DECEMBER 2025

WHITE PAPER

S-Test

A new method to characterise fluting performance

CONTAINERBOARD EUROPE

1. Introduction

The purpose of this document is to provide insight into the S-Test, which can be described as a compressive strength test of a sample held in s-shape. It is a performance measurement for containerboard fluting. Recently developed, the S-Test offers distinctive characteristics that merit detailed explanation and understanding.

To explain it, we will follow the process downstream, from packaging, to corrugated cardboard, to finally containerboard paper. For each step we will detail the relevant performance properties, to eventually contextualise S-Test relevance.

Finally, associated standard and practical information will be described.

2. Ensuring good box performance through a new measurement in paper production

The performance of corrugated cardboard packaging is primarily measured using BCT (Box Compression Test). When the right level of BCT is achieved, the contents of the pack can be securely transported through the supply chain and the packaging fulfils its main purpose.

For corrugated cardboard manufacturers, it is critical to ensure that the performance of the corrugated cardboard has the potential to deliver this required BCT.

There are many different steps in the packaging supply chain that can have an impact on board performance. The process of converting board into packaging on a converting line (Flexo Folder Gluer, Rotary Die Cutter, etc) carries the potential to reduce its performance through damage, typically to the flute profile. Transit through a converting machine or a printer are just two processes that can impact final board strength.

Reduction in strength can also occur when packaging is handled at end customer's premises, manual or automatic erection of the pack on a packing line can result in reduced performance due to damage.

This damage is typically characterised through board crush, this reduces box performance which can be measured through lower BCT.

Containerboard Europe
Avenue Louise, 250
B-1050 Brussels

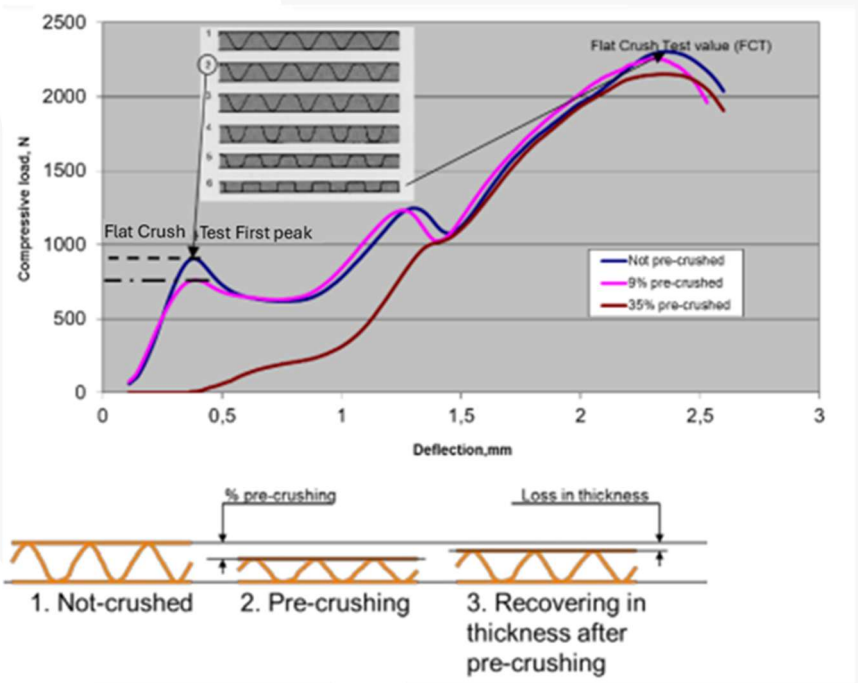
hello@containerboard.org
Tel: +32 (0)2 647 41 57
www.containerboardeurope.org

Trade Name of
Cepi ContainerBoard
TVA BE0833.959.775

There are several board performance parameters that exist to assess this crush level (DST Torsional Stiffness, Bending Stiffness, etc), but one of the most common is FCT (Flat Crush Test).

Specifically, the FCT first peak (cf. graph I below – stage 2), refers to the ability of the board to resist the type of damage already described. Beyond the FCT first peak level, the board is irrevocably damaged as it has entered the plastic zone. Before that point, the material still operates in the elastic zone, where partial recovery in board thickness is possible.

Graph I: FCT graphical output[1]



Within the corrugated cardboard structure, the role of the fluting paper is to create distance between the liners, to build the thickness of the board. This thickness is directly correlated to the strength of the corrugated board.

