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Imaging materials — Reflection colour photographic prints — Method for testing humidity fastness

Matériaux pour l'image — Tirages photographiques en couleurs par réflexion — Méthode d'essai de la solidité à l'humidité

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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 18946:2011), which has been technically revised.

The main changes are as follows:

— Low humidity test has been removed, since the low humidity test was separated from ISO 18946 and published as ISO 18949.

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.

Introduction

This document addresses the methods and procedures for testing the humidity fastness of reflection colour photographic prints exposed to high humidity. This is of particular relevance to dye-based ink-jet prints or dye diffusion process prints[11][12][13][14][15][16][17].

Some types of colour photographic prints suffer from changes in image appearance when exposed to a high relative humidity environment. The observed changes relate to colour, tone and loss of sharpness caused by horizontal and vertical diffusion of colorants as a result of exposure to elevated humidity.

The elevated humidity can arise from:

a) exposure to high relative humidity of the environment of the display area or storage space;

b) trapped moisture as a result of stacking prints, or inserting them into albums, in a high relative humidity environment;

c) trapped moisture as a result of stacking prints, or inserting them into albums, before sufficient dry time has elapsed.

Note For the investigation of cases b) and c), the “sealed bag” method within the thermal test ISO 18936 can be adopted.

Therefore, humidity based on meteorological data and users’ behaviour was considered in determining the appropriate test conditions for the humidity fastness test. The test method stipulated in this document is validated for case a).

Image deterioration of dye-based prints caused by high humidity is often detectable by the following characteristics.

— Blur (sharpness loss), change of colour and/or tone is observed.

— The deterioration is observed in higher humidity, commonly over 80 % RH or over 90 % RH.

— The deterioration can occur in a relatively short time, even within one or two weeks.

— Higher density images, or images that contain more secondary or mixed colours, are generally more affected. The largest change is usually observed at the boundary of different colours, or with images that have contrasting background colours. The size of the higher density area also affects the deterioration because the solvent and water of the ink diffuses to the adjacent lower density area when the higher density area is small.

It is important to take into account these characteristics when determining the appropriate test chart and test conditions.

This document makes use of a checkerboard pattern that allows assessment of humidity-induced blur by means of a relatively simple colorimetric measurement[12].

Imaging materials — Reflection colour photographic prints — Method for testing humidity fastness

1 Scope

This document describes test methods for evaluating reflection colour photographic prints with regard to changes in image appearance resulting from exposure to high relative humidity.

NOTE Testing under low humidity conditions is described in ISO 18949.

The observed changes relate to colour, tone and loss of sharpness caused by horizontal and vertical diffusion of colorants from exposure to elevated humidity levels. Other humidity-related factors, such as mould and mildew growth, and physical damage, such as curl, cockle, cracking or delamination due to humidity cycling, are outside the scope of this test method.

Although the method and procedures described in this document can be used to test any colour hardcopy technology, it is particularly appropriate to systems where the colorants are applied by a mechanism involving the diffusion of colorant into image-receiving layers (for example inkjet or dye diffusion processes) or applied onto uncoated fibrous materials such as paper.

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 18913, *Imaging materials — Permanence — Vocabulary*

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

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

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO/CIE 11664-4, *Colorimetry — Part 4: CIE 1976 L*a*b* colour space*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18913 and the following 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

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

3.1
colour fringing
area of anomalous colour, most visible around a printed edge

Note 1 to entry: The cause is colorants that diffuse laterally at different rates. It is visually analogous to chromatic aberration effects seen in images from simple lens systems.

3.2
operational fluctuation
positive and negative deviations from the setting of the sensor at the operational control set point during equilibrium conditions in a laboratory accelerated weathering device

Note 1 to entry: Operational fluctuations are the result of unavoidable machine variables and do not include measurement uncertainty. Operational fluctuations apply only at the location of the control sensor and do not imply uniformity of conditions throughout the test chamber.

[SOURCE: ASTM G113-22]

3.3
operational uniformity
range around the operational control point for measured parameters within the intended exposure area, within the limits of the intended operational range

[SOURCE: ASTM G113-22]

4 Requirements

This document specifies a set of recommended test methods with associated requirements for permitted reporting. Data from these tests shall not be used to make life expectancy claims, such as time-based print lifetime claims, either comparative or absolute. Conversion of data obtained from these methods for the purpose of making public statements regarding product life shall be in accordance with the applicable International Standards for specification of print life.

