[INCH-POUND]
A-A-59511
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SUPERSEDING
MIL-C-43708
30 September, 1986

COMMERCIAL ITEM DESCRIPTION

CLOTH, COATED OR CLOTH, LAMINATED, REFLECTIVE

The General Services Administration has authorized the use of this commercial item description as a replacement for types I and II of MIL-C-43708 for all federal agencies.

1. Scope. This document covers two types of retroreflective cloth. The retroreflective cloths are intended for use in the manufacture of safety clothing, high visibility.

2. Classification.

Type I - Cloth, coated, reflectorized coating
- Class 1 – Gray color, heavyweight, woven fabric backing
- Class 2 – Silver color, lightweight, woven fabric backing
- Class 3 – Fluorescent, lime-yellow color, knit fabric backing

Type II - Cloth, bonded, reflectorized film
- Class 1 – White color
- Class 2 – Fluorescent, lime-yellow color

3. Salient characteristics.

3.1 Description.

3.1.1 Type I cloths. The base cloth for all classes shall be woven or knitted cloth of cotton nylon or polyester or blends thereof. The binder shall be a resin composition that will securely bind retroreflective glass beads to the base cloth. The finished cloth shall conform to the physical requirements specified in Table I and shall meet the applicable reflectivity requirements specified in Table II.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center Philadelphia, Clothing and Textiles Directorate, Attn: DSCP-COCT, 700Robbins AVE, Philadelphia, PA 19111-5092.

3.1.2 Type II cloths. The backing cloth shall be a polyvinylchloride coated or laminated cloth. The reflectorized film shall be a polyvinylchloride film, 0.012 inch nominal thickness, of color selected to meet the color requirements. The finish on the face side of the film shall be smooth and polished. The back side of the reflectorized film shall be bonded to the face side of the backing cloth by means of continuous thermal or dielectric bonds, 1/16 ± 1/32 inch wide, parallel and perpendicular to the warp direction of the cloth. Each edge of the cloth shall be continuously bonded with a bond 3/16 ± 1/16 inch wide. The number and location of the bonds shall be such that the reflectorized film is securely fastened to the backing cloth. When the cloth is cut into tape or strip form, the bonding shall be such that the edges of the tape shall be continuously bonded with a bond 3/16 ± 1/16 inch and that the other bonds parallel to the warp direction of the tape shall be located symmetrically about the center warpwise line of the tape. The finished cloth shall conform to the physical requirements specified in Table I and shall meet the applicable reflectivity requirements specified in Table III.

3.2 Physical requirements. The cloth shall conform to the requirements specified in Table I.

TABLE I. Physical Requirements

Characteristic	Requirements							
	Type I						Type II	
	Class 1		Class 2		Class 3		Classes 1&2	
	Min	Max	Min	Max	Min	Max	Min	Max
Weight Oz/yd^2	--	13.5	--	11.0	--	15.0	--	21.0
Breaking Strength, lbs.								
Warp	75	--	50	--	50	--	50	--
Filling	32	--	20	--	40	--	40	--
Tearing Strength, g.								
Warp	--	--	650	--	--	--	--	--
Filling	--	--	350	--	--	--	--	--
Colorfastness to:								
Laundering	1/	--	--	--	--	--	--	--
Wet dry cleaning	1/	--	--	--	--	--	--	--
Weather	1/	--	--	--	--	--	--	--
Light	--	--	1/	--	--	--	--	--
Stiffness, machine or warp direction (cm)								
At 70°F ± 2°F	--	--	--	7.0	--	16.0	--	16.0
At – 10° ± 2°F --	--	--	--	12.0	--	--	--	
Blocking, scale rating	--	--	No. 3	--	No. 2	--	No. 2	--
Resistance to cold crack								
At – 20° ± 5°F --	--	--	--	2/		2/	--	
Adhesion of coating, lbs/2 inch width	--	--	10.0	--	--	--	--	--

TABLE I. Physical Requirements (continued)

