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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 3631A

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Superseding AMS 3631

PLASTIC EXTRUSIONS, FLEXIBLE, HIGH TEMPERATURE
Polyvinyl Chloride

1. SCOPE:

1.1 Form: This specification covers a polyvinyl chloride (PVC) plastic in the form of extruded tubing, cord, tape, and shapes.

1.2 Application: Primarily as sleeving on wire or as bus bar insulation, particularly where transparency of the sleeve is desired, for operating temperatures up to 120°C (250°F).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications 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 D149 - Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D471 - Rubber Property - Effect of Liquids
ASTM D570 - Water Absorption of Plastics
ASTM D573 - Rubber - Deterioration in an Air Oven
ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D876 - Testing Nonrigid Vinyl Chloride Polymer Tubing Used for Electrical Insulation
ASTM G21 - Determining Resistance of Synthetic Polymeric Materials to Fungi

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: Shall be polyvinyl chloride (PVC) or one of its co-polymers and shall contain no mercury compounds.

3.2 Color: Colorless and transparent. Colored transparent, translucent, or opaque material shall be furnished only when specified.

3.2.1 Material shall be considered colorless if the color identification of the wire inside the tubing is legible and shall be considered transparent if other identification marking on the wire inside the tube is legible.

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

3.3.1	Tensile Strength, minimum	1,800 psi (12.5 MPa)	ASTM D876
3.3.2	Elongation, minimum	250%	ASTM D876
3.3.3	Water Absorption (24 hours immersion), change in weight, maximum	1.5%	ASTM D570
3.3.4	Flammability, time to cease burning, maximum (See 8.2)	15 sec	4.5.1
3.3.5	Dielectric Strength (short time test)		ASTM D876 (tubing) ASTM D149 (other forms)
	Under 0.020 inch (0.51 mm) thick, minimum	750 V per mil (29,525 V/mm)	
	0.020 inch (0.51 mm) thick and over, minimum	15,000 V per mil (590,550 V/mm)	
3.3.6	Fungus Resistance:	Rating of 1 or less	ASTM G21
3.3.7	Petroleum Hydraulic Oil Resistance: (Immediate Deteriorated Properties)		ASTM D471 Medium: ASTM Oil No. 3 Temperature: 100°C + 1 (212°F ± 2) Time: 8 hours ± 0.25
3.3.7.1	Shrinkage, Lengthwise, maximum	10%	

3.3.7.2	Bend, 180 degrees around 0.25 inch (6.25 mm) dia at approximately 60 degrees per second at room temperture	No cracking	4.5.2
3.3.7.3	Decomposition	None	
3.3.7.4	Surface Tackiness	None	
3.3.8	Dry Heat Resistance:		ASTM D573 Temperature: 130°C ± 1 (266°F ± 2) Time: 2 hours ± 0.25 4.5.2
3.3.8.1	Shrinkage, Lengthwise, maximum	10%	
3.3.8.2	Surface Tackiness	None	
3.3.8.3	Loss of Transparency	Negligible	
3.3.9	Low-Temperature Brittleness:		4.5.3
3.3.9.1	At -32°C ± 1 (-26°F ± 2), as received	Pass	

3.3.10 Weathering: When specified, extrusions shall have weather resistance acceptable to purchaser, determined by a procedure agreed upon by purchaser and vendor.

3.3.11 Corrosion: Extrusions shall not have a corrosive effect on other materials when exposed to conditions normally encountered in service, determined by a procedure agreed upon by purchaser and vendor. Discoloration of metal shall not be considered objectionable.

3.4 Quality: Extrusions, as received by purchaser, shall be uniform in quality and condition, smooth, and free from foreign materials and from imperfections detrimental to their use.

3.5 Tolerances:

3.5.1 Tubing: Shall conform to Table I; for intermediate nominal ID, use the tolerance for the next larger size:

TABLE I

Nominal ID Inches	ID, Inches min	ID, Inches max	Nominal Wall Thickness Inch	Wall Thickness Tolerance, Inch Plus and Minus
0.022	0.020	0.027	0.012	0.002
0.027	0.025	0.032	0.012	0.002
0.034	0.032	0.039	0.016	0.003
0.042	0.040	0.049	0.016	0.003
0.053	0.051	0.061	0.016	0.003
0.066	0.064	0.072	0.016	0.003
0.085	0.081	0.089	0.016	0.003
0.095	0.091	0.101	0.016	0.003
0.106	0.102	0.112	0.016	0.003
0.118	0.114	0.124	0.020	0.003
0.133	0.129	0.141	0.020	0.003
0.148	0.144	0.158	0.020	0.003
0.166	0.162	0.178	0.020	0.003
0.186	0.182	0.198	0.020	0.003
0.208	0.204	0.224	0.020	0.003
0.234	0.229	0.249	0.020	0.003
0.263	0.258	0.278	0.020	0.003
0.294	0.289	0.311	0.020	0.003
0.330	0.325	0.347	0.020	0.003
5/16	0.312	0.334	0.025	0.003
3/8	0.375	0.399	0.025	0.003
7/16	0.438	0.462	0.025	0.003
1/2	0.500	0.524	0.025	0.003
5/8	0.625	0.655	0.030	0.003
3/4	0.750	0.786	0.035	0.005
7/8	0.875	0.911	0.035	0.005
1	1.000	1.036	0.035	0.005
1-1/4	1.250	1.290	0.040	0.005
1-1/2	1.500	1.550	0.045	0.006
1-3/4	1.750	1.812	0.055	0.008
2	2.000	2.070	0.060	0.010
2-1/4	2.250	2.330	0.065	0.010
2-1/2	2.500	2.590	0.070	0.010

