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Superseding
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The following commercial specification is originally adopted from the military document. Revision A includes all known accepted revisions, amendments, notices, and Department of Defense (DoD) engineering changes previously developed for this item. Revisions B and forward include changes adopted to reflect technology and design evolution.

CLOTH, PARACHUTE, NYLON, LOW PERMEABILITY

The Parachute Industry Association makes this document available for use by Industry and Government organizations that wish to apply this specification to their products.

1. SCOPE

1.1 Scope. This specification covers six types of nylon cloth for use in the fabrication of parachutes.

1.2 Type designation. The nylon cloth shall be of the following types as specified (see 6.2).

Type I	- 1.20 oz/sq. yd (0.5-5.0 cfm air permeability) - Rip stop weave
Type II	- 1.12 oz/sq. yd (30-50 cfm air permeability) - Rip stop weave
Type III	- 1.17 oz/sq. yd (30-50 cfm air permeability) - Rip stop weave
Type IV	- 1.20 oz/sq. yd (0.5-3.0 cfm air permeability) - Rip stop weave
Type V	- 1.17 oz/sq. yd (0.5-5.0 cfm air permeability) - Rip stop weave
Type VI	- 1.5 oz/sq. yd (0.5-3.0 cfm air permeability) - Rip stop weave

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in Sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification nor is it recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of the documents cited in Sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government publications.

2.2.1 Government publications. The following Government publications form a part of this document.

STANDARDS

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Documents

Document Sharing Hub

FEDERAL

FED-STD-595 - Colors Used In Government Procurement

MILITARY

MIL-DTL-6645 - Parachutes, Personnel, General Specification For

(Unless otherwise indicated, copies of the above specifications and standards are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. Electronic copies of Military and Federal standards and specifications may be obtained from <https://assist.daps.dla.mil/quicksearch/>.)

FEDERAL TRADE COMMISSION

16 CFR 303 - Rules and Regulations Under the Textile Fiber Products Identification Act

(Copies are available online at: www.ftc.gov or from the Federal Trade Commission, 600 Pennsylvania Avenue, N.W., Washington, DC 20580-0001. Electronic copies may also be obtained from <http://www.access.gpo.gov/>.)

2.3 Non-government publications. The following documents form a part of this document.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 8	- Colorfastness to Crocking; Crockmeter Method
AATCC 16.2	- Colorfastness to Light: Carbon-Arc
AATCC 16.3	- Colorfastness to Light: Xenon-Arc
AATCC 22	- Water Repellency: Spray Test
AATCC 61	- Colorfastness to Laundering: Accelerated
AATCC 81	- pH of the Water-Extract from Wet Processed Textiles
AATCC 192	- Weather Resistance of Textiles: Sunshine-Arc Lamp Exposure with and without Wetting
AATCC Evaluation Procedures:	

- 1 Gray Scale for Color Change
- 2 Gray Scale for Staining
- 8 AATCC 9 - Step Chromatic Transference Scale
- 9 Visual Assessment of Color Difference Textiles.

(Applications for copies should be addressed to the AATCC National Headquarters, P.O. Box 12215, Research Triangle Park, NC 27709-2215. Electronic copies may be obtained from www.aatcc.org.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

ANSI/ASQ Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Copies are available online at: www.asq.org or American Society For Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203.)

ASTM INTERNATIONAL (ASTM)

ASTM D276	- Standard Test Methods for Identification of Fibers in Textiles
ASTM D629	- Standard Test Method for Quantitative Analysis of Textiles
ASTM D737	- Standard Test Method for Air Permeability of Textile Fabrics
ASTM D1776	- Standard Practice for Conditioning and Testing Textiles
ASTM D1777	- Standard Test Method for Thickness of Textile Materials
ASTM D2261	- Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)
ASTM D3774	- Standard Test Method for Width of Textile Fabric
ASTM D3775	- Standard Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics
ASTM D3776	- Standard Test Methods for Mass Per Unit Area (Weight) of Fabrics
ASTM D3882	- Standard Test Method for Bow and Skew in Woven & Knitted Fabrics
ASTM D5035	- Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM G151	- Standard Practice for exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
ASTM G155	- Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

(Application for copies should be addressed to the ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Electronic copies may be obtained from www.astm.org.)