[1] "A novel test method for predicting crushing elasticity in medium fluting with higher relevance than for instance currently used methods like CMT", White paper | Thomas Fürst (ABB) Lorentzen & Wettre products, Sweden | Peter Gerards (Smurfit Westrock) Product Development, Netherlands

Containerboard Europe
Avenue Louise, 250
B-1050 Brussels

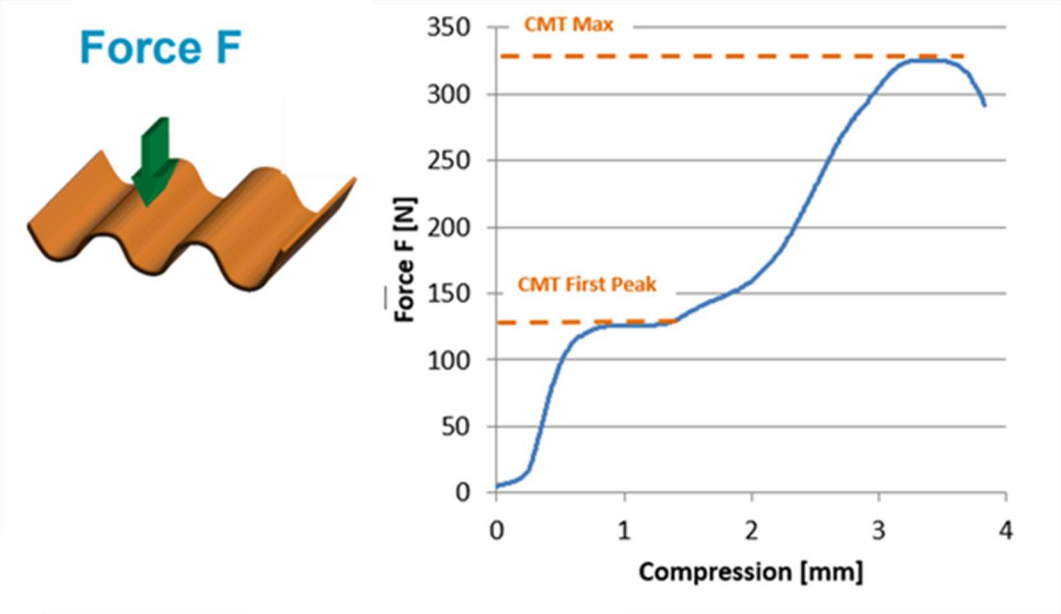
hello@containerboard.org
Tel: +32 (0)2 647 41 57
www.containerboardeurope.org

Trade Name of
Cepi ContainerBoard
TVA BE0833.959.775

Crush and damage to the fluting paper impacts board performance as described earlier.

Fluting paper performance is historically assessed by measuring its CMT performance (Corrugating Medium Test). This test is performed by corrugating a small fluting paper strip and measuring its resistance to compression.

Graph II: CMT sample and its measurement graphical output[2]



A parallel can be drawn between FCT / FCT first peak of the board vs CMT / CMT first peak of the fluting paper. The CMT first peak is the point beyond which the fluting paper and consequently the board is irrevocably damaged.

S-Test has been created as a simple way to assess fluting performance, measuring the point at which it matters most to ensure board and box performance. It correlates very well with CMT first peak, and can be measured using automatic bench equipment, this provides paper performance data very quickly to the paper machine production team.

[2] "S Test A new method predicting crushing elasticity in medium fluting", Peter Gerards (Smurfit Westrock), FEFCO Technical seminar, Vienna, 2017

Containerboard Europe
Avenue Louise, 250
B-1050 Brussels

hello@containerboard.org
Tel: +32 (0)2 647 41 57
www.containerboardeurope.org

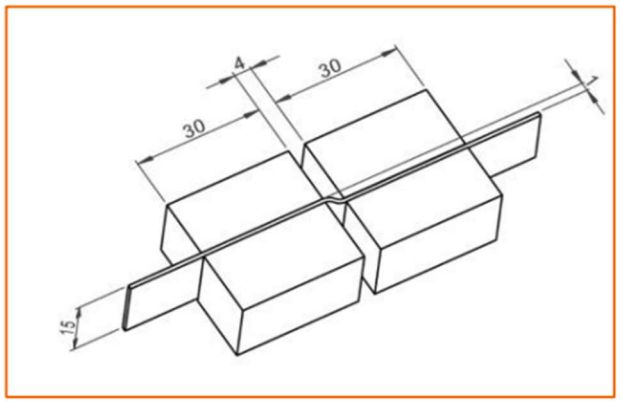
Trade Name of
Cepi ContainerBoard
TVA BE0833.959.775

3. How does S-Test work?

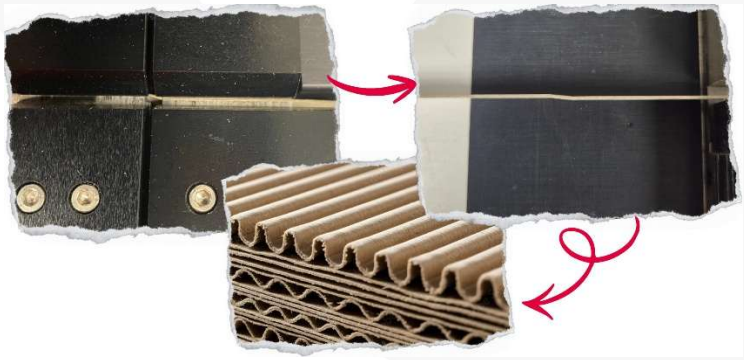
A fluting paper strip is inserted into fixed S-Tester clamps. There is a defined offset between the clamps, which presents the paper sample in such a way that a double bend is created resulting in an "S" shape, hence the name of the test (cf. graph III below).

