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Paper, board and printing inks – Printability – Laboratory test method for offset ink setting

Papier, carton et encres d'impression – Imprimabilité – Méthode d'essai de laboratoire pour le séchage de l'encre offset

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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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This document was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

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 describes a test method to evaluate the ink setting characteristics of a specific ink/substrate combination in offset lithographic printing.

Set-off is the transfer of ink from the front of one sheet to the back or the front of the next sheet.

Setting is the process of penetration of liquid ink components of low viscosity into the penetrable substrate. These low-viscosity liquids within the ink are mineral oils, vegetable oils or esters of vegetable oils. By separation from those low-viscous liquids, the remaining ink film solidifies. This is combined with a varying change in the surface tack depending on the inks-varnish system and the time. The surface tack usually increases at the begin of the setting and later-on drops to zero. Setting is either the main drying mechanism for ink systems (e.g. news inks) or part of a multi-channel drying mechanism (e.g. conventional sheet fed offset inks or heatset inks). The laboratory test for setting performs a set-off print of the fresh print to a non-printed substrate at defined times. The ink transfer to the non-printed substrate not only depends on the degree of solidification of the ink by setting, but also on the actual level of tack of the original ink film. Thus, the test result is a combined measure.

The absorption properties of the paper are of great influence in offset lithography printing. Inappropriate absorption can lead to numerous printing problems such as ink set-off, bad adhesion, mottling, unpredictable tone value increase, poor rub resistance, damaging of first printed side on perfecting presses after perfecting and others.

The more absorbent the paper is, the less time will be needed for the ink to set sufficiently for further processing, but other properties can be affected adversely by fast ink setting. Very short times should be used when testing the processing of wet sheets, e.g. in a perfector press. Longer times are used for paper handling right after printing, and very long times are used for further processing such as folding and cutting.

Depending on the purpose of the test, there are three options for the paper-ink combination:

— Reference ink on production paper;

— Production ink on reference paper;

— Production ink on production paper, which can be divided into the following, depending on the application of the print:

  — Set-off face-to-face (e.g. set-off after folding);

  — Set-off face to back (e.g. set-off in a stack of paper).

Paper, board and printing inks – Printability – Laboratory test method for offset ink setting

1 Scope

This document describes a laboratory test method, using an IGT[1)]-type or a prüfbau[2)]-type printability tester, for the preparation of specimens to evaluate the absorption rate of an ink on a substrate in offset lithography by setting-off the printed surface to an unprinted surface.

This method describes testing with an amount of ink simulating either single colour or multi-colour printing. The print and the set-off print (counter print) are made with interval times, between print and set-off, common for the target process.

This method evaluates a particular ink and substrate combination.

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 5-4, *Photography and graphic technology — Density measurements — Part 4: Geometric conditions for reflection density*

ISO 2834-1, *Graphic technology — Laboratory preparation of test prints — Part 1: Paste inks*

ISO 2846-1, *Graphic technology — Colour and transparency of printing ink sets for four-colour printing — Part 1: Sheet-fed and heat-set web offset lithographic printing*

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 https://www.iso.org/obp

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

3.1
ink setting
process by which the ink dries by absorption and/or oxidation

3.2
set-off
effect produced when the ink on a print is transferred from the printed surface to another surface

1) These materials are available from IGT Testing Systems, www.igt.nl. This information is given for the convenience of the users of this document and does not constitute an endorsement by ISO of the products. Equivalent products may be used if they can be shown to lead to the same results.

2) These materials are available from prüfbau, Dr.-Ing. H. Dürner GmbH, www.pruefbau.de. This information is given for the convenience of the users of this document and does not constitute an endorsement by ISO of the products. Equivalent products may be used if they can be shown to lead to the same results.

3.3
set-off paper
counter-paper
paper used to make a counter print for *set-off* (3.2) evaluation

3.4
ink film
<on substrate> amount of ink applied on the surface of the substrate to obtain the required optical density of the print for the purpose of this test

Note 1 to entry: The amount is specified in g/m^2 or in µm.

