INTERNATIONAL STANDARD

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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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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 2834-2 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This first edition of ISO 2834-2 together with ISO 2834-1:2006 cancels and replaces the third edition ISO 2834:1999, which has been technically revised. It also incorporates its Technical Corrigendum, ISO 2834:1999/Cor. 1:2003).

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, and 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 the characterization of mechanical and/or chemical properties of links, the user may apply less accurate methods. The methods described in this part of ISO 2834 are used in other International Standards, such as ISO 2846-3, ISO 2846-5 and ISO 2836. The preparation of test prints for paste inks (lithography) is described in ISO 2834-1 whilst screen inks will be 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. In addition, it is generally acknowledged that it is not possible to directly determine the actual thickness of an ink film printed by gravure or flexography. Therefore, the guidelines included in this part of ISO 2834 are more general and will, of necessity, result in more opportunities for operator error when making the test prints.

Graphic technology — Laboratory preparation of 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 colorimetry, transparency and reflection density as described in ISO 2846-3 and ISO 2846-5. They can also be used for testing gloss, 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 referenced documents are indispensable for the application 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 2431, *Paints and varnishes — Determination of flow time by use of flow cups*

ISO 2846-3, *Graphic technology — Colour and transparency of printing ink sets for four-colour-printing — Part 3: Publication gravure printing*

ISO 2846-5, *Graphic technology — Colour and transparency of printing ink sets for four-colour printing — Part 5: Flexographic printing*

ISO 14981, *Graphic technology — Process control — Optical, geometrical and metrological requirements for reflection densitometers for graphic arts use*

3 Terms and definitions

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

3.1
anilox roller
roller with a chromium-plated or a ceramic surface 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) 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 or laser-engraved or chemically-etched cylinder, sleeve or plate for application of printing ink to a print substrate

3.5
printability tester
device for uniformly applying a reproducible amount of ink to a substrate under specified conditions

3.6
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

3.7
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 the characterization of mechanical and/or chemical properties of inks 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 costumer 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 of 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. This can be evaluated by the use of a reflection densitometer using aim values that are agreed upon between parties. However, it is possible to duplicate results between two laboratories. Where different laboratories use the same or comparable laboratory testing equipments 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,

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

For electromechanically engraved formes, the width of channel, expressed in micrometers (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 (as well as for anilox rollers for flexographic ink transport) 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 costumer 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. However, it is 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:

— material,

— Shore A hardness,

— supplier,

— thickness,

— design of the forme,

— sticky back, and

— screen frequency of tone values.

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 ink films applied by the flexographic process using water based or solvent based inks is 3 µm ± 1 µm and for radiation cured inks is 2 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 of 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,

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

For electromechanically engraved anilox rollers, the width of channel, expressed in micrometers (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 for and diameter(s).

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 The precise measurement of cell volumes is difficult. There are several possible methods all having their drawbacks regarding accuracy and reproducibility. Therefore, it could 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 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 inks in accordance with ISO 2846-3. Density measurements made in accordance with ISO 14981 shall be performed in an equally spaced pattern adapted to the geometric form of the print area (minimum 25 measurements). Colouration gradients (e.g. ink feed, printing forme or pressure gradients) may therefore be identified and, if so, measures shall be taken to adjust the printability tester. The standard deviation of density measurements shall not exceed 0,03.

For testers for flexographic inks, the homogeneity of the print within defined printed areas shall be evaluated by using test prints of inks in accordance with ISO 2846-5. Density measurements made in accordance with ISO 14981 shall be performed in an equally spaced pattern adapted to the geometric form of the print area (minimum 25 measurements). Colouration gradients (e.g. ink feed, printing forme or pressure gradients) may therefore be identified and, if so, measures shall be taken to adjust the printability tester. The standard deviation of density measurements shall not exceed 0,04 for a tester using the anilox–flexo-plate–substrate principle and no more than 0,03 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.

NOTE If prints are prepared using ISO 2846-3 or ISO 2846-5, be aware that it is necessary to use the reference substrate defined within those parts of ISO 2846.

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.

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).

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.

Preferably use 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 2834-2:2007;

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.

Bibliography

[1] ISO 2836, *Graphic technology — Prints and printing inks — Assessment of resistance of prints to various agents*

[2] ISO 2846-3, *Graphic technology — Colour and transparency of printing ink sets for four-colour-printing — Part 3: Publication gravure printing*

[3] ISO 2846-5, *Graphic technology — Colour and transparency of printing ink sets for four-colour printing — Part 5: Flexographic printing*

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