TABLE I (SI)

Nominal ID, Millimetres	ID, Millimetres min	ID, Millimetres max	Nominal Wall Thickness Millimetres	Wall Thickness Tolerance, Millimetre Plus and Minus
0.56	0.51	0.69	0.30	0.05
0.69	0.64	0.81	0.30	0.05
0.86	0.81	0.99	0.41	0.08
1.07	1.02	1.24	0.41	0.08
1.35	1.30	1.55	0.41	0.08
1.68	1.63	1.83	0.41	0.08
2.16	2.06	2.26	0.41	0.08
2.41	2.31	2.57	0.41	0.08
2.69	2.59	2.84	0.41	0.08
3.00	2.90	3.15	0.51	0.08
3.38	3.28	3.58	0.51	0.08
3.76	3.66	4.01	0.51	0.08
4.22	4.11	4.52	0.51	0.08
4.72	4.62	5.03	0.51	0.08
5.28	5.18	5.69	0.51	0.08
5.94	5.82	6.32	0.51	0.08
6.68	6.55	7.06	0.51	0.08
7.47	7.34	7.90	0.51	0.08
8.38	8.26	8.81	0.51	0.08
7.94	7.92	8.48	0.64	0.08
9.52	9.52	10.13	0.64	0.08
11.11	11.12	11.73	0.64	0.08
12.70	12.70	13.31	0.64	0.08
15.88	15.88	16.64	0.76	0.08
19.05	19.05	19.96	0.89	0.13
22.22	22.22	23.14	0.89	0.13
25.40	25.40	26.31	0.89	0.13
31.75	31.75	32.77	1.02	0.13
38.10	38.10	39.37	1.14	0.15
44.45	44.45	46.02	1.40	0.20
50.80	50.80	52.58	1.52	0.25
57.15	57.15	59.18	1.65	0.25
63.50	63.50	65.79	1.78	0.25

3.5.2 Tape: Shall conform to Tables II and III.

3.5.2.1 Width:

TABLE II

Nominal Width Inches	Tolerance, Inch Plus and Minus
Up to 0.500, incl	0.016
Over 0.500 to 0.625, incl	0.020
Over 0.625 to 0.750, incl	0.025
Over 0.750 to 1.000, incl	0.032
Over 1.000 to 1.250, incl	0.040
Over 1.250 to 2.000, incl	0.064

TABLE II (SI)

Nominal Width Millimetres	Tolerance, Millimetres Plus and Minus
Up to 12.70, incl	0.41
Over 12.70 to 15.88, incl	0.51
Over 15.88 to 19.05, incl	0.64
Over 19.05 to 25.40, incl	0.81
Over 25.40 to 31.75, incl	1.02
Over 31.75 to 50.80, incl	1.63

3.5.2.2 Thickness:

TABLE III

Nominal Thickness Inch	Tolerance, Inch Plus and Minus
Up to 0.019, incl	0.005
Over 0.019 to 0.031, incl	0.008
Over 0.031	0.010

TABLE III (SI)

Nominal Thickness Millimetre	Tolerance, Millimetre Plus and Minus
Up to 0.48, incl	0.13
Over 0.48 to 0.79, incl	0.20
Over 0.79	0.25

3.5.3 Cord: Shall conform to Table IV.

TABLE IV

Nominal Dimension Inch	Tolerance, Inch Plus and Minus
Up to 0.156, incl	0.005
Over 0.156 to 0.188, incl	0.008
Over 0.188	0.010

TABLE IV (SI)

Nominal Dimension Millimetres	Tolerance, Millimetre Plus and Minus
Up to 3.96, incl	0.13
Over 3.96 to 4.78, incl	0.20
Over 4.78	0.25

4. QUALITY ASSURANCE PROVISIONS:

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

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for Ø tensile strength (3.3.1), elongation (3.3.2), dielectric strength (3.3.5), loss of transparency (3.3.8.3), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical Ø requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of extrusions to a purchaser, when a change in material, 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, contracting officer, or request for procurement.

4.3 Sampling: Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient extrusions shall be taken at random from Ø each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 Ø A lot shall be all extrusions produced in a single production run from the same batches of raw materials under the same fixed conditions or all material subjected to the same unit chemical or physical processes intended to make the final product homogeneous, and presented for vendor's inspection at one time. An inspection lot shall not exceed 500 pounds (227 kg) and may be packaged in smaller quantities and delivered under the basic lot approval provided that the lot identification is maintained.

4.3.1.2 Ø When a statistical sampling plan and acceptance quality level (AQL) have 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 Ø For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

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

4.4.2 Ø Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production extrusions which are essentially the same as those used on the approved sample extrusions. 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, processing, or both, and, when requested, sample extrusions. Production extrusions made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Flammability: Shall be determined in accordance with ASTM D876. When forms other than tubing are tested, the specimen shall be wrapped around the wire or otherwise held at the same angle as for tubing.

4.5.2 Petroleum Hydraulic Oil and Dry Heat Resistance Specimens: Shall be 6 inches (152 mm) long and in full section wherever possible. Tubing may be split if desired.

4.5.3 Ø Low-Temperature Embrittlement: Shall be determined in accordance with ASTM D746. Test specimens shall have thickness of 0.20 inch ± 0.003 (0.51 mm ± 0.08), except that samples which are too small to provide standard test specimens may be tested in the full section.