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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 3500D
Superseding AMS 3500C

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LEATHER, CHROME-VEGETABLE RETANNED, CATTLE HIDE
Fuel and Hot Oil Resistant

1. SCOPE:

1.1 Form: This specification covers leather tanned with chromium salts and retanned with vegetable tanning material.

1.2 Application: Primarily for parts, such as packings, washers, and back-up rings, requiring resistance to fuel and to hot, petroleum-base lubricating oil.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D471 - Rubber Property - Effect of Liquids
ASTM D573 - Rubber - Deterioration in an Air Oven
ASTM D2209 - Tensile Strength of Leather
ASTM D2617 - Total Ash in Leather
ASTM D2807 - Chromic Oxide in Leather (Perchloric Acid Oxidation)
ASTM D2810 - pH of Leather
ASTM D2813 - Sampling Leather for Physical and Chemical Tests
ASTM D2868 - Nitrogen Content (Kjeldahl) and Hide Substance Content of Leather

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material and Fabrication: The product shall consist of butt ends close trimmed from green salted steer hides, tanned with chromium salts and retanned with vegetable tanning material. The tanning process shall be such that, in retanning with vegetable tanning material, the leather will be tanned throughout so that examination of a cross-section will show no indication of a chrome streak. The tanning process shall also preserve the highest percentage of natural fiber of the butt and bring the fiber into closest contact.

3.1.1 Impregnation: Leather shall not be impregnated except for the greases and oils used in currying.

3.1.2 Color: No dyes except the tanning agents shall be used.

3.1.3 Composition: Leather shall conform to the following requirements; tests shall be performed on the product supplied and in accordance with specified test methods, insofar as practicable:

3.1.3.1	Hide Substance	40 - 60%	ASTM D2868
3.1.3.2	Vegetable Tanning Material	20 - 35%	4.5.1
3.1.3.3	Petroleum Ether Extract	10 - 18%	4.5.2
3.1.3.4	Total Ash, max	7%	4.5.3
3.1.3.5	Chromic Oxide (Cr_2O_3), min	3%	4.5.4
3.1.3.6	Acidity (pH), min	3.0	ASTM D2810
3.1.3.7	Glucose	None	4.5.1

3.2 Properties: Leather shall conform to the following requirements; tests shall be performed on the product supplied and in accordance with specified test methods, insofar as practicable:

3.2.1 As-Received:

3.2.1.1	Tensile Strength:	ASTM D2209
	Minimum Average of 5 specimens	2500 psi (17.0 MPa)
	Individual Minimum	2000 psi (14.0 MPa)

3.2.1.2 Deflection, max	0.63 in. (16.0 mm)	4.5.5
3.2.1.3 Bend 180 deg	No cracks	4.5.6
3.2.2 Fuel Resistance:		4.5.7
3.2.2.1 Deflection, max	0.63 in. (16.0 mm)	
3.2.2.2 Bend 180 deg	No cracks	
3.2.3 Lubricating Oil Resistance:		4.5.8
3.2.3.1 Linear Shrinkage, max	15%	
3.2.3.2 Bend 180 deg	No cracks	
3.2.4 Water Resistance:		4.5.9
3.2.4.1 Deflection, max	0.63 in. (16.0 mm)	
3.2.4.2 Bend 180 deg	No cracks	
3.2.5 Dry Heat Resistance:		4.5.10
3.2.5.1 Deflection, max	0.63 in. (16.0 mm)	
3.2.5.2 Linear Shrinkage, max	5%	
3.2.5.3 Bend 180 deg	No cracks	

3.2.6 Forming: Leather shall be capable of being formed without tearing, cracking, or noticeably wrinkling.

3.2.7 Oozing: Leather shall not ooze on flat surfaces or edges. Leather showing evidence of oozing within six months of receipt by purchaser shall be subject to rejection.

3.3 Quality:

3.3.1 Leather, as received by purchaser, shall be firm and solid, free from shoulder and belly portions and from holes, slaughter cuts, brand marks, deep wrinkles, soft, harsh, raw, or spongy spots, grub holes, and other imperfections detrimental to usage of the leather.

3.3.2 Leather shall be full grain with the flesh side smooth and free from loose flesh. Leather may be shaved to an even thickness. The grain side shall be tight, smooth, and free from soapstone, chalk, or other smoothing material.

3.3.3 Leather shall be free from hard spots or grit that will scratch polished metal surfaces.

3.4 Tolerances: A variation in thickness of ±0.016 in. (0.40 mm) will be permitted.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of leather shall supply all samples for vendor's tests and shall be responsible for performing all Ø required tests. Results of such tests shall be reported to the purchaser as required by 4.6. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the leather conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for Ø composition (3.1.3), properties as received (3.2.1), and fuel resistance (3.2.2) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests Ø and shall be performed prior to or on the initial shipment of leather to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when Ø requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with ASTM D2813 and as follows:

4.3.1 For Acceptance Tests: Each lot of leather shall be 100% visually examined for quality (3.3) and sampled at random for all other tests, with the Ø number of determinations for each requirement to be as specified in the applicable test procedure, or, if not specified therein, not less than three.

