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Edgewise compressive strength of corrugated fiberboard using the clamp method (short column test)

1. Scope

1.1 This method describes procedures for determining the edgewise compressive strength, with flutes vertical, loading perpendicular to the axis of the flutes, of a short column of single-, double-, or triple-wall corrugated fiberboard.

1.2 The method includes procedures for cutting the test specimen (saw cutting and knife cutting), one procedure for specimen support (spring support clamp fixture), and two procedures for applying the compressive force (constant strain rate, or constant load rate). Studies have shown that any combination of these procedures will yield similar test results with the stated precision (Section 9).

2. Significance

2.1 Research has shown that the edgewise compressive strength of specimens with flutes vertical, in combination with the flexural stiffness of the combined board and box dimensions, relates to the top-to-bottom compressive strength of vertically fluted corrugated fiberboard shipping containers (1,2).

2.2 This method may also be used for comparing the edgewise compressive strength of different lots of similar combined boards or for comparing different material combinations (3,4).

3. Apparatus¹

3.1 *Compression testing machine* meeting the requirements of either 3.1.1 or 3.1.2, and 3.1.3, 3.1.4, and 3.1.5.

¹ Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list, available as part of the CD or printed set of Standards, or on the TAPPI website general Standards page.

3.1.1 *Rigid Support Compression Tester.* Two platens, one rigidly supported and the other driven. Each platen shall have a working area of approximately 100 cm² (16 in.²). The platens are not to have more than 0.050 mm (0.002 in.) lateral relative movement, and the rigidly supported platen not more than 0.150 mm (0.006 in.) movement, perpendicular to the surface, within a load range of at least 0 to 2224 N (0-500 lbf). Within a 100 cm² (16 in.²) working area, each platen shall be flat within ± 0.0025 mm (± 0.0001 in.) of the mean platen surface, and the platens shall remain parallel to each other within 1 part in 2000 (.0125 mm/25 mm, .0005 in./1.00 in.) throughout the test (5).

3.1.1.1 Within a range of platen separations necessary to cause compressive failure of the test specimen, and within a load range of at least 0 to 2224 N (0-500 lbf), the speed of the driven platen shall be controllable at 12.5 ± 0.25 mm (0.50 ± 0.01 in.) per minute. (For convenience, the test machine should be capable of rapid return and automatic, settable positioning).

3.1.2 *Flexible Beam Compression Tester.* Two platens, one flexible beam supported and the other driven. Each platen shall have a working area of approximately 100 cm² (16 in.²). Within the specimen contact area, each platen shall be flat within ± 0.0025 mm (± 0.0001 in.) of the mean platen surface, and the platens shall remain parallel to each other within 1 part in 2000 throughout the test. The platens are required to have not more than 0.05 mm (0.002 in.) lateral relative movement.

3.1.2.1 Within a range of platen separations necessary to cause compressive failure of the specimen, and within a load range of at least 0 to 2224 N (0-500 lbf), the speed of the driven platen shall be controlled so that the rate of force increase (without considering specimen deformation) is 111 ± 22 N/s (25 ± 5 lbf/s) (5).

3.1.3 The driven platen shall be moveable to achieve an initial platen separation of at least 74 mm (2.9 in.).

3.1.4 The tester shall have a capacity of at least 2224 N (500 lbf).

3.1.5 The tester shall have a means for measuring and indicating the maximum load sustained by the test specimen, with an accuracy of 0.5% or better between a measured load of 440N (100 lbf) and the equipment's maximum load. Below this measured load, the accuracy shall be 2.2N (0.5 lbf) or better.

3.2 A means such as a saw or other device for cutting specimens having clean, parallel and perpendicular edges within the tolerances specified in 6.2 and 6.3. Opposite edges shall be parallel to each other and perpendicular to adjacent edges (6).

3.2.1 *Knife cutter,* single knife device with guides, or a twin-knife device with guides to cut the test pieces according to the specifications in Section 6. The knives must be sharp and arranged in the device so that it/they are at 90° to the specimen's surface.

3.2.2 *Saw,* circular, equipped with a sharp, no-set (hollow-ground or taper-ground is desirable) saw blade. The saw blade shall be 90° to the table supporting the specimen, and have the ability to consistently hold specimen size to ± 0.8 mm (± 0.03 in.).

3.3 *Test fixture* (Fig. 1) consisting of,

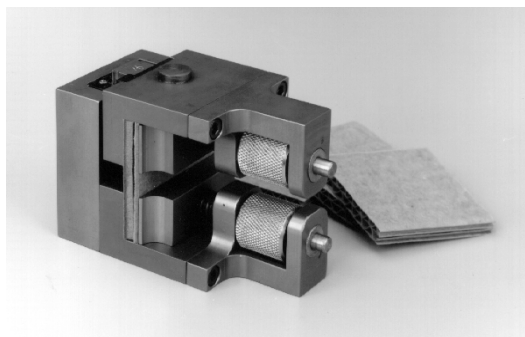


Fig. 1. Test fixtures may vary in appearance.

3.3.1 *Clamps,* upper and lower to secure the test specimen. One side of each clamp must be fixed and so aligned that the test specimen is held exactly perpendicular to the base of the fixture. The moveable side of each clamp is actuated by a spring or springs such that the test specimen is held by a uniform pressure between 27 kPa and 55 kPa (4 and 8 psi) (7). The four flat contact surfaces of the clamps must be covered with 120 – 180 grit sandpaper to prevent slippage of the specimen during testing. ("Grit" is a reference to the number of abrasive particles per 6.452cm² (1 in.²).) Each clamp side must be at least 50.8 mm (2.00 in.) wide by 19.8 mm ± 0.25 mm (0.78 in. ± 0.01 in.) tall.

3.3.2 Means to open the jaws against the spring load so as to be able to insert the test specimen (e.g., thumb screws).