Characteristic	Requirements							
	Type I						Type II	
	Class I		Class II		Class III		Classes 1&2	
	Min	Max	Min	Max	Min	Max	Min	Max
Flame resistance								
After flame (seconds)								
(warp)	--	--	--	--	--	2.0	--	2.0
(fill)	--	--	--	--	--	2.0	--	2.0
After glow (seconds)								
(warp)	--	--	--	--	--	6.0	--	6.0
(fill)	--	--	--	--	--	6.0	--	6.0
Char length (in)								
(warp)	--	--	--	--	--	4.0	--	4.0
(fill)	--	--	--	--	--	4.0	--	4.0

1/ The cloth shall show fastness equal to or better than the standard sample. When no standard sample is available, the cloth shall show fastness equal to or better than a rating of "4" on the AATCC Gray Scale for Color Change.
2/ The cloth shall show no evidence of cracking, flaking or separation of the components of the finished cloth.

3.3 Reflectivity. The reflectivity requirements of the cloths shall be as specified in Tables II and III when measured at the indicated observation angles.

Table II Reflectivity requirements of Type I cloths

Type	Class	Observation angle (degrees)	Reflectivity (candle power/ft candle/ft^2) (minimum) at entrance angles (degrees) -4	+10	+20	+30	+40	+50
I	1	0.5	180	140	140	135	120	80
		2.0	21	30	20	20	14	11
I	2	0.2	330	---	290	180	65	---
		0.5	115	---	90	70	20	---
		2.0	4.5	---	4.0	3.5	2.5	---
I	3	0.2	130	---	65	23	6	---
		0.5	20	---	18	15	4.5	---
		2.0	1.5	---	1.2	0.8	0.4	---

Table III Reflectivity requirements of type II cloths

Type	Class	Observation angle (degrees)	Reflectivity (candle power/ft candle/ft²) (minimum) at entrance angles (degrees) -4	+15	+30
II	1	0.2	110	90	40
		0.5	80	75	30
		2.0	6	5	4
II	2	0.2	83	68	30
		0.5	60	56	23
		2.0	4.5	3.8	3.0

3.4 Color. The color of the cloth shall be as follows and match the applicable standard sample.

Type I: Class 1 - Reflective Gray
Class 2 - Reflective Silver
Class 3 - Reflective, fluorescent lime-yellow

Type II: Class 1 - Reflective White
Class 2 - Reflective, fluorescent lime-yellow

3.5 Workmanship. The finished cloth shall conform to the quality of product established by this document. The occurrence of defects shall not exceed the applicable acceptable quality levels.

3.6 Width. The minimum width shall be specified in the contract. For the coated cloth, the width requirement shall apply to the cloth without selvages. Trimming of selvages shall result in straight cut edges, with no rolling or folding occurring. For the bonded cloth the width shall apply to the bonded cloth or strip with selvages 3/16 ± 1/16 inch wide.

3.7 Length and put-up. The cloth shall be put-up in rolls as specified.

4. REGULATORY REQUIREMENTS.

4.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials 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.

5. QUALITY ASSURANCE PROVISIONS

5.1 Product conformance. The products provided shall meet the salient characteristics of this commercial item description and conform to the producer's own drawings,

specifications, standards and quality assurance practices. The Government reserves the right to require proof of such conformance.

5.2 End item testing. Testing shall be performed for the characteristics specified in Table IV. All test reports shall contain the individual values utilized in expressing the final result. The sample unit shall be 3 yards full width of the cloth, when the cloth is procured in strips, testing shall be performed on the cloth prior to cutting into strip form.

Lot Size (yards)	Sample Size (Sample units)
800 or less	2
801 up to and including 22,000	3
22,001 and over	5

Table IV End item tests

Characteristics	Test method
Weight	ASTM-D-3776 Method C (small swatch of fabric method)
Breaking strength:	1/
Tearing Strength	ASTM-D-1424
Colorfastness to:	
Laundering	AATCC-61, Test 3A
Wet dry cleaning	2/
Weather	AATCC-111A 3/
Light	AATCC-16 Opt A 3/
Stiffness	
at 70° F ±2° F	4/
at -10° F ± 2° F	5/ and 4/
Blocking	ASTM-D-751 6/
Resistance to cold crack at -20°F ± 5°F	7/
Adhesion of coating	ASTM-D-751 8/
Flame resistance	9/

