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## Standard Performance Specification for Men's and Boys' Knitted and Woven Beachwear and Sports Shirt Fabrics<sup>1</sup>

This standard is issued under the fixed designation D 4154; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This performance specification covers knitted and woven fabrics comprised of any textile fiber or mixture of fibers used in men's and boy's beachwear and sports shirts.

1.2 This performance specification is not applicable to knitted and woven fabrics used for interlining and swimwear.

1.3 These requirements apply to both the length and width directions for those properties where fabric direction is pertinent.

1.4 *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:*

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<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.561 on Performance Standards for Textile Fabrics—Apparel.

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- D 123 Terminology Relating to Textiles<sup>2</sup>
- D 434 Test Method for Resistance to Slippage of Yarns in Woven Fabrics Using a Standard Seam<sup>2</sup>
- D 1424 Test Method for Tear Resistance of Woven Fabrics by Falling-Pendulum Type (Elmendorf) Apparatus<sup>2</sup>
- D 2262 Test Method for Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant Rate-of-Travel Tensile Testing Machine)<sup>3</sup>
- D 2594 Test Methods for Stretch Properties of Knitted Fabrics Having Low Power<sup>2</sup>
- D 2724 Test Methods for Bonded, Fused, and Laminated Apparel Fabrics<sup>2</sup>
- D 2905 Practice for Statements on Number of Specimens for Textiles<sup>2</sup>
- D 3786 Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics—; Diaphragm Bursting Strength Tester Method<sup>4</sup>
- D 3787 Test Method for Bursting Strength of Knitted Goods—; Constant-Rate-of-Travel (CRT) Ball Burst Test<sup>4</sup>
- D 5034 Test Method for Breaking Force, Strength and Elongation of Textile Fabrics (Grab Test)<sup>5</sup>
- 2.2 *AATCC Test Methods:*<sup>6</sup>
  - 8 Colorfastness to Crocking: AATCC Crockmeter Method
  - 15 Colorfastness to Perspiration
  - 16 Colorfastness to Light
  - 23 Colorfastness to Burnt Gas Fumes
  - 61 Colorfastness to Washing, Domestic, and Laundering, Commercial: Accelerated
  - 96 Dimensional Changes in Laundering of Woven and Knitted Textiles Except Wool
  - 116 Colorfastness to Crocking: Rotary Vertical Crockmeter Method
  - 124 Appearance of Durable Press Fabrics After Repeated Home Launderings
  - 132 Colorfastness to Drycleaning
  - 135 Dimensional Changes in Automatic Home Launderings of Durable Press Woven of Knit Fabrics
  - 172 Colorfastness to Non-chlorine Bleach in Home Laundering
  - 188 Colorfastness to Chlorine Bleach in Home Laundering
- Evaluation Procedure 1 Gray Scale for Color Change
- Evaluation Procedure 2 Gray Scale for Staining
- Evaluation Procedure 3 AATCC Chromatic Transference Scale
- 2.3 *Federal Standard:*<sup>7</sup>
  - 16 CFR, Chapter II—Consumer Product Safety Commission Subchapter D—Flammable Fabrics Act Regulations.
- 2.4 *Military Standard:*<sup>8</sup>
  - MIL-STD-105D Sampling Procedures and Tables for Inspection by Attributes

NOTE 1—Reference to test methods in this specification give only the permanent part of the designation of ASTM, AATCC, or other test methods. The current editions of each test method cited shall prevail.

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *dimensional change, n*— in pressing and finishing of textiles, the change in dimensions of a fabric caused by pressing and finishing during garment manufacture.

3.2 For definitions of other textile terms used in this specification, refer to the individual ASTM and AATCC test methods and to Terminology D 123.

#### 3.3 Definitions of Terms Specific to This Standard:

3.3.1 *pressing and finishing*—This term takes into account all of the industrial pressing and finishing treatments used in garment production.

NOTE 2—No standard method is available for reproducing on a laboratory level the results of industrial pressing or finishing treatments used in the manufacture of garments.<sup>9</sup>

<sup>2</sup> Annual Book of ASTM Standards, Vol 07.01.

<sup>3</sup> Discontinued; see 1994 Annual Book of ASTM Standards, Vol 07.021.

