SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS3380 | REV. D

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Reaffirmed 2012-12

Superseding AMS3380C

Hose, Polytetrafluoroethylene TFE Fluorocarbon Resin Wire Braid Reinforced

RATIONALE

AMS3380D has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 Form: This specification covers a polytetrafluoroethylene resin in the form of extruded and sintered flexible tube reinforced with wire braid.

1.2 Application: Primarily for fluid lines operating in service up to 230°C (446°F) and under pressures up to 1500 psi (10,342 kPa).

1.3 Safety - Hazardous Materials: While the materials, methods, applications and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

AMS 3160 - Solvent, Petroleum

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS3380D

2.1.2 Aerospace Recommended Practices:

ARP1153 - Method for Determining Relative Specific Gravity of Polytetrafluoroethylene Tubing

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 412 - Rubber Properties in Tension
ASTM D 471 - Rubber Property - Effect of Liquids
ASTM D 792 - Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 1457 - PTFE Molding and Extrusion Materials

2.3 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Federal Specifications:

TT-S-735 - Standard Test Fluids, Hydrocarbon

2.3.2 Military Specifications:

MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
MIL-H-83282 - Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft

2.3.3 Military Standards:

MIL-STD-2073-1 - DOD Material Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Material and Fabrication: Hose shall consist of a polytetrafluoroethylene (PTFE) tube and overlaying corrosion-resistant steel wire braid reinforcement.

3.1.1 Tube: Shall be a seamless, continuous extrusion of virgin polytetrafluoroethylene (PTFE) resin. Base resin shall conform to ASTM D 1457, Type III, Grade 2 or Grade 3. Pigments may be included in the compound from which the tube is extruded.

3.1.2 Reinforcement: Shall be of austenitic corrosion-resistant steel wire, uniform in quality and size, of sufficient strength to ensure that the hose will meet the requirements of this specification; it shall be evenly and firmly braided, and shall be free from dirt, lumps, and irregularities of braid. Hose under 0.875 inch (22.22 mm) in nominal ID shall have a single layer of braid; hose 0.875 inch (22.22 mm) and over in nominal ID shall have two layers of braid.

3.2 Properties:

3.2.1 Tube: The tube, before braiding or with reinforcement removed, shall conform to the following requirements; tests shall be conducted in accordance with specified test methods, insofar as practicable:

3.2.1.1	Tensile Strength at 25°C ± 1 (77°F ± 2), minimum		ASTM D 412 except separation speed 2 inches (51 mm) per minute for sizes 0.500 inch (12.70 mm) ID and under; ASTM D 1457 for larger sizes
	Longitudinal, All sizes	3000 psi (20.6 MPa)	
	Transverse, Sizes over 0.500 inch (12.70 mm) ID	2500 psi (17.2 MPa)	
3.2.1.2	Elongation at 25°C ± 1 (77°F ± 2), minimum	200%	As for tensile strength (3.2.1.1)
3.2.1.3	Specific Gravity		
3.2.1.3.1 Ø	Apparent Specific Gravity at 25°C ±1 (77°F ± 2)	2.125 - 2.23	ASTM D 792, Method A Add 2 drops of wetting agent to water
3.2.1.3.2	Relative Specific Gravity at 25°C ± 1 (77°F ± 2), maximum	2.210	ARP1153

3.2.1.4 Roll and Proof Pressure: Tube pigmented throughout the wall, and other types of tube when specified by purchaser, shall be subjected to the test of 3.2.1.4.1; all tubing shall be subjected to the test of 3.2.1.4.2.

3.2.1.4.1 Tube shall be passed, in a single pass, through six sets of metal rollers so that it is subjected to the following sequence of diametral flexings; rollers shall be arranged to prevent inadvertent rotation of the tube:

3.2.1.4.1.1 Roller angles specified in the following table assume that the tube is in a horizontal position and that pressure of the first set of rolls is exerted vertically; angles given for the final three sets of rolls may be taken as either clockwise or counterclockwise from the vertical diameter of the tube. A tolerance of ±2 degrees is allowed on each roller angle.

