

T 820 cm-09

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Flexural stiffness of corrugated board

1. Scope

This method is used to measure the bending resistance of corrugated fiberboard in the machine or cross machine direction with a bench-type instrument.

2. Summary

2.1 This method measures the flexural stiffness of corrugated board using a four-point beam test (Fig. 1). A specimen cut either in the machine or cross direction is placed on two supporting anvils. Two loading anvils are placed on top of the specimen. The top anvils are then successively loaded with weights of equal increments. The deflection caused by each weight is measured with a micrometer.

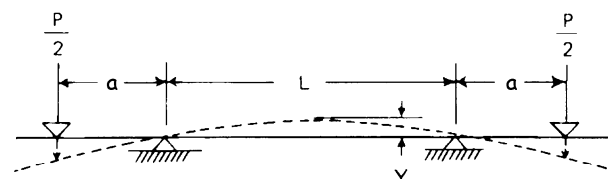


Fig. 1. Four point beam.

2.2 This method is intended to be used as a bench test. Mechanical instrumentation can be used for loading and measuring deflection.

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3. Significance

3.1 Work performed by the Institute of Paper Chemistry shows that the top-to-bottom compression strength of corrugated boxes is partly dependent on the load-carrying ability of the central panel areas. The ability of these central areas to resist bending under load will increase the stacking strength of the box. The difference in box compression strengths between boxes of identical size made from the same components but of different flute sizes (if the load is applied parallel to the flutes) is primarily due to differences in the flexural stiffness of the box panels. Flexural stiffness measurements of the combined board when used with the edge crush test can accurately predict the top-to-bottom compression strength of a box.

3.2 Flexural stiffness measurements may be of value in determining the board requirements for such uses as construction materials where rigidity is desired.

4. Apparatus

4.1 The four-point beam test can be run either manually or on automatic testing equipment. This procedure describes the apparatus for the manual test only.

4.2 The lower support assembly consists of two vertical support anvils having a 0.318-cm (1/8-in.) radius on the loading edge. The anvils should be 5.08 to 7.62 cm (2 to 3 in.) high, 5.08 cm (2 in.) wide and movable on the support base. The span should be adjustable from 5.08 to 30.48 cm (2 to 12 in.). A micrometer caliper hooked to a battery and a light is used to measure the amount of deflection of the beam under load. This micrometer caliper should be attached to the support base but made movable for centering within the span.

4.3 The upper loading assembly is constructed of lightweight metal such as magnesium. It consists of two vertical loading anvils attached perpendicular to the length of the support beam. The radius of the loading anvils is 0.318 cm (1/8 in.). The anvils should be 5.08 cm (2 in.) wide and adjustable to provide a span of 10.16 to 45.72 cm (4 to 18 in.). In the center of the support beam is mounted a platform to carry weights. It is essential that the upper loading assembly be made as light as possible without sacrificing rigidity.

5. Sampling

5.1 Select specimens of corrugated board for testing from undamaged areas. Avoid scores or other crushed areas which may affect the test results.

5.2 Cut 10 specimens 2.54 to 5.08 cm (1 to 2 in.) wide in each of the two principal directions (MD, CD). The specimen should be 5.08 cm (2 in.) longer than the length of the span on the upper assembly, so that a minimum of 2.54 cm (1 in.) will overhang the edges of the top anvils. Make all cuts accurately within ± 0.025 cm (± 0.010 in.) with a sharp knife or saw using a template or proper guide. All cuts must be parallel or perpendicular to the corrugation.

6. Conditioning

Precondition and condition the specimens in accordance with TAPPI T 402 "Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products" prior to testing.

7. Procedure

7.1 Adjust the bottom anvils on the bottom support frame to a minimum span of 10.16 cm (4 in.). Center the micrometer within the span. Adjust the loading anvils on the top assembly so that the span between the upper loading anvils is at least two times greater than the span on the lower support anvils. Center the weight platform on the upper assembly within the span.

7.2 On the underside of the test specimen (the side facing the bottom support anvils), adhere a thin strip of conducting metal (using a thin piece of pressure sensitive tape) so that it will be centered on the specimen. Next attach a wire to this metal strip and connect it to the outside terminal of a small light bulb. Connect another wire from the micrometer to the negative terminal of a flashlight battery. Complete the circuit by contacting the tip of the light bulb to the positive side of the battery.