PARACHUTE INDUSTRY ASSOCIATION (PIA)

PIA-STD-851	- CODING, MANUFACTURER'S IDENTIFICATION, NYLON PARACHUTE CLOTH
PIA-TEST METHOD-503	- PERMANENCE OF SET AND SHRINKAGE IN PARACHUTE FABRIC

(Electronic copies may be obtained from www.pia.com.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

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3.1 Yarn. The nylon yarn used in the manufacture of the cloth shall be a continuous multi-filament, bright, high tenacity, light and heat resistant polyamide prepared from hexamethylene diamine and adipic acid or its derivatives. The yarn shall have a melting point of 244°C (471°F) minimum when tested as specified in TABLE II. The yarn shall not be bleached in any manner or during any subsequent process.

3.1.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered and environmentally preferable material should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements and promotes economically advantageous life cycle costs.

3.2 Yarn twist. Any yarn twist (warp and filling) is acceptable, provided all requirements for this specification are met.

3.3 Weave.

3.3.1 Types I, III, IV and V weave. The weave pattern for Types I, III, IV and V cloth shall be as specified in Figure 1 or Figure 1 Alternate.

3.3.2 Type II weave. The weave pattern for Type II cloth shall be as specified in Figure 2 or Figure 2 Alternate.

3.3.3 Type VI weave. The weave pattern for Type VI shall be as specified in Figure 3 or Figure 3 Alternate.

3.3.4 Loom type. The use of flyshuttle or shuttleless loom fabric is acceptable. No chemical means or coatings shall be used to form a selvage.

3.4 Standard. Where applicable, the finished cloth shall match the standard for shade and appearance and shall, unless otherwise indicated, be equal to or better than the standard with respect to all characteristics for which the standard is referenced (see 6.3).

3.5 Physical and chemical properties. The physical and chemical properties of the finished cloth shall conform to TABLE I and the following subparagraphs thereto. The frequency of testing shall be 5 tests across the width of the delivered fabric. The test methods in TABLE IV shall be followed.

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TABLE I Physical requirements.

Characteristic	Type I	Type II	Type III	Type IV	Type V	Type VI
Weight, (ounces per sq. yd.) max.	1.20	1.12	1.17	1.20	1.17	1.5
Thickness, (inch) max.	0.003	0.003	0.003	0.003	0.003	0.003
Breaking strength, (pounds) min. ^{1/} :						
Warp	45	42	45	45	45	50
Filling	45	42	45	45	45	50
Elongation, (percent) min. ^{1/} :						
Warp	20	20	20	20	20	25
Filling	20	20	20	20	20	25
Tearing strength, (pounds) min. ^{1/} :						
Warp	5	5	5	5	5	7
Filling	5	5	5	5	5	7
Air permeability, (ft. ³ /min./ft. ²)	0.5-5.0	30-50	30-50	0.5-3.0	0.5-5.0	0.5-3.0
Yarns per inch, (min.):						
Warp	126	120	126	126	126	115
Filling	132	120	132	132	132	116

Note:

^{1/}No individual test specimen shall have a value lower than the minimum physical requirement.

3.6 Finish. The cloth shall be scoured to remove sizing and other contaminants at a temperature which will not cause fixation of same into cloth or result in permanent setting of the cloth. The cloth shall be heat-treated and may be calendered at such temperature and pressure as required to control the air permeability to the level required by this specification. Where calendering is required, the fabric shall be turned over with each calender run. The cloth covered by this specification shall not be bleached, resinated or treated with oxalic or phosphoric acid in any manner or process (see 6.4).

3.6.1 Permanence of set. When the cloth is tested as specified in 4.9.1 the permanence of the cloth set shall be as follows.

3.6.1.1 Air permeability Types I, IV, V and VI. Air permeability readings for Types I and V cloth shall be within 0.5-5.0 ft³/min/ft² and Types IV and VI cloth shall be within 0.5-3.0 ft³/min/ft² after testing as specified in TABLE IV.

3.6.1.2 Air permeability Types II and III. Air permeability readings for Types II and III cloth shall be within 30-50 ft³/min/ft² after testing as specified in TABLE IV.

3.6.1.3 Thickness. The thickness of the Types I, II, III, IV, V and VI cloth shall not exceed 0.003 inch after testing as specified in TABLE IV.

3.6.1.4 Shrinkage (Types I, II, III, IV, V and VI). Cloth shrinkage shall not exceed 3 percent in the warp or in the filling direction after testing as specified in TABLE IV.

3.6.2 Water-soluble material. The total water-soluble material of the finished cloth shall not exceed 2 percent when tested as specified in TABLE IV.

3.6.2.1 Fluorocarbon (Types I, II, III, IV, V and VI). Finished cloth shall be treated with a fluorocarbon so applied that it is evenly distributed throughout the cloth. The amount of fluorocarbon finish added shall be a minimum of 0.05 percent based on the weight of the dry cloth. The finisher shall

submit a certificate of compliance for each shipment indicating that fluorocarbon finish was used. The fabric shall have an initial spray rating of 80, 80, 70 minimum when tested as specified in TABLE IV.