3.5
ink film
<on printing forme> amount of ink applied on the surface of the printing forme for transfer to the substrate in the printing operation

Note 1 to entry: The amount is specified in g/m^2 or in µm. The ink film applied on the inking system is normally about double the amount from the amount transferred to the substrate.

4 Apparatus and materials

4.1 Printing device

4.1.1 To perform this test, use a printability tester with one or two printing units capable of applying a force (via a metal printing forme) on the printed sample independently from the preparation of the printed sample. The interval time may be defined by the printing speed (and the distance between units) or be adjusted by a timer.

Examples of commercially available printability testers that conform to these requirements are the prüfbau Multipurpose Printability Testing Instrument MZII,[8] IGT AIC2-5[4] or any compatible tester. A High Speed Inking Unit 4 is recommended for the IGT instruments while the inking unit is integrated in the MZII. Refer to footnote further down.

4.1.2 **IGT-type printing device** having a sector with a radius of (85,0 ± 0,2) mm, incorporating a facility enabling a packing (4.6) to be mounted under tension on the sector and a test piece to be mounted on the packing. The sector shall be capable of being driven over a distance of 200 mm at a uniform speed.

The actual speed shall not differ by more than 5 % from the theoretical value over the workable range as specified for the tester.

The force with which the printing forme contacts the test piece on the sector shall be adjustable. The actual force shall not deviate by more than ±10 N from the set force.

The printing device should be properly calibrated with regard to printing speed and printing force between the printing forme and the sector (see Annex A).

4.1.3 **Prüfbau-type printing device** having the possibility to run a substrate carrier, with a test piece mounted on it, with uniform speed under the printing formes.

The actual speed shall not differ by more than 5 % from the theoretical value over the workable range as specified for the tester.

The force with which the printing forme contacts the test piece on the sector shall be adjustable. The actual force shall not deviate by more than ±10 N from the set force.

The printing device should be properly calibrated with regard to printing speed and printing force between the printing forme and the sector (see Annex A).

4.2 Inking device

To distribute an even ink film of known thickness an inking device shall be used consisting of two or more inking drums having contact with a top-roller. The ink distributing surface area A of the rollers shall be known to the nearest 0,1 cm^2. Each inking arrangement shall incorporate one or more holders on which the printing forme to be inked in can be mounted.

The distributing surface area, A, is calculated as in Formula (1):

$$A = \sum_{n=1}^{n} (\pi \cdot d_n \cdot l_n) \tag{1}$$

where

d_n is the diameter of roller or drum number (n);

l_n is the effective length of roller or drum number (n);

n is the number of rollers excluding the printing forme.

NOTE The lifetime of the rubber or elastomer-covered parts is limited, if properly handled, to a maximum of approximately 3 years.

The transfer characteristics of rubber rollers can change by, e.g. using them for different applications, inks, bad cleaning, unsuitable cleaning solvents and ageing. If tests are made using different top-rollers, the top-rollers should be identical, and a test to determine the ink transfer might have to be performed.

4.3 Printing formes

4.3.1 For IGT-type testers, one or more aluminium printing formes, with known width and a diameter of (65,0 ± 0,2) mm and a temperature-insulating handgrip shall be used: one for the ink to be applied, and another one on which the set-off paper will be mounted. These printing formes shall be of the same type. See Figure 1.

4.3.2 For prüfbau-type testers, a rubber blanket printing forme of the width of the whole printing area and an aluminium printing forme with a smaller width than the blanket printing forme shall be used. The rubber blanket printing forme is used for printing and the aluminium printing forme is used for set-off counter printing. The prüfbau tester has a separate holder for the set-off paper so no wrapping of the set-off paper around the aluminium printing forme is needed. The area not counter-printed will be used for optical density evaluations of the original print.