Reflectivity	5.3

1/ For type I, class 1 cloth, ASTM-D-5034 (G-T or G-E) shall be used. For all other types and classes, ASTM-D-5035 (Specimen Type 1C) shall be used.
2/ The cloth shall be subjected to three (3) commercial dry cleaning cycles and then evaluated for colorfastness by comparison to the standard sample or, if no standard sample is available, to the AATCC Gray Scale for Color Change.
3/ The time of exposure shall be 100 hours.
4/ TAPPI Method T-451, Preferred Procedure (1), except that five specimens with long dimension parallel to the warp direction of the finished cloth shall be used and that the standard textile test conditions as specified in ASTM-D-1776 shall be used.
5/ The specimens shall be exposed in the low-temperature chamber at the specified temperature within a tolerance of $\pm$ 1.8°F ($\pm$1°C) for a minimum of 4 hours before testing. Tests shall be performed at the specified temperature and in still air.
6/ The test shall be performed at a temperature of 180 $\pm$ 2°F for 30 minutes. Evaluate the resistance of the specimen to blocking by the scale given below:

1 -- *No Blocking*. Cloth surfaces are free and separate without any evidence of cohesion or adhesion.
2 -- *Trace Blocking*. Cloth surfaces show slight cohesion or adhesion.
3 -- *Slight Blocking*. Cloth surfaces must be lightly peeled to separate.
4 -- *Blocking*. Cloth surfaces separate with difficulty or coating is removed during separation.

7/ The test specimen of coated fabric shall be a 8 in. (203 mm) square with edges oriented parallel to the warp and filling directions of the coated fabric. The specimen shall be exposed in the low-temperature chamber at the specified temperature within a tolerance of $\pm$1°C ($\pm$ 1.8°F) for the specified conditioning time. Without removal from the chamber, the specimen shall be creased 180° in the center in the warp and filling directions respectively by folding slightly while lying on a flat smooth surface and running the center of the steel roller over the fold a single time. The face side of the cloth shall be toward the outside of the fold. The steel roller, approximately 5-1/2 in. (140 mm) in diameter, approximately 2 in (51 mm) wide, weighing 10 lb (4.5 kg), with a suitable handle guide shall be used. The specimen shall be opened between the two creasing operations. The pressure on the specimen shall be the weight of the roller. The temperature of the roller shall be the same as that of the specimen. The specimen shall be handled with gloves and care taken that its temperature remains uniform throughout the test. The specimen shall be removed from the chamber and visually examined for signs of coating cracking or flaking. Unless otherwise specified, at least three specimens from the sample of material shall be tested. Results of tests shall be expressed as "pass" or "fail" as exhibiting visible coating cracking.
8/ Except that 2-inch wide reinforced coating adhesion specimens, cyanoacrylate (solventless) adhesive, and pulling clamp speed of 5 mm/s shall be used. The test shall be performed on the face side of the cloth.
9/ Method 5903 of FED-STD-191 unless NFPA testing is required. When NFPA testing is required, the test shall be conducted in accordance with NFPA 701, Test Method 2.

5.3 Reflective intensity.

5.3.1 Apparatus. Arrangement of the apparatus for the retroreflectivity test shall be as shown in Figure 1. A light projector having a lens diameter of 1 to 3 inches and capable of projecting a uniform field of light shall be used to illuminate the specimens. The source of illumination shall be a 750 watt projection lamp having a color temperature in the range of 2850° to 3250°K. The level of illumination at the specimen surface as measured with a light meter shall be 4 to 6 foot candles (3.75 to 5 foot lamberts). The light reflected from the test specimen surface (specimen brightness) shall be measured using a photoelectric receiver whose response can be read in foot lamberts either directly for from a calibration chart. The photoelectric receiver shall be a cadmium sulphide cell or one having response characteristics comparable to that of cadmium sulphide. The photoelectric receiver shall be capable of reading accurately to 0.01 foot lamberts at the smallest incidence angles (i.e., at the lowest brightness levels). The apeture of the receiver shall be such as to provide an acceptance angle of 1 degree and an overall viewing angle of 21 degrees. The active area of the receiver shall be mounted normal to the beam of retroreflected light. The surface for mounting the test specimen shall be a black nonreflecting surface larger than the specimen to be tested.

