SCAN-P 36:02
Revised 2002

SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

Paper and board

Evaluation of test prints

0 Introduction

This SCAN-test Method replaces SCAN-P 36:96 from which it differs in that the standards referred to in the evaluation of the test prints have been changed from SCAN-test Methods to the corresponding EN and/or ISO standards.

The test prints can be prepared according to any of the following SCAN-test Methods:

SCAN-P 78	Paper and board – Test printing using a Prüfbau-type printability tester
SCAN-P 79	Newsprint – Test printing using a Prüfbau-type printability tester
SCAN-P 86	Paper and board – Test printing using an IGT-type printability tester
SCAN-P 87	Newsprint – Test printing using an IGT-type printability tester

At the same time SCAN-P 35 has been withdrawn.

1 Scope

This Method describes the evaluation of test prints with black inks in terms of ink requirement, print density and set-off on all types of papers and boards, and print-through on papers. The test prints can be prepared by any of the procedures listed in the Introduction.

2 References

ISO 187	Paper, board and pulps – Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples (EN 20187)
ISO 2471	Paper and board – Determination of opacity (paper backing) – Diffuse reflectance method
ISO 5631	Paper and board – Determination of colour (C/2 °) – Diffuse reflectance method
ISO 2469	Paper, board and pulps – Measurement of diffuse reflectance factor + Corr. 1:1998

Note – SCAN-test has withdrawn a number of test methods and refers instead to the corresponding ISO and/or EN Standards.

3 Definitions

For the purpose of this Method, the following definitions apply:

3.1 *Print density, D* – The logarithm to base 10 of the ratio of the Y-value of the unprinted paper to the luminous reflectance factor of the print when it is placed over an opaque pad of the unprinted paper.

Note 1 – The term *luminous reflectance factor* is defined in ISO 2471 and *Y-value* in ISO 5631.

3.2 *Ink requirement, IR_D* – The weight per unit area of printing ink required on the paper to reach a specified print density.

3.3 *Print-through, PT* – The logarithm to base 10 of the ratio of the *Y*-value of the reverse side of the unprinted paper to the luminous reflectance factor of the reverse side of the printed paper when it is placed over an opaque pad of the unprinted paper.

3.4 *Set off, SO* – The logarithm to base 10 of the ratio of the Y-value of the recipient surface to the luminous reflectance factor of the area stained by printing ink transfer when the stained paper is placed over an opaque pad of the recipient paper.

Note 2 – Set-off is a measure of the tendency for printing ink from a newly printed surface to be transferred to another surface with which the test print is brought into contact under the action of a normal force without shear.

Note 3 – The recipient paper may be a standard paper or a sheet of the paper being tested.

4 Principle

The *print density* and *print-through* are determined by reflectance measurements on both sides of the unprinted paper and on both sides of test prints.

The *set-off* is determined by reflectance measurements on the unused recipient paper and on the stain created on the recipient paper by a set-off test.

The *ink requirement* is calculated as the weight per unit area of printing ink on the paper needed to reach a specified print density and the *print-through* and the *set-off* are calculated at this printing ink weight per unit area.

Alternatively, the *print density*, the *print-through* and the *set-off* are calculated at a specified weight per unit area of printing ink on the paper.

5 Apparatus

5.1 *Reflectometer* and equipment, as specified in and calibrated according to ISO 2471.

6 Preparation of test pieces

Condition the test prints, a sample of the unprinted paper used for the prints, and the set-off paper, as specified in ISO 187 and keep them in the conditioning atmosphere throughout the test.

The test prints can be produced as described in SCAN-P 78, SCAN-P 79, SCAN-P 86 or SCAN-P 87.

The weight per unit area of printing ink on each test print should be known to the nearest 0,01 g/m^2, and the date and time of printing should also be known.

7 Procedure

At a time (24 ± 2) h after printing using the method described in ISO 2471, determine:

7.1 The Y-value on the two sides of the unprinted paper used for the test print, R_∞ and $R_{\infty B}$, and of the specified set-off paper, $R_{\infty SO}$.

7.2 The luminous reflectance factor of the test print, R_P, as the average of three single measurements on each printed area, using an opaque pad of the same unprinted paper as backing.

7.3 The luminous reflectance factor of the unprinted side of the test print, R_{PB}, as the average of three single measurements for each printed area, using an opaque pad of the same unprinted paper as backing, with the unprinted paper facing in the same direction as in the measurement of $R_{\infty B}$.

Note 1 – If necessary, the measurements on the test prints may be performed $2\text{ h} \pm 10$ min after printing. This must then be stated in the report.

7.4 The luminous reflectance factor of the recipient paper, R_{SO}, as the average of three single measurements on each set-off area, using an opaque pad of unused recipient paper as backing.

Note 2 – If necessary, the measurements on the recipient paper can be performed (2 ± 1) h after the set-off test. This must then be stated in the report.