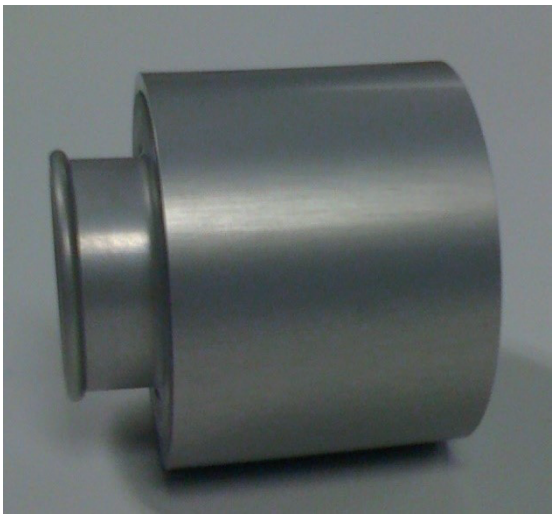

Figure 1 — Example of a printing forme meeting the criteria of 4.3.1

4.4 Ink pipette

To apply an accurate quantity of ink to the inking device an ink pipette having a minimum volume of 2 ml and a resolution of at least 0,01 ml, but preferably 0,001 ml shall be used.

NOTE 1 If the inking device is equipped with a dispensing system with sufficient accuracy, no ink pipette is needed.

NOTE 2 In principle, it is also possible to use the analytical balance to weigh the required amount of ink. In that case, the required ink film thickness can be calculated considering the mass density of the ink.

4.5 Packing

In general, backing materials shall be suitable for the printing forme type. In the IGT-type printability testers, rubber backing consisting of rubber blanket with a thickness of (1,70 ± 0,05) mm shall be used since aluminium printing formes are used to make this test.

Refer to the printability tester manufacturer's instruction manual to mount and adjust backing tension.

Over time, a rubber packing will deteriorate and in general get harder or get cracked. Also, dents can occur where smaller printing formes are used to over-print prints made with wider printing formes. In either case, make sure to replace the rubber before these effects take place. Annex B shows some of the possible defects.

4.6 Substrate carrier

A rigid carrier covered with a special rubber blanket with a thickness and hardness required for the used printability tester and for the used substrate thickness.

Over time a rubber will deteriorate and in general get harder or get cracked. Also, dents can occur where smaller printing formes are used to over-print prints made with wider printing formes. In either case make sure to replace the rubber before these effects take place. Annex B shows some of the possible defects.

4.7 Analytical balance

A balance with a capacity of at least 160 g and an accuracy of 0,1 mg at this weight.

NOTE Most modern analytical balances reach the specified accuracy only if after tarring the weight difference is less than 40-60 g.

Depending on the type of analytical balance and its sensor principle, some are sensitive to magnetism and others are sensitive to static upcharge. The printing formes should be demagnetized with steel parts and discharge printing formes with plastic parts.

4.8 Timer

A manual timer or stopwatch with a resolution of 1 s. Several testers incorporate automatic timing facilities.

4.9 Densitometer

A densitometer or spectrodensitometer in accordance with ISO 5-4. Other instruments with suitable discrimination of colour, optical density or other ways of reflection measurement, such as instruments in conformance with ISO 2469, can be used if results are suitable for the purpose.

4.10 Test paper

This test method is suitable for use with all papers used for offset printing. The paper strip shall be cut to fit to the used printability tester. The top or bottom, MD/CD and grain direction shall be chosen in accordance with the application and recorded.

4.11 Reference counter test strips

Cut to suitable size for the printability tester, commonly the reference paper as specified in ISO 2846-1 is used, commercially available as C2846[1) 2)]. The paper strip shall be cut to fit to the used printability tester. In case of other than the reference counter test strips the top or bottom, MD/CD and grain direction shall be chosen in accordance with the application and recorded.

4.12 Setting test ink

This test is suitable for use with all oxidative/setting printing inks intended for sheet-fed offset printing, in the paper industry this test is commonly executed with the (cyan) ink 404.520.068[1)] or 520068[2)].

In case of testing papers intended for heatset or coldest web printing, other inks might have to be used for representative results.