Phase	Type of Action	Roller Angle Degrees
A	Flattening	0
B	Flattening	90
C	Rounding	0
D	Flattening	45
E	Flattening	135
F	Rounding	45

3.2.1.4.1.2 Roller gaps shall be not larger than specified below for each size.

Size	Flattening Gap		Rounding Gap	
	Inch	Millimeters	Inches	Millimeters
3	0.203	5.16	0.218	5.54
4	0.218	5.54	0.218	5.54
5	0.218	5.54	0.250	6.35
6	0.218	5.54	0.312	7.92
8	0.234	5.94	0.375	9.52
10	0.250	6.35	0.500	12.70
12	0.250	6.35	0.500	12.70
16Z	0.250	6.35	0.750	19.05
20Z	0.312	7.92	0.875	22.22
24Z	0.375	9.52	1.250	31.75

3.2.1.4.2 Tube shall not leak, burst, or show other evidence of malfunction when held for not less than 2 minutes at a pressure not lower than the proof pressure shown in Table I, using water or air as the test medium; the pressure used shall be not higher than the minimum burst pressure value of that table. When the test of 3.2.1.4.1 is required, tubing shall be subjected to that test before being proof pressure tested.

TABLE I

Proof and Burst Pressures of Tube

Size	Nominal ID		Proof Pressure		Burst Pressure	
	Inches	Millimeters	psi	kPa	psi	kPa
3	0.125	3.18	390	2689	600	4137
4	0.188	4.78	360	2482	550	3792
5	0.250	6.35	290	1999	500	3447
6	0.313	7.95	230	1586	390	2689
8	0.406	10.31	180	1241	320	2206
10	0.500	12.70	170	1172	290	1999
12	0.625	15.88	140	965	220	1517
16Z	0.875	22.22	90	621	140	965
20Z	1.125	28.58	65	448	100	689
24Z	1.375	34.92	45	310	60	414

3.2.1.5 Burst Pressure: Tube shall not burst at any pressure lower than the burst pressure shown in Table I when pressure is applied at a uniform rate so as to reach the specified minimum burst pressure in 5 - 10 seconds and the rate of rise is maintained at the same rate until the tube bursts. Any suitable fluid may be used as the test medium. The tube shall be suitably clamped so as to prevent leakage but to permit axial movement of the tube during test.

3.2.1.6 Conductivity: Tube sizes 8 and smaller shall conduct a direct current of not less than 10 microamperes and sizes 10 and larger a current of not less than 20 microamperes with a test potential of 1000 volts, determined in accordance with 4.5.1.

3.2.2 Hose: Specimens of suitable length but not shorter than 9 inches (229 mm), cut from the complete hose, with suitable end fittings attached (except for the braid flare test) shall conform to the following requirements; tests shall be performed in accordance with specified test methods, insofar as practicable:

3.2.2.1 Braid Flare: A specimen shall fall, from the position specified in 4.5.2, through the specified ring and the sleeve normally used in making hose assemblies shall pass over the tube without interference from the braid.

3.2.2.2 Proof Pressure:

3.2.2.2.1 Hose shall not leak, burst, or show other evidence of malfunction when held at a pressure not lower than shown in Table II, column 3, for not less than 30 seconds and not more than 5 minutes. The pressure used shall be not higher than 50% of the minimum burst pressure in Table II, column 4.

TABLE II

Size (Col. 1)	Nominal ID Inches (Col. 2)	Proof Pressure psi (Col. 3)	Burst Pressure At Room Temperature psi (Col. 4)	Burst Pressure At 446°F psi (Col. 5)	Operating Pressure psi (Col. 6)
3	0.125	3000	12,000	7500	1500
4	0.188	3000	12,000	7000	1500
5	0.250	3000	10,000	6500	1500
6	0.313	3000	9,000	6500	1500
8	0.406	3000	8,000	6000	1500
10	0.500	3000	7,000	5500	1500
12	0.625	2000	5,000	3500	1000
16Z	0.875	2500	5,000	3500	1250
20Z	1.125	2000	4,000	3000	1000
24Z	1.375	2000	4,000	3000	1000

TABLE II (SI)

Size (Col. 1)	Nominal ID Millimeters (Col. 2)	Proof Pressure kPa (Col. 3)	Burst Pressure At Room Temperature kPa (Col. 4)	Burst Pressure At 230°F kPa (Col. 5)	Operating Pressure kPa (Col. 6)
3	3.18	20,684	82,737	51,711	10,342
4	4.78	20,684	82,737	48,263	10,342
5	6.35	20,684	68,948	44,816	10,342
6	7.95	20,684	62,052	44,816	10,342
8	10.31	20,684	55,158	41,369	10,342
10	12.70	20,684	48,263	37,921	10,342
12	15.88	13,790	34,474	24,132	6,895
16Z	22.22	17,237	34,474	24,132	8,618
20Z	28.58	13,790	27,579	20,684	6,895
24Z	34.92	13,790	27,579	20,684	6,895