5.3.2 Specimen. The specimen shall be not less than 1 ft square and shall be mounted in an 18-inch by 18-inch holder in nonreflective black color. The holder shall be mounted on a turntable or similar device to provide the required angles of incidence as indicated in Tables II and III.

5.3.3 Procedure. With the test apparatus set in a darkened room, mount the specimen on the black mounting surface so that the surface of the specimen being tested shall be 50 feet $\pm$ 2 inches from the projector lens and the receiver. Turn on the projector and adjust it so that the incident light falls entirely on the specimen surface. Measure the illumination incident on the receiver due to reflection from the test surface at six angles of incidence for each angle of divergence. Read the reflected brightness expressed in light level values directly from the light meter at each angle of incidence for each angle of divergence. Take the average of three determinations and convert this average value to reflective brightness in foot lamberts by the use of tables or charts supplied with the reflective brightness meter.

5.4 Color matching. The color of the cloth shall match the standard sample when viewed under filtered tungsten lamps that approximate artificial daylight and that have a correlated color temperature of 7500 $\pm$ 200°K, with illumination of 100 $\pm$ 20 foot candles, and shall be a good match to the standard sample under incandescent lamplight at 2300 $\pm$ 200°K.

5.5 Yard-by-yard examination. The required yardage of each roll in the sample shall be examined on one side only for the defects listed below, however the side shall be alternated for every other roll examined. The same yardage shall be given a through-light inspection for pinholes and thinly coated areas. The through-lighting inspection shall be

performed in accordance with paragraph 5.5.1. The defects found shall be counted regardless of their proximity to each other, except where two or more defects represent a single local condition of the cloth, in which case only the more serious defect shall be counted. A continuous defect shall be counted as one defect for each warpwise yard or fraction thereof in which it occurs. The sample unit shall be 1 linear yard. The number of yards from which the sample yardage shall be selected shall be as follows:

Lot Size (yards)	Sample Size (Rolls)
Up to 1,200 inclusive 1/	3
1,201 to 3,200 inclusive	5
3,201 to 10,000 inclusive	8
10,001 to 35,000 inclusive	13
35,001 to 150,000 inclusive	20
150,001 and over	32

1/ If a lot contains fewer than 3 rolls, each roll in the lot will be examined.

5.5.1 Through-light inspection. The through-light inspection shall be performed in a darkened area using the lighting table described as follows: The light table shall have a clear glass top and shall be illuminated with a minimum of two 25-watt fluorescent tubes. The tubes shall be positioned 9 to 10 inches below the glass top and 6 to 8 inches from the sides of the light housing. The spacing between the tubes shall be 5 to 6 inches and the interior of the light housing shall be white. During the examination when the surface of the coated cloth is in contact with the light table, the illumination in the darkened room shall be 20, +/- 5 foot candles of natural or artificial light.

5.6 Defects. The cloth shall be examined for the following defects: Any hole, cut, pinhole, tear, scratch or abrasion mark; Any blister or delamination; Any lump; Any crease or wrinkle resulting in fold, pleat or doubling or adhesion of surfaces that cannot be corrected by manual pressure; Any film or coating missing to expose the base cloth; Any spot, stain or streak more than 1 inch in combined directions, clearly visible at normal inspection distance (3 feet); Any objectionable odor (odors of chemicals commonly used in coating compounds shall not be regarded as objectionable); Width specified not within a tolerance of $\pm$ 1/2 inch; Broken or missing yarn clearly visible at normal inspection distance (3 feet) by either direct viewing or through-lighting; 3 or more contiguous broken or missing yarns of any length; Crease or wrinkle of single ply film or coating or any crease wrinkle or bunching of base cloth that cannot be corrected by manual pressure; Any embedded foreign matter clearly visible at normal inspection distance (3 feet); by either direct viewing or through-lighting; Color not as specified; Color not uniform or is mottled, blotchy or spotted; Selvages not removed on the type I coated cloth, edges not cut straight, folded or rolled; Bonded edges of the type II bonded cloth, strip or tape less than 1/8 inch or more than 1/4 inch in width; Face side of reflectorized film bonded to face side of backing cloth (Type II only); Back side of reflectorized film bonded to back side of backing cloth (Type II only); Reflectorized film not securely fastened to backing cloth (Type II only); Uneven thickness of film or coating clearly noticeable. Any tackiness (film or coating shall not block so as to cause surfaces

