SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

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Pulps

In-plane shrinkage of laboratory sheets

1 Scope

This SCAN-test Method describes a procedure for determining the in-plane shrinkage of pulp measured on laboratory sheets dried under light pressure.

It is applicable to laboratory sheets prepared from all kinds of pulps.

2 Normative references

ISO 187	Paper, board and pulps – Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples
ISO 5263-1	Pulps – Laboratory wet disintegration – Part 1: Chemical pulps
ISO 5263-2	Pulps – Laboratory wet disintegration – Part 2: Mechanical pulps at 20 °C
ISO 5263-3	Pulps – Laboratory wet disintegration – Part 3: Mechanical pulps at > 85 °C
ISO 4119	Pulps – Determination of stock concentration
ISO 5267-1	Pulps – Determination of drainability Part 1: Schopper-Riegler method
ISO 5267-2	Pulps – Determination of drainability – Part 2: "Canadian Standard" freeness method
ISO 5269-1	Pulps – Preparation of laboratory sheets for physical testing – Part 1: Conventional sheet-former method

Note SCAN-test has withdrawn a number of test methods and refers instead to the corresponding ISO and/or EN Standards.

3 Definitions

3.1 *In-plane shrinkage* – The shrinkage of a test piece from a laboratory sheet when dried from the wet state to the dry state under defined conditions.

4 Principle

Circular or rectangular sheets are formed from a pulp suspension on a wire screen in a conventional sheet-former. Each sheet is pressed between blotting papers with a pressure of 410 kPa. After pressing, circular test pieces are punched from the sheets and the diameter is measured..The test pieces are then dried between wires on a drying equipment at a temperature of (60 ± 10) °C. During drying, the sheets are restrained by a pressure of (250 ± 100) Pa. After drying, the new diameter of the sheets is measured and the shrinkage is calculated.

5 Apparatus

5.1 *Sheet former*, according to ISO 5269-1.

5.2 *Dewatering device*, as described in ISO 5267-1 or ISO 5267-2.

5.3 *Plastic wire*, with a wire diameter of (20 ± 2) µm and an aperture width of (20 ± 2) µm.

5.4 *Punch*, for preparing test pieces with a diameter of (150 ± 5)mm.

The inner diameter of the punch defines the initial diameter, D1, of the test piece, and must be known to an accuracy of 0,7 %.

5.5 *Blotters* as described in ISO 5269-1.

5.6 *Couch weight* as described in ISO 5269-1

5.7 *Drying equipment*, capable of bringing an even temperature over the whole surface. It shall be covered with a cloth which can keep the sheets in place and allow the steam to pass through.

> *Note 1*– The drying equipment can for example be a drying drum or similar equipment.
>
> *Note 2* - The drum should have a diameter of at least 500 mm

5.8 *Measuring device*, to enable the diameter of the dry test piece to be measured with an accuracy of 0,07 % of the diameter.

> *Note* – The measuring device can for example be a scanner or a camera connected to some image analysis device.

6 Pre-treatment and preparation of sample

6.1 Pre-treatment

Disintegrate the pulp in accordance with ISO 5263-1, -2 or -3, whichever is relevant.

6.2 Preparation of the sample.

Dilute the stock to a concentration of 0,20 %. Determine the stock concentration in accordance with ISO 4119.

If necessary, determine the drainability on the stock in accordance with ISO 5267-1 or ISO 5267-2.

Prepare the sheets in accordance with ISO 5269-1.

7 Procedure

7.1 Sheet forming

Wash the wire screen with water and open the inlet valve and wait until all water has left the system. Close the valve and clamp the upper section in position and let water rise to at least 50 mm above the wire screen. Add an amount of the stock corresponding to a grammage of (60 ± 2) g/m^2 of the sheet, calculated on an oven-dry basis.

Fill up to the mark with water and mix the suspension by inserting the stirrer. Perform the double movement 6 times sufficiently vigorously to ensure thorough mixing, then once more slowly. After 10 s, open the drain valve and make sure that no drops damage the sheet.

When the water has left the wire screen, let the sheet drain for a period that is equal to about 10 per cent of the draining time, but not less then 5 s. Disconnect the stock container and then close the valve. Place two pieces of blotting paper with the wire side up, centrally over the wet sheet on the wire screen. Place the couch weight gently and centrally on the blotters and remove it again after about 20 s.

The blotter that is in contact with the laboratory sheet (the couch blotter) shall be new. Used blotters that are in good condition may be re-used after drying provided they are not placed in direct contact with a laboratory sheet.

Carefully remove the blotters from the wire screen and the laboratory sheet. Avoid any unnecessary bending. Empty the drainage vessel and prepare the sheet former for the next sheet. Make at least four approved sheets from each sample.

7.2 Stacking

On a pressing plate, place two dry blotters, then the laboratory sheet attached to the couch blotter. Mark the laboratory sheet at an angle of 90° to the machine direction of the couch blotter and place a new blotter with the wire side up, with its machine direction perpendicular to that of the couch blotter. Then place two old dry blotters on top of the stack. From the bottom upwards, the stack should be composed in the following way:

Pressing plate - two dry blotters - couch blotter and laboratory sheet - three dry blotters, couch blotter and laboratory sheet etc.

