Tensile strength and elongation at break for fiber glass mats

(Five-year review of Official Method T 1009 om-16)
(Re-balloted due to low percentage of votes)
(No changes from previous Draft)

1. Scope

This method covers the determination of the tensile strength and elongation at break of fiber glass mats.

2. Applicable documents

2.1 TAPPI T 494 “Tensile Breaking Properties of Paper and Paperboard (Using Constant Rate of Elongation Apparatus).”

2.2 TAPPI T 1007 “Sample Location.”
3. **Summary of method**

The average tensile strength and elongation of fiber glass mat is determined by fixing the test specimen in place with a suitable clamping mechanism and then applying a smoothly increasing load until the specimen breaks.

4. **Significance**

Tensile strength and elongation are fundamental properties associated with fiber glass mats since both properties are influenced by the kind and treatment of the fiber, by the manner in which the sheet has been formed and by the binder and curing conditions employed in the mat production. Tensile strength and elongation measurements indicate the potential resistance to breaking when the fiber glass mat is subjected to stress during subsequent converting operations or in the finished product.

5. **Apparatus**

5.1 *Tensile testing machine*, having the following characteristics:

5.1.1 Two jaws, 1, 2, or 3 in. (25, 51 or 76 mm) wide, depending on test sample width, with clamping surfaces in the same plane parallel to the direction of motion of the applied stress and so aligned that they hold the test specimen in that plane throughout the test without slippage and without damage to the sample. The four faces of the jaws should be padded with a thin strip of soft gasket rubber to prevent slippage and damage to the specimen. At the start of the test, the edges of the jaws are set apart from 3 to 6 ± 0.1 in. (76 to 152 ± 2 mm) depending on the sample length for both the constant rate of strain tester and the pendulum-type tester.

5.1.2 The apparatus used to conduct this test should be one which will apply a pulling force at a constant rate of extension while measuring the force required to extend the specimen.

**NOTE 1:** This condition is fulfilled by most motor-driven tensile breaking testers, including the pendulum-type and constant rate of strain-type.

The recommended maximum rate of extension is 12 in./min (30 cm/min) for pendulum testers and 2 in./min (5 cm/min) for load cell test machines. For more accurate measurement of elongation, slower rates of extension are necessary for some materials.

5.1.3 Means of indicating elongation of the specimen at failure to within 1%.

5.1.4 Paper cutter, template or other specimen cutting device of suitable size to prepare specimens. The cutting edge of the device should produce specimens with clean, parallel edges without distorting the test specimens.
6. **Calibration**

Calibration of the instrument should be accomplished in accordance with the manufacturer’s instructions in both procedure and frequency.

7. **Test specimen**

7.1 Obtain samples in accordance with TAPPI T 1007 “Sample Location.” For each direction to be tested, collect samples across the web on a per lane basis of one sample per every 15 to 18 in. (38 to 45 cm). Cut all samples with clean, parallel edges to width 1/32 in. (0.8 mm) of that specified. Avoid abnormalities, creases, and wrinkles.

7.2 Specimen size should be specified by the end user. Typical sizes are 3 × 5 in. (7.6 × 12.7 cm), 3 × 9 in. (7.6 × 22.9 cm), 3 × 10 in. (7.6 × 25.4 cm), 3 × 12 in. (7.6 × 30.5 cm), and 2 × 10 in. (5.1 × 25.4 cm). The clamp separation should be 2 in. (5.1 cm) less that the sample length to accommodate the sample and grip width.

8. **Procedure**

8.1 Conduct all specimens testing in a conditioned environment of 77°F ± 5°F (25°C ± 3°C) and with 50 ± 5% relative humidity. Specimen should remain in conditioned atmosphere until test is run.

8.2 Clamp the specimen carefully in the top jaw, being certain that the specimen is aligned, and held securely enough so that the specimen will not slip, but not so tightly as to damage the specimen. When specimen is aligned, clamp securely in lower jaw.

8.3 Crosshead speed should be specified by the end user. Typical crosshead speeds are 2 in./min (50 mm/min) and 12 in./min (300 mm/min).

8.4 Reject readings from individual specimens if the specimen slips or breaks in or at the edge of the jaw face.

8.5 Record the results of each individual breaking force to the number of significant figures recommended by the manufacturer of the testing instrument.

8.6 Directly read or calculate the percent elongation in accordance with the procedure recommended by the manufacturer of the testing instrument, using the instrument recorder.

8.7 Calculate the average breaking force and average percent elongation for each specimen set.

9. **Report**

9.1 Report the average value of the breaking force as the tensile strength for both the machine and cross machine direction of the fiber glass mat to the nearest 0.1 lbf/3 in. (0.006 kN/m) of width, or 0.1 lbf/in. (0.02 kN/m) of width.
9.2 Report the average value of elongation for both the machine and cross machine direction of the fiber glass mat to the nearest 0.1%.

9.3 The test report should include:

9.3.1 Test instrument used.

9.3.2 Cross head or driven clamp speed.

9.3.3 Specimen size.

9.3.4 Distance between jaws at start of test.

9.3.5 Number of specimens tested in each direction.

9.3.6 Standard deviation for each specimen set tested.

10. Precision

10.1 On the basis of studies made in accordance with TAPPI T 1200 “Interlaboratory Evaluation of Test Methods” test results, each representing an average of 10 determinations from the same sample (commercial 2.0 lb / 100 ft² fiberglass mat), are expected to agree within the amounts stated below. The study included five laboratories.

10.1.1 Average machine direction tensile strength
Repeatability 20 % - 19.6 lb/3 in.
Reproducibility 21 % - 20.5 lb/3 in.

10.1.2 Average machine direction elongation 1.35%
Repeatability 14 % - 0.19 elongation %
Reproducibility 17 % - 0.23 elongation %

10.1.3 Average cross-machine direction tensile strength: 67.0 lb/3 in.
Repeatability 24 % - 16.1 lbs/3 in.
Reproducibility 25 % - 16.5 lbs/3 in.

10.1.4 Average cross-machine direction elongation 1.19%
Repeatability 16 % - 0.19 elongation %
Reproducibility 20 % - 0.20 elongation %

11. Keywords

Fiber mats, Glass fibers, Tensile strength, Elongation, Stretch
12. Additional information

12.1 Effective date of issue: To be assigned.
12.2 Referee instrument is constant rate of strain, load-cell-type.
12.3 For referee testing, laboratory conditions should be 77° ± 2°F (25° ± 1°C) and 50 ± 3% relative humidity, or other conditions mutually agreed upon by buyer and seller.
12.4 Changes in the 2015 edition included revisions to the clamping length, specimen width, sample conditioning, and crosshead speed.

*Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department.*