to adhere and not unroll readily); Edges rolled, folded, scalloped, or corded; Not evenly laminated or coated; Any roll not having the coated side of the cloth facing the inside of the roll.

5.7 Length examination. Each individual roll in the sample shall be examined for the defects listed below. If the total number of defects in the sample roll exceeds the maximum number of defects specified below, the lot shall be rejected.

Any roll containing more than two pieces.
Any piece in roll less than 25 yards.
Any roll with a total length of less than 80 yards or more than 125 yards.
Any roll with a total length more than two yards less than that marked on ticket.
End of pieces in roll not overlapped.
End of pieces in roll joined by a seam.

5.8 Acceptance criteria. Acceptance criteria shall be as specified in the contract or purchase order.

6. PACKAGING

6.1 Preservation, packing and marking. The preservation, put–up, packing and marking shall be as specified in the contract or order.

7. NOTES

7.1 Source of Government Documents. Copies of Military and Federal documents are available from:

Standardization Documents Order Desk
Bldg. 4D
700 Robbins Avenue
Philadelphia, PA 19111-5094

FED-STD-191 - Federal Standard for Textile Test Methods

7.2 Sources of Nongovernment Documents.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM-D-751	-	Standard Test Methods for Coated Fabrics
ASTM-D-1424	-	Tear Resistance of Woven Fabrics by Falling Pendulum (Elmendorf) Apparatus
ASTM-D-1776	-	Practice for Conditioning Textiles for Testing

ASTM-D-3776	-	Mass Per Unit Area (Weight) of Fabric
ASTM-D-5034	-	Breaking Force, and Elongation of Textile Fabrics
ASTM-D-5035	-	Breaking Force, and Elongation of Textile Fabrics (Strip Test)

(Applications for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19426-2959.)

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
TECHNICAL MANUAL

AATCC Gray Scale For Color Change

AATCC Chromatic Transference Scale

AATCC-16	-	Colorfastness to Light of Textile Materials
AATCC-61	-	Colorfastness to Laundering, Home and Commercial: Accelerated
AATCC-111	-	Weather Resistance: Sunshine Arc Lamp Exposure With Wetting

(Applications for copies of referenced documents should be addressed to the American Association of Textile Chemists and Colorists, PO Box 12215, Research Triangle Park, NC 27709-2215.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 - Fire Tests for Flame Resistant Textiles and Films

(Applications for copies should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269)

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI Method T-451	-	Flexure Properties of Paper (Clark Stiffness)

(Application for copies should be addressed to TAPPI Press, Technology Park/Atlanta, P.O. Box 105113, Atlanta, GA 30348-5113.)

7.3 Ordering Data Acquisition documents should specify the following:

a. Title, Number, and date of this document.
b. Type and class required (see 2)
c. Acceptance criteria (see 5.8)
d. Selection of packaging, preservation, put-up, and marking (see 6.1)

7.4 Standard sample. Standard color samples of the reflectorized cloth may be obtained from the contracting activity. For coated cloth, roll number 1439 may be used as a reference standard for calibration. Roll number 1439 has the following readings when measured with the equipment referenced.

Entrance angle degree	0.5^o	2.0^o
-4	225	21
+10	182	30
+20	182	21
+30	175	21
+40	160	14
+50	130	11

Reflectivity values. The values contained in 3.3 were obtained by measurement of retroreflective materials conforming to this document using the following equipment:

Illumination meter – Huygen Corp., Model 615
Sample holder – 18 inch by 18 inch frame on turntable calibrated in angles of incidence in accordance with receiver positions controlled by extended arm graduated in angles of divergence as given in 3.3.