<sup>4</sup> AATCC Technical Manual, available from the American Association

<sup>4</sup> Discontinued; see 1997 Annual Book of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709; ASTM Standards, Vol 07.02.

<sup>5</sup> Available from Superintendent

<sup>5</sup> Annual Book of Documents, Government Printing Office, Washington, DC 20402; ASTM Standards, Vol 07.02.

<sup>6</sup> AATCC Technical Manual, available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS; the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

<sup>7</sup> The development

<sup>7</sup> Available from Superintendent of a standard method has been referred to Subcommittee D13.59 on Fabric Test Methods, General. Documents, Government Printing Office, Washington, DC 20402.

<sup>8</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

<sup>9</sup> The development of a standard method has been referred to Subcommittee D13.59 on Fabric Test Methods, General.

**TABLE 1 Specification Requirements**

NOTE 1—Class for colorfastness and DP rating is based on a numerical scale of 5 for negligible or no color change, color transfer, or wrinkle to 1 for very severe color change, color transfer, or wrinkle. The numerical rating in Table 1 or a higher numerical rating is acceptable.

Characteristic	Requirements		Section
	Knitted	Woven	
Breaking strength (load) (CRT)	...	111 N (25 lbf), min	7.1
Bursting strength (load) (ball burst)	222 N (50 lbf)	...	7.2
Yarn slippage, 6-mm (¼-in.) separation	...	89 N (20 lbf), min	7.3
Tongue tear strength	...	6.7 N (1.5 lbf), min	7.4
Dimensional Change:			
Pressing and finishing	2 % max	1 % max, pre-finished fabrics	7.5.1
After five launderings (see 7.5.2.2 if shrinkage exceeds 3 %)	3 % max	2 % max, post-finished fabrics	7.5.2
After three dry cleanings	3 % max	3 % max	7.5.3
Growth	3 % max	3 % max	7.5.4
Colorfastness:			
Burnt Gas Fumes—2 Cycles:			
Shade change, original fabric	Class 4 <sup>A</sup> min	Class 4 <sup>A</sup> min	7.6.1
Shade change after 1 laundering or 1 dry cleaning	Class 4 <sup>A</sup> min	Class 4 <sup>A</sup> min	
Laundering:			
Shade change	Class 4 <sup>A</sup> min	Class 4 <sup>A</sup> min	7.6.2
Staining	Class 3 <sup>B</sup> min	Class 3 <sup>B</sup> min	
Dry cleaning:			
Shade change	Class 4 <sup>A</sup> min	Class 4 <sup>A</sup> min	7.6.3
Crocking:			
Dry	Class 4 <sup>C</sup> min	Class 4 <sup>C</sup> min	7.6.4
Wet	Class 3 <sup>C</sup> min	Class 3 <sup>C</sup> min	
Perspiration:			
Shade Change	Class 4 <sup>A</sup> min	Class 4 <sup>A</sup> min	7.6.5
Staining	Class 3 <sup>B</sup> min	Class 3 <sup>B</sup> min	
Light (40 AATCC FU) (xenon-arc)	Step 4 <sup>A</sup> min	Step 4 <sup>A</sup> min	7.6.6
Chlorine Bleach	Class 4 <sup>A</sup> , min	Class 4 <sup>A</sup> , min	7.6.7
Non-chlorine Bleach	Class 4 <sup>A</sup> , min	Class 4 <sup>A</sup> , min	7.6.8
Fabric appearance (see 7.7.1.1)	DP 3.5 <sup>D</sup> min	DP 3.5 <sup>D</sup> min	7.7
Flammability	pass	pass	7.8

<sup>A</sup> AATCC Gray Scale for Color Change.

<sup>B</sup> AATCC Gray Scale for Staining.

<sup>C</sup> AATCC Chromatic Transference Scale.

<sup>D</sup> For durable-press fabrics only.

3.4 Definitions of terms used in a dictionary of common terms are suitable for terms used in this performance specification.

#### 4. Specification Requirements

4.1 The properties of fabrics of woven and knitted fabrics for mens's and boy's beachwear and sport shirts shall conform to the specification requirements in Table 1.

