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SCANDINAVIAN PULP, PAPER AND BOARD
TESTING COMMITTEE

Paper and board

CCT value and CCT index

Corrugated Crush Test

1 Scope

This SCAN-test Method specifies the procedure for determining the CCT value and CCT index of fluting and liner. The CCT value is an arbitrary measure of the expected compression strength of a corrugated fibre-board made from the material under test.

The Method applies to papers and boards with a thickness of not less than 0,15 mm and not more than 0,49 mm. The Method may also be used for laboratory sheets prepared for the testing of pulp. The grammage of such sheets should be 140 g/m^2, on an oven-dry basis.

2 References

ISO 187 Paper, board and pulps – Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples

ISO 536 Paper and board – Determination of grammage

Note – SCAN-test has withdrawn a number of test methods and refers instead to the corresponding ISO and/or EN Standards.

3 Definition

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

3.1 CCT value – The maximum compression force per unit length that a laboratory-corrugated test piece of paper or board can support until the onset of break in a compression test where the force is applied in the direction of the flute tubes, the test being performed under standardized conditions.

3.2 CCT index – CCT value divided by grammage.

4 Principle

A rectangular test piece is corrugated between heated corrugating rolls. The corrugated test piece is mounted in a holder with the flute tubes placed vertically. It is then subjected to a compression test in a compression tester. The maximum compression force per unit length is reported as the CCT value.

5 Apparatus

5.1 *Corrugating machine* consisting of two A-flute rolls, at least 16 mm wide and having an outer diameter of (228,5 ± 0,1) mm. One of the rolls is rotated by a motor at a rate of (4,0 ± 0,5) rpm. Each roll has 84 teeth, (4,75 ± 0,05) mm high with a top radius of 1,5 mm and a bottom radius of 2,0 mm, *Figure 1*. The rolls can be heated to a surface temperature of (177 ± 5) °C and pressed together with a force adjustable to (100 ± 10) N.

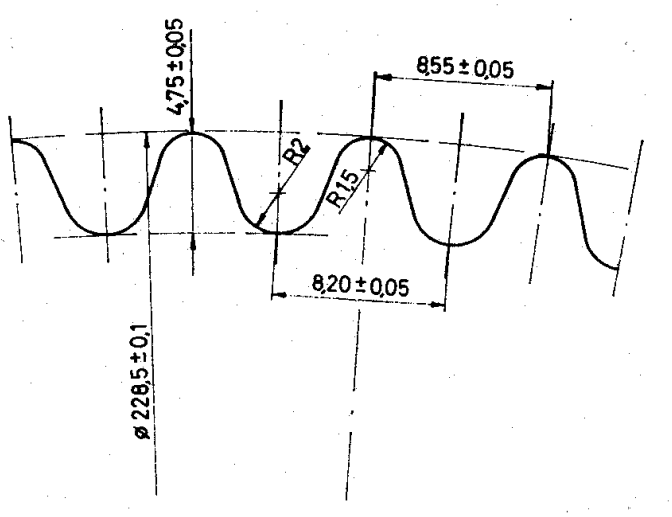

Figure 1 A-flute

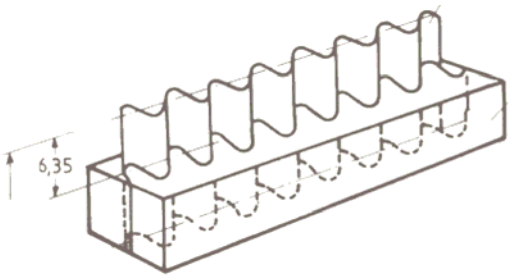

Figure 2 Test piece holder
A. Test piece
B. Holder

5.2 *Holder* with a profile matching the profile of the corrugated board, *Figure 2*, able to hold the test piece so that the flute tubes are vertical. The holder can be opened for mounting of test pieces.

5.3 *Compression tester* designed to measure compressive force and fulfilling the following requirements. The test piece is placed between two horizontal flat plates, each measuring at lest 100 x 100 mm. The plates are parallel within 1 part in 2000 for any position of the test piece and irrespective of the compressive force applied. The lateral play does not exceed 0,05 mm. One of the plates is motor-driven so as to approach the other plate at a speed of (12,5 ± 2,5) mm/min. The plates are covered with fine emery cloth, or their surfaces are worked to a similar degree of roughness by etching or other suitable treatment.