Finally, place a second pressing plate on top of the stack.

7.3 Pressing

Place the stack of sheets centrally in the press and raise the effective pressure on the sheets to (410 ± 10) kPa continuously during (25 ± 5) s. Maintain this pressure for 4 min ± 15 s.

> *Note* – The specified pressure is that which is applied to the laboratory sheets and may differ from the reading on the pressure gauge.

7.4 Preparation of test pieces

Remove the laboratory sheets from the press and remove the wet blotters except for the couch blotter. Punch out circular test pieces with a diameter of (150 ± 5) mm. The diameter of the test piece, D1, is considered to be equal to the inner diameter of the punch (see 5.4).

7.5 Drying

Remove the test piece carefully from the couch blotter and place it between two plastic wires (5.3). Make sure that the cloth is restraining the sheets by a pressure of 250 ± 100 Pa (i.e. 250 ± 100 N/m^2) against the sheets. The pressure should prevent the sheet from cockling. Dry the test pieces between the wires on a drying equipment at a temperature of (60 ± 10) °C until the dry matter content exceeds 95 %.

> *Note 1* – The time for drying the laboratory sheets to a dryness of 95 % is normally 1 h and 30 min.
>
> *Note 2* – Instead of using a drying drum, a convex metal plate can be used where the sheets are kept in place by a cloth.
>
> *Note 3* –Chemical pulp can be dried at room temperature.

7.6 Conditioning

Condition the test pieces according to ISO 187. Keep the test pieces in the conditioning atmosphere throughout the measurements.

7.7 Measurement

Remove the wires and place the test pieces in a dark and secure space to ensure that the test pieces are not exposed to unnecessary light. Using the measuring device (5.8), measure and record the diameter, *D2*, in at least two places perpendicular to each other on each test piece.

8 Calculation

For each measurement, calculate the shrinkage using the formula:

$$K = \frac{100\,(D_1 - D_2)}{D_1} \qquad (1)$$

where

K is the shrinkage, as a percentage;
D_1 is the mean inner diameter before drying (given by the diameter of the punch), in millimetres (see Figure 1);
D_2 is the diameter after drying, in millimetres (see Figure 1).

Calculate the shrinkage as the mean of eight measurements, and express the result as a percentage to three significant figures. Calculate the standard deviation.

9 Report

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

(a) date and place of testing;
(b) precise identification of the sample;
(c) if required, the drainability (SR or CSF) of each sample;
(d) the shrinkage as a percentage to three significant figures;
(e) the standard deviation or the coefficient of variation;
(f) any departure from the procedure described in this Method or any other circumstances which may have affected the results.

10 Precision

10.1 Repeatability

One laboratory tested three pulp samples four times each. The results are shown in Table 1.

Table 1 Repeatability

	Shrinkage	
	Mean shrinkage %	Coefficient of variation %
Bleached sulphate softwood, unbeaten	3,22	14
Bleached sulphate softwood, 35°SR	5,71	7,5
TMP, CSF 60 ml	2,41	6,8
BCTMP	1,54	4,42

10.2 Reproducibility

Five laboratories tested one chemical pulp and one mechanical pulp. The results are shown in Table 2.

Table 2 Reproducibility

	Shrinkage	
Sample	Mean shrinkage %	Coefficient of variation %
Bleached sulphate softwood, unbeaten	3,22	14
Bleached sulphate softwood, 35°SR	5,44	10
TMP, CSF 60 ml	2,03	13
BCTMP	1,51	4,54

Annex A
Precision – Repeatability additional information (informative)

One laboratory performed the test with restrained and and unrestrained cloths, using Standard- and Plastic wire at a grammage of 60 g/m^2 and 140 g/m^2. The results are shown in Table A1 and Table A2.

The restrained cloths have been under the pressure of (250 ± 100) Pa.

Table A1. Grammage 60 g/m^2

	Bleached sulphate softwood, 35° SR		TMP, CSF 60 ml	
	Shrinkage (%)	CoV (%)	Shrinkage (%)	CoV (%)
Free drying* **Standard wire**	5,75	3,0	2,36	12
Pressed cloths** **Standard wire**	4,75	3,6	1,75	2,3
Pressed cloths** **Teflonwire**	4,15	4,1	1,19	16

Table A2. Grammage 140 g/m^2

	Bleached sulphate softwood, 35° SR		TMP, CSF 60 ml	
	Shrinkage (%)	CoV (%)	Shrinkage (%)	CoV (%)
Free drying* **Standard wire**	6,32	2,8	2,34	3,8
Pressed cloths** **Standard wire**	5,44	2,6	1,69	5,3
Pressed cloths** **Teflon-wire**	5,01	3,0	1,58	4,4

*Free drying means that no pressure was applied to the cloths during drying.
**Pressed cloths means that the cloths were under a pressure of 250 ± 100 Pa.

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