Designation: D 4109 – 02

Standard Performance Specification for Men's and Boys' Woven Coverall, Dungaree, Overall, and Shop-Coat Fabrics[1]

This standard is issued under the fixed designation D 4109; 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 performance specification covers woven fabrics comprised of any textile fiber or mixture of fibers, to be used in men's and boys' coveralls, dungarees, overalls, and shop-coats.

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

1.3 This performance specification is not applicable to woven fabrics used for interlinings and industrial-protective clothing.

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:*

D 123 Terminology Relating to Textiles[2]

D 434 Test Method for Resistance to Slippage of Yarns in Woven Fabrics Using a Standard Seam[2]

D 1424 Test Method for Tear Resistance of Woven Fabrics by Falling-Pendulum (Elmendorf) Apparatus[2]

D 2261 Test Method for Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant-Rate-of-Extension Tensile Testing Machine)[2]

D 2262 Test Method for Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant-Rate-of-Traverse Tensile Testing Machine)[2]

D 2724 Test Methods for Bonded, Fused, and Laminated Apparel Fabrics[2]

D 2905 Practice for Statements on Number of Specimens for Textiles[2]

D 5034 Test Method for Breaking Force and Elongation of Textile Fabrics (Grab Test)[3]

2.2 *AATCC Test Methods:*[4]

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

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 Laundering of Woven or Knit Fabrics

172 Colorfastness to Non-Chloride Bleach in Home Laundering

188 Colorfastness to Chlorine Bleach in Home Laundering

Evaluation Procedure No. 1 Gray Scale for Color Change

Evaluation Procedure No. 2 Gray Scale for Staining

Evaluation Procedure No. 3 AATCC Chromatic Transference Scale

2.3 *Federal Standard:*[5]

16 CFR, Chapter II–Consumer Product Safety Commission, Subchapter D—Flammable Fabrics Act Regulations

2.4 *Military Standard:*[6]

MIL-STD-105D Sampling Procedure and Tables for Inspection by Attributes

NOTE 1—Reference to test methods in this standard 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 For definitions of textile terms used in this specification, refer to the individual ASTM and AATCC methods and to Terminology D 123.

3.2 *Definitions of Terms Specific to This Standard:*

[1] This specification is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.61 on Apparel.

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

[3] *Annual Book of ASTM Standards,* Vol 07.02.

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

[5] Available from Superintendent of Documents, Government Printing Office, Washington, DC 20402.

[6] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, Pa. 19111-5094, Attn: NPODS.

3.2.1 *Type I Apparel*—apparel designed for general heavy work. It may be subjected to breaking and tearing stresses indoors or out.

3.2.2 *Type II Apparel*—apparel designed for light work or leisure activities. It will not be expected to undergo severe physical stresses.

TABLE 1 Specification Requirements

NOTE 1—Class for color change, color transfer, and DP rating is based on a numerical scale of 5 for negligible or no wrinkle, color change, or color transfer to 1 for severe wrinkle, color change, or color transfer.

Characteristics	Requirements		Section
Breaking strength(*load*)(CRT):			7.1
Type I	308 N (70 lbf), min		
Type II	178 N (40 lbf), min		
Yarn slippage:			7.2
Type I	6.3 mm (¼ in.) separation at 133 N (30 lbf), min		
Type II	6.3 mm (¼ in.) separation at 111 N (25 lbf), min		
Tongue-tear strength (CRT):			7.3
Type I	13 N (3.0 lbf), min		
Type II	11 N (2.5 lbf), min		
Fabric Appearance (see 7.4.1.1)	DP 3.5[A], min		7.4
Colorfastness:	Non-Indigo Dyed	Indigo Dyed	
Burnt gas fumes—2 cycles:			
Shade change, original fabric	Class 4[B], min	Class 4[B], min	7.5.1
Shade change, after one laundering or one drycleaning	Class 4[B], min	Class 4[B], min	
Chlorine Bleach	Class 4[B], min	Class 4[B], min	7.5.7
Non-Chlorine Bleach	Class 4[B], min	Class 4[B], min	7.5.8
Laundering:			
Shade change	Class 4[B], min	Class 2[B], min	7.5.2
Staining	Class 3[C], min	Class 2[C], min	
Drycleaning:			
Shade change	Class 4[B], min	Class 3[B], min	7.5.3
Perspiration:			
Shade change	Class 4[B], min	Class 3[B], min	7.5.4
Staining	Class 3[C], min	Class 3[C], min	
Light (20 AATCC FU) (xenon-arc)	Step 4[B], min	Step 4[B], min	7.5.5
Crocking:			
Dry	Class 4[D], min	Class 3[D], min	7.5.6
Wet	Class 3[D], min	Class 2[D], min	
Dimensional change:			
Pressing and finishing (DP fabrics)	2 % max	2 % max	
Laundering (DP fabrics)	2.5 % max	2.5 % max	7.6.1
Laundering (non-DP fabrics)	3.0 % max	3.0 % max	
Drycleaning	2.5 % max	2.5 % max	7.6.3
Flammability	pass	pass	7.7

[A] For durable press (DP) fabrics only.
[B] AATCC Gray Scale for Color Change.
[C] AATCC Gray Scale for Staining.
[D] AATCC Chromatic Transference Scale.

