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Graphic technology — Laboratory preparation of test prints —

Part 2: Liquid printing inks

Technologie graphique — Préparation en laboratoire des impressions d'essai —

Partie 2: Encres d'impression liquides

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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).

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 130, *Graphic technology*.

This third edition cancels and replaces the second edition (ISO 2834-2:2015), which has been technically revised.

The main changes are as follows:

— parameters describing the preparation of printing forms and anilox cylinders are replaced by data (to be acquired by the user of this document) describing the ink transfer of particular settings of tester, printing forme, ink and substrate.

A list of all parts in the ISO 2834 series can be found on the ISO website.

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 the test print preparation of liquid inks (gravure and flexography). These test prints have a homogeneous distribution of ink on a substrate, a reproducible ink composition and relative ink coverage. Therefore, they are suitable for optical tests so that the measured reflectance can be assigned to a known ink coverage. If tests are done only for mechanical and chemical resistance, the user may apply less accurate methods. The preparation of test prints for paste inks (lithography) is described in ISO 2834-1, while screen inks are covered in ISO 2834-3.

In ISO 2834-1, specific operational settings for the “round-to-round” and the “round-to-flat” offset ink printability testers are provided. Laboratory proofers (printability testers) for liquid inks encompass a much wider array of operating processes and associated settings. Therefore, the guidelines included in ISO 2834-2 are more general and will, of necessity, result in more opportunities for operator error in making the test prints.

Graphic technology — Laboratory preparation of test prints —

Part 2: Liquid printing inks

1 Scope

This document specifies a test method for preparation of test prints produced with liquid printing inks, either water-based, solvent-based or radiation cured printing inks as used in flexography and gravure printing. Such test prints are intended to be used for reflection-based measurements, such as colorimetry and optical density as well as for testing light fastness, and the resistance of printing inks to mechanical and chemical attack regarding either printing ink and/or substrate. This document is not applicable to inks for ink jet printing.

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 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
anilox roller
chromium plated or ceramic roller with evenly distributed small cells generally mounted on a flexographic printing press to control the quantity of ink transferred to the printing forme

3.2
extender
transparent material (varnish or polymer solution) used to reduce the colorant concentration while maintaining viscosity to adapt ink colour concentration to print substrates

3.3
laboratory proofer
printability tester
device for uniformly applying a reproducible amount of ink to a substrate under specified conditions

Note 1 to entry: Earlier editions of this document used the term "printability tester" which is still commonly used in the market.

3.4
flexographic printing forme
cylinder or sleeve covered with a relief type rubber or photopolymer plate for application of *printing ink* (3.6) to print substrate

3.5
gravure printing forme
mechanically engraved, laser-engraved or chemically etched cylinder, sleeve or plate for application of *printing ink* (3.6) to a print substrate

3.6
printing ink
composite material containing colorants, functional components, vehicle and additives

Note 1 to entry: In most cases, it is applied as a fluid to a substrate by a printing process and it is setting or drying by either physical (evaporation) and/or chemical (polymerizations, e.g. oxidation, radiation induced, or other) processes in order to form an image for decorative, informative or technical purposes.

3.7
retarder
additive to reduce the evaporation speed of the solvent in a liquid ink to prevent drying during the application of ink to the substrate

3.8
test-ready ink
printing ink (3.6) of the appropriate composition and viscosity for the purpose of the test

4 Test method

4.1 Principle

Using a laboratory proofer, the gravure or flexographic printing ink is applied consistently and uniformly on the chosen substrate. The ink transfer depends on many aspects of the proofer, the printing forme, the ink and the substrate. For each individual setting, the ink transfer shall be determined according to any method described in 4.4.4. As long as there are no changes in these settings and the printing forms are cleaned thoroughly, the ink transfer is constant.

NOTE 1 Test samples for mechanical and chemical resistance tests can be prepared using any technique resulting in a uniform ink film in a desired thickness range. Ink film thicknesses different from those used in practice will have a strong influence on the results of such tests. These methods are not covered by this document.

NOTE 2 Due to differences between a printing press and a laboratory proofer, prints produced on a laboratory proofer can be different in appearance and in ink film thickness from commercial prints. To reach the same colour strength or print density, different settings from the actual press settings are generally required.

4.2 Apparatus and quality requirements

4.2.1 Apparatus

Any laboratory proofer for liquid printing inks of the type to be tested, liquid printing ink (solvent, water or radiation cured), substrate and drying apparatus may be used as long as the resulting printed

ink film is uniform and at the required ink film thickness. Test conditions and variables associated with such equipment and materials shall be agreed upon between parties since variations in design and process have a strong influence on the test results and comparability of the properties of the test sample.