Note 3 – Instead of using a reflectometer and calculating the print density from the reflectances of the unprinted and printed papers, a densitometer may be used for direct measurement of the print density. The densitometer must then be zero positioned on the unprinted paper.

However, most densitometers are not accurate enough and should not be used for measurements of print-through or set-off. If a densitometer is used, a sufficient number of measurements should be made to compensate for the small sample aperture and obtain a representative mean.

Densitometers do not give the same print density level as reflectometers specified in ISO Standards. The difference depends on the grade of paper.

If a densitometer is used for print density measurements care also must be taken not to make comparisons with measurements performed with any other densitometer (of the same or another make).

If a densitometer is used, this must be stated in the report.

8 Calculation and evaluation

8.1 *Print density* and *print-through*. Calculate the print density and the print-through for each test print, using the expressions:

$$D = log\frac{R_\infty}{R_P} \quad [1]$$

where
D is the print density;
R_∞ is the Y-value of the unprinted paper, print side;
R_P is the luminous reflectance factor of the test print.

and

$$PT = log\frac{R_{\infty B}}{R_{PB}} \quad [2]$$

where
PT is the print-through;
$R_{\infty B}$ is the Y-value of the unprinted paper, reverse side;
R_{PB} is the luminous reflectance factor of the reverse side of the test print.

8.2 *Ink requirement to a specified print density*, IR_D. Plot, for each side of the paper separately, the print density against the weight per unit area of printing ink on the paper. Fit the Tollenaar-Ernst equation to the points, which should be five or at least four, using a least squares method. The Tollenaar-Ernst equation (10.1) is:

$$D = D_\infty\left(1 - e^{-mw}\right) \quad [3]$$

where
D is the print density for a weight per unit area of printing ink w on the paper;
D_∞ is the limit print density at infinite weight per unit area of printing ink on the paper;
m is a parameter depending on the paper and the printing conditions;
w is the weight per unit area of printing ink on the paper in grams per square metre.

Calculate or read off the weight per unit area of printing ink at the specified print density. Report the ink requirement, as IR_D, to the nearest 0,01 g/m^2.

Note – The fitting of the Tollenaar-Ernst equation requires an iterative computerized procedure. If such a procedure is not available, a logarithmic or a second order equation may be used. In this case, or if some other method of interpolation is used, this must be stated in the report.

8.3 *Print density at a specified weight per unit area of printing ink on the paper, D_w*. Plot the print density against the weight per unit area of printing ink on the paper. Fit the Tollenaar-Ernst equation to the points, which should be five or at least four, and calculate or read off the print density at the specified weight per unit area of printing ink. Report the print density as D_W to the nearest 0,01 unit.

8.4 *Print-through at a specified print density, PT_D, or at a specified weight per unit area of printing ink on the paper, PT_w*. Plot the print-through against the weight per unit area of printing ink on the paper. Fit a second order equation, or if suitable a straight line, to the points, which should be five or at least four, and read off the print-through value corresponding to the specified print density value or to the specified weight per unit area of printing ink and report this as PT_D or PT_W respectively to the nearest 0,001 unit.

8.5 *Set-off at a specified print density, SO_D, or at a specified weight per unit area of printing ink on the paper, SO_w*. Calculate the set-off for each test print using the expression:

$$SO = \log\frac{R_{\infty SO}}{R_{SO}} \quad [4]$$

where
SO is the set-off;
$R_{\infty SO}$ is the Y-value of the recipient paper before the set-off test;
R_{SO} is the luminous reflectance factor of the recipient paper after the set-off test.

Plot, for each side of the paper separately, the set-off against the weight per unit area of printing ink on the paper. Fit a second order or if suitable a third order equation to the points, which should be five or at least four, and calculate or read off the set-off value corresponding to the specified print density value or specified weight per unit area of printing ink and report this as SO_D or SO_W respectively to the nearest 0,005 unit (10.2).

9 Report

The test report shall include reference to this SCAN-test Method and the following particulars:

(a) date and place of testing;
(b) identification of the test prints;
(c) a copy of the report from the test printing;
(d) the evaluation method (specified print density or weight per unit area of printing ink);
(e) the results, as stated above (8.1-8.5);
(f) any departure from the procedure described in this SCAN-test Method and any other circumstances that may have affected the result (see the notes to 7.3, 7.4 and 8.2).

Note – Since the results of this evaluation are an integral part of a test printing, the report of the evaluation is not complete unless details of the test printing are appended.

10 Literature

10.1 Tollenaar D, Ernst P A H. Adv. Print Sci. Tech., Pergamon vol 2, p. 214-233 (1962)

10.2 Bristow J A, Bergenblad H. Adv. Print Sci. Tech., Pentech vol 21, p. 133-167 (1992)

SCAN-test Methods are issued and recommended by KCL, PFI and STFI-Packforsk for the pulp, paper and board industries in Finland, Norway and Sweden.
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