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Standard Test Methods for Bonded, Fused, and Laminated Apparel Fabrics[1]

This standard is issued under the fixed designation D 2724; 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 These test methods cover procedures for characterizing the delamination, strength of bond, appearance, and shrinkage propensity of bonded, fused, and laminated apparel fabrics after drycleaning and laundering.

1.2 The values stated in SI units are to be regarded as standard; the values in parentheses are provided as information only.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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:*

D 76 Specification for Tensile Testing Machines for Textiles[2]

D 123 Terminology Relating to Textiles[2]

E 337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)[3]

2.2 *AATCC Standard:*

124 Appearance of Durable Press Fabrics After Repeated Home Launderings[4]

2.3 *Federal Trade Commission Trade Regulation Rule:*

16 CFR 423 Care Labeling of Textile Wearing Apparel and Certain Piece Goods[5]

3. Terminology

3.1 *blister, n—in bonded, fused, or laminated fabrics,* a bulge, swelling, or similar surface condition on either the face fabric or the backing fabric characterized by the fabric being raised from the plane of the underlying component over a limited area to give a puffy appearance.

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

3.2.1 *Discussion*—In this context a thin layer of foam is considered an adhesive when the cell structure is completely collapsed by a flame.

3.3 *bond strength, n— of bonded, fused, or laminated fabrics,* the tensile force expressed in ounces per 25 mm (1 in.) of width, required to separate the component layers under specified conditions.

3.4 *bubble*—See preferred term *blister*.

3.5 *crack mark, n—in bonded, fused, or laminated fabrics,* a sharp break or crease in the surface contour of either the face fabric or the backing fabric that becomes evident when the bonded, fused, or laminated composite is rolled, bent, draped, or folded.

3.5.1 *Discussion*—Crack marks are usually the result of combining tight fabric constructions at least one of which does not have sufficient residual stretch to allow the combined fabrics to be bent in an arc without producing crack marks on the concave side of the arc. Crack marks also occur when bonded fabrics are allowed to remain in a creased or wrinkled state before full adhesive cure has taken place. Other causes include the use of excessive adhesive in bonding, or excessive foam thicknesses and excessive foam collapse in flame lamination.

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

3.7 *fused fabric, n*—a type of bonded fabric made by adhering a fusible fabric to another fabric, such as for use as an interlining.

3.8 *fusible fabric, n*—a utilitarian fabric which has a thermoplastic adhesive applied to one side, sometimes in a pattern of dots, so that the surface can be bonded to another fabric surface by the use of heat and pressure.

3.9 *interlining, n*—any textile which is intended for incorporation into an article of wearing apparel as a layer between an outer shell and an inner lining.

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[1] These test methods are under the jurisdiction of ASTM Committee D13 on Textiles, and are the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.

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[2] *Annual Book of ASTM Standards*, Vol 07.01.

[3] *Annual Book of ASTM Standards*, Vol 11.03.

[4] Available from American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

[5] As amended effective January 2, 1984, Section A236, available from U.S. Government Printing Office, North Capital and H Streets NW, Washington DC, 20401.

3.10 *laminated fabric, n*—a layered fabric structure wherein a face or outer fabric is joined to a continuous sheet material, such as polyurethane foam, in such a way that the identity of the continuous sheet material is retained, either by the flame method or by an adhesive, and this in turn normally but not always, is joined on the back with a backing fabric such as tricot.

3.11 *lot, n—in bonded, fused, 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 gray goods lot.

3.12 *puckering, n— in bonded, fused, or laminated fabrics,* a wavy, three-dimensional effect typified by closely spaced wrinkles, on either the face fabric or the backing fabric or both.

3.12.1 *Discussion*—Puckering may be due to (*1*) differential shrinkage of the component layers, (*2*) differences in tension when the component layers are combined, or (*3*) selective lineal delamination.

3.13 *solvent relative humidity, n*—the humidity of air over a drycleaning bath and in equilibrium with the solvent and its small amount of water.

3.13.1 *Discussion*—Every drycleaning solvent bath containing detergent can require a different absolute water content to reach the Federal Trade Commission (FTC) specified level of solvent relative humidity for a normal drycleaning. The actual solvent relative humidity in the air over a solvent must be measured by an hygrometer after equilibrium has been reached between the water content of air and the solvent.

3.14 For definitions of other textile terms used in this test method, refer to Terminology D 123D 123.

4. Summary of Test Methods

4.1 Bench marks are placed at specified distances on the fabrics, which are then measured, 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 examined for appearance and delamination and measured to determine any accompanying shrinkage and, if desired, tested to determine the strength of the bond.