Check the parallelism of the plates by means of an adjustable gauge provided with a micrometer screw, or by means of a micrometer gauge. Measure the distance between the plates at each corner by means of the gauge.

Note – If the compression tester operates on the principle of beam deflection, the beam should be such that the results of the test lie within 20 % to 80 % of the normal range of deflection. When the plates are in contact the rate of increase in force should be (67 ± 13) N/s. If a machine operating with beam deflection has been used, this should be stated in the report.

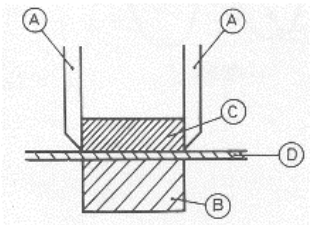

Figure 3. Cutting device
A. Knives
B. Base
C. Restraining bar
D. Specimen

5.4 *Force-measuring device*, enabling the compression force to be measured with an accuracy of 1 N.

5.5 *Cutting device* designed to give test pieces with clean and parallel edges. A device with two knives, such as that in *Figure 3*, or a punch, is recommended. Devices in which the edge of the test piece may be damaged by contact with the obliquely ground side of a knife are unsuitable.

6 Preparation of test pieces

Condition the specimens at 23 °C and 50 % relative humidity as specified in ISO 187 and keep them in the conditioning atmosphere throughout the test.

From specimens free from wrinkles, creases and other visible faults cut, one at a time, rectangular test pieces, (12,7 ± 0,1) mm wide and (152 ± 0,5) mm long. The long edges shall be parallel to within 0,015 mm over the length, clean and without defects. For the determination of the corrugated crush resistance in the machine or cross direction, cut the test pieces with the longer side perpendicular to the desired direction.

Cut enough test pieces from each sample to enable at least 10 tests to be made in each direction.

If CCT index is to be calculated, determine the grammage in accordance with ISO 536.

7 Procedure

Heat the corrugating rolls to /177 ± 5) °C and start the motor. Corrugate a test piece by inserting it between the rolls with its longer side perpendicular to the nip.

Condition the test piece for at least 30 min, but for not more than 4 h, in the conditioning atmosphere.

Mount the test piece in the holder (5.2) and place this in the centre of the lower plate of the compression tester.

Operate the tester and read, to the nearest 1 N, the maximum force sustained by the test piece.

> *Note* – This test, like all other tests depending on resistance to compression, is very sensitive to changes in the moisture content of the test piece. Keep the test pieces away from moisture, heat, direct illumination, expiration air and other circumstances that may change their moisture content. Ensure that the holder is not influenced by heat from lamps, motors, etc.

8 Calculation

8.1 *CCT value*

Calculate the CCT value by dividing the maximum compression force by the length of the test piece, using the expression

$$X = f/l \qquad [1]$$

where
X = the CCT value, in kilonewtons per metre;
f = the maximum compression force, in newtons;
l = the length of the test piece, in millimetres.

Calculate separately for the machine and cross directions the CCT value as the mean of all the replicate tests. Calculate also the standard deviation.

Report the result to the nearest 0,01 kN/m.

8.2 *CCT index*

If required, calculate the CCT index from the expression

$$Y = 1000\ X/W \qquad [2]$$

where
Y = the CCT index, in newtonmetres per gram;
X = the mean value of the CCT value, in kilonewtons per metre;
W = the grammage, in grams per square metre.

Report the result to the nearest 0,1 Nm/g.

9 Report

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

(a) date and place of testing;
(b) description and identification mark of the material tested;
(c) the direction of the test;
(d) the number of replicates carried out;
(e) the test results as specified above;
(f) the standard deviation of the results;
(g) if relevant, a statement that a compression tester working on the principle of beam deflection has been used;
(h) any departure from the procedure described in this Method or other circumstances which may have affected the results.

10 Precision

When 23 laboratories tested the same flutings (grammage between 112 g/m^2 and 150 g/m^2) and kraft liners (grammage between 125 g/m^2 and 200 g/m^2), the coefficient of variation between laboratories was close to 6 %.

11 Literature

Fellers, C. and Jonsson, P. Kompressionshållfasthet hos liner och fluting – En analys av provningsmetoder. Svensk Papperstidn. 78: (1975) 9,329.

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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