SCAN-CM 11:95
Revised 1995

SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

Mechanical and chemical pulps

Preparation of laboratory sheets (optical properties)

Sheets for measuring ISO brightness

0 Introduction

This SCAN-test Method replaces SCAN C 11:75, from which it differs in that the scope is now limited to the preparation of sheets and the Method does not describe the measurement of ISO brightness, which is now described in ISO 2470. The procedure for preparing the sheets has been modified so that a sheet former as well as a funnel may be used in the sheet forming. The use of a filter paper when forming the sheets has been replaced by the use of a wire screen, the sheet forming consistency is specified and, finally, the sheets are dried under restraint.

The retention of fine material in the sheet is slightly lower when a wire screen is used than when a filter paper is used. This may lead to a somewhat higher ISO brightness than was given by the former version in the case of mechanical pulps.

> *Note* – When, as in SCAN-C 11:75, sheets are formed on a filter paper, fine material is retained on the top side of the filter paper. This material then tends to stick to the sheet or the filter paper and may lead to lower and uneven brightness on one side of the sheet.

The Method is expected to conform with ISO 3688 *Pulps – Preparation of laboratory sheets for the measurement of diffuse blue reflectance factor (ISO brightness),* which is currently being revised.

1 Scope

This Method specifies the method for the preparation of laboratory sheets to be used for determining the ISO brightness of pulps. It is applicable to all kinds of pulps. Details of the subsequent measurement procedure are given in ISO 2469 and ISO 2470.

> *Note* – Many pulps, especially recycled fibre pulps, may contain very small particles, with a colour deviating from the colour of the fibres, which will not be retained by a normal filter paper or wire screen. These particles may strongly affect the brightness value.
>
> If the brightness value of a pulp including these particles is of interest, a retention aid may be added prior to the sheet forming. The type and amount of the retention aid should be stated in the report. For example, an addition of 0,4 % polyacrylamide to a recycled pulp has proved effective (see Annex). The addition of a retention aid also improves the distribution of fine material in the sheet and reduces the two-sidedness.

2 References

ISO 5263-1 Pulps – Laboratory wet disintegration – Part 1: Disintegration of chemical pulps

ISO 5263-2 Pulps – Laboratory wet disintegration – Part 2: Disintegration of mechanical pulps at 20 °C

ISO 14487 Pulps – Standard water for physical testing

ISO 2469 Paper, board and pulps – Measurement of diffuse reflectance factor

ISO 2470 Paper, board and pulps – Measurement of diffuse blue reflectance factor (ISO brightness)

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 *Diffuse blue reflectance factor (ISO brightness)*, R_{457} – The intrinsic reflectance factor of an opaque pad of test pieces measured at an effective wavelength of 457 nm under the conditions specified in ISO 2470.

3.2 *Opaque pad* – A pad of test pieces such that the brightness is not changed if the total grammage (number of sheets) is doubled.

4 Principle

Laboratory sheets are prepared, either in a funnel or in a sheet former. In both cases, the sheets are formed on a wire screen, according to specified procedures.

Note – The ISO brightness is considered to be measured as described in ISO 2470, provided that the laboratory sheets have been dried, conditioned and measured as described in this Method.

5 Reagents

5.1 *Water*, prepared and purified according to ISO 14487.

5.2 *EDTA solution*, 5 g/l. Dissolve 5 g of ethylene-diaminetetra-acetic acid disodium salt, analytical grade, $C_{10}H_{14}O_8N_2Na_2 \cdot 2\ H_2O$, in 1 litre of water (5.1).

5.3 *Sulphuric acid*, about 0,5 mol/l. To 1 litre of water (5.1) add carefully 28 ml of sulphuric acid, H_2SO_4, density 1840 kg/m^3, stirring constantly.

5.4 *Sodium hydroxide solution*, about 1 mol/l, containing 40 g of NaOH per litre of water (5.1).

6 Apparatus

All equipment which comes into contact with the wet pulp shall be of non-corrosive materials, such as glass, porcelain, plastic or stainless steel. Iron, copper, brass and bronze in particular shall be avoided, because iron and copper ions tend to affect the brightness of pulp.

6.1 *Wet-disintegration apparatus* by means of which dry or wet pulp can be completely disintegrated with a minimum of beating and contamination.

6.2 *pH meter*

6.3 *Sheet-forming equipment:*

6.3.1 *Funnel* with a flat, perforated bottom, for example a Büchner funnel, between 115 mm and 150 mm inner diameter, and with a sufficient volume. A wire screen (6.4) is placed securely in the bottom of the funnel. The funnel is connected to a vacuum or filter pump.

or

6.3.2 *Sheet former* with an upper section, the stock container, and a lower section, the drainage vessel. The upper section can be opened and a wire screen (6.4) horizontally mounted on the top of the lower section.

The cross-section of the stock container is constant throughout the height. If the container is circular, the diameter shall be at least 80 mm. If the container is rectangular or square, the shorter side shall be not less than 80 mm and the quotient of the longer side divided by the shorter side shall not exceed 2,5.