Conversion from light level readings to foot lamberts. The conversion from light readings on the Pentax meter to foot lamberts was in accordance with the following table:

Light level	Foot lamberts
3	0.25
4	0.50
5	0.97
6	1.9
7	4.0
8	7.8
9	15.7
10	31.4
11	62.8
12	125

Light level	Foot lamberts
13	251
14	502
15	1004
16	2009
17	4019
18	8038 .

7.5 Sources of Supply. Manufactures Whose Products are know to meet the requirements of this CID are listed below, but these manufactures may not produce all types; however, competition is not limited to these companies.

Durcote Corporation
350 N. Diamond Street
Ravenna OH 44266-2155

Bond Cote Corp
Pulaski County Corp. Center
4090 Pepperell Way
Dublin, VA 24084

Protective Plastics INC
1200 Woodruff RD.
Suite f-15
Greenville,SC 29607

CIVIL AGENCY COORDINATING ACTIVITY:
GSA - FSS

Custodians:
Army - GL
Air Force – 99

Review activities:
Army - MD
Air Force – 45, 82

Preparing activity
DLA-CT
Project No. 8305-0728

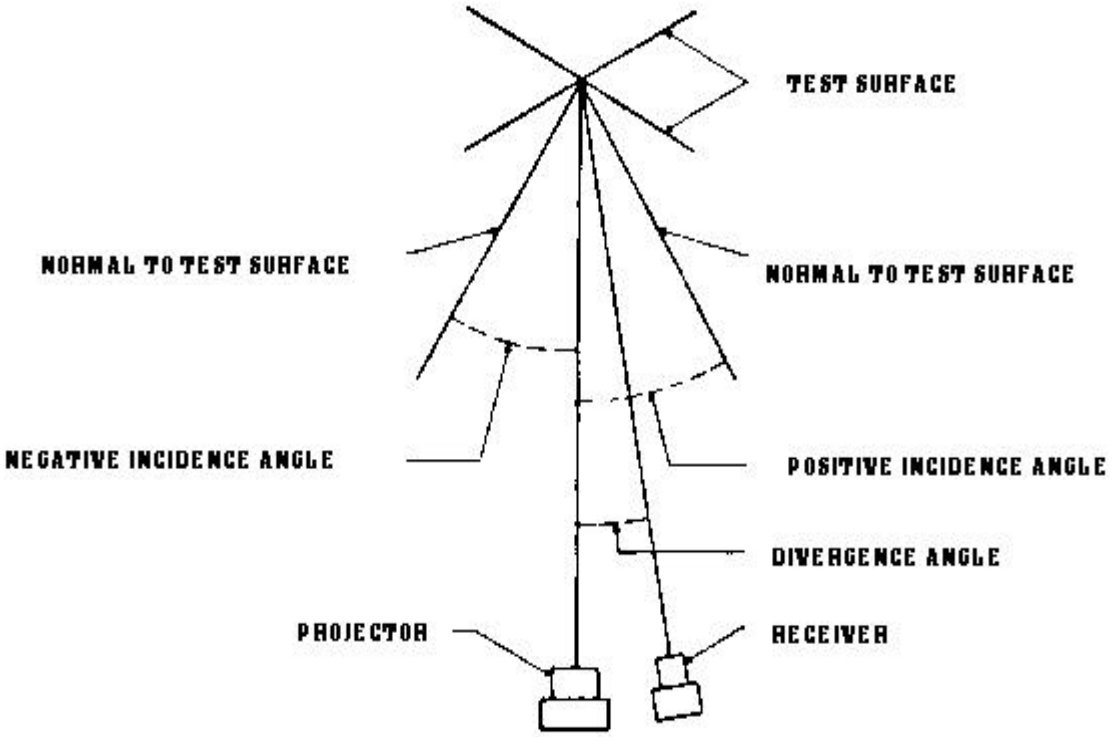

Figure I - Incidence and Divergence Angles