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Imaging materials — Colour images — Determination of water resistance of printed colour images

Matériaux pour l'image — Images en couleurs sur impressions en papier — Détermination de la résistance interne de la couleur à l'eau

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

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 42, *Photography*.

This second edition cancels and replaces the first edition (ISO 18935:2005 and ISO 18935:2005, Cor. 1:2007), which has been technically revised.

Introduction

Water resistance is not an important consideration in the normal storage of colour prints. However, in a disaster situation, such as floods, earthquakes or water main breaks, this property can be of critical importance if the print is to be salvaged. A wide variety of materials are used for digital colour prints and the colorants used in some digital prints are water soluble. The degree of their water resistance varies depending upon the colorants used and if the print has a water-resistant overcoat. In addition, the paper or other substrate may be of equal importance. The same colorants may exhibit very good water resistance on one substrate but can be completely washed off from a different substrate. Even print systems that use water-insoluble colorants may be damaged by water exposure if the substrate is not also water resistant. This document provides a standardized method to evaluate the qualitative water resistance of colour prints.

Imaging materials — Colour images — Determination of water resistance of printed colour images

1 Scope

This document specifies tests to determine the relative water resistance of printed colour images. This document is applicable to both digital and analogue prints.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

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

3.1
ambient conditions
environmental conditions of (23 ± 1) °C and (50 ± 5) % RH

3.2
mordant
substance that combines with a dye, used to fix it in a material

4 Categories of water resistance

4.1 General

The water resistance of a print is categorized into one of three categories, i.e. water resistant, moderately water resistant and not water resistant as defined in 4.2 to 4.4.

4.2 Water resistant

Water-resistant print is print that is not noticeably affected by exposure to liquid water.

NOTE No significant degradation of the colorant (bleeding, smearing, hue change), of the support (curl, cockle, delamination) or of the image surface (gloss changes, water rings, etc.) is found.

4.3 Moderately water resistant

Moderately water-resistant print is print that exhibits some change or damage by water but is still considered usable for its intended application.

NOTE The damage can manifest itself as slight media curl, partial delamination along an edge, or ring-like watermarks due to gloss changes or a minor amount of colorant migration. This damage can be mitigated by the rapid removal of the water (careful blotting, shaking off the water, etc.).

4.4 Not water resistant

Print that is not water-resistant is print that is easily damaged by contact with water, even when incidental (e.g. a water mist) and is considered unsuitable for applications involving contact with water.

NOTE Such damage can manifest itself as appreciable curl, delamination of the image layer, colorant bleed into non-imaged areas or from colour to colour, or image degradation (hue and gloss changes, surface marks, etc.). It is strongly advisable to users of these materials to prevent water contact.

5 Water resistance estimating procedures

5.1 General considerations

Water resistance is the ability of a print to resist water damage which may manifest itself in a number of ways, such as migration of colorants; changes in the size and/or optical density of image elements; degradation of the image layer, as well as cockle, curl or loss of gloss. The water resistance of prints made by current methods varies considerably. For example, some ink-jet prints sustain no observable damage when the surface is rubbed immediately after water has been poured over the image. While others that do not show any water damage after soaking for hours, lose a portion of their image layer if it is wiped off before drying.

For dye-based inkjet, water resistance of many systems is dependent on three interdependent variables: ink absorption, coating solubility, and effectiveness of mordant[1]. For other systems where the ink is not absorbed into the substrate, water resistance is dependent on adhesion of the colorant to the substrate. In both cases, water-resistant laminates will improve water resistance.

Extensive tests have shown that full characterization of water resistance requires several different methods. Many attempts were made to quantify the test data generated by these methods in interlaboratory comparison, but none were successful. It is likely that within a given laboratory, the tests described in this document are sufficiently reproducible to yield statistically reliable data. However, this is not enough to adopt fixed evaluation criteria. For these reasons, qualitative analysis of the test results is prescribed. This entails grouping of the results obtained from different print materials into water-resistant (no change) or not water-resistant categories. An intermediate level of moderate water resistance is also recognized, although its boundaries cannot be determined exactly.

This document requires the use of deionized or distilled water for all of the tests. The pH of this water is not controlled (unless it is certified, which will be at pH 7) but pH will have little effect on the tests. This is because any water-soluble components in the media coating will dissolve into the water and rapidly change the pH. The final value of this will depend on the media used.