5. Uses and Significance

5.1 These test methods for the determination of properties of bonded, fused, or laminated apparel fabrics, are considered satisfactory for acceptance testing of commercial shipments of bonded and laminated apparel fabrics since the methods have been used extensively in the trade for acceptance testing.

5.1.1 In case of a dispute arising from differences in reported test results when using Test Methods D 2724 for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before the testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in the light of the known bias.

6. Apparatus and Materials

6.1 *Drycleaning Machine,*[6] single-unit, coin-operated type, capable of providing a complete automatic dry-to-dry cycle using perchlorethylene. It shall consist of a commercial rotating cage type, totally enclosed machine. The diameter of the rotating cage shall be not less than 600 mm (24 in.) and not more than 1080 mm (42 in.). Its depth shall be not less than 300 mm (12 in.). It shall be fitted with two to four lifters. The speed shall be such as to give a *g*-factor between 0.5 and 0.9 for cleaning and between 35 and 120 for extraction. The machine shall be equipped with thermometers for the measurement of the solvent temperature and the air drying temperature.

NOTE 1—The *g*-factor is calculated using Eq 1 or Eq 2:

$$g = 1.42n^2D/100\ 000 \quad (1)$$

$$g = 5.59n^2d/10\ 000\ 000 \quad (2)$$

where:
n = revolutions per minute,
D = cage diameter, in., and
d = cage diameter, mm.

6.2 *Domestic Automatic Washer,*[7] top-loading, spin-extracting type.

6.3 *Domestic Automatic Tumble Dryer,*[7] front-loading type.

6.4 *Aspirated Psychrometer*, which meets the requirements of Test Method E 337E 337.

6.5 *Marking Device*[8]—A thin sheet of stainless steel or other rigid flat material in which a square opening 254 by 254 mm (10 by 10 in.) has been cut.

6.6 *Rule*, 305-mm (12-in.) or longer, preferably divided into tenths of an inch. A premarked device calibrated to give the percentage of shrinkage or growth may also be used.

6.7 *Sewing Machine*, suitable for sewing a single row of stitching, preferably with No. 00 mercerized cotton thread, 25 mm (1 in.) from the edge of the fabric specimen.

6.8 *Steam Iron*, hand type.

6.9 *Steam Press,*[9] a press, 600 by 1250 mm (24 by 50 in.), or larger, provided with 60 to 70 psig steam pressure at the press. Any steam press large enough for pressing a specimen 380 mm (15 in.) square may be used.

[6] Sources of suitable equipment are: McGraw-Edison Co., Speed Queen Div., Ripon, Wis.; Philco-Bendix Corp., Fairfield, IO; American Permac, Inc., 175 Express St., Plainview, L. I.; Valley Industries Productions, Inc., 133 E. Jericho Turnpike, Mineola, NY; and Atlas Electric Devices, Chicago, IL.

[7] Kenmore Model 600 washer and dryer, available from Sears Roebuck and Co., are satisfactory for this purpose.

[8] Other suitable devices are available from Better Fabrics Testing Bureau, Inc., 101 W. 31 St., New York, NY, and from Cluett, Peabody and Co., Inc., Sanforized Div., Troy, NY.

[9] Sources of suitable equipment are: Hoffman Machine Co., Syracuse, NY; Pentax Co., Pawtucket, R. I.; Prosperity Co., Syracuse, NY; U. S. Testing Co., Hoboken, NJ.

6.10 *Tensile Testing Machine*, conforming to Specification D 76D 76, either a constant rate of traverse type[10] or a constant rate of extension type, equipped with clamps having a width of 76.2 mm (3.00 in.) and preferably calibrated in kilograms with a range from 0 to 4.5 kg (0 to 160 oz). The constant rate of extension type machine is preferred because of the inherently lower machine-induced errors in this type of machine.

6.11 *Detergent*, home laundry type.

6.12 *Perchlorethylene*, commercial grade.

NOTE 2—**Warning:** Perchlorethylene is toxic, and the usual precautions for handling chlorinated solvents should be taken. It should be used only under well-ventilated conditions. The solvent is nonflammable.

6.13 *Drycleaning Detergent,*[11] anionic drycleaning detergent.

7. Sampling

7.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider rolls of fabric to be the primary sampling units.

NOTE 3—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between rolls of fabric and between specimens from a swatch from a roll of fabric so as to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

7.2 *Laboratory Sample*—As a laboratory sample for acceptance testing, take a full width swatch 1 m (1 yd) long from the end of each roll of fabric in the lot sample, after first discarding a minimum of 1 m (1 yd) of fabric from the very outside of the roll.