3.2.2.2.2 Ø Hose shall not leak when given a final check by completely immersing in water, to which may be added a wetting agent or corrosion inhibitor or both, applying air or nitrogen pressure not lower than the operating pressure shown in Table II, column 6, but not higher than the proof pressure shown in Table II, column 3, and holding at lected pressure for not less than 30 seconds after stabilizing the pressure. If the test of 3.2.2.2.1 is conducted using air or nitrogen as the test medium, this test is not required.

3.2.2.3 Burst Pressure at Room Temperature: Hose shall not leak, burst, or show evidence of malfunction at any pressure lower than the values specified in Table II, column 4, when pressure is applied at rate of applied at a rate of increase of 15,000 - 25,000 psi per minute (1725 - 2870 kPa/second) with hose extended straight and the free end unrestrained.

3.2.2.4 Burst Pressure at 230°C(446°F): Hose shall not leak, burst, or show other evidence of malfunction at any pressure lower than the values specified in Table II, column 5, determined in accordance with 4.5.3 at 230°C ± 5 (446°F ± 9).

3.2.2.5 Change in Length Under Presssure: Hose shall not change in length by more than +0.20 inch (+5.1 mm) or -0.30 inch (-7.6 mm) in 10 inches (254 mm) at the operating pressure specified in Table II, column 6, determined in accordance with 4.5.4.

3.2.2.6 Impulse Test: Hose shall not burst, leak, or show other evidence of malfunction during 100,000 impulse cycles at 200°C ± 5 (392°F ± 9), determined in accordance with 4.5.5.

3.2.2.7 Stress Degradation: Hose shall not burst, leak, or show other evidence of malfunction during the sequence of tests specified in 4.5.6. The effusion rate during that portion of the cycle specified in 4.5.6.5 shall be not greater than the following:

Size	Nominal ID Inches	Nominal ID Millimeters	Effusion Rate mL per inch (25.4 mm)
3	0.125	3.18	10
4	0.188	4.78	8
5	0.250	6.35	8
6	0.313	7.95	8
8	0.406	10.31	4
10	0.500	12.70	2
12	0.625	15.88	2
16Z	0.875	22.22	2
20Z	1.125	28.58	2
24Z	1.375	34.92	2

3.2.2.8 Leakage: Hose shall not leak when subjected to the test of 4.5.7.

3.2.2.9 Fuel Resistance: Hose shall not leak or show other evidence of malfunction during the test of 4.5.8.

3.2.2.10 Flexibility: Hose shall withstand bending at -55°C ± 1 (-67°F ± 2) without cracking, breaking, or splitting, determined in accordance with 4.5.9.

3.2.2.11 Vacuum: Hose shall not collapse to the extent that a ball of the specified diameter will fail to pass through the hose and without showing other permanent damage, determined in accordance with 4.5.10.

3.2.2.12 Volumetric Expansion: Hose of sizes 3, 4, and 5 shall show a volumetric expansion not greater than specified below, determined at a pressure of 1000 psi (6895 kPa).

Size	Nominal ID Inch	Nominal ID Millimeters	Volumetric Expansion mL per inch free length	Volumetric Expansion Ml per mm Free length
3	0.125	3.18	0.028	1.10
4	0.188	4.78	0.028	1.10
5	0.250	6.35	0.040	1.57

3.2.2.13 Pneumatic Effusion: The average effusion rate through the hose and two fittings, measured over the last 8 hours of testing at each temperature, shall be not greater than shown in Table III, determined in accordance with 4.5.11.

