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An American National Standard

Standard Test Method for Tensile Breaking Strength of Perforations in One-Part Continuous Forms Paper[1]

This standard is issued under the fixed designation D 4987; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the procedure for testing the tensile breaking strength of the perforations in one-part continuous forms.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, or Related Products

D 685 Practice for Conditioning Paper and Paper Products for Testing

D 828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process

D 1968 Terminology Relating to Paper and Paper Products

3. Terminology

3.1 Definitions shall be in accordance with Terminology D 1968 and the *Dictionary of Paper*[3].

4. Summary of Test Method

4.1 ASTM test methods for tensile strength form the basis of this test. The size of test specimens may be modified to accommodate the characteristics of the material that is being tested.

5. Significance and Use

5.1 Minimum tensile strength of the perforation is important to assure that the form will not prematurely break apart during the printing, converting, and forms handling operation.

5.2 Where the various parts are detached for further processing maximum tensile strength of the perforation is important in the various operations to which the form is subjected.

6. Interferences

6.1 Avoid manipulation by folding and refolding a perforation since this will cause weakening of the ties in the perforation. The folded specimen should not be unfolded until just prior to testing.

6.2 To avoid placing uneven stress on the perforation, exercise extreme care in placing the test piece in the jaws of the tensile tester to be sure that the strip is not skewed. Uneven stress results in a“ tear’’ effect rather than the “tensile’’ effect.

7. Apparatus

7.1 *Tensile Tester*— Testing machines meeting the requirements of Test Method D 828.

NOTE 1—Test Method D 828 describes the apparatus and calibration of the instrument to be used for conducting tests described in this test method. The sampling, test specimen, and procedure portions of the test should follow the instructions given in this test method.

7.2 *Specimen Cutter*— A device for cutting test specimens with clean and parallel edges to a width of 25.4 ± 1 mm (1± 0.04 in.).

8. Sampling

8.1 For acceptance sampling, obtain the sample in accordance with Practice D 585.

8.2 When sampling for other purposes, use Practice E 122 as an alternative.

8.3 From the material obtained in 8.1 or 8.2, select sufficient test units of each sample to meet the requirements of 8.5 and 8.6 as follows:

[1] This test method is under the jurisdiction of ASTM Committee D06 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.92 on Test Methods.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard’s Document Summary page on the ASTM website.

[3] Available from the Technical Association of the Pulp and Paper Industry, P.O. Box 105113, Atlanta, GA 30348.

8.3.1 *Folded perforations*—Take consecutive duplicate samples of the perforation folded so that the front printing is not visible (infold perforation) and consecutive duplicate samples so that the front printing is visible (outfold perforation).

8.3.2 *Unfolded perforations perpendicular to the machine or web direction*—Take duplicate samples of each perforation between consecutive "infold'' perforations.

8.3.3 *Unfolded perforations parallel to the machine or web direction*—Take duplicate samples of each perforation, the length of which should be the distance between two consecutive" infold'' perforations.

8.4 In preparing test specimens for the folded perforation, cut the specimen without unfolding the perforation.

8.5 On the folded or horizontal perforations, select ten test specimens or enough to represent 50 % of the width from a full perforation from each of the duplicate samples.

8.6 For vertical perforations, select ten test specimens or enough to represent 50 % of the length from each of the duplicate samples.

8.6.1 The 50 % provision is intended to address perforations that are shorter than 10 in. In the case of short perforations, test no less than five specimens, using additional samples if necessary.

8.7 When cutting the test specimens, make certain that the edges are cut clean and parallel. Make certain that the perforations are perpendicular to the edge of the specimen. Avoid abnormalities, watermarks, creases, and wrinkles. Cut test specimens one at a time.

8.8 Test Method D 828 specifies specimen length. The length may be modified to adapt to the size of the specimen available. There must be sufficient length to allow the test specimen to be manipulated as it is placed in the jaws. The length is not important since the failure will occur at the perforation.

8.9 When cutting specimens, avoid non-uniform areas designed into the perforation. These may appear as unusually large uncut areas intended to protect areas sensitive to breakage.

8.10 The tensile breaking strength of a 1-in. specimen will depend upon the number of ties (uncut areas) left unruptured. The variation from specimen to specimen in the number of ties will be one tie. Thus, if the perforation cut were to have ten ties per inch, some specimens would have ten ties, others nine. Thus, the variation alone would account for a specimen to specimen tensile variation of approximately 10 %. This variation increases as the ties per inch of a perforation cut decreases. If perforation cuts under eight per inch are to be tested, cut the specimen so that equal numbers of the *n* per inch and (*n*-1) per inch are present in the sample.

9. Preparation of Apparatus

9.1 Prepare the apparatus following instructions given in Test Method D 828.

10. Conditioning

10.1 Condition and test the test specimens at the conditions specified in Practice D 685.

11. Procedure

11.1 Avoid touching the perforation. Tightly clamp one end of the test piece in the upper jaw after placing it loosely in the lower jaw and checking its alignment. Then tightly clamp the lower end of the piece and apply the load.

11.2 When testing the folded perforation, allow the specimen to straighten out just once prior to clamping in the jaw and testing.

11.3 Adjust the tester so that the average time for testing a perforated specimen will be within 10 ± 5 s. Determine time to break by testing two or three extra specimens.

11.4 Reject readings from individual specimens if it is apparent that the sample is skewed. Reject readings from individual specimens if the specimen does not "snap'' open breaking.

11.5 Record the result of each individual breaking load to the nearest three significant figures.

11.6 Compute the average breaking strength of the specimens of each perforation.

12. Report

12.1 Report the following information:

12.1.1 The breaking strength of the individual specimen, the average for each sample, and the average of the duplicates,

12.1.2 The position from which the samples were obtained, that is, at the fold, or internal vertical or horizontal, and

12.1.3 The test method and type of testing machine used.

13. Precision and Bias

13.1 The precision and bias for this test method for measuring tensile breaking strength of perforations in one part continuous form paper are essentially as specified in Test Method D 828.

13.2 The variability of results may actually be greater than that implied by 13.1, as variations in perforations caused by perforating wheels, knives, and other perforation production machinery, as well as varing numbers of unruptured ties in the test specimen all increase variability in measured data.

14. Keywords

14.1 continuous forms; paper; tensile breaking strength