7.3 *Test Specimens*—Proceed as follows:

7.3.1 *Drycleaning and Laundering*—Cut four specimens from each swatch in the laboratory sample with each specimen being 380 by 380 mm (15 by 15 in.) in size, with the one side of the specimens from a single swatch parallel to the selvage. Locate two of the specimens from each swatch about ⅓ of the distance from one selvage and locate the other two specimens from each swatch about ⅓ of the distance from the other selvage. Locate each of the two specimens from one side of the swatch along a diagonal line on the swatch so that they will contain different warp ends and filling picks. Sew a straight line of stitching around each specimen 25 mm (1 in.) from each edge. Reserve the rest of the swatch for comparison with the drycleaned and laundered test specimens.

7.3.2 *Strength of Bond*—Prepare three test specimens, each measuring 76 mm (3 in.) wide, and 152 mm (6 in.) long, the length of the specimens corresponding to the length direction of the fabric. Do not take the test specimens closer to the selvage than a distance equal to 20 % of the fabric width.

NOTE 4—Samples that are 51 mm (2 in.) wide may be used as the minimum width.

[10] Model X-5, available from Edward H. Benz Co., 283 Whiteford Ave., Providence, RI 02908, has been found satisfactory.

[11] Formula 886, petroleum sulfonate type or staticol, amine sulforate type, available from R. R. Street, Inc., 561 W. Monroe St., Chicago, IL; or Perksheen 324, amine sulfonate type, available from Adco, Inc., 900 W. Main St., Sedalia, MO, have been found suitable for this purpose.

8. Conditioning

8.1 Bring the samples from the prevailing atmosphere and condition them for at least 4 h in the standard atmosphere for testing textiles if shrinkage is to be determined. Preconditioning is not necessary.

9. Specimen Preparation

9.1 Using an indelible fineline marker, mark a 254 by 254 mm (10 by 10 in.) reference square centrally located on the face of each test specimen. Apply three sets of reference markings 254 ± 2 mm (10 ± 0.1 in.) apart, as measured with a rule, in the direction of the fabric length. Locate the markings within 25 mm (1 in.) of each end and at the midpoint of each side of the square. Similarly, apply three sets of markings in the direction of the fabric width. Any other method of accurately locating the 254-mm reference marks is satisfactory as long as the three marks on each side of the square are at least 105 mm (4 in.) apart.

10. Drycleaning Procedure

NOTE 5—Launderable fabrics are expected normally to be drycleanable, except where the face fabric is not drycleanable and is so labeled. For example, the fabric could contain a functional finish soluble in the solvent, or the fiber could be degraded by the solvent, which would be the case with poly(vinyl chloride) fiber.

10.1 *Solvent Preparation*—Prepare a standard detergent/drycleaning solvent mixture by adding sufficient detergent to the solvent to make a 1 % volume/volume solution. Add sufficient water to the solution to give a solvent relative humidity level of 75 % for the particular drycleaning detergent used. Put this solvent in the machine storage tank. The same solution can be used for repeated cleanings until it becomes dirty and needs replacing as long as the necessary water additions to maintain the solvent relative humidity constant are made prior to each test run. This is so because the specimens being run could conceivably alter the solvent relative humidity for succeeding test runs while the detergent level would remain constant.

10.2 *Sample and Dummy Load Preparation*— Prepare a load consisting of all specimens to be tested and made up to 3.6 kg (8 lb) total with dummy load of approximately 380 by 380-mm (15 by 15-in.) fabric pieces of similar material. Condition this load at least 4 h in the standard atmosphere for testing textiles. After the drycleaning operation, condition the load again before running through each additional drycleaning cycle. Conditioning before each drycleaning cycle is intended to minimize depletion of water from the drycleaning solution specified in 10.1.1 which may affect shrinkage results.

10.3 *Drycleaning Procedure*—Run through the complete dry-to-dry cycle in the machine. Run the solvent phase of the drycleaning cycle with the solvent no higher than 32°C (90°F). During the drying phase of the drycleaning cycle, either the air outlet temperature should not exceed 60°C (140°F) or the inlet air temperature should not exceed 80°C (175°F). If heat-sensitive fibers, for example, modacrylic fibers, are involved, the outlet air temperature should not exceed 40°C (105°F) or the inlet air temperature should not exceed 60°C (140°F). After the complete drycleaning cycle, remove the sample from machine for examination and reconditioning.