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Imaging materials — Reflection colour photographic prints — Method for testing stability under low humidity conditions

Matériaux pour l'image — Tirages photographiques en couleurs par réflexion — Méthode d'essai de la stabilité dans des conditions de faible humidité

Reference number
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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 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

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 covers the methods and procedures for testing the low humidity fastness of reflection colour photographic prints. Low relative humidity exposure is covered; for high relative humidity testing see ISO 18946. Both low and high relative humidity testing is of particular relevance to dye- and pigment-based inkjet prints printed on swellable and porous media, dye diffusion process prints, and silver halide prints, see References [11] to[17].

In this test method the impact on the sample to be measured is the result of low moisture content in the sample, caused by low absolute humidity. When a temperature is fixed and equilibrium reached in the test environment, the measurement of the moisture content in the test environment is most easily done by specifying the relative humidity, not the humidity or absolute humidity. Therefore, the term “low relative humidity” will be used throughout this document.

The method and procedures described in this document can be used to test any colour hardcopy technology. Some types of colour photographic prints experience changes in image appearance when exposed to a low relative humidity environment. It has been observed that low relative humidities can accelerate the substrate yellowing of certain types of inkjet papers and this increase in the blue D_{min} (substrate white) has been observed with certain types of porous media, resulting in a yellow appearance. A possible mechanism for this effect is degradation of optical brighteners, see Reference [12].

The low relative humidity indoor environment can arise from cold dry air being drawn into the storage environment and heated to room temperature. Indoor low relative humidities are common in colder climates and can be especially prevalent in higher latitude countries in winter where outside air dew point temperatures can be well below 0 °C. When this air is warmed to room temperature in the print storage environment, relative humidities as low as 5 % or lower can be encountered.

Indoor low relative humidities are also common in hot, dry climates in combination with air conditioning. Low relative humidity environment is often encountered in desert environments or areas with long dry seasons..

In addition to substrate yellowing, very low relative humidities have also been shown to cause physical degradation of image receiving layers. Visual assessment and reporting of physical degradation are included.

Imaging materials — Reflection colour photographic prints — Method for testing stability under low humidity conditions

1 Scope

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

The observed changes relate primarily to substrate yellowing. Other observed humidity related physical damage factors such as curl, cockle, cracking, or delamination due to humidity cycling are also within the scope of this test method.

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

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions used in ISO 18913 and the following apply.

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

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

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

3.1
operational control point
set point for equilibrium conditions measured at sensor location(s) in an exposure device

[SOURCE: ASTM G113]

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: The operational fluctuations are the result of unavoidable machine variables and do not include measurement uncertainty. The 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]

3.3
operational uniformity
range around the *operational control point* (3.1) for measured parameters within the intended exposure area within the limits of intended operational range

[SOURCE: ASTM G113]

3.4
uncertainty (of measurement)
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could be reasonably attributed to the measurement

Note 1 to entry: The parameter can be, for example, a standard deviation (or a given multiple of it), or the half-width of an interval having a stated confidence level.

Note 2 to entry: Uncertainty of measurement comprises, in general, many components. Some of these components can be evaluated from statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. The other components, which can also be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information.

Note 3 to entry: It is understood that the result of the measurement is the best estimate of the value of the measurement, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standards, contribute to the dispersion.

[SOURCE: ASTM G113]

3.5
delamination
separation of a laminate into its constituent layers

3.6
cockle
planar distortion in flat materials, especially paper or vellum, that is characterized by puckering, waves, or rippling

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 Standard(s) for specification of print life.

The test methods in this document may 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. Comparisons shall be limited to test cases using test equipment with matching specifications.

5 Outline of test procedure

The eight-patch test target shown in Figure 1 shall be printed at 23 °C ± 2 °C and 50 % RH ± 10 % RH.

The test samples shall be conditioned, positioned with unrestricted airflow, for 24 h ± 2 h at 23 °C ± 2 °C and 50 % RH ± 10 % RH.

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

Colorimetric measurements shall be taken from ISO 13655 as specified in Clause 8.

The colour and minimum density, D_{min}, patches shall be measured using CIELAB colorimetry before and after the relative humidity exposures. The CIELAB colour difference, ΔE^*_{ab}, for each of the eight test patches of the test target shall be calculated.

This document specifies a test method that demonstrates the degree of the deterioration (average ΔE of the printed image) quantitatively in a fixed relative humidity condition. This includes demonstrating the propensity of the image receiving layer or underlying substrate to yellow upon exposure to low relative humidities, i.e. 25 °C at 10 % RH for 12 months, see Reference [19]. This test method is most useful for research and development of printing systems or printing materials where humidity fastness of many samples can be screened and closely compared.

NOTE To achieve relative humidities as low as 10 %, it can be necessary to either reduce the ambient relative humidity in and around the test chamber environment to well below 50 %, or install a dry air tank to provide separate dry air to the humidity test chamber.

The test procedure is summarized in Table 1.

Table 1 — Summary of the test procedures

Steps		**Procedures and test conditions**
Sample preparation	Test target	Eight patch target shown in Figure 1
	Temp and RH	23 °C ± 2 °C and 50 % RH ± 10 % RH
Sample conditioning	Temp and RH	23 °C ± 2 °C and 50 % RH ± 10 % RH
	Duration	24 h ± 2 h, unrestricted airflow
Measurement	Method	CIE colorimetry conforming to ISO 13655, M2 conditions. Optionally, condition M1 may also be used
	Parameter	$L^*a^*b^*$ of eight patches in the test target before the humidity exposure
Humidity exposure	Method	25 °C at 10 % RH for 12 months
Measurement	Method	CIE colorimetry conforming to ISO 13655, M2 conditions. Optionally, condition M1 may also be used
	Parameter	$L^*a^*b^*$ of eight patches in the test target after the humidity exposure. Visual observations for physical changes
Calculation		Individual ΔE^*_{ab} of eight colour patches in the test target after the humidity exposure. All ΔE^* measurements calculated from measurements taken before and after the humidity exposure.
Report		Measured deterioration at a fixed relative humidity, both ΔE^* and physical

6 Sample preparation

6.1 General

The test target shown in Figure 1 shall be printed at 23 °C ± 2 °C and 50 % RH ± 10 % RH.

NOTE The sample printing conditions in this test method refer only to the ambient printing environment, not the conditions inside the printer during the printing process.

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

The sample holding environment shall be ozone free (<2 nl/l average concentration over any 24 h period) for ozone sensitive samples, as determined according to 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