5.2 Control sample

The evaluation of test results based on qualitative criteria for water resistance (as defined in Clause 4) requires that untreated control specimens be used for comparison with water-treated specimens.

6 Test methods

6.1 General

Four test methods are given for water resistance. Method 1 models the effect of water spilt on an image and left to dry. Method 2 tests the physical integrity of the colorant receptive layer. This may be an important feature, as it is possible to have images that may resist smearing and other defects when in sustained contact with water, but will be destroyed if touched before fully drying. Method 3 indicates how images will behave under catastrophic conditions (e.g. flood damage). Method 4 explores the effect of water penetration from an exposed edge, such as an upright book on a flooded shelf.

The test methods discussed in 6.2 to 6.5 all involve the cyan, magenta, yellow, red, green, blue and black colours. For black, the processed black generated by the printer with the user specified driver settings (see 7.1 for more information and warnings) shall be used. As an option, the user may also use black generated in a different manner (e.g. 3- or 4-colour composite, pure black, etc.) if the option is available to the user. Some printer systems utilize more than cyan, magenta and yellow primary colours (e.g. systems that also use additional spot or process colours, such as red, green, blue, orange, and violet). In such a case, the user of this document may include these extra colours in the tests. All print specimens shall be allowed to dry at ambient conditions for at least 24 h prior to proceeding with the test.

NOTE Figure 1 shows some example test patterns that were generated using a simple drawing program on a computer.

6.2 Method 1 — Standing water evaporation

The test target consists of cyan, magenta, yellow, black, red, green and blue colour blocks of convenient size (~2 cm^2) with a chequered board fill pattern (1,5 mm^2) printed at the maximum density for that colour allowable by the printing system. Another set of chequered board squares is also printed at 0,5 ± 0,1 density above d_{min}. A 0,1 ml drop of water is then placed onto the centre of each colour patch and allowed to dry for at least 24 h at ambient conditions.

6.3 Method 2 — Standing water plus wiping effects

The test target and initial procedure is the same as Method 1, except that the 0,1 ml water drop is applied only to the maximum density patches. After allowing this drop to stand for 1 min, the water is wiped up. This is accomplished by placing a 2 cm^2 piece of laboratory tissue [e.g. Kimwipe®[1)]] backed by a semi-rigid support (e.g. cardboard) of the same size on top of the test target (over the water drop). A 50 g weight is applied to the laboratory tissue and the tissue is pulled once across the sample at an approximate rate of 5 cm/s.

6.4 Method 3 — Water soak

The test target consists of cyan, magenta, yellow, black, red, green and blue colour blocks (2,5 cm × 2 cm, h × w) printed at approximately 0,5 density above d_{min} with 7 lines (approximately 1 mm width) separated by 2 mm, drawn through the colour blocks. Each line is a different colour (CYMKRGB) printed at the full density allowable by the printing system for that media [see Figure 1 c)]. Another set of the chequered board test patterns used in 6.2 is also printed. Then they are immersed into deionized or distilled water at ambient temperature for 1 h, removed and hung vertically to dry (about 0,5 h to 1 h). Separate containers shall be used for each test specimen to avoid cross-contamination.

NOTE It may be necessary to use weights to hold the test specimen under the water.

6.5 Method 4 — Edge immersion

The line target and maximum density test targets in Method 3 are printed with 1,0 cm border on the lower edge. The line target and maximum density test targets are then placed separately in a closed chromatography tank containing water at a depth of 0,5 cm water that has been left to come to equilibrium at ambient conditions. Other containers that are large enough to hold the test print without interference from the sides of the tank may be used instead of the chromatography tank. The print is kept in the chromatography tank or other container for 24 h and evaluated after removal. For prints on paper or other substrates with grain direction, edge immersion shall be evaluated with and perpendicular to the grain direction[2]. Grain direction is easily determined using a variety of methods[3].

NOTE 1 Shorter edge immersion times, for example 4 h, will allow differentiation between printed images that show similar performance after 24 h required in Method 4.

1) Kimwipe® is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product. Equivalent products may be used if they can be shown to lead to the same results.