#### 5. Significance and Use

5.1 Upon mutual agreement between the purchaser and the supplier, fabrics intended for this end use should meet all of the requirements listed in Table 1 of this specification.

5.2 It is recognized that for purposes of fashion or aesthetics, the ultimate consumer of articles made from these fabrics may find acceptable fabrics that do not conform to all of the requirements in Table 1. Therefore, one or more of the requirements listed in Table 1 may be modified by mutual agreement between the purchaser and the supplier.

5.2.1 In such cases, any references to the specification shall specify that: This fabric meets ASTM Specification D 4154 except for the following characteristic(s)."

5.3 Where no prepurchase agreement has been reached between the purchaser and the supplier, and in case of controversy, the requirements listed in Table 1 are intended to be used as a guide only. As noted in 5.2, ultimate consumer demands dictate varying performance parameters for any particular style of fabric.

5.4 The uses and significance of particular properties and test methods are discussed in the appropriate sections of the specified test methods.

#### 6. Sampling

6.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls as directed in an applicable specification or other agreement between the purchaser and the supplier, such as an agreement to use MIL-STD-105D.

6.2 *Laboratory Sample*—From each roll or piece in the lot sample, cut two laboratory samples the full width of the fabric and at least 375 mm (15 in.) along the selvage.

#### 7. Test Method (see Note 1)

7.1 *Breaking Force (Woven Fabric Only)*—Determine the dry breaking force, in the standard atmosphere for testing textiles,

as directed in Test Method D 5034, using a constant rate of traverse (CRT) tensile testing machine with the speed of the pulling clamp at  $300 \pm 10$  mm ( $12 \pm 0.5$  in.)/min.

NOTE 3—If preferred, the use of a constant-rate-of-extension (CRE) tensile testing machine is permitted. The crosshead speed should be agreed upon between the purchaser and the supplier. There may be no overall correlation between the results obtained with the CRT machine and with the CRE machine. Consequently, these two breaking load testers should not be used interchangeably. In case of controversy the CRT method shall prevail.

7.2 *Bursting Strength* (Knitted Fabric Only)—Determine the bursting strength, in the standard atmosphere for testing textiles, as directed in Test Method D 3787 using an approved type of CRT machine equipped with a bursting attachment or Test Method D 3786 using an approved type of diaphragm bursting tester as agreed upon between the purchaser and the supplier.

NOTE 4—There is no overall correlation between the results obtained with the CRT machine equipped with a bursting attachment and the diaphragm bursting tester. Consequently, these two bursting testers cannot be used interchangeably. In case of controversy, Test Method D 3786 shall prevail.

NOTE 5—The precision of the ball burst method using the CRT machine equipped with a bursting attachment and the precision of the diaphragm bursting tester method are being established by Subcommittee D13.59. The test methods are accordingly not recommended for acceptance testing unless preceded by an interlaboratory test in the laboratory of the purchaser and the laboratory of the supplier using randomized replicate specimens of the material to be evaluated.

7.3 *Resistance to Yarn Slippage* (Woven Fabric Only)—Determine the resistance to yarn slippage as directed in Test Method D 434.

NOTE 6—The precision of Test Method D 434 is being established, and it may not be suitable for fabrics with low yarn counts (see 5.2).

7.4 *Tear Strength* (Woven Fabric Only)—Determine the tear strength as directed in Test Method D 1424.

NOTE 7—If preferred, use of Test Method D 2262 is permitted with existing requirements as given in this specification. There may be no overall correlation between the results obtained with the tongue tear machine and with the Elmendorf machine. Consequently, these two tear testers should not be used interchangeably. In case of controversy, Test Method D 1424 shall prevail.

#### 7.5 *Dimensional Change:*

7.5.1 *Pressing and Curing During Manufacturing*—Mark specimen(s) as directed in 4.4 of AATCC Test Method 135. When appropriate press and cure specimen(s) as agreed upon between the purchaser and the supplier with respect to time cycles, temperature, steam, vacuum, and mechanical pressure of the press head. Measure the specimen(s) and calculate the dimensional change as directed in Section 6 and 7 of AATCC Test Method 135 (see Note 2).

7.5.1.1 If no agreement has been made between the purchaser and the supplier, press the specimen(s) using a flat-bed steam press according to the cycle in 10.1.4.1 through 10.1.4.5 of Test Methods D 2724.

