



Papers and boards

Identification of machine and cross directions

0 Introduction

This SCAN-test Method replaces SCAN-P 9:64. The major change is that Test 4, which defined machine and cross directions by a curl test, is replaced by two new test methods, which define machine and cross directions by tensile stiffness measured by the speed of propagation of ultra-sound (6.1.2) and by interpreting the rupture pattern in a bursting test (6.2.4).

It is important to be able to identify the machine and cross directions of papers and boards since physical properties such as tensile properties, tear resistance, bending resistance and compression resistance are different in the two directions.

It is also important to be able to identify the wire side of papers and boards. Procedures for the identification of wire side are described in SCAN-P 10.

1 Scope

This SCAN-test Method applies to all kinds of machine-made papers and boards except crêped or machine-shrunk papers or specialties produced by techniques which differ from normal paper machine practice.

It is assumed that the test sheets are cut with their sides parallel to or at right angles to the machine direction. To determine the machine and cross directions, a clear difference in fibre orientation and/or elasticity properties of the paper is required.

This Method does not include the identification of running direction. Properties such as friction, gloss, fibre rising and surface strength are different in the running direction and in the opposite direction.

2 References

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| SCAN-P 10 | Papers and boards – Identification of wire side |
| SCAN-P 24 | Papers – Bursting strength and bursting energy absorption |
| ISO 2759 | Board – Determination of bursting strength |
| ISO 1924-2 | Papers and boards – Determination of tensile properties – Part 2: Constant rate of elongation method (EN ISO 1924-2) |

Note – SCAN-test has withdrawn a number of test methods and refers instead to the corresponding ISO and/or EN Standards.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 *Machine direction, MD* – The direction in paper and board which coincides with the longitudinal direction of the web.

3.2 *Cross direction, CD* – The direction perpendicular to the machine direction.

3.3 *Running direction, RD* – The direction in which the paper web is running in the paper machine. The running direction of a sample is defined by the end that passed first through the paper machine.

4 Principle

The paper is tested to determine properties known to differ systematically between the machine and cross directions.

The decision of the identification is made on the basis of the results.

5 Apparatus

Depending on the test procedure to be used, the following apparatus are applicable:

- 5.1 *The equipment* described in the SCAN-test Method and/or ISO standard referred to.
- 5.2 *Microscope*.
- 5.3 *Ultra sound speed tester*.

6 Procedure

Find the machine direction of paper and board by one or preferably more of the following tests. It is recommended that experience in these tests be obtained by practising with paper or board of known machine and cross directions.

6.1 Non destructive tests

6.1.1 *Surface inspection*. Note the orientation of the fibres on the surface of the paper. The fibres, especially on the wire side, are preferentially oriented in the machine direction. To view the paper, hold it horizontally, with the light incident at an angle of about 45° and with the line of vision also at an angle of about 45° to the normal to the paper. Observation of the paper surface under a microscope (5.2) is helpful.

6.1.2 *Tensile stiffness test*. Determine the tensile stiffness index by the speed of propagation of ultra-sound (5.3). Measure the speed in two directions, one parallel to and the other perpendicular to the same edge of the specimen. The highest value of the tensile stiffness index, i.e. the highest speed of ultra-sound propagation is in the machine direction.

6.2 Destructive tests

6.2.1 *Stiffness test*. Cut two test pieces from the specimen, measuring 250 mm x 15 mm, one parallel to the other perpendicular to the same edge of the specimen. Mark each test piece so that its orientation in the specimen is known.

Hold each piece in a horizontal plane by one edge. When the pieces are held together, the stiffer piece is the one which, when placed below the other, does not bend and fall away from the upper piece. The machine direction is the longitudinal direction of the stiffer test piece.

6.2.2 *Tensile test*. Cut two test pieces from the specimen measuring 250 mm x 15 mm ± 0,1 mm, one parallel to and the other perpendicular to the same edge of the specimen. Determine the tensile strength of each of the two test pieces in accordance with ISO 1924-2. The longitudinal direction of the stronger piece is the machine direction.

6.2.3 *Tear test*. For rapid determination, tear the specimen at right angles to the edge inwards from the two edges and compare the tears. The tear that is most delaminating is usually in the cross direction and the tear in the machine direction is usually the straightest.

6.2.4 *Bursting test*. Perform a bursting test in accordance with SCAN-P 24 or ISO 2759. Remove the test piece from the bursting tester and observe the principal line of rupture. This line, with approximately perpendicular fractures at either end, indicates the cross direction.

Note – The bursting test is convenient for paper with a "normal" distribution of tensile and stretch characteristics; however, there are numerous exceptions to this. The principal line of rupture is parallel to the direction with the higher stretch. In those papers where there is no significant difference in the stretch for the two directions, the rupture tends to be more random and less reliable as an indication.

7 Report

When machine and cross directions have been identified according to this SCAN-test Method in connection with the determination of physical properties, it should be stated in the test report, including details of the kinds of tests used.

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. Distribution: Secretariat, Scandinavian Pulp, Paper and Board Testing Committee, Box 5604, SE-114 86 Stockholm, Sweden.