3.6.3 pH. The pH of the water extract of the finished cloth shall be no less than 5.5 or more than 9.0 when tested as specified in TABLE IV.

3.6.4 Light and heat resistance. The cloth shall not lose more than 25 percent of its original strength when tested in accordance with 4.9.2.

3.7 Color. The color of the finished cloth and its referenced standard shall be as specified by the procuring activity (see 6.2).

3.7.1 Dyeing. When dyed fabric is required, the fabric shall be yarn or piece dyed.

3.7.2 Visual shade matching. When evaluated in accordance with 4.9.4, the color of the dyed fabric shall match the standard when viewed with sources simulating artificial daylight D75 illuminant, and shall be a good match to the standard under incandescent lamplight.

3.7.3 Colorfastness to light. PIA has adopted AATCC 16.3 as an acceptable alternative test method to AATCC 16.2 for the testing of Broad Fabrics using Xenon (TABLE IV).

3.7.4 Colorfastness. When tested as specified in 4.5.3, the finished fabric shall show fastness to light, laundering, crocking and bleeding in damp air as follows:

Characteristic	Rating, minimum
Light (Fade) ^{1/}	3-4
Laundering: ^{2/}	
Color Change	3-4
Staining	3-4
Crocking: ^{3/}	
Dry	3.5
Wet	3.5
Bleeding in damp air ^{2/}	3-4

Notes:

^{1/} Rating using the AATCC Evaluation Procedure 1, Gray Scale for Color Change.

^{2/} Rating using the AATCC Evaluation Procedure 1, Gray Scale for Color Change and AATCC Evaluation Procedure 2, Gray Scale for Staining.

^{3/} Rating using the AATCC Evaluation Procedure 8 and AATCC 9 Step Chromatic Transference Scale.

3.8 Dimension.

3.8.1 Width. Unless otherwise specified the overall width of the finished fabric shall be 36½ inches ±½ inch, 48½ inches ±½ inch, or 65½ inches ±½ inch. The acceptable width shall be inclusive of the selvages but exclusive of fringed ends produced on shuttleless looms (see TABLE IV and 6.2). The selvage shall be hot slit and sealed against raveling if woven on shuttleless looms, unless otherwise specified.

3.8.2 Length and put-up. Unless otherwise specified (see 6.2), a shipper's roll shall be a minimum of 100 yards with a minimum piece size of 50 yards. A shipper's roll shall have a maximum of two splices with no more than 10 percent of the yards ordered containing splices.

3.8.3 Bias (skew) and bow in fabric. Bias and bow shall be measured according to ASTM D3882. Requirements shall be as listed in TABLE V. End Item Visual Defects.

3.9 Date of manufacture. The date of manufacture is defined as the date (month and year) of the last manufacturing process that affects the physical characteristics of the cloth. This would not include slitting, inspection or rewinding.

3.10 Identification

3.10.1 Identification of fiber. Each roll of the finished fabric shall be labeled or ticketed and invoiced for fiber content in accordance with the Rules and Regulations Under the Textile Fiber Products Identification Act.

3.10.2 Identification yarns. Identification warp yarns assigned in PIA-STD-851 shall be a maximum of 2 inches from at least one edge of the finished cloth. The dye used in the identification yarns shall have no adverse effect on the physical properties of the fabric and the dyed yarns shall show no bleeding or color transfer when subjected to the tests as specified in TABLE II.

3.10.3 Identification of product. Each roll of finished cloth shall be marked for identification in accordance with good commercial practice. In addition, each piece of cloth in each roll shall be clearly and legibly marked with the finisher's roll number or code, and each roll shall have attached a durable tag on which the finisher's roll number or code is listed. The date of manufacture (see 3.9) of the cloth shall be included on the tag attached to each roll.

3.11 Workmanship. The finished cloth shall be clean and evenly woven and shall conform to the quality and grade of product established by this specification and the occurrence of defects shall not exceed the applicable Acceptance Quality Limit. The finished cloth shall not show spottiness or be off shade of the standard range. The finished cloth shall not have an objectionable odor. (Normal residual odor of chemicals commonly used shall not be regarded as objectionable.)

3.12 First article. When specified (see 6.2), a sample representative of the production quality shall be submitted for first article inspection in accordance with 4.3.

4. VERIFICATION

4.1 Classification for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the procuring activity. The procuring activity reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of Sections 3, 4 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the procuring activity for acceptance comply with all requirements of the contract. Sampling for quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the procuring activity to accept defective material.