7.5.2 *Laundering*—Determine the maximum dimensional change after five launderings as directed in the applicable procedure in AATCC Test Method 135.

NOTE 8—Launderable fabrics are expected to be dry-cleanable except where all or part of the fabric is not dry-cleanable 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. Goods labeled “dry-cleanable” are to be dry-cleaned only.

NOTE 9—Specimens prepared for 7.5.1 may be used for 7.5.2 and 7.5.3 as desired. When this is done, subtract the pressing and curing dimensional change from the total dimensional change to obtain that portion due to laundering or dry cleaning. The dimensional change to pressing and curing is determined on the fabric as it will reach the user. It is not to be added to the dimensional change due to laundering or dry cleaning of the fabric (see 6.1).

7.5.2.1 The wash conditions and drying procedure shall be as specified by the supplier.

7.5.2.2 When the dimensional change after five launderings exceeds 3%, determine the stretch of the fabric after five launderings as directed in Test Methods D 2594 using a 2.2-N (0.5-lbf) load. If the difference between the percent stretch of the laundered fabric and the percent shrinkage due to laundering does not exceed 3% shrinkage, then the fabric meets the specification requirements in Table 1.

7.5.3 *Dry Cleaning*—Determine the maximum dimensional change after three drycleanings in accordance with 10.1.1 through 10.1.4 of Test Methods D 2724 (see Note 8).

7.5.4 *Growth* (Knitted Fabric Only)—Determine the growth of the fabric as directed in Test Methods D 2594.

#### 7.6 *Colorfastness:*

7.6.1 *Burnt Gas Fumes*—Determine the colorfastness to burnt gas fumes on the original fabric and after one laundering or one dry cleaning as directed in AATCC Test Method 23.

NOTE 10—Washing conditions shall be the same as those used in 7.5.2.1. Dry-cleaning conditions shall be the same as those used in 7.5.3.

7.6.2 *Laundering*—Determine the colorfastness to laundering as directed in the applicable procedure of AATCC Test Method 61. The test conditions shall be as specified by the supplier (see Note 7).

7.6.3 *Dry Cleaning*—Determine colorfastness to dry cleaning as directed in AATCC Test Method 132 (see Note 8).

7.6.4 *Crocking*—Determine colorfastness to dry and wet crocking as directed in AATCC Test Method 8 for solid shades and AATCC Test Method 116 for prints, or as agreed upon between the purchaser and the supplier.

7.6.5 *Perspiration*—Determine colorfastness to perspiration as directed in AATCC Test Method 15.

7.6.6 *Light*—Determine colorfastness to light as directed in AATCC Test Method 16.

NOTE 11—There are distinct differences in spectral distribution between the various types of machines listed in AATCC Test Method 16, with no overall

correlations between them. Consequently, these machines cannot be used interchangeably. In case of controversy, results obtained with the water-cooled xenon-arc machine listed in Option E shall prevail.

7.6.7 Colorfastness to Chlorine Bleach—Determine colorfastness to light as directed in AATCC Test Method 16.

7.6.8 Colorfastness to Non-chlorine Bleach—Determine colorfastness to light as directed in AATCC Test Method 16.

7.7 Fabric Appearance—Determine the fabric appearance as directed in AATCC Test Method 124 after laundering using the wash-and-wear cycle or the normal cycle as agreed upon between the purchaser and the supplier as specified in 7.5.2.1 for washable fabrics or after dry cleaning as specified in 7.5.3 for dry-cleanable fabrics (see Note 8).

7.7.1 For fabrics not intended for use in “durable-press” (DP) garments, determine the fabric smoothness after pressing as specified in 5.12 of AATCC Test Method 96.

7.7.1.1 The fabric smoothness (DP) rating of such fabrics, and the DP rating of dry-cleaned fabrics, shall have decreased no more than ½ DP rating from that of the fabric before it is laundered or dry-cleaned.

7.8 *Flammability*—The flammability requirements shall be agreed upon between the purchaser and the supplier, provided they meet or exceed those of Part 1610 of the Flammable Fabrics Act Regulations.

## 8. Keywords

8.1 beachwear; fabric; performance; shirt; specification

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