INTERNATIONAL STANDARD

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Corrugating medium — Determination of the flat crush resistance after laboratory fluting

Papier cannelure pour carton ondulé — Détermination de la résistance à la compression à plat après cannelage en laboratoire

Reference number
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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 7263 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

This third edition cancels and replaces the second edition (ISO 7263:1994), which has been technically revised. The major revision is the change in how the time between fluting and compression testing is expressed. Description and calibration of the compression testing equipment have been eliminated and the appropriate International Standard is referenced. Precision statements for the rigid platen instrument and for the procedure involving conditioning prior to testing have been added. An annex describing steps to be taken for fluter maintenance is included.

Introduction

The flat crush resistance of laboratory-fluted corrugating medium is regarded as an important property because it is an indication of the potential flat crush resistance of corrugated fibreboard made from that medium. The corrugated medium is fluted by passing it between heated rollers. Two different test procedures are then widely used:

a) the fluted corrugating medium is compressed immediately after fluting (i.e. 5 s to 8 s after fluting);

b) the fluted corrugating medium is conditioned for 30 min to 35 min under standard laboratory test conditions before being compressed.

Procedure a) generally gives considerably higher results than those obtained with procedure b). The differences in results are claimed to be caused by

— the lower moisture content (and thus higher stiffness) of the unconditioned fluted corrugating medium,

— the change in flute profile which occurs during the conditioning period.

Since considerable advantages are claimed for both procedures and both are widely used, this International Standard describes both procedures.

A method of determining the flat crush resistance of manufactured corrugated fibreboard is given in ISO 3035:1982, *Single-faced and single-wall corrugated fibreboard — Determination of flat crush resistance*.

Corrugating medium — Determination of the flat crush resistance after laboratory fluting

1 Scope

This International Standard specifies two methods for the determination of the flat crush resistance of corrugating medium after laboratory fluting.

The procedures are applicable to any corrugating medium intended to be used, after fluting, in the manufacture of corrugated board.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 186, *Paper and board — Sampling to determine average quality*

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

ISO 13820, *Paper, board and corrugated fibreboard — Description and calibration of compression-testing equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
flat crush resistance
maximum force that a corrugated test piece will withstand before the flutes collapse under an increasing force applied perpendicular to its surface

4 Principle

Fluting of the corrugating medium by passing it between heated rollers, and its formation into single-faced corrugated board using pressure-sensitive adhesive tape as the facing. Application of a crushing force, in the direction perpendicular to the plane of the flutes, and determination of the flat crush resistance.

5 Apparatus

5.1 **Cutting device**, for cutting the test pieces to the dimensions required.

5.2 **Fluter**, consisting of a pair of matched steel corrugating rolls.

The roll temperature shall be maintained at 175 °C ± 8 °C. The temperature is controlled by any suitable method. Check the temperature when the rolls are in motion.

One roll is motor-driven at 4,5 r/min ± 1,0 r/min and the rolls are held in mesh by a force of 100 ± 10 N exerted between the rolls and distributed evenly across the teeth, under test conditions. In some instruments, the force between the rolls is applied by a spring acting in a slide. In such instruments, friction in this device can result in the force which acts upon the test piece being considerably less than the force required to displace the rolls initially. When verifying that an instrument conforms to the requirements given in 5.2, it is therefore necessary to measure the force required to just prevent the undriven roll from moving towards the driven roll, from a position about 200 µm away.

The essential characteristics of each roll are the following (see also Figure 1):

Roll diameter	228,5 mm ± 0,5 mm
Roll face width	16 mm ± 1 mm
Number of teeth	84 (see Note)
Radius of teeth at peak	1,5 mm ± 0,1 mm
Radius of teeth at base	2,0 mm ± 0,1 mm
Depth of teeth	4,75 mm ± 0,05 mm
Distance between teeth (peak to peak around the arc)	8,55 mm ± 0,05 mm

In order to optimize the matching of pairs of rolls, pairs of rolls should be selected in which the differences in dimensions between the two are substantially less than the tolerances shown. A difference of ± 0,1 mm or better is recommended. Prior to first use, the rolls should be run at the operating temperature for about 6 h with a mild abrasive on the teeth. The two rolls should then be marked in some way so that, after removal for cleaning or maintenance, they can be reassembled with exactly the same teeth in mesh.