4.1.2 Certification of Compliance. A Certificate of Compliance shall be prepared for each lot of material offered for acceptance (see 4.5.1). The certificate shall include all quantitative data resulting from specified chemical and mechanical tests. Qualitative results of nondestructive tests and other inspections or tests shall be recorded on the certificate. The certificate shall also state that each lot has been sampled, tested and inspected in accordance with the specification and meets all specification requirements. The certificate shall be signed by a responsible representative of the contractor. When Certificates of Compliance are submitted, the procuring activity reserves the right to inspect and or test such items to determine the validity of the certificate.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3)
- b. Quality conformance inspection and testing (see 4.4 and 4.5).

4.3 First article inspection. When a first article is required (see 3.12 and 6.2), it shall be examined for the defects specified in TABLE V, 4.6-4.8 and tested for all requirements listed in TABLE IV.

4.4 Conformance inspection. Sampling for inspection shall be performed as specified in this document unless otherwise specified in the contract or order (see 6.2). Quality conformance inspections shall be performed on every shipper's roll as specified. Shipper's rolls are created after finishing when a finisher's roll is divided for the purpose of handling and delivery. Each shipper's roll shall be tagged (see 3.10.3) with the number code of the finisher's roll of which it was a part. Unless otherwise specified by the procuring activity, sampling for examination and testing shall be performed in accordance with paragraphs 4.5 and 4.6.

4.4.1 Components and material inspection and testing. In accordance with 4.1, components and materials shall be inspected and tested (see TABLE II) in accordance with all the requirements of referenced documents unless otherwise specified by the procuring activity.

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TABLE II Component and material certification.

	Characteristics	Requirement paragraph	Test methods	Results reported as
Material warp and filling yarns	Tenacity	3.1	^{1/}	^{1/}
	Luster	3.1	Visual	^{1/}
	Melting point	3.1	ASTM D276	^{1/}
	Not bleached	3.1		^{1/}
	Heat and light resistance	3.1	^{1/} , ^{3/}	^{1/}
Identification yarns	Colorfastness to: Light Laundering Bleeding in damp air Adverse effect of dye	3.7.4	AATCC 16.2 ^{1/} , ^{3/} or AATCC 16.3 ^{1/} , ^{3/}	^{1/}
		3.7.4	AATCC 61, Test 1A ^{1/} , ^{2/}	^{1/}
		3.7.4, 3.10.2	4.9.3 ^{1/}	^{1/}
		3.10.2	^{1/}	^{1/}
Fluorocarbon identification	Applied to Fabric	3.6.2.1	^{1/}	^{1/}

Note:

^{1/} Acceptance with respect to this characteristic will be based on a contractor's "Certificate of Compliance".

^{2/} Except the time shall be one hour for sample immersion.

^{3/} Exposure shall be 40 AATCC Fading Unit (AFU).

4.4.1.1 Components and material sampling. In addition to the quality assurance provisions of the subsidiary specifications, components and materials listed in TABLE II shall be tested for the characteristics specified and in accordance with the referenced test methods of TABLE II and TABLE IV. The lot size shall be expressed in units of one cone, tube, or spool for each component. Acceptance sampling plan shall be determined by using ANSI/ASQ Z1.4, Inspection Level S-1 with an Acceptance Quality Limit (AQL) of 6.5. The test data required by this sampling plan shall be provided to the finisher by the greige goods weaver or the yarn producer unless otherwise specified by the procuring activity.

4.4.2 In-process inspection. Inspection of the manufacturing process shall be made to ascertain that the cloth has been treated in accordance with the finish requirements under 3.6 and that the cloth age will be in accordance with 3.9. The procuring activity reserves the right to exclude from consideration for acceptance, any material or service for which in-process inspection has indicated nonconformance.

4.4.3 Finished cloth testing for Government source sampling and first article requirements. The cloth shall be tested for the characteristics as specified in TABLE IV. The methods of testing in TABLE IV shall be followed. The physical and chemical values specified in Section 3 apply to the average of the determinations made on a sample unit for test purposes as specified in the applicable test method. The sample unit shall be a minimum of 6 continuous yards (full width) of the finished cloth. All individual test results must also be recorded and reported. Each sample unit for testing shall be evenly removed throughout the length of the roll. The identity (see 3.10.3) of a particular shipper's roll from which each test sample was derived must also be reported per each test result. The lot shall be unacceptable if one or more sample units fail to meet any test requirements specified. The sample size for Government source sampling shall be as follows: