

CORRUGATED BOX MANUFACTURERS' PRACTICAL STANDARDS

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Published in the interest of manufacturers and users of corrugated boxes.
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FCBM 14:96

Standard Test Method for Compression Strength of Corrugated Box



**FEDERATION OF CORRUGATED BOX
MANUFACTURERS OF INDIA**

Establishing standards for Test Procedures and Measurement of Performance Parameters of Corrugated Boards and Boxes, is a continuing process.

This booklet is yet another step forward in this direction.

Right from 1987, the R&D Committee has been continually engaged in formulating standards and publishing booklets for the benefit of the industry.

This booklet, which describes the Test Procedure for Measuring the Compression Strength of a Corrugated Box will be a useful reference book for everyone engaged in the manufacture, testing and quality control of corrugated packagings.

I congratulate the R&D Committee on its efforts.

A. B. Ajmera

President

Federation of Corrugated
Box Mfrs. of India

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FCBM STANDARD

Standard Test Method for Compression Strength of Corrugated Box

1.0 SCOPE

This test is used to measure the ability of corrugated boxes (including cartons, cases and containers as defined in para 47 of FCBM 7:91 nomenclatures) to resist external compressive loads.

These compressive loads are similar to some of those loads on corrugated boxes either in storage or in transportation.

2.0 DEFINITION

The compression strength is defined as the maximum load a corrugated box can withstand before failure (or specified deformation) under standard test conditions.

3.0 PRINCIPLE

A representative sample of corrugated box is placed between the platens of the compression tester. The sample is then compressed till failure occurs or till specified values of load/deflection are obtained.

The corrugated box may be positioned in the machine so as to test the compression strength in any desired direction, i.e., top-to-bottom, side-to-side or end-to-end.

Generally, it is desirable to test the empty corrugated box. To study the box performance where the fitments are involved, test may be conducted with all the fitments in place.

If overall performance of the corrugated box in transit and storage is required to be studied, the test may be conducted with the corrugated box duly packed with the product (content) and all fitments inside. This is important in cases where the product and the fitments share the compression load.

4.0 APPARATUS

A compression test machine includes the following :

4.1 Two parallel platens, flat to within 0.5 mm, one of which is movable in the vertical direction so as to compress the specimen between the platens. One is a load measuring platen and both are of sufficient size so that the test specimen does not extend beyond the edges of the platens. The platens should be sufficiently rigid so as to not deform at any point by more than 1 mm. The platens are fixed in the horizontal direction so as to have no lateral movement greater than 1 mm and are held parallel throughout the test such that difference in height between lowest and highest point is not more than 1 mm.

Floating or swivelling platens are not recommended. Such platens tend to seek the weakest point on the horizontal surface of the sample during deformation and thus become out of parallel with the bottom platen.

If the objective is to test the box with its contents and simulate the conditions in warehouse (godown), then floating/swivel platens are used because they tend to tilt as the top surface of the box would under deformation. However, for quality assurance data, fixed platens are recommended.

The readings from fixed platens and floating/swivel platens are likely to be different.

4.2 Means of driving, either mechanically or hydraulically, the movable platens at a uniform speed of $10.0 \text{ mm} \pm 3.0 \text{ mm}$ per minute during the test.

4.3 Means of recording or indicating the applied load to within $\pm 0.5\%$ of the scale capacity or 22 N, whichever is greater.

4.4 Means of recording or indicating the resultant deformation within $\pm 0.50 \text{ mm}$.

5.0 CALIBRATION

The rate of loading (driving movable platens) shall be checked by direct measurement of the relative movement of the platens in a measured period of time and maintained within specified limit.

The recording of load shall be checked by applying weights or with a load cell or any other appropriate method and maintained within a total tolerance range of 2%.

The recording of deflection shall be checked by direct measurement between the platens with an internal micrometer and maintained within a total tolerance range of 5%.

6.0 TEST SPECIMENS

Test at least five representative corrugated boxes for each direction required. Select only those corrugated boxes which have not been damaged by previous handling/testing.

6.1 Prepare the specimens as follows:

Square the corrugated box, bend each of the four bottom flaps backward 180 degrees on the score line until the flap touches its side of the box. Then, fold the inner flaps 270 degrees and close the box for sealing. Take proper care to see that the corrugated box is not out of square, since it will affect the load bearing ability of the specimen.

6.2 The inner flaps should be sealed (fastened) to the outer flaps by either tape or by adhesive so that the inner flaps are not free to move inside the box during the test.

6.3 Suitable adhesive tape of sufficient width should be used to seal the outer flaps as well as the edges.

6.4 When testing the filled box, its inner as well as outer flaps should be closed and sealed in the manner intended for shipment in actual practice.

7.0 CONDITIONING

7.1 A relative humidity of 65 ± 2 % and temperature of 27 ± 2 degree Centigrade will be taken as standard atmospheric condition for the purpose of testing.

7.2 A suitable room or chamber is required for conditioning samples. Specific relative humidity and temperature, as specified in 7.1 above, should be uniformly maintained throughout the chamber. Samples should preferably be suspended so that the conditioning atmosphere has free access to all its surfaces. The samples will be deemed to be conditioned when the results of two weighings, at an interval of not less than one hour, do not differ by more than 0.25 % of the total weight.

After the samples are so conditioned, they shall be touched and/or handled as little as possible and tested immediately. Moisture content of the corrugated box should be 8% or less.

8.0 PROCEDURE

8.1 Test each specimen in the conditioned environment. If this is not possible, test each specimen immediately after removing from the conditioning room.

8.2 Centre the specimen on the bottom platen. Adjust the load indicator to zero, i.e., counterbalance or compensate by adjustment for the gross weight of the specimen. Select the lowest load range of the machine compatible with the greatest anticipated load. Apply a preload to the specimen and set the deformation point to zero, or begin the deformation measurement at zero at this point. The preload ensures definite platen contact and in most instances levels off any irregularities of the corrugated box.

8.3 The initial preload is 220 N.

8.4 Apply the test load at the rate of 10 ± 3 mm per minute. Record the load applied and the deformation until the specimen fails. Take readings at each 2.5 mm deformation.

9.0 TOLERANCE

Results of the tests made on different samples from the same shipment or results of the tests made on different compression testing machines are expected to agree within 12%.

10.0 REPORT

10.1 Dimension of the corrugated box, style, flute, number of plies, grammage of paper used, flute direction, type of manufacturer's joint, inner fitments, if any.

10.2 Moisture content of sample, humidity and temperature at the time of testing.

10.3 Method of sealing the flaps.

10.4 The orientation in which the specimen was tested, i.e., top-to-bottom, side-to-side or end-to-end.

10.5 Number of specimens tested.

10.6 The highest and the lowest readings will be ignored. Arithmetic mean of the remaining test results, both compression load and deflection, shall be reported.

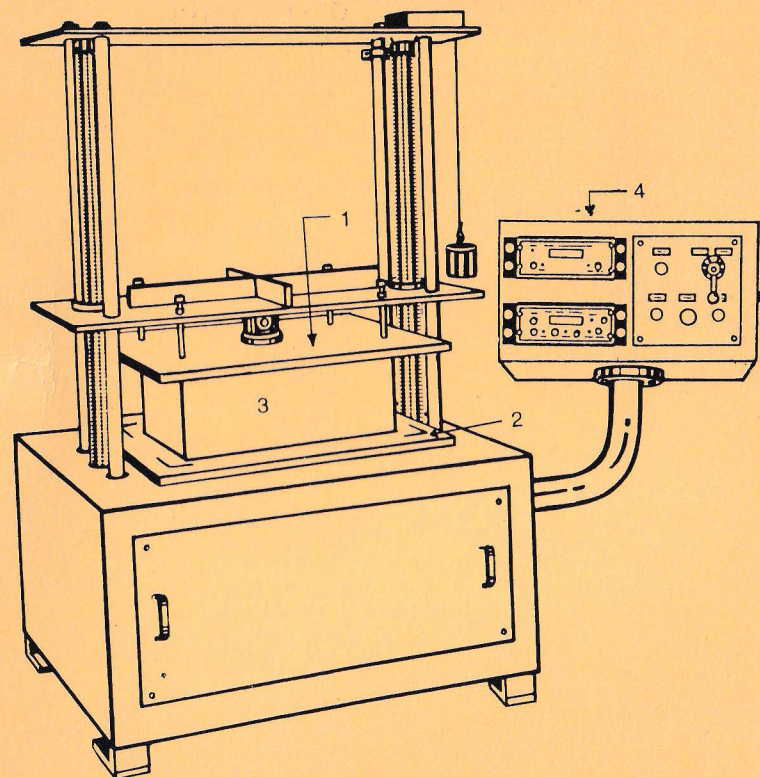
10.7 Any deviation from the test procedure.

10.8 In case, destructive test is to be avoided, the testing machine may be equipped with a limit switch which will shut the machine at a predetermined load or deflection. If the specimen has not failed at this load, then it may be reported that the specimen's compression strength exceeds the predetermined load or deflection.

11.0 LIMITATION

Due to the mostly manual nature of material handling, it is difficult to find suitable specimens free of handling damage.

BOX COMPRESSION STRENGTH TESTING MACHINE



LEGEND

1. UPPER PLATEN
2. LOWER PLATEN
3. SPECIMEN
4. CONTROL PANEL

CONVERSION TO OTHER UNITS

$$1 \text{ N} = 0.102 \text{ kg}$$

$$1 \text{ N} = 0.225 \text{ lbs}$$

$$1 \text{ kg} = 9.800 \text{ N}$$

$$1 \text{ kg} = 2.205 \text{ lbs}$$

$$1 \text{ lb} = 4.450 \text{ N}$$

$$1 \text{ lb} = 0.454 \text{ kg}$$