

# Bond Strength of Bonded and Laminated Fabrics

Developed in 1972 by AATCC Committee RA79; editorially revised and reaffirmed 1980, 1985, 1995; editorially revised 1988, 1990, 1997; reaffirmed 1989; revised 2003.

## 1. Purpose and Scope

1.1 This test method provides a procedure for characterizing bond strength of bonded and laminated fabrics. Bond strength tests can be made on the fabric as bonded or laminated or after a specified number of drycleaning and/or laundering cycles.

## 2. Principle

2.1 Bond strength tests can be made on the fabric as bonded or laminated and subsequently drycleaned, or laundered and dried, or both, through a prescribed cycle that is repeated a specified number of times. The drycleaned or washed specimens are tested to determine the strength of the bond.

## 3. Terminology

3.1 **bond strength**, *n.*—*in bonded and laminated fabrics*, the tensile force expressed in g/cm (oz/in.) of width required to separate the component layers under specified conditions.

3.2 **bonded fabric**, *n.*—a layered fabric structure wherein a face or shell fabric is joined to a backing fabric with an adhesive that does not significantly add to the thickness of the combined fabrics.

NOTE 1: In this context, a thin layer of foam is considered an adhesive when the cell structure is completely collapsed by a flame.

NOTE 2: Normally, but not always, the backing fabric may be tricot or non-woven.

3.3 **foam tear**, *n.*—*in laminated fabrics*, a condition wherein the foam portion of the fabric ruptures prior to the failure of the bond.

3.4 **laminated fabric**, *n.*—a layered fabric structure wherein a face or outer fabric is joined to a continuous sheet material in such a way that the identity of the continuous sheet material is retained.

NOTE 1: Either the flame or adhesive method of laminating can be used.

NOTE 2: Normally, but not always, the sheet material is joined to a backing fabric.

NOTE 3: Normally, but not always, the backing fabric may be tricot or non-

woven, and the sheet material may be polyurethane.

3.5 **lot**, *n.*—*in bonded or laminated fabric*, a single run on the bonding or laminating machine in which the processing is carried out without stopping or changing processing conditions and consisting of either a single dye lot or a single greige goods lot.

## 4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedure and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practice should be followed. Wear safety glasses in all laboratory areas.

4.2 All chemicals should be handled with care.

4.3 Perchloroethylene is toxic by inhalation, by repeated contact with the skin and by ingestion; it should be used only in a well-vented atmosphere. Toxicology studies with laboratory animals have shown evidence of cancer in rats and mice exposed to perchloroethylene vapors at 100-400 ppm concentrations for prolonged times. Fabric saturated with this solvent should be dried in an adequately ventilated hood. Use chemical goggles or face shield, impervious gloves and an impervious apron when handling perchloroethylene.

4.4 An eyewash/safety shower should be located nearby and an organic vapor respirator should be readily available for emergency use.

4.5 The drycleaning apparatus should be ventilated to the outside atmosphere in accordance with the manufacturers instructions.

4.6 Manufacturer's safety recommendations should be followed when operating laboratory testing equipment.

4.7 Exposure to chemicals used in this procedure must be controlled at or below levels set by governmental authorities (e.g., Occupational Safety and Health Administration's [OSHA] permissible exposure limits [PEL] as found in 29 CFR 1910.1000 of January 1, 1989). In addition, the American Conference of

Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) comprised of time weighted averages (TLV-TWA), short term exposure limits (TLV-STEL) and ceiling limits (TLV-C) are recommended as a general guide for air contaminant exposure which should be met (see 14.1).

## 5. Uses and Limitations

5.1 This test method is used to estimate the durability and strength of the bond that may be expected when the garments made from bonded and laminated fabrics are laundered or drycleaned.

## 6. Apparatus and Materials

6.1 Drycleaning machine, single-unit, coin-operated type, capable of providing a complete automatic dry-to-dry cycle using perchloroethylene (see 14.7). Reference AATCC Method 158, Dimensional Changes on Drycleaning in Perchloroethylene: Machine Method.

