BS ISO 2834-2:2015

BSI Standards Publication

Graphic technology — Laboratory preparation test prints

Part 2: Liquid printing inks

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National foreword

This British Standard is the UK implementation of ISO 2834-2:2015. It supersedes BS ISO 2834-2:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PAI/43, Graphic technology.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Graphic technology — Laboratory preparation 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

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).

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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 WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO 2834-2:2007), which has been technically revised.

ISO 2834 consists of the following parts, under the general title *Graphic technology — Laboratory preparation of test prints*:

— *Part 1: Paste inks*

— *Part 2: Liquid printing inks*

— *Part 3: Screen printing inks*

Introduction

This part of ISO 2834 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. 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.

This revised version of ISO 2834-2 was developed to incorporate an ink coverage and an dry ink film thickness determination and to remove the references to ISO 2846-3 and ISO 2846-5.

INTERNATIONAL STANDARD **ISO 2834-2:2015(E)**

Graphic technology — Laboratory preparation test prints —

Part 2: Liquid printing inks

1 Scope

This part of ISO 2834 specifies a test method for preparation of test prints produced with liquid water-based or solvent-based printing inks as used in flexography and gravure printing. These test prints are intended primarily for optical tests, such as gloss, colorimetry, transparency and reflection density. They can also be used for testing light fastness and the chemical, physical and mechanical resistance to mechanical and chemical attack regarding either printing ink and/or substrate. Flexographic inks with higher viscosity, such as those cured by radiation, are also covered. This part of ISO 2834 is not applicable to inks for ink jet printing.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 2431, *Paints and varnishes — Determination of flow time by use of flow cups*

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.

3.1
anilox roller
chromium plated or a 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
printing forme for flexography
cylinder or sleeve covered with a relief type rubber or photopolymer plate for application of printing ink to print substrate

3.4
printing forme for gravure
mechanically engraved or laser-engraved or chemically etched cylinder, sleeve or plate for application of printing ink to a print substrate

3.5
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 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.

3.6
printability tester
device for uniformly applying a reproducible amount of ink to a substrate under specified conditions

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 of the appropriate composition and viscosity for the purpose of the test

4 Test method

4.1 Principle

Using a printability tester, the gravure or flexographic printing ink is applied consistently and uniformly on the chosen substrate.

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 part of ISO 2834.

NOTE 2 Due to differences between a printing press and a laboratory printability tester, prints produced on a laboratory printability tester 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 printability tester specifically designed 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 Printability tester

To ensure repeatable operation, the printability tester shall provide motorized 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 printability tester must 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 agreed upon and specified.

4.2.1.2 Printing formes

4.2.1.2.1 Gravure printing forme

These may be produced by electromechanical engraving, laser engraving or 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 printability tester or special with respect to customer needs. Printing formes shall have a designation.

It is not practical to duplicate commercial production printing in the laboratory, and therefore, it is not necessary for the lab printability tester to have the same gravure engraved cylinder as a commercial printing press. The ink transfer process of the lab printability tester shall produce a printed ink film with a thickness that is representative of the industry. 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. Where different laboratories use the same or comparable laboratory testing equipment, the following parameters are important to specify and should be exchanged.

Electromechanically engraved and etched formes, solid and tint areas, shall be specified by

— screen frequency, expressed in inverse centimetres (cm^{-1}),

— screen angle, expressed in degrees, and

— cell volume, expressed in millilitres per metres squared (ml/m^2) or both cross-diagonal of cells, expressed in micrometres (µm); and depth, expressed in micrometres (µm) or both diameter, expressed in micrometres (µm); and depth, expressed in micrometres (µm).

For electromechanically engraved formes, the width of channel, expressed in micrometres (µm) and the angle of the engraving stylus (in degrees) shall be specified additionally.

Laser-engraved formes shall be specified by cell shape, diameter(s), depth, (diameter/depth ratio), bottom shape, type of laser used and cell volume for solid areas and diameter(s), depth and cell volume for each gradation step.

NOTE 1 The cell volume can be calculated using shape and dimensions of cells or measured directly by applying definite volumes of liquids.

NOTE 2 There is no reliable relation between tone values and cell volumes or dimensions.

NOTE 3 Gravure printing formes can be cylinders, sleeves or plates. The precise measurement of cell volumes of gravure printing formes is difficult. There are several possible methods, all having their drawbacks regarding accuracy and reproducibility. Therefore, it might 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 4 The typical thickness of ink films applied by the gravure process is 6 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 printability tester or special with respect to customer needs. Printing formes shall have a designation.

It is not practical to duplicate exactly commercial production printing in the laboratory, and therefore, it is not necessary for the lab printability tester to have the same relief plate as a commercial printing press. The ink transfer process of the lab printability tester shall produce a printed ink film at a thickness that is representative of the industry. It is in this way possible to duplicate results between two laboratories.

Where different laboratories use the same or comparable laboratory testing equipment, the following parameters are important to specify and should be exchanged:

— the individual materials composing the printing form identified by their commercial reference;

— Shore A hardness of the printing plate;

— supplier;

— thickness;

— design of the forme;

— sticky back, its complete commercial reference (including compressibility level) and thickness;

— screen frequency, screen type, screen angle of tone values and dot shape;

— other information regarding printing forme production that is deemed of influence for the future reproducibility of results (e.g. imaging and exposure technology).

NOTE 1 The choice of the printing forme material determines solvent resistance, hardness design limitations concerning dot shapes, line ruling, dot shoulder, capping etc.

NOTE 2 The typical thickness of individual dried ink films applied by the flexographic process using water based or solvent based or radiation cured inks is 1 µm ± 0,5 µm.

To minimize distortion of the image elements and elastic deformation of the photopolymer or elastomer, a minimum diameter of 150 mm for the forme cylinder should be used.

4.2.1.3 Flexographic anilox roller

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

Electromechanically engraved and etched anilox rollers shall be specified by

— nominal screen frequency, expressed in inverse centimetres (cm^{-1}),

— final screen frequency after production, expressed in inverse centimetres (cm^{-1}),

— screen angle, expressed in degrees, and

— cell volume, expressed in millilitres per metres squared (ml/m^2) or both cross-diagonal of cells, expressed in micrometres (µm); and depth, expressed in micrometres (µm) or both diameter, expressed in micrometres (µm); and depth, expressed in micrometres (µm).

For electromechanically engraved anilox rollers, the width of channel, expressed in micrometres (µm), and the angle of the engraving stylus, expressed in degrees, shall be specified additionally.

Laser engraved anilox rollers shall be specified by cell shape, diameter(s), depth, (diameter/depth ratio), bottom shape, type of laser used, finishing method and cell volume and diameter(s).

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

4.2.2 Quality requirements for printability testers

For printability testers for gravure inks, the homogeneity of the print within defined printed areas shall be evaluated by using test prints of a four colour process ink on a suitable non-absorbent substrate. Colour measurements made in accordance with ISO 13655 shall be performed in an equally spaced pattern adapted to the geometric form of the print area (minimum nine measurement positions). The minimum configuration should be three readings at the very centre of the print, than a set of three readings (side–centre–side) 25 mm away from the centre point of the print, in both directions along

the length of the print, and one reading from each corner of the print. 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 printability tester. 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 0,5 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 four colour process ink on a suitable non-absorbent substrate. Colour measurements made in accordance with ISO 13655 shall be performed as described for printability testers 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 printability tester. 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 specific 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 has to 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 has to be recorded. The printing ink viscosity shall be determined in accordance with ISO 2431. There shall be prior agreement as to the viscosity to be applied, the flow cup and the solvent to be used.

NOTE To compensate for different printing speeds and therefore different drying conditions between test and production printing, the adjustment of the viscosity will 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 printability tester should be adjusted according to the recommendations and instructions of the device manufacturer. This will include 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 might be necessary (this might 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

The amount of dried ink on the substrate shall be determined by measuring the difference in mass of 10 printed patches thoroughly dried and 10 substrate patches of known area A. The patches shall be either squares or rectangles or circles. Each patch is cut out of a test print with exactly the same dimensions 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 shapes. The printed substrate should be sampled from the centre of the print and no more than 25 % of the print area should be included in the test area. The test prints are prepared according to Clause 5, using the same test ready ink (same viscosity and the same extension ratio).

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

The amount of dried ink on film substrate shall be determined by measuring the difference in mass of 10 test prints thoroughly dried and 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 needs to 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 printability tester, the ink and the printing substrate for a period of time (2 h) to create temperature and humidity equilibrium.

Use preferably non-powdered gloves and safety goggles during preparation and test.

Thoroughly clean and dry the lab printability tester 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 printability tester according to the recommendations and instructions of the device manufacturer. This will include setting the correct printing speed and pressure for the ink transfer rollers, printing forme and printing substrate to be tested. Allow substrate time to equilibrate to room conditions.

Place the substrate on the printability tester 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 printability tester in order to meet the requirement described in 4.2.2.

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

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

Measure the optical density of the print and approximate film thickness of the print as described in 4.2.2.

6 Test report

The test report shall contain the following:

a) a reference to this part of ISO 2834, ISO 2834-2;

b) any deviation from this part of ISO 2834;

c) any operations not specified in this part of ISO 2834 which might have influenced the result;

d) the type of printability tester used and all its settings;

e) all aspects of the image design and the designation of the printing forme in accordance with 4.2.1.2;

f) the amount and nature of any addition of extender, retarder or diluting material to the printing ink according to 4.3.1;

g) the temperature of the printing ink if different from ambient;

h) the viscosity of the printing ink according to 4.3.1;

i) the type of printing substrate;

j) the method of drying or curing;

k) the ambient temperature and relative humidity at the time of printing;

l) the optical density of the print.

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