NOTE In some fluters, a full roll is not used.

Dimensions in millimetres

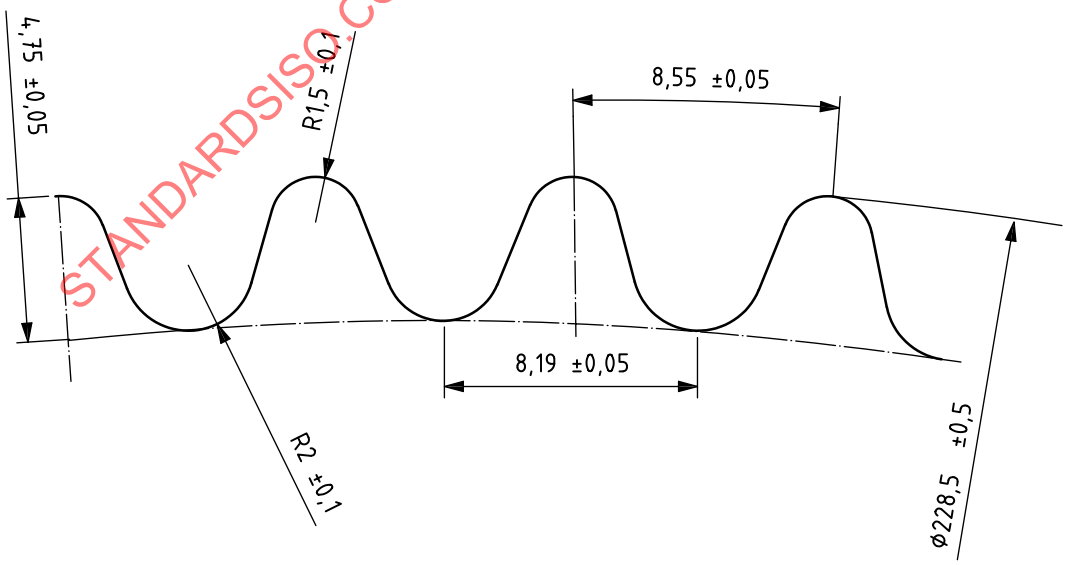


Figure 1 — Profile of corrugating rolls

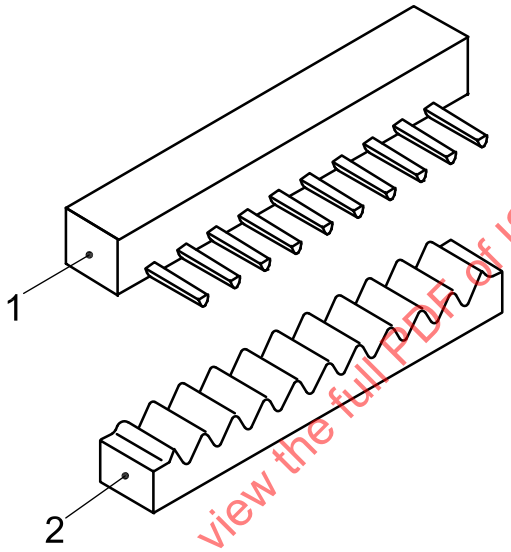
5.3 Rack and comb

5.3.1 **Rack**, at least 19 mm wide with a profile corresponding to the teeth of the corrugating rolls.

It has nine full teeth and one incomplete tooth at each end so as to form 10 valleys. The tooth spacing is 8,50 mm ± 0,05 mm and the height of the teeth is 4,75 mm ± 0,05 mm. (See 2 in Figures 2 and 3.)

5.3.2 **Comb**, at least 19 mm wide with 10 prongs, 3,4 mm ± 0,1 mm high. (See 1 in Figures 2 and 3.)