6.2 Drycleaning tester, stainless steel cylinder which rotates on an axis 50' off center (see 14.3).

6.3 Domestic automatic washer, top loading, spin-extracting type (see 14.4).

6.4 Domestic automatic tumble dryer, front loading type (see 14.4).

6.5 Press, flat bed, steam, a flat bed press, approximately 60 × 127 cm (24 × 50 in.), or larger, provided with 413-482 kPa (60-70 psig) steam pressure at the press. Any flat bed press large enough for pressing a specimen 38 cm (15 in.) square may be used (see 14.5).

6.6 Tensile testing machine, constant rate of traverse type or constant rate of extension type, equipped with 76 mm (3 in.) clamps and preferably calibrated in kilograms and conforming to ASTM D 76, Standard Specification for Tensile Testing Machines for Textiles (see 14.6 and 14.7).

6.7 Detergent, home laundry type (see 14.8).

6.8 Perchloroethylene, commercial grade (see 4.3).

6.9 Drycleaning detergent (see 14.9), petroleum sulfonate type.

6.10 Templates, 25 × 152 mm (1 × 6 in.) or 76 × 152 mm (3 × 6 in.).

## 7. Selection and Number of Samples

7.1 In the absence of any applicable material specifications, take at random one 1 m long (1.1 yd long), full width sample from each lot to be tested. If the

lot consists of more than two pieces, take the samples from other than the first or last piece. If the lot consists of two pieces, take samples from each piece, adjacent to the place where the two pieces are joined. In any case, do not take samples closer than approximately 0.5 m (19.7 in.) from either end each piece.

7.2 If the fabric sample is of such size not permitting full lot sampling, other sampling procedures may be used.

## 8. Conditioning

8.1 Samples from which specimens are to be taken to determine dry bond strength are conditioned for at least 4 h in the standard atmosphere for testing textiles as described in ASTM D 1776, Standard Practice for Conditioning and Testing Textiles (see 14.7).

## 9. Preparation and Number of Test Specimens

### 9.1 Test Conditions.

9.1.1 Bond strength tests may be made on the fabric as bonded or laminated, or after a specified number of drycleaning cycles or after a specified number of laundering cycles. These tests also may be made on dry specimens (conditioned in the standard atmosphere for testing textile for a minimum of 4 h), or on wet specimens, saturated with water at room temperature following laundering.

### 9.2 Laundering and Drycleaning Specimens.

9.2.1 From each sample cut four specimens, two located approximately one-third the distance of the width of the fabric from one side and two located approximately one-third the distance of the width of the fabric from the other side, each specimen 38 × 38 cm (15 × 15 in.). Use a specimen from each side of the fabric for drycleaning and a specimen from each side of the fabric for laundering.

### 9.3 Bond Strength Test Specimens.

9.3.1 Prepare three test specimens, each measuring either 25 mm (1 in.) wide, and 152 mm (6 in.) long or 76 mm (3 in.) wide, and 152 mm (6 in.) long, the length of the specimens corresponding to the length direction of the fabric for each condition to be tested. Do not take the test specimens closer to the selvege than the distance equal to 20% of the fabric width.

## 10. Drycleaning and Laundering

### 10.1 Procedure for Drycleaning.

10.1.1 Coin-operated type machine. Follow procedure described in ASTM D 2724, Standard Test Method for Bonded, Fused and Laminated Apparel Fabrics, for the required number of cycles (see 14.7).

10.1.2 Drycleaning Cylinder. Follow

procedure described in AATCC Method 158 for the required number of cycles.

10.2 Procedure for Laundering. Follow procedure described in AATCC Method 124, Appearance of Fabrics after Repeated Home Laundering, for the required number of cycles.

## 11. Strength of Bond

11.1 Test Conditions. Bond strength tests may be made on the fabric as bonded or laminated, or after the specified number of drycleaning or laundering cycles. These tests also may be made on dry specimens (conditioned in the standard atmosphere for testing textiles for a minimum of 4 h), or on wet specimens saturated with water at room temperature following the laundering tests (see Section 4).

