in ISO 18936, shall be used to test individual pages or covers. In addition to the required sealed bag method, the 'free hanging' method, also detailed in ISO 18936, may be used to minimize page or cover interactions; it does not, however, reflect the actual storage conditions of the photo book. The 'free hanging' test does not simulate interactions between components that may be present in a photo book, such as between the cover and the first page. To simulate those interactions the user may conduct a "sandwich" type thermal ageing test as described in Annex D.

During actual storage of photo books the temperature and humidity will fluctuate, including potentially large fluctuations depending on the differences in seasons. The testing shall be done at a relative humidity (RH) of 50 %. However, because the effects of humidity on image stability can differ markedly from one product to another, it is useful to evaluate its effect. This is done by means of a temperature test series carried out at different relative humidity. If the relative humidity during storage is expected to be significantly lower than 50 % RH, such as when stored in accordance with some conditions specified in ISO 18911, ISO 18920 or in an arid climate, or significantly higher, as in a tropical climate, the relative humidity selected for the test should correspond to the storage conditions. Such tests are often conducted at conditions of various % RH levels, such 20 % RH to pick up low humidity effects and 70 % RH to pick up high humidity effects. In order to make use of the Arrhenius method in ISO 18924, the temperatures used shall span a minimum range of 20 °C.

4.3.3 Reporting

Reporting shall comply with the reporting requirements of ISO 18936. The results of these tests are reported as temperatures and time for thermal testing to reach the observed losses in optical densities, together with the percentage of optical density losses, or the amount of densitometric and/or colorimetric change observed for a given temperature and time. Reporting shall include results for each tested photo book component, printed and unprinted. For each photo book component, reporting shall also include the presence or absence of physical and biological changes including, but not limited to, delamination, adhesive failure, mould growth, and blocking. In particular, if a sample photo book component held in the interior of a three-layer sandwich in the sandwich sample holder adheres to or transfers colourant to the materials comprising the outer layers of the three-layer sandwich, this failure shall be reported. In addition, visible edge yellowing, differentiating the component edge region from the interior shall be reported.

4.4 Light stability

4.4.1 General

The test method for "simulated indoor daylight typical home display" according to ISO 18937 (all parts), shall be used. For general testing purposes, users of this document are free to choose whatever target patches and

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starting densities they feel are appropriate for their testing needs. An example of such a target is included in ISO 18944 along with requirements and recommendations for sample preparation.

NOTE Be aware that different starting densities of the test prints can yield different test results in terms of fading rate. Once a test sample density is chosen, it is important to be consistent across all test samples for comparison. If testing is being done according to a standard that uses specific starting densities it is important that those densities be adhered to.

4.4.2 Covers

The total cumulative exposure shall be 20 Mlx·h. Data may also be collected at lower and higher cumulative exposures if applicable to the usage case.

4.4.3 Pages

The total cumulative exposure shall be 2 Mlx·h. Data may also be collected at lower and higher cumulative exposures if applicable to the usage case.

NOTE The total cumulative exposure of 20 Mlx·h corresponds to 25 y exposure assuming that 12 h a day at a light level of 200 lx. 200 lx is the light level for book shelves at library which is described in ISO/CIE 8995-1. The pages are typically not exposed to as much light as the covers, and it is estimated to be less than ten percent of the cover value.

4.4.4 Reporting

Reporting shall comply with the reporting requirements of ISO 18937 (all parts). The results of these tests are reported as the amount of densitometric or colorimetric change observed for a given cumulative exposure (lx·h) together with the percentage losses in optical densities. If multiple exposures are used, the results are reported as the cumulative exposure to reach the observed densitometric or colorimetric change together with the percentage losses in optical densities.

4.5 Ozone stability

4.5.1 General

The test method described in ISO 18941 shall be used. For general testing purposes, users of this document are free to choose whatever target patches and starting densities they feel are appropriate for their testing needs. An example of such a target is included in ISO 18944 along with requirements and recommendations for sample preparation.

NOTE Be aware that different starting densities of the test prints can yield different test results in terms of fading rate. Once a test sample density is chosen, it is important to be consistent across all test samples for comparison. If testing is being done according to a standard that uses specific starting densities it is important that those densities be adhered to.

4.5.2 Covers

The total cumulative exposure shall be 1 450 µl/l·h. Data may also be collected at lower and higher cumulative exposures if applicable to the usage case. Unless otherwise specified, the test shall be carried out at 1,0 µl/l, with an operational uniformity of ±0,1 µl/l ozone as specified in ISO 18941:2020, 9.4. Other optional concentrations, such as 0,5 µl/l or 5,0 µl/l, may be useful for testing. If concentrations other than 1,0 µl/l are used, the operational uniformity tolerances shall be ±10 % of aim or the best achievable with the test equipment. If greater than ±10 %, the actual tolerance shall be reported. If optional concentrations are used, the tester should evaluate the materials for ozone reciprocity behaviour before making any comparative conclusions. For testing at ozone concentrations greater than 1,0 µl/l, reciprocity testing shall be conducted at an ozone concentration of 1,0 µl/l or lower (as discussed in ISO 18941:2020, Annex B).

NOTE 1 µl/l = 1 ppm (1×10^{-6}) and is measured in terms of volume.

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