4.3.1.1 A lot shall be all leather produced in a single production run under the Ø same fixed conditions and presented for vendor's inspection at one time. An inspection lot shall not exceed 500 sq ft (50 m^2).

4.3.1.2 When a statistical sampling plan and acceptance quality level (AQL) have Ø been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6.1 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.
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4.4 Approval:

4.4.1 Sample leather shall be approved by purchaser before leather for production use is supplied, unless such approval be waived by purchaser. Results of tests on production leather shall be essentially equivalent to those on the approved leather.

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production leather which are essentially the same as those used on the approved sample leather. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material or processing, or both, and, when requested, sample leather. Production leather made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Vegetable Tanning Material and Glucose: Shall be determined by procedures agreed upon by purchaser and vendor.

4.5.2 Petroleum Ether Extract: Dice 10 - 12 g of leather into approximately 0.13 in. (3 mm) cubes. Place in a weighed weighing bottle and dry at 100° - 105°C (210° - 220°F) for not less than 16 hours. Cool and weigh the dried leather and bottle. Transfer the dried leather to a Soxhlet extraction thimble. Add 200 mL of petroleum ether to a weighed 250 mL flask. Assemble the Soxhlet apparatus to the flask and adjust the heat so that the siphon chamber fills in about 15 minutes. Complete 20 - 25 extraction cycles. Cool the apparatus, remove the extraction thimble, wash the siphon chamber with 25 mL of petroleum ether, and add the washings to the flask. Evaporate the ether on a steam bath, dry the flask for 30 - 35 min. at 100° - 105°C (210° - 220°F), cool, and weigh. Calculate the petroleum ether extract (evaporation residue in the flask) as a percentage of the dried weight of the leather.

4.5.3 Total Ash: Air dry the extracted leather (from the Soxhlet thimble of 4.5.2) for 10 - 15 min. and oven dry for 30 - 35 min. at 100° - 105°C (210° - 220°F). Determine ash content of the extracted, dried leather in accordance with ASTM D2617.

4.5.4 Chromic Oxide: Shall be determined in accordance with ASTM D2807 on the ash from 4.5.3.

4.5.5 Deflection: Cut specimens approximately (0.13 x 1 x 3 in. (3 x 25 x 75 mm). Support specimen as a horizontal cantilever beam, with flesh side down, with 2.50 in. (62.5 mm) of free span. Attach a 45-g weight to the midwidth of the strip at a distance of 2 in. (50 mm) from the supported end. Measure the resultant deflection from horizontal at the end of the strip. This test applies only to leather nominally 0.13 in. (3 mm) thick but other thicknesses shall be of the same grade of leather.

4.5.6 Bending: Specimens shall be bent at room temperature around a diameter equal to two times the nominal thickness of the leather with the flesh side of the leather on the inside of the bend.

4.5.7 Fuel Resistance: Specimens shall be immersed in ASTM Reference Fuel A for 60 min. ± 2 at 20° - 30°C (68° - 86°F) in accordance with ASTM D471. After removal, specimens shall be allowed to rest for 60 min. ± 5. Deflection and bending tests shall be conducted in accordance with 4.5.5 and 4.5.6.

4.5.8 Oil Resistance: Specimens shall be immersed in ASTM Oil No. 1 for 120 sec ± 15 at 225°C ± 3 (440°F ± 5) in accordance with ASTM D471. Shrinkage shall be measured immediately after removal. Bending tests shall be conducted in accordance with 4.5.6.

4.5.9 Water Resistance: Specimens shall be immersed in boiling water for 10 min. ± 1 in accordance with ASTM D471. Shrinkage shall be measured immediately after removal. Specimens shall be allowed to rest for 60 min. ± 5 and subjected to deflection and bending tests in accordance with 4.5.5 and 4.5.6.

4.5.10 Dry Heat Resistance: Specimens shall be aged in accordance with ASTM D573 for 60 min. ± 2 at 95°C ± 1 (200°F ± 2). Shrinkage shall be measured immediately after removal from the oven. Specimens shall be allowed to rest for 60 min. ± 5 and subjected to deflection and bending tests in accordance with 4.5.5 and 4.5.6.

4.6 Reports:

4.6.1 The vendor of leather shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the leather conforms to the other technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 3500D, and quantity.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 3500D, contractor or other direct supplier of leather, part number, and quantity. When leather for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of leather to determine conformance to the requirements of this specification and shall