The test methods in this document might be useful as stand-alone test methods for comparison of the stability of image materials with respect to one specific failure mode. Data from the test methods of this document may be used in stand-alone reporting of the absolute or comparative stability of image materials with respect to the specific failure mode dealt with in this document, when reported in compliance with the reporting requirements of this document. Caution shall be exercised when comparing test results for different materials. Comparisons shall be limited to test cases that use equipment with matching specifications and matching test conditions.

5 Outline of test procedure

The checkerboard pattern[12] shown in Figure 1 shall be printed at (23 ± 2) °C and in an environment of (50 ± 10) % RH.

The test samples shall be conditioned, positioned with unrestricted airflow, for (24 ± 2) h at (23 ± 2) °C and (50 ± 5) % RH.

The printed samples shall be exposed to high humidity as specified in Clause 7.

The colour patches shall be measured using CIELAB colorimetry before and after the humidity exposures. The colour difference $\overline{\Delta E^*_{ab}}$ for the patches of the checkerboard pattern shall be calculated according to Formula (1) in Clause 9.

This document stipulates two test methods: A and B.

Method A demonstrates the degree of the deterioration ($\overline{\Delta E^*_{ab}}$ of the printed image) quantitatively in a fixed humidity condition, i.e. 25 °C and 85 % RH, for a given period of time. Four weeks is the recommended duration. One, two or eight weeks durations can be used. Method A is most useful for research and development of printing systems or printing materials where the humidity fastness of many samples can be screened and closely compared.

Method B demonstrates the limitations of printing systems and materials by analysing data from tests at various levels of humidity, i.e. 25 °C for two weeks at three or more humidity levels chosen from 60 %

RH, 65% RH, 70 % RH, 75 % RH, 80 % RH, 85 % RH, 90 % RH and 95 % RH, and showing where each sample starts to show significant changes with respect to the average $\overline{\Delta E^*_{ab}}$ of 84 patches. Method B is especially useful for communicating with end users who will be able to recognize the high humidity limitations for each product tested.

The test procedures are summarized in Table 1.

Table 1 — Summary of test procedures

Steps		Procedures and test conditions
Sample preparation	Test target	Checkerboard pattern shown in Figure 1
	Temperature and RH	(23 ± 2) °C and (50 ± 10) % RH
Sample conditioning	Temperature and RH	(23 ± 2) °C and (50 ± 5) % RH
	Duration	(24 ± 2) h, unrestricted airflow
Humidity exposure	Method A	25 °C and 85 % RH Recommended duration of 4 weeks One, two or eight week durations can be used
	Method B	25 °C for two weeks at three or more humidity levels chosen from 60 % RH, 65 % RH, 70 % RH, 75 % RH, 80 % RH, 85 % RH, 90 % RH and 95 % RH
Measurement	Method	CIE colorimetry conforming to measurement condition M0 of ISO 13655
	Parameter	$\overline{\Delta E^*_{ab}}$ of 84 patches in Figure 1 before and after the humidity exposure
Report	Method A	Measured deterioration at a fixed humidity
	Method B	Highest limit humidity without significant deterioration

6 Sample preparation

6.1 General

The checkerboard pattern shown in Figure 1 shall be printed at (23 ± 2) °C and (50 ± 10) % RH.

The test samples shall be conditioned for (24 ± 2) h at (23 ± 2) °C and (50 ± 5) % RH before humidity exposure, positioned with unrestricted airflow.

The sample holding environment shall be substantially ozone-free [≤2 nl/l[1)] average ozone concentration over any 24 h period] for ozone-sensitive samples, as determined in accordance with ISO 18941. A material that is not sensitive to ozone shall have demonstrated no measurable D_{min} or printed patch colour change at ambient ozone exposure levels and measurement condition temperature and humidity, over time periods consistent with measurement and test-staging time periods.

At least two replicate prints are required for each test case. Replicates shall be located for testing in different regions of the test chamber volume.

It is recommended that reference samples be included in every exposure test to track consistency of the test procedures as well as unintended changes of test conditions[10].

1) 1 nl/l = 1 ppb (1×10^{-9}). Although the notation "ppb" (parts per billion) is widely used in the measurement and reporting of trace amounts of pollutants in the atmosphere, it is not used in International Standards because it is language-dependent.