The upper part of the lower section shall have the same cross-section as the stock container. The required vacuum for the sheet forming can be provided by a vacuum pump or by a drainage pipe with a water seal.

Stirrer, either a mechanical stirrer, for instance a perforated plate, or a pneumatic device for blowing clean compressed air into the lower part of the stock container.

Couch weight with a plane bottom of the same size as the wire screen and having a suitable mass.

Note – A conventional sheet former according to ISO 5269-1 fulfils the requirements and can be used provided the metals in the sheet former do not affect the brightness value.

6.4 *Wire screen* with a mesh aperture of (125 ± 6) µm and a wire diameter between 77 µm and 104 µm. The wire screen is backed by another coarser wire screen, which, in turn, may be backed by a rigid framework (6.3.2) or the bottom of a funnel (6.3.1).

6.5 *Blotters*, free from fluorescent substances and soluble impurities and with a grammage of approximately 250 g/m^2. The blotters shall be at least as large as the laboratory sheets.

Their surface strength must be sufficient to avoid fibre material sticking to the laboratory sheets.

6.6 *Pressing plates,* of the same size as the laboratory sheets.

6.7 *Press,* capable of pressing the laboratory sheets at 300 kPa.

6.8 *Drying device*, for restrained drying of the laboratory sheets, either by clamping them between drying frames or by keeping them in place on a slightly convex plate by means of a cloth. A number of such frames or plates can be mounted in a cabinet.

7 Preparation of sample

The sampling procedure is not covered by this Method. Make sure that the pulp taken to disintegration is representative of the sample received.

The amount of pulp to be prepared depends on the opacity of the sheets prepared from the pulp, which is in turn dependent upon intrinsic optical properties of the pulp itself. Sufficient test pieces with approximate dimensions 50 mm × 50 mm are required to form an opaque pad. From the total grammage required to form an opaque pad of test pieces, calculate the number of laboratory sheets required. A total grammage (oven-dry) of 800 g/m^2 of the pad of test pieces is normally sufficient. Make at least 2 laboratory sheets.

Note – Depending on the size of the sheet forming equipment used, a laboratory sheet may be divided into several test pieces or be a test piece itself. When brightness is to be determined according to ISO 2470, a minimum size of 60 mm in any direction of the test piece is recommended.

8 Procedure

8.1 *Disintegration of pulp*.

Note 1 – It is recommended to use the disintegration procedure described in ISO 5263-1 or ISO 5263-2 and to separate an appropriate amount of pulp from this disintegration for the sheet preparation.

Split if necessary the pulp and tear it into pieces measuring approximately 20 mm x 20 mm. Weigh out the appropriate quantity of the pulp and disintegrate it in the water (5.1) in the disintegration apparatus (6.1). Add 0,5 ml of the EDTA solution (5.2) per gram of pulp to the water before soaking or disintegration. The volume of water should not exceed 250 ml per gram of oven-dry pulp. Disintegrate the pulp until the fibres are well separated, but no longer.

For pulps which do not require disintegration, determine the pulp concentration and add 0,5 ml of the EDTA solution (5.2) per gram of pulp.

Note 2 – To facilitate fibre separation it is recommended to soak the pulp in the water (5.1) prior to the disintegration.

Note 3 – The addition of EDTA may be excluded for pulps for which there is no doubt that it does not affect the brightness value.

8.2 *Dilution of pulp*. Dilute the pulp suspension with water (5.1) to a consistency of (4,0 ± 0,2) g/l.

8.3 *pH adjustment*. Using the pH meter (6.2), check that the pH value of the suspension, prepared as described in 8.1, is (5,0 ± 0,3). If required, adjust the pH value by adding drops of the sulphuric acid (5.3) or of the sodium hydroxide solution (5.4), as appropriate.

For some pulps, such as Cottonwood kraft, for which the change in brightness is more than 1,0 % per unit change in pH, adjust the pH to (5,0 ± 0,1).

Note 4 – If a pulp contains material which undesirably dissolves at pH 5,0, for instance a filler, the pulp may be tested at pH (7,0 ± 0,3) provided this is stated in the report.

8.4 *Sheet forming*. Prepare sheets with a grammage (oven-dry) of (200 ± 20) g/m^2. Form the sheets in a funnel (6.3.1) or in a sheet former (6.3.2), in both cases on a wire screen. Stir the pulp suspension and measure an amount of pulp corresponding to the prescribed grammage**.** If a funnel is used, ensure that the wire screen is horizontal. Pour the measured pulp suspension into the funnel or the stock container of the sheet former, mix it if necessary and drain it under suction. Avoid drawing any appreciable amount of air through the sheet that is formed. If a funnel is used, remove the sheet by inverting the funnel, blowing into the stem and catching the sheet on a blotter (6.5). If the suction is provided by a drainage pipe with a water seal, couch the sheet with one or several blotters and the couch weight. Mark the wire side of the sheet.

Proceed in the same manner with the remaining pulp suspension until the required number of laboratory sheets has been made.