4.2.1.1 Laboratory proofer

To ensure repeatable operation, the laboratory proofer shall provide automated control of the ink transfer function. It is not practical to duplicate exactly a commercial production printing process in the laboratory. However, it is possible to duplicate results between two laboratories. The chosen laboratory proofer shall provide a consistent, uniform printed ink film at the required ink film thickness. To achieve this control, the printing speed and the pressure or impression (for flexography) between the printing forme and printing substrate shall be adjustable and shall be constant and uniform during the printing process.

For gravure, the Shore hardness of the pressure roller as well as the use of an electrostatic printing aid shall be agreed upon and specified. For flexography, the anilox roller (see also 4.2.1.3) and the type of blade or doctoring device shall be specified.

NOTE The Shore hardness, compressibility and smoothness of the impression roller depend on the purpose of the test. There are different pressure roller surfaces in the market. Often, these are harder plastic surfaces typically measured as Shore D and sometimes softer surfaces are used to be measured as Shore A. Guidance on the use of shore measurement can be found in corresponding ISO Standards. The determination of the Shore hardness requires a minimum thickness of the material to be tested. This sometimes is not present.

4.2.1.2 Printing formes

4.2.1.2.1 Gravure printing forme

These may be produced by electromechanical engraving, laser engraving or chemical etching. Printing formes can contain solid and tinted areas. The design of printing formes can either be of a standard layout with a designation of the supplier of the laboratory proofer or special with respect to customer needs. Printing forms containing half-tone images are not covered in this document. Printing formes shall have a designation. Printing forms should contain 100 % tone value patches with an area of at least 1 600 mm^2.

Gravure printing formes should be specified by the amount of ink transferred for each tone value present and shall be specified by the amount of ink transferred for the 100 % tone value. The transfer characteristic of the forme shall be characterized according to either method described in 4.4.4.

It is not practical to duplicate commercial production printing in the laboratory, and therefore, it is not necessary for the laboratory proofer to have the same gravure engraved cylinder as a commercial printing press. The ink transfer process of the laboratory proofer shall produce a printed ink film with a thickness that is representative of the industry. While the solid tone will be printed with the correct optical density, the tone scales will not necessarily be reproduced exactly. This can be evaluated by the use of a reflection densitometer or colourimeter using aim values that are agreed upon between parties. It is, in this way, possible to duplicate results between two laboratories.

NOTE 1 The cell volume can be approximately calculated using shape and dimensions of cells, measured directly by applying definite volumes of liquids or measured by optical means using, such as an interferometer. Gravure printing formes can be cylinders, sleeves or plates. The precise measurement of cell volumes of gravure printing formes is difficult. The cell volume can be determined: 1) approximately from calculation using shape and dimensions of cells; 2) measured directly by applying known volumes of liquids or 3) measured by optical means using, such as an interferometer. It can be useful to obtain a sufficient number of printing formes of a single lot to be shared between parties to ensure comparability of test prints.

NOTE 2 The relation between tone value, cell volumes and cell dimensions is complex and strongly substrate dependent.

NOTE 3 The typical thickness of dried ink films applied by the gravure process is 2,25 µm ± 1 µm.

4.2.1.2.2 Flexographic printing forme

Flexographic printing formes shall be relief type formes. The design of printing formes can either be of a standard layout with a designation of the supplier of the laboratory proofer or special with respect to customer needs. Printing forms containing half-tone images are not covered in this document. Printing formes shall have a designation. Printing forms should contain 100 % tone value patches with an area of at least 1 600 mm^2. Flexographic printing forms or print-ready printing forme cylinders may be prepared in different ways. This includes developed photopolymer or laser engraved rubber plate material and subsequent fixation on cylinders using, e.g. double sided (compressible) pressure sensitive tape, or direct laser engraving on a photopolymer or rubber covered printing forme cylinder.

It is not practical to exactly duplicate commercial production printing in the laboratory, and therefore, it is not necessary for the laboratory proofer to have the same relief plate as a commercial printing press. The ink transfer process of the laboratory proofer shall produce a printed ink film at a thickness that is representative of the industry. While the solid tone needs to be printed with the correct optical density, the tone scales will not necessarily be reproduced exactly. It is of primary concern to get the correct amount of ink on the substrate and not that the printing forme of the proofer matches the printing forme of the commercial printing press. In order to be able to duplicate results between two laboratories, it is necessary that the parameters of the printing forms are as close as possible.

NOTE 1 In flexographic printing, many different materials and manufacturing processes are used to make the printing forms. These parameters have a massive impact on the amount of ink, which is transferred and on the lay of the ink on the printed surface, which influences the optical density of the printed ink film. If standard conditions and print forms are used, it is possible to create a factor in order to translate the results on the laboratory proofer to the production machines.

The following parameters are important to specify the printing forme and should be exchanged:

— brand name, type, hardness and thickness and general material (e.g. photopolymer, EPDM rubber) of the printing forme (plate or sleeve) specification according to the technical data sheet;

NOTE 2 The choice of the printing forme material determines solvent resistance, hardness, design limitations concerning dot shapes, line ruling, dot shoulder, capping, etc.

— brand name, type, compressibility and thickness of the cliché tape/sticky-back according to the technical data sheet;

— design of the forme (full tone, text, screen areas);

— for tone scale areas: screen frequency, screen type, screen angle of tone values and dot shape;

— for full tone areas: details of surface structuring if used;

— other information regarding printing forme production that influences the reproducibility of results (e.g. imaging and exposure technology, dot gain correction curves if used).

NOTE 3 The typical thickness of individual dried ink films applied by the flexographic process using water based, solvent based or radiation cured inks is 1,25 µm ± 0,5 µm.

Any distortion of image elements should be compensated.

4.2.1.3 Flexographic anilox roller

Anilox rollers may be produced by electromechanical engraving, laser engraving or chemical etching, the ratio of screen frequencies between anilox roller and printing forme shall be at least 2,5.

Anilox rollers shall be specified by the amount of ink transferred. The transfer characteristic of the roller shall be characterized according to either method described in 4.4.4.

NOTE The cell volume can be approximately calculated using shape and dimensions of cells or measured directly by applying definite volumes of liquids.

Aniloxes can be cylinders or sleeves. The precise measurement of cell volumes of aniloxes is difficult. The cell volume can be determined:

a) approximately from calculation using shape and dimensions of cells;

b) measured directly by applying known volumes of liquids; or

c) measured by optical means using, such as an interferometer.

It can be useful to obtain a sufficient number of printing formes of a single lot to be shared between parties to ensure comparability of test prints.

4.2.2 Quality requirements for laboratory proofers

For laboratory proofers for gravure inks, the homogeneity of the print within defined printed areas shall be evaluated by using test prints of a process colour ink on a suitable non-absorbent substrate. Colour measurements made in accordance with ISO 13655 shall be performed in an equally spaced grid pattern, consisting of at least nine measurement positions, each at a minimum distance of 5 mm away from the edges of the printed area. Colouration gradients (e.g. ink feed, printing forme or pressure gradients) can therefore be identified, and if so, measures shall be taken to adjust the laboratory proofer. The readings at the centre point shall be averaged and utilized as the colour reference to which the other readings will be compared. The mean colour difference of all measured points versus the mean of the centre point shall not exceed 0,4 CIEDE2000 units.

For testers for flexographic inks, the homogeneity of the print within defined printed areas shall be evaluated by using test prints of a process colour ink on a suitable non-absorbent substrate. Colour measurements made in accordance with ISO 13655 shall be performed as described for laboratory proofers for gravure. Colouration gradients (e.g. ink feed, printing forme or pressure gradients) can therefore be identified, and if so, measures shall be taken to adjust the laboratory proofer. The mean colour difference of all measured points versus the mean of the centre point shall not exceed 0,6 CIEDE2000 units for a tester using the anilox-flexoplate-substrate principle and no more than 0,4 CIEDE2000 units for any other principle.

4.3 Materials

4.3.1 Printing ink

Printing inks to be tested may be received as concentrates, with high viscosity, or press-ready.

Since extension, drying properties and viscosity of the printing inks to be printed and tested have a strong influence on the print result; these parameters shall be specified and adjusted to create a test-ready ink.

Prepare the printing ink as follows.

a) Extension

If a printing ink is supplied at a high colorant concentration, it should be mixed with extender. There shall be prior agreement as to the type and amount of extender to be used.

b) Viscosity adjustment

The viscosity shall be determined and adjusted with a solvent at a certain temperature. The initial viscosity, the nature and amount of material used to dilute the sample and the final viscosity shall be recorded. The printing ink viscosity should be determined in accordance with ISO 2431[1]. There

shall be prior agreement as to the viscosity to be applied, the flow cup or other device and the solvent to be used.

To compensate for different printing speeds and therefore different drying conditions between test and production printing, the adjustment of the viscosity may require different diluting materials in test and production printing.

4.3.2 Printing substrate

There shall be prior agreement as to the printing substrate to be used and its preparation (e.g. application of primer, corona treatment) and properties.

4.4 Test conditions

4.4.1 Climatic conditions

Tests shall be executed under standard climatic conditions in accordance with ISO 187.

4.4.2 Printing speed and printing pressure

There shall be prior agreement regarding the printing speed and printing pressure. The laboratory proofer should be adjusted according to the recommendations and instructions of the device manufacturer. This includes setting the correct printing speed and pressure in order to achieve the desired ink transfer for the printing substrate to be tested.

4.4.3 Drying

The method of drying (e.g. ambient temperature, hot air or radiation) shall be agreed upon between parties and recorded.

NOTE Especially for radiation curing printing inks on paper or board, an appropriate time interval between printing and curing can be necessary (this can be as short as a fraction of a second).

4.4.4 Determination of ink film coverage and ink film thickness

4.4.4.1 Determination of mass differences by weighing prints and substrates

4.4.4.1.1 Determination of mass differences by weighing before and after the print for samples groups

The amount of dry ink on the substrate shall be determined by measuring the difference in mass of 10 thoroughly dried printed patches and 10 substrate patches of known area A. The patches shall be either squares, rectangles or circles. Each patch is cut with exactly the same dimensions out of a test print and the tolerances of the edge lengths or diameters shall be ±1 %. It is recommended that a precision paper punch be used to create the patches. The printed patches should be sampled from the centre of the print. The test prints are prepared according to Clause 5, using the same test-ready ink (same viscosity and the same extension ratio).

NOTE Paper punches are available in arts and crafts supply stores. They are used to make precise shapes of coloured or printed papers for use in assembling Mondrian displays or decorative displays.

4.4.4.1.2 Determination of mass differences by weighing before and after the print for individual samples

Because the weight difference between many unprinted substrates of small area, <25 cm^2, is in the same range as the applied amount of ink on that area, a more accurate way to determine the applied ink amount is as follows.

— Take a piece of substrate cut to the size needed to fit the type of proofer.

— Use a punch or (circular) cutter to cut a piece out of the full sample from a location which will be printed.

— Weight the cut piece to 0,1 mg accuracy.

— Remount the cut piece into the original sample and stick it, with a small piece of adhesive tape on the back, in position.

— Make the print.

— Dry or cure the print.

— Remove the cut piece carefully and weigh it again.

— Calculate the ink coverage from the patch area and the mass difference.

Depending on the type of proofer one or more such patches can be cut from a print.

4.4.4.2 Determination of mass differences by removal of the ink from test prints

This method is only usable for prints on foil or other non-absorbing material and with inks which can be dissolved with a suitable solvent.

The amount of dried ink on film substrate shall be determined by measuring the difference in mass of 10 thoroughly dried test prints of known printed area A and the same 10 test prints after the removal of the ink by an appropriate solvent. The removal of the ink shall be complete and the substrate dried thoroughly.

4.4.4.3 Calculation of ink coverage

The ink coverage shall be expressed in grams per square meter and is calculated according to Formula (1):

$$C = \frac{m_1 - m_2}{10A} \tag{1}$$

where

C is the ink coverage;

m_1 is the mass of the 10 printed patches (g);

m_2 is the mass of the 10 substrate patches (g);

A is the patch area (m^2).

4.4.4.4 Calculation of ink film thickness

Conversion of the ink coverage C to ink film thickness shall be made by using the mass density of the dried ink film according to Formula (2):

$$d = \frac{C}{\rho} \tag{2}$$

where

d is the ink layer thickness (µm);

C is the ink coverage (g/m^2);

ρ is the mass density of the dried ink film (g/cm^3).

The mass density of the dried ink film can be difficult to measure. For all non-opaque white and all non-metallic ink films, the mass density of the dried ink film is regarded to be around 1 g/cm^3. In cases of doubt, only the ink coverage in g/m^2 should be used.

5 Procedure

Condition the laboratory proofer, the ink and the printing substrate for a period of time (2 h) to create temperature and humidity equilibrium.

Non-powdered gloves and safety goggles should be used during preparation and test.

Thoroughly clean and dry the laboratory proofer and all items that come in contact with ink or the printing substrate.

Prepare the ink to get a test-ready ink. Before applying the ink, stir it thoroughly without introducing air in it.

Switch on the curing devices, if required.

Set up the laboratory proofer according to the recommendations and instructions of the device manufacturer. This includes setting the correct printing speed and pressure for the ink transfer rollers, printing forme and printing substrate to be tested. Allow time for the substrate to equilibrate to room conditions.

Place the substrate on the laboratory proofer according to the instructions of the device manufacturer. Do not touch the printing surface to prevent fingerprints or other contamination.

Apply the required amount of ink to the laboratory proofer in order to meet the requirement of the purpose of the test.

Carry out the print process according to the instructions of the device manufacturer.

Dry or cure the print in accordance with the ink manufacturers or other agreed upon instructions.

Measure the approximate film thickness of the print, and other properties of interest, e.g. optical density, colour coordinates.

6 Test report

The test report shall contain the following:

a) a reference to this document, i.e. ISO 2834-2:2022;

b) any deviation from this document;