11.1.1 An optional procedure would be to test washed but undried specimens.

### 11.2 Procedure for Bonded Fabrics.

11.2.1 Manually separate the two layers of fabric along the narrow width of each test specimen for a distance approximately 25 mm (1 in.) in the direction of the specimen length.

11.2.2 Set the lower clamp at a distance of 25 mm (1 in.) from the upper clamp of the tensile testing machine in such a way that the longitudinal axis of the specimen forms a right angle with the closed clamping surface. Secure the separated backing fabric in the center of the lower clamp of the machine in such a way that the longitudinal axis of the specimen forms a right angle with the closed jaws of the lower clamp.

11.2.3 If the indicating scale in the machine is provided with a pawl and ratchet mechanism, disengage the mechanism to permit readings of variable force when the machine is placed in operation.

11.2.4 Operate the constant rate-of-traverse machine at a pulling speed of  $305 \pm 13.0$  mm/min ( $12 \pm 0.5$  in./min).

11.2.5 Operate the constant rate-of-extension machine per procedure described in ASTM D 76.

11.2.6 Record the average bond strength in grams per 25 mm (ounces per 1 in.) registered for 102 mm (4 in.) of delamination from direct readout instruments. Determine the average of at least the five highest and the five lowest peak loads of resistance per 25 mm (1 in.), registered for 102 mm (4 in.) of delamination when reading peel strength from a chart recorder.

11.2.7 Repeat the operations described in 11.2.1-11.2.6 for each of the remaining test specimens.

11.2.8 Report the bond strength in g/cm (oz/in.) as the average strength of the three test specimens.

11.3 Procedure for Laminated Fabrics, Foam.

11.3.1 Manually separate the face fabric from the foam along the narrow width of each test specimen for a distance of approximately 25 mm (1 in.) in the direction of the specimen length.

11.3.2 Set the lower clamp at a distance of 25 mm (1 in.) from the upper clamp. Secure the separated face fabric of a test specimen in the upper clamp of the tensile testing machine in such a way that the longitudinal axis of the specimen forms a right angle with the closed clamping surface. Secure the separated foam or foam and backing fabric in the center of the lower clamp of the machine in such a way that the longitudinal axis of the specimen forms a right angle with the closed jaws of the lower clamp.

11.3.3 Proceed as instructed in 11.2.3-11.2.8.

11.3.4 If foam is laminated to a backing fabric, retain each test specimen from 11.3.3 after the bond strength has been determined for face to foam. Manually separate the backing fabric from the foam as instructed in 11.3.1 except that the manual separation should be made at the opposite end of the test specimen separated for the face fabric-to-foam test.

11.3.5 Set the lower clamps at a distance of 25 mm (1 in.) from the upper clamp. Secure the separated foam or foam and face fabric of a test specimen in the upper clamp of the tensile testing machine in such a way that the longitudinal axis of the specimen forms a right angle with the closed clamping surface. Secure the separated backing fabric in the lower clamp of the machine in such a way that the longitudinal axis of the specimen forms a right angle with the closed jaws of the lower clamp.

11.3.6 Proceed as instructed in 11.2.3-11.2.8.

11.3.7 Examine both sides of the foam on the test specimens after testing for bond strength. Determine whether the foam portion ruptured during peeling allowing any foam to adhere to either fabric surface. If this has occurred, make the notation "foam tear" for that test specimen for the side or sides where foam tear occurred. If foam tear occurs only on one side of one test specimen, disregard this result and report the average bond strength for that side of the remaining two specimens. If foam tear occurs on the same side of two or three specimens, report the bond strength for that side as foam tear.

11.3.8 In the event it is impossible to separate manually the foam from either the face or the backing fabric as instructed in 11.3.1 and 11.3.4 without rupturing the foam, report the bond strength for the side or sides where this occurred as foam tear.