6.2 Test target

The checkerboard test pattern (see Figure 1) shall be used as the test target. The ISO 18946 humidity test target is contained in the image permanence test target collection that is available at https://www.imaging.org/site/IST/IST/Standards/Image_Permanence_Targets.aspx

The standard humidity print stability digital test file shall be downloaded and maintained in the tiff file format. No lossy image or file compression shall be applied to the target file. The digital file resolution shall be maintained as 600 dpi. The humidity print stability digital test file is encoded in sRGB, defined as per IEC 61966-2-1[8], and uses the tiff format with the sRGB ICC profile embedded. After downloading, the humidity print stability digital test file shall be retained in that format and encoding with the ICC profile retained.

NOTE Other file formats that retain the state of exactly unchanged pixel encoding values, no lossy compression, embedded sRGB ICC profile, and 600 dpi, can be treated as equivalent to the tiff format for internal use in a test environment.

This test pattern contains all of the cyclic combinations of Y, M, C, R, G, B, white and black as a checkerboard pattern. Rows 1, 7, 13 and 14 consist of solid-fill colour patches, which are used to evaluate changes in colour quality. Rows 2 to 6 and 8 to 12 consist of colour patches with a fine checkerboard pattern of interleaved colour squares which manifest colour changes that correlate well with loss of line quality caused by lateral migration of colorants.

The RGB values for each patch of the test target are shown in Annex B, Table B.1.

This test target was created to measure both colour and tone change and blur of the checkerboard pattern. The change in the CIELAB colorimetric value of each patch in Figure 1 caused by humidity exposure shall be measured as specified in Clause 8. However, the measurement of the colorimetric value of CIELAB of the checkerboard pattern is not always accurate in detecting line profile change as it cannot detect image sharpness loss if there is no colorimetric change in the checkerboard pattern. The requirement for visual evaluation is covered in 10.4.1.

It is recommended that a printed reference be kept in a freezer after conditioning and that it be used for the additional visual evaluation, comparing it to the humidity-exposed samples. The freezer should comply with the cold storage conditions given in ISO 18920, ensuring in particular that the humidity is less than 50 % RH.

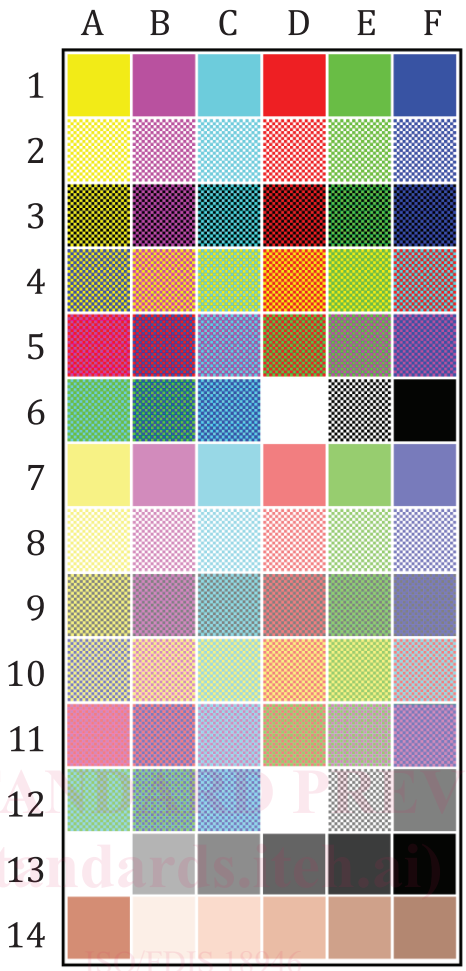

Figure 1 — Test target for humidity fastness test

6.3 Printer driver setting

When making prints for the humidity test, the manufacturer's recommended printer driver settings for each applicable medium should be used. Other printer driver settings may be used depending on the objectives of the test. The driver setting used shall be reported.

The standard target file shall be used, with no density or colour adjustment, when preparing the test samples.

Note The term “printer driver” refers to the (set of) software components that enable(s) communication between a computer and a printer, allowing the computer to send print commands and control the printing process. Other terms, that are interchangeably used include printer (or printing) software, device driver for printing, printer controller, printer management software, print utility or print processor.

6.4 Printing conditions

The test samples shall be printed in accordance with the manufacturer’s recommended procedures for each printing system. The temperature and humidity for printing shall be (23 ± 2) °C and (50 ± 10) % RH.

6.5 Sample conditioning

The printed samples shall be conditioned for (24 ± 2) h at (23 ± 2) °C and (50 ± 5) % RH before humidity exposure, positioned with unrestricted airflow. This is not mandatory for traditional chromogenic