TABLE III

Size	Nominal ID Inches	Effusion Rate mL per hour per foot of Length At Temperature Indicated			
		Room	-65°F	+275°F	+400°F
3	0.125	8.0	3.0	100	250
4	0.188	8.0	3.0	100	250
5	0.250	10.0	3.0	110	275
6	0.313	10.0	3.0	125	300
8	0.406	10.0	3.0	125	350
10	0.500	10.0	3.0	140	400
12	0.625	12.0	3.0	140	450
16Z	0.875	16.0	4.0	180	600
20Z	1.125	16.0	4.0	350	700
24Z	1.375	16.0	4.0	400	900

TABLE III (SI)

Size	Nominal ID Millimeters	Effusion Rate mL per hour per 100 mm of Length At Temperature Indicated			
		Room	-54°C	+135°C	+204°C
3	3.18	2.6	1.0	32.5	81.2
4	4.78	2.6	1.0	32.5	81.2
5	6.35	3.2	1.0	35.8	89.4
6	7.95	3.2	1.0	40.6	97.5
8	10.31	3.2	1.0	40.6	113.8
10	12.70	3.2	1.0	45.5	130.0
12	15.88	3.9	1.0	45.5	146.2
16Z	22.22	5.1	1.3	58.5	195.0
20Z	28.58	5.1	1.3	113.8	227.5
24Z	34.92	5.1	1.3	130.0	292.5

3.2.2.14 Pneumatic-Surge Test: There shall be no evidence of leakage a the end fittings of hose subjected to the rated proof pressure shown in Table II, column 3, after 16 cycles of pressurization and rapid depressurization, determined as in 4.5.12.

3.2 Quality: Hose, as received by purchaser, shall be uniform in quality and condition, smooth, and free from foreign materials and from imperfections detrimental to usage of the hose.

3.3.1 Broken or missing reinforcement wires and loops of wire extending above the surface a distance greater than one wire diameter are not acceptable; crossed over reinforcing wires are permissible.

3.3.2 Hose shall have a smooth bore and shall be free from pitting or projections on the inner surface of the tube.

3.4 Sizes and Tolerances:

3.4.1 Diameter and Wall Thickness: Hose shall be furnished in the sizes and to the dimensions shown in Table IV.

TABLE IV

Size	Nominal ID Inches	ID Tolerance Inch plus	ID Tolerance Inch minus	Tube Wall Thickness Inch	OD Over Braid Inches
3	0.125	0.025	0.000	0.035 - 0.047	0.237 - 0.268
4	0.188	0.015	0.015	0.035 - 0.047	0.304 - 0.343
5	0.250	0.015	0.015	0.035 - 0.047	0.356 - 0.406
6	0.313	0.015	0.015	0.035 - 0.047	0.430 - 0.469
8	0.406	0.015	0.015	0.038 - 0.050	0.546 - 0.585
10	0.500	0.015	0.015	0.042 - 0.054	0.641 - 0.687
12	0.625	0.020	0.010	0.042 - 0.054	0.766 - 0.812
16Z	0.875	0.031	0.024	0.042 - 0.054	1.078 - 1.140
20Z	1.125	0.031	0.024	0.045 - 0.057	1.328 - 1.390
24Z	1.375	0.031	0.031	0.065 - 0.077	1.637 - 1.707

TABLE IV (SI)

Size	Nominal ID Millimeters	ID Tolerance Millimeters plus	ID Tolerance Millimeters minus	Tube Wall Thickness Millimeters	OD Over Braid Millimeters
3	3.18	0.64	0.00	0.89 - 1.19	6.02 - 6.81
4	4.78	0.38	0.38	0.89 - 1.19	7.72 - 8.71
5	6.35	0.38	0.38	0.89 - 1.19	9.04 - 10.31
6	7.95	0.38	0.38	0.89 - 1.19	10.92 - 11.91
8	10.31	0.38	0.38	0.97 - 1.27	13.87 - 14.86
10	12.70	0.38	0.38	1.07 - 1.37	16.28 - 17.45
12	15.88	0.51	0.25	1.07 - 1.37	19.46 - 20.62
16Z	22.22	0.79	0.61	1.07 - 1.37	27.38 - 28.56
20Z	28.58	0.79	0.61	1.14 - 1.45	33.73 - 35.31
24Z	34.92	0.79	0.79	1.65 - 1.96	41.58 - 43.36

3.4.2 Length: Hose shall be furnished in the lengths shown in Table V but not more than 5% of a shipment shall be in 3-foot (914-mm) lengths.