The test itself is comparable to the SCT measurement (Short-span Compression Test), where the maximum compressive force which the sample withstand is measured. The only differences are the clamps offset, the closing sequence of the clamps and a larger distance between those clamps.

Graph III: S-Test tested sample schematic view[3]



Graph IV: S-Test Illustration



[3] "L&W Autoline S-Test OPERATING INSTRUCTIONS"

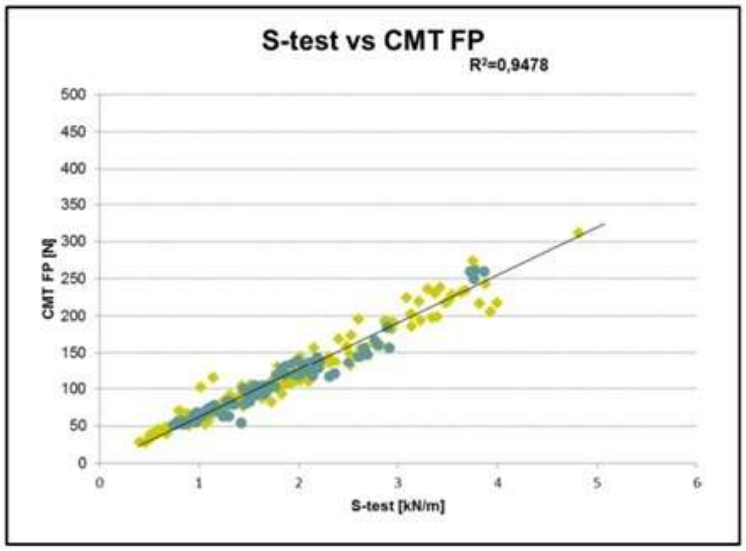
Containerboard Europe
Avenue Louise, 250
B-1050 Brussels

hello@containerboard.org
Tel: +32 (0)2 647 41 57
www.containerboardeurope.org

Trade Name of
Cepi ContainerBoard
TVA BE0833.959.775

There is a good correlation between S-Test and CMT first peak, as can be observed in the graph V below (timeseries with 170 and 120 datapoints, collected 6 months apart). Consequently, a good correlation can also be observed between S-Test and FCT first peak, an important characteristic for board and box performance.

Graph V: S-Test to CMT first peak correlation[4]



The S-Test measurement procedure has been initially described in DIN 5014:2019-04. This has now been developed further in ISO 7763:2024.

The grammage range for S-Test is defined to 80 – 220 g/m².

[4] "A novel test method for predicting crushing elasticity in medium fluting with higher relevance than for instance currently used methods like CMT", White paper | Thomas Fürst (ABB) Lorentzen & Wettre products, Sweden | Peter Gerards (Smurfit Westrock) Product Development, Netherlands

Containerboard Europe
Avenue Louise, 250
B-1050 Brussels

hello@containerboard.org
Tel: +32 (0)2 647 41 57
www.containerboardeurope.org

Trade Name of
Cepi ContainerBoard
TVA BE0833.959.775

4. Benefits of S-Test

First and foremost, S-Test can be well correlated with board and box performance both of which are important to the packaging supply chain.

Secondly, the measurement is taken directly from a paper strip that requires minimal sample preparation. This provides rapid test results critical to paper machine production and enables effective processes and accurate quality assessments.

Finally, the test allows the use of either standalone equipment or an integrated module in the automatic bench equipment utilised by paper mills for quality control. This also minimises the potential impact of variation in operator measuring practice or other external factors.

S-Test is a measurement that has proven to be both repeatable and reproducible.

5. Conclusion

S-Test development has been driven by the necessity of finding a fluting paper parameter that can be well correlated to board properties of prime importance to ensure box performance in the supply chain.

S-Test is also suitable for fluting specification, due to its ease of measurement, automatic bench availability and the resulting speed of quality control.

S-Test is an additional viable option for customers requiring a reliable method to predict their box performance.

Containerboard Europe
Avenue Louise, 250
B-1050 Brussels

hello@containerboard.org
Tel: +32 (0)2 647 41 57
www.containerboardeurope.org

Trade Name of
Cepi ContainerBoard
TVA BE0833.959.775