4. Specification Requirements

4.1 The properties of woven fabrics for men's and boys' woven coveralls, dungarees, overalls, and shop-coats shall conform to the specification requirements in Table 1.

5. Significance and Use

5.1 Upon 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 upon 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 4109 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.

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 Methods (See Note 1)

7.1 *Breaking Force*— Determine the dry breaking force 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 ± 10 mm (12 ± 0.5 in.)/min.

NOTE 2—If preferred, the use of the constant-rate-of-extension (CRE)

testing machine is permitted. The crosshead speed should be as agreed upon between the purchaser and the supplier. There may be no overall correlation between the results obtained with the CRT machine and the CRE machine, consequently, these two breaking-load testers cannot be used interchangeably. In case of controversy, the CRT machine shall prevail.

7.2 *Resistance to Yarn Slippage*—Determine the resistance to yarn slippage as directed in Test Method D 434.

NOTE 3—The precision of Test Method D 434 is being established, and it may not be suitable for fabrics with low-yarn counts in terms of ends and picks per inch (see 5.2).

7.3 *Tear Strength*— Determine the tear strength as directed in Test Method D 2262.

NOTE 4—If preferred, the use of Test Methods D 1424 and D 2261 is permitted with existing requirements as given in this specification. There may be no overall correlation between the results obtained with the tongue-tear machines and the Elmendorf machine. Consequently, these tear testers cannot be used interchangeably. In case of controversy, Test Method D 2262 shall prevail.

7.4 *Fabric Appearance*—Determine the fabric appearance as directed in AATCC Test Method 124 after laundering using the wash-n-wear cycle, or the normal cycle as agreed upon between the purchaser and the supplier as specified in 7.6.2 for washable fabrics, or after dry-cleaning as specified in 7.6.3 for dry-cleanable fabrics (see Note 5).

7.4.1 For fabrics not intended for use in "Durable Press" garments determine the fabric smoothness after pressing as specified in 10.2.5 of Test Methods D 2724.

7.4.1.1 The fabric smoothness or durable press (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 drycleaned.

7.5 *Colorfastness*:

7.5.1 *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 after 2 cycles.

7.5.2 *Laundering*—Determine the colorfastness to laundering as directed in AATCC Test Method 61. The test conditions shall be as agreed upon between the purchaser and supplier (Note 5).

7.5.3 *Drycleaning*— Determine the colorfastness to drycleaning as directed in AATCC Test Method 132.

NOTE 5—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 that is soluble in the solvent, or the fiber could be degraded by the solvent, as would be the case with poly(vinyl chloride) fiber. Goods labeled "dry-cleanable" are to be drycleaned only.

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

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

NOTE 6—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.

7.5.6 *Crocking*—Determine the colorfastness to 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.

7.5.7 *Colorfastness to Chlorine Bleach*— Determine the colorfastness to chlorine bleach as directed in AATCC Test Method 188.

7.5.8 *Colorfastness to Non-Chlorine Bleach*— Determine the colorfastness to non-chlorine bleach as directed in AATCC Test Method 172.

7.6 *Dimensional Change*:

7.6.1 *Pressing and Finishing During Manufacturing*—Mark specimen(s) as directed in 4.4 of AATCC Test Method 135. Press and finish 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 Sections 6 and 7 of AATCC Test Method 135 (see Note 5).

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

7.6.2 *Laundering*—Determine the maximum-dimensional change after five launderings or as agreed upon between the purchaser and the supplier as directed in the applicable procedure in AATCC Test Method 135 (Note 5 and Note 7).

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

NOTE 7—Specimens prepared for 7.6.1 may be used for 7.6.2-7.6.3 as desired. When this is done, the dimensional change due to laundering or drycleaning is calculated using Eq 1. The dimensional change to pressing is determined on the fabric as it will reach the user. It is not additive to the dimensional change to laundering or drycleaning of the fabric as it will reach the consumer. (See 6.1.)

$$\text{Percent Dimensional Change} = 100\,(D_1 - D_2)/D_2 \qquad (1)$$

where:

D_1 = the measurement after laundering or drycleaning, and
D_2 = the measurement after pressing and finishing.

7.6.3 *Drycleaning*— Determine the maximum-dimensional change after three drycleanings or as agreed upon between the purchaser and the supplier as directed in 10.1.1 through 10.1.5 of Test Methods D 2724.

7.7 *Flammability*— The flammability requirements shall be as 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 career apparel; fabric; pants; performance; specification