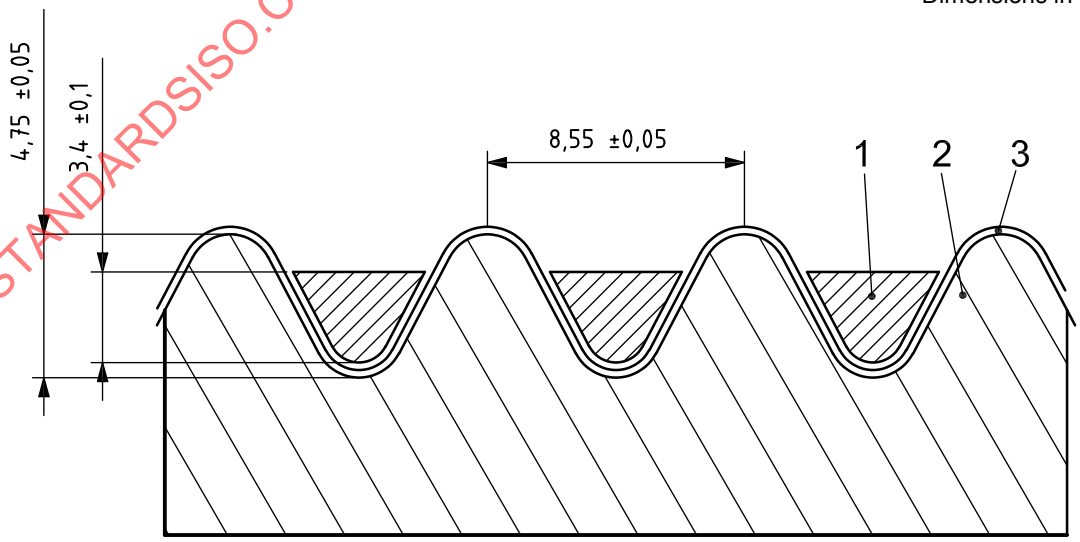
The rack (5.3.1) and comb (5.3.2) may be replaced with an automatic device, provided it can be demonstrated that this device will produce the same results.



Key
1 comb
2 rack

Figure 2 — Profile of comb and rack

Dimensions in millimetres



Key
1 comb
2 rack
3 paper

Figure 3 — Dimensions of comb and rack

5.4 Pressure-sensitive adhesive tape[1)], at least 15 mm wide.

The tape shall be of low stretch and have good adhesion properties and it shall not transfer moisture to the substrate during the test.

5.5 Flat crush tester, motor-driven, fixed platen-type in accordance with ISO 13820.

6 Sampling

If the tests are being made to evaluate a lot, the sample shall be selected in accordance with ISO 186. If the tests are made on another type of sample, make sure that the specimens taken are representative of the sample received.

7 Conditioning

When using the reconditioning procedure (see 9.3), before preparation of the test pieces, condition the sample for at least 4 h in one of the conditioning atmospheres specified in ISO 187.

8 Preparation of test pieces

Cut at least 10 test pieces having a width of 12,7 mm ± 0,1 mm and a length between 150 mm and 160 mm, the length being cut in the machine direction. Care should be taken not to damage the edges of the test pieces and they should not be handled more than is necessary.

A test piece width of 15,0 mm ± 0,1 mm may be used provided the corrugating roll width is greater than the test piece width. If a test width of 15 mm is used, the force between the corrugating rolls, as defined in 5.2, is to be adjusted to 118 N ± 10 N. The use of a 15 mm test piece width is not to be considered as being in accordance with this International Standard and its use is to be stated in the test report.

9 Procedure

9.1 General

The compression test may be carried out immediately after fluting (see 9.2) or after reconditioning (see 9.3).

9.2 Testing immediately after fluting

If the test is to be carried out immediately after fluting, the total time between discharge of the fluted test piece from the fluting rolls and the initial application of the crushing force shall be 5 s to 8 s. Arrange all equipment to facilitate completing the operations in the specified time.

For the most reliable results, the times shall be maintained within the 5 s to 8 s time limit from the discharge of the fluted test piece from the fluter to the initial application of force in the compression tester. To do this expeditiously, pre-cut the adhesive tape (5.4) that is to serve as the facing to its prescribed length (at least 120 mm long) and adhere one end of each strip lightly to the workbench.

1) 3M grade 410 tape is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.

9.3 Testing after 30 min reconditioning

If the test is to be carried out after reconditioning, the composite test piece (the fluted test piece attached to the adhesive tape) shall be reconditioned for 30 min to 35 min in the conditioning atmosphere used to condition the samples (see Clause 7). If the test is carried out on reconditioned samples, all of the composite test pieces may be formed prior to testing.

9.4 Fluting and testing

Start the motor and heat the corrugating rolls (5.2) to 175 °C ± 8 °C. Taking care that one edge is flat on the guide, feed a test piece into the corrugating rolls with its longer side perpendicular to the nip. When the corrugated test piece emerges from the fluting rolls, place it on the rack (5.3.1) so that approximately equal lengths rest on the flat surfaces at each end of the rack.

Place the comb (5.3.2) over the corrugated test piece and press down so that it is held firmly in the valleys of the rack, ensuring that the test piece is bottomed uniformly in each of the flutes.

NOTE A rolling motion of the comb as it is placed on the test piece aids in forming the test pieces on the rack.

Flatten the ends of the corrugated test piece to facilitate the further removal of the test piece from the comb, then place a strip of the adhesive tape (5.4), at least 120 mm long, adhesive side down, along the tips of the flutes and apply pressure (preferably by means of a flat rigid block) to the tape in contact with the tips of the flutes and the test piece ends. Carefully withdraw the comb from the flutes, without damage to the test piece, and lift the resulting 10-flute composite test piece out of the rack. If more than 10 flutes are formed, crush the extra flute(s) by hand prior to testing.

Care should be taken to avoid distortion of the flutes caused by applying too great a pressure when adhering the tape to the tips of the flutes.

Perform the flat crush tests either immediately or after reconditioning (in the same conditioning atmosphere used to condition the samples).

Place the composite test piece centrally on the lower platen of the crush tester (5.5) with the uncovered flutes upwards. Start the compression and read, to the nearest 5 N, the maximum force registered when completely crushing the flutes.

If the flutes have been pressed askew during the compression or if they have come away from the tape at any point, reject the results.

Repeat the procedure for the remaining test pieces until a total of at least 10 valid results have been obtained.

10 Expression of results

Calculate the mean flat crush resistance, to the nearest 5 N, from the valid results.

Calculate the standard deviation from the mean of the valid results.

To assist in the immediate identification of the results, for many purposes it may be most convenient to express results in the form

$CMT_0 = 350$ N

$CMT_{30} = 250$ N

where CMT denotes “corrugated medium test” and the subscript denotes the time, in minutes, for reconditioning.

11 Precision

Where a rigid platen tester is used and crushing commences 5 s to 8 s after the emergence from fluting, a repeatability of 5 % and a reproducibility of 11 % have been found for test results, each of which is an average of 10 determinations. These data were obtained in an interlaboratory trial among 53 laboratories using rigid platen testers[1].

Where the test specimen is conditioned before fluting and reconditioned 30 min after fluting, a repeatability of 9 % and a reproducibility of 11 % have been found for test results, each of which is an average of 10 determinations. These data were obtained in an interlaboratory trial among 14 laboratories[2].

12 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) the date and place of testing;

c) the type of tester used (see 5.5) and, where applicable, the rate of loading;

d) a description and identification of the product tested;

e) if tested after reconditioning, the conditioning atmosphere used;

f) the time, to the nearest minute, between fluting and crushing (or reconditioning after fluting);

g) the number of valid tests, the arithmetic mean and the standard deviation of all replicate test results, to the nearest 5 N;

h) details of any deviation from this International Standard, including if a test width of 15 mm has been used;

i) any other information that may assist in the interpretation of the test results.