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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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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.

NOTE 2 If the water fails to reach the colorant after 24 h, include this observation in the test report.

7 Test pattern preparation

7.1 General considerations

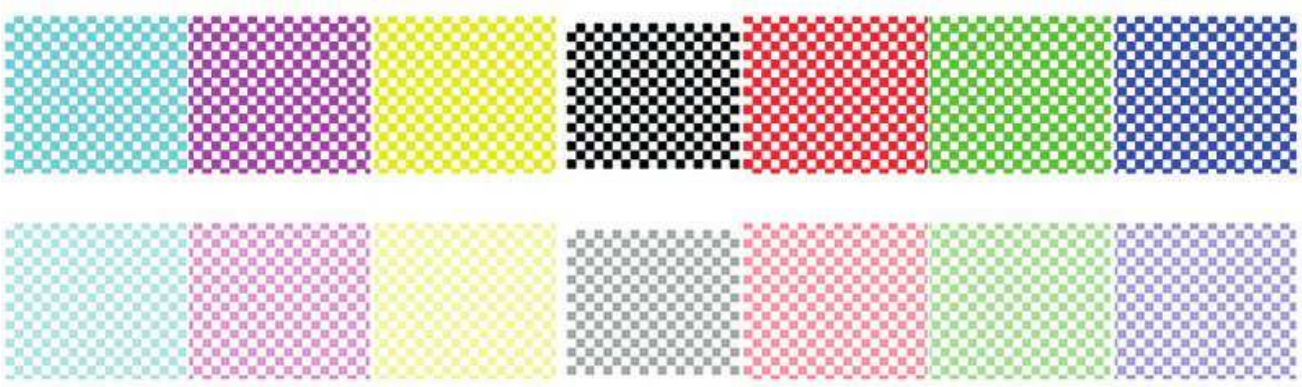
The example test pattern shown in 6.1 can be produced in any of the available image programs [in this case, Adobe Photoshop®[2)] was used]. The high-density areas were generated by assigning them the maximum RGB colour values. The lower density areas are targeted to be approximately 0,5 OD above d_{min}. The RGB values used are determined by trial and error and will likely be different for each printer system investigated. The print should be made by using the manufacturer's recommended driver settings for the colorant and media being investigated. Strong caution should be observed when using driver settings that are not recommended or unknown (i.e. the media and/or colorant being used has no recommended values by the printer's manufacturer). In these cases, the amount of colorant delivered to the media may be too little or too much and thus not represent a true maximum density d_{max} for that system. This can cause the results of the above tests to be in error. However, if those settings represent the intended use, then these shall be used, as they will then represent what the end user will observe. In all cases, the exact printer settings used, the colour settings (i.e. RGB values) given by the imaging-processing program, and the program used shall be reported.

When producing print samples from analogue imaging systems, the manufacturer's recommended processing conditions shall be used. If deviations from that method occur, they shall be reported.

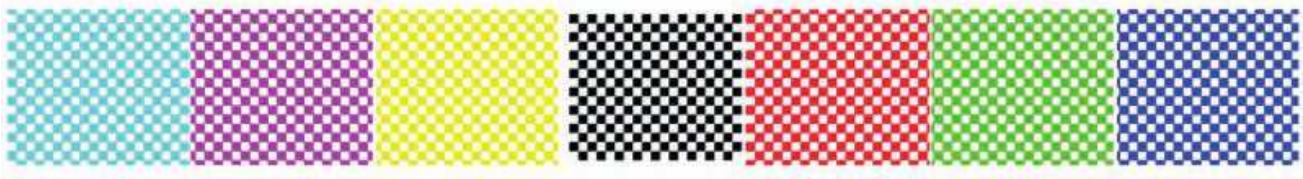
2) Adobe Photoshop® is an example of a suitable software package available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product. Equivalent products may be used if they can be shown to lead to the same results.

7.2 Example test patterns

Examples of test patterns are given in Figure 1.



a) Standing water evaporation



b) Standing water plus wiping

c) Water soak

Figure 1 — Examples of test patterns

8 Test report

For each system tested, the user of this document shall report the primary failure mode, such as colorant bleed, cockle, delamination, formation of rings (caused by colorant migration or water damage to the medium), loss of gloss, and removal of colorant, colour to colour bleed, etc. Comparison to the control (untreated) print is very helpful in this regard. The overall water resistance shall also be assigned using the categories listed in 4.2 to 4.4. It is especially important to note conditions where the print is

damaged to the point that image information is lost. For the edge immersion test, the grain direction shall also be reported.

NOTE Not all test methods may be relevant to a specific usage case.

In addition to the results, the printer settings used to make the print sample shall be reported, since as noted in 7.1, these settings may have a significant impact on the observed water resistance. In the case of analogue test specimens, the process used to make the print shall be reported.

Scanned images of the tested samples may also be included in the test report, as these images may facilitate data interpretation.

Annex A
(informative)

Determination of resistance to other liquids

The test methods in the document were developed for use with water; however, depending on the usage case they may also be used with other liquids. Applications include cleaning solutions, which photographic prints might be exposed to, and simulating the effect of accidental contact with foods other than water[4]. Liquids other than distilled water are frequently used to simulate the effect of contact with food items. Specific examples include 10 % ethanol for aqueous foods; 3 % acetic acid for aqueous foods with pH below 4,5; 20 % ethanol for aqueous, alcoholic with less than 20 % alcohol and fatty foods; 50 % ethanol for fatty, alcoholic containing greater than 20 % alcohol, and foods containing oil emulsions in water; vegetable oil for foods with free fatty acids contacting the material surface[5][6].

For non-volatile liquids, such as vegetable oil, Method 1 will reflect the performance of the printed image in the presence of the liquid, rather than the effect of evaporation.

These test methods evaluate bleeding of prints, not staining of the liquids; consequently, these test methods should be used with transparent, non-staining liquids.

Consumers may be cautioned to avoid contact of photographs with potentially damaging liquids.

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