4.13 Cleaning

Use lint free towels and cleaning solvent compatible with the ink, the printing forme and the inking unit top-roller rubber materials.

After each test, clean all the inked parts of the printability tester and the inking unit with the cleaning solvent and towels. Dry the surface or give the solvent sufficient time to evaporate.

5 Test method

5.1 Principle

A sample of the paper to be tested is printed on a printability tester under standard conditions with a defined amount of ink. After a specified time, the printed strip is counter printed against a strip of unprinted paper: the set-off paper. Part of the ink situated on the surface of the printed strip will transfer to the set-off paper. The more ink is absorbed into the printed strip in a defined time frame, the less ink will transfer to the set-off paper. The optical density of the transferred ink on the set-off paper is a value for the absorption in the tested paper.

The test should be repeated at least 3 times per combination of ink and paper. Depending on the purpose of the test, different combinations of interval times should be used, e.g. 0,1 s; 0,4 s; 3 s; 10 s; 15 s; 30 s; 60 s; 120 s; 180 s and 240 s or very long times. These times can be timed automatically by the printability tester or by hand with an external timer or stop watch.

Different combinations of paper and ink for different user groups, e.g., paper industry, ink industry or printing industry/converters are covered.

The ink setting/ink absorption can be analysed by making a graph of the optical density of the set-off paper against the used interval times.

5.2 Test conditions

5.2.1 Climatic conditions

All equipment shall be conditioned at least 2 hours; tests shall be conducted under standard atmosphere; to most standards it is (23,0 ± 1,0) °C and (50 ± 2) % RH.

Papers and equipment should be conditioned during more than 6 hours but at least as long as needed to reach equilibrium.

Inks should be conditioned during more than 6 hours but long enough to reach temperature equilibrium for the type of package. In case of large packing, it is recommended to repack the ink for the test in smaller containers.

5.2.2 Settings of the printability tester

The printability tester shall be set to a printing force of 200 N/cm print width on both printing units and to a constant printing speed of 0,5 m/s.

The interval times shall be selected in accordance with the purpose of the test according to Table 1.

Table 1 — Interval time Settings

	IGT	prüfbau	Preferred intervals
Very Short time (one interval time)	0,014 to 1,0 s [a]	-	0,1 s
Short time (two interval times)	0,1 to 10 s [b]	-	0,1 s – 3 s
Medium time (four or more Interval times)	5 to 300 s	5 to 300 s	30 s – 60 s – 90 s – 120 s
Long time (four or more interval times)	30 to 1 000 s [c]	30 to 1 000 s [c]	60 s – 120 s – 300 s – 600 s

[a] One interval time per test, speed dependent, AIC2-5 only.

[b] Two interval times per test.

[c] Longer interval times, manually timed on some instruments.

5.2.3 Settings for the inking unit

Prior to the test, an amount of ink shall be applied to the inking unit using an ink pipette, the ink shall be distributed and applied to the printing forme homogenously using one section of the inking unit top-roller. To improve reproducibility, distribution and inking shall be done under controlled time and temperature so whenever available, the thermostat on the inking unit shall be used.

For best repeatability the ink can be applied using an ink pipette. This way, the ink is applied as a volume and the ink film thickness, I, in µm, is defined by Formula (2):

$$I = \frac{V}{A + A_p} \tag{2}$$

where

V is the applied volume of ink in ml;

A is the inked area of the inking unit from Formula (1);

A_p is the surface of the used printing forme in cm^2.

For print tests using production ink and production paper, the ink film thickness shall be in conformance with the application. This is in sheetfed offset commonly between 1,0 µm and 1,3 µm (about 1 g/m^2 to 1,3 g/m^2). For a maximum ink coverage of 300 %, this comes to 2,5 µm to 4 µm in case of multi-colour printing but with a drying time between the different colours and a back-trap effect.

For this reason, there are two options given for the ink film thickness during the test. Note that this refers to the ink film thickness on the substrate, while the ink film applied on the inking system is normally about double the amount.