Note 5 – If the suction in the sheet former used is provided by a drainage pipe with a water seal, it shall be filled with water to the level of the wire screen, but not more, before the pulp suspension is poured into it. The water closest to the wire must be according to ISO 14487, at least to a depth of 100 mm.

8.5 *Pressing*. Arrange, centrally placed on each other, the pressing plates (6.6), blotters (6.5) and laboratory sheets in a stack for pressing in the following sequence, beginning from the bottom:

one pressing plate
two dry blotters
one laboratory sheet
two dry blotters
one pressing plate
two dry blotters
the next laboratory sheet, and so on

Place the stack centrally in the press (6.7) and for 1 minute apply a pressure of 300 kPa calculated on the area of a laboratory sheet (the pressure gauge may show a different reading).

8.6 *Drying*. Loosen the blotters from the laboratory sheets but leave, if necessary, the two nearest blotters in place as a protection or replace them by new blotters. Dry the sheets under restraint in the drying device (6.8). Dry them in a current of clean air at room temperature to a dry matter content between 85 % and 95 %. Protect the laboratory sheets from contamination and from unnecessary exposure to light or heat.

9 Measurement of brightness

After drying and conditioning the laboratory sheets, measure the next day at the latest the brightness according to ISO 2470 on an opaque pad of test pieces. Laboratory sheets of sufficient size may be cut to several test pieces. Notice that the measurements shall be made on both sides of the sheets. Calculate and report the mean ISO brightness.

Note 1 – Curling of the test pieces affects the brightness value. For certain pulps it may therefore be necessary to apply an extra pressure to the opaque pad to keep the test pieces plane during the measurement.

Note 2 – The wire side of the laboratory sheets is often somewhat darker than the top side. The difference indicates the content of easily washed out coloured material, such as fines and very small particles of printing ink in recycled pulp, in the sample. If the difference is 0,5 % or more, the use of a retention aid is recommended.

10 Report

The following data should accompany the laboratory sheets:

(a) date and place of laboratory sheet preparation;
(b) precise identification of the sample;
(c) reference to this SCAN-test Method;
(d) if retention aid has been used, the kind and amount of retention aid and time of treatment;
(e) any departure from the procedure described in this Method and any other circumstances that may affect the results.

11 Precision

In an interlaboratory test, six laboratories made sheets according to this Method. Each laboratory used both a Büchner funnel and a conventional sheet former. ISO brightness of the sheets was measured according to SCAN-P 3 (nowadays replaced by ISO 2470). The results are shown in *Table 1*.

To illustrate that there is no difference in results between laboratory sheets prepared in a funnel and in a sheet former, the results in *Table 1* have been reported separately for the two sides of the sheet.

Table 1. The repeatability (within lab) and the reproducibility (between labs) calculated as the coefficient of variation for different pulp grades. A sheet former, as well as a funnel have been used in the sheet-forming procedure.

Pulp	Measure-ment side	Funnel			Sheet former		
		ISO bright-ness %	Coeff of variation		ISO bright-ness %	Coeff of variation	
			Within lab %	Between labs %		Within lab %	Between labs %
TMP	top	60,5	0,4	2,0	60,6	0,8	0,8
	wire	60,6	0,5	2,0	60,6	0,8	0,8
Bleached softwood sulphate	top	85,7	0,1	0,4	85,5	0,1	0,5
	wire	85,6	0,2	0,5	85,4	0,1	0,5
Bleached hardwood sulphate	top	89,3	0,1	0,2	89,1	0,1	0,4
	wire	89,2	0,1	0,3	89,0	0,1	0,5

Annex (informative) – The influence on ISO brightness of the addition of retention aid

For non-deinked recycled pulp and for deinked recycled pulp containing residues of printing ink, the measured ISO brightness is influenced by the retention in the sheet-forming procedure. This applies to the preparation of laboratory sheets in both a sheet former and in a Büchner funnel, since a wire cloth is used in both of the preparation alternatives. This means that small particles, such as fines from the pulp and residues of printing ink, may pass through the meshes of the wire cloth.

The addition of retention aid increases the retention of both fines and printing ink residues. This means that the ISO brightness of sheets prepared from recycled pulp will decrease when a retention aid is added, *Table 2*. In the table, the ISO brightness values for the wire side and for the top side are given separately to illustrate the correlation between the retention obtained, the reduced two-sidedness and the ISO brightness measured.

Table 2. The influence on ISO brightness of the addition of retention aid (polyacrylamide)

Pulp	Addition of retention aid %	Grammage g/m^2 (sheet 1)	Dry matter content in the white water, % of weight of the sheet, sheet 1	ISO brightness, %			
				Top side		Wire side	
				$\bar{x}$	s	$\bar{x}$	s
Flash dried TMP	0	187	2,2	59,1	0,14	58,8	0,36
	0,1	192	0,8	58,2	0,25	58,1	0,58
Recycled pulp*	0	202	2,2	48,0	0,22	46,9	0,24
	0,1	203	1,0	44,2	0,27	44,0	0,34
	0,2	204	0,6	43,8	0,17	43,9	0,14
	0,4	201	0,5	43,6	0,14	43,3	0,34

* From non-deinked recycled newspaper

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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