TABLE V

Size	Percent of Shipment in Length Ranges Shown: 3 to 14 feet, (914 to 4267 mm), incl	Over 14 feet (4267 mm)
4 to 8 incl	35	65
10 to 16Z, incl	45	55
20Z to 24Z, incl	60	40

4. QUALITY ASSURANCE PROVISIONS:

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

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests of the tube for tensile strength (3.2.1.1), elongation (3.2.1.2), specific gravity (3.2.1.3), and roll and proof pressure (3.2.1.4) and of hose for braid flare (3.2.2.1), burst pressure at room temperature (3.2.2.3), change in length under pressure (3.2.2.5), and sizes and tolerances (3.4) are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of hose to a purchaser, when a change in ingredients and/or processing 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 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 and Testing: Shall be as follows: Ø

4.3.1 For Acceptance Tests:

4.3.1.1 Tube: Three specimens shall be selected from each lot of tube for tests for tensile strength, elongation, specific gravity, and proof pressure. A lot shall be all tube of the same size, produced from the same batch of polymer, extruded and sintered under essentially the same conditions, and presented for vendor's inspection at one time. When the roll test of 3.2.1.4.1 is required, the test shall be applied to 100% of the tube.

4.3.1.2 Hose: Three specimens shall be selected from each lot of hose for braid flare, burst pressure at room temperature, and change in length under pressure. A lot shall be not more than 3500 feet (1067 m) of hose of the same size produced from the same lot of tube and presented for vendor's inspection at one time.

4.3.2 For Preproduction Tests: Except where a specific number of samples is specified in 4.5, sampling shall be as agreed upon by purchaser and vendor.

4.4 Approval:

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

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

4.5 Test Methods:

4.5.1 Conductivity: A 14-inch (356-mm) length of tube, without braid, shall be washed on the ID with AMS 3160 or equivalent petroleum solvent and then with isopropyl alcohol and thoroughly dried at room temperature. The specimen shall be mounted for test as shown in Figure 1 and 1000 volts direct current shall be applied between the upper and lower electrodes. The electrodes shall be mercury or a saltwater solution. The saltwater solution shall consist of 450 grams sodium chloride (NaCl) in 1 liter chemically pure water. The current shall be measured with an instrument having sensitivity of less than 1 microampere. The temperature in the testing area shall be 16° - 32°C (61° - 90°F) and the relative humidity shall be less than 70%.

4.5.2 Braid Flare: Specimens not over 12 inches (305 mm) in length, shall be expanded at each end by forcing a plug of the diameter shown in the "Expansion Diameter A" column of Table VI into the ID of the hose for a distance of not less than 3/16 inch (4.8 mm). After expansion, the hose shall be inserted through a ring having an ID as shown in the "Maximum Flare Diameter B" column, Table VI, with the bottom of the flare extending 1/2 - 9/16 inch (12.7 - 14.3 mm) above the top of the ring. From this position, the hose shall be allowed to fall freely. The test shall be made not more than 15 minutes after cutting the specimen.

TABLE VI

Size	Nominal ID Inches	Expansion Diameter A Inches	Maximum Flare Diameter B Ring ID, Inches
3	0.125	0.155	0.375
4	0.188	0.230	0.500
5	0.250	0.300	0.560
6	0.313	0.370	0.625
8	0.406	0.475	0.750
10	0.500	0.585	0.875
12	0.625	0.720	1.000
16Z	0.875	0.995	1.400
20Z	1.125	1.270	1.700
24Z	1.375	1.545	1.950

TABLE VI (SI)

Size	Nominal ID Millimeters	Expansion Diameter A Millimeters	Maximum Flare Diameter B Ring ID, Millimeters
3	3.18	3.94	9.52
4	4.78	5.84	12.70
5	6.35	7.62	14.22
6	7.95	9.40	15.88
8	10.31	12.06	19.05
10	12.70	14.86	22.22
12	15.88	18.29	25.40
16Z	22.22	25.27	35.56
20Z	28.58	33.26	43.18
24Z	34.92	39.24	49.53

4.5.3 Burst Pressure at 230°C (446°F): Hose shall be filled with a suitable test fluid, such as ASTM Service Fluid No. 101 (Ref. ASTM D 471), at 230°C ± 5 (446°F ± 9) and maintained in ambient atmosphere at that temperature for 60 minutes ± 5. At the end of this period and while maintained at 230°C ± 5 (446°F ± 10), pressure shall be applied up to the operating pressure specified in Table II, column 6, and held for not less than 5 minutes; pressure shall then be raised at a rate of increase of 15,000 - 25,000 psi per minute (1724 - 2873 kPa/second) until failure.

4.5.4 Change in Length Under Pressure: Hose shall be held in a straight, unpressurized condition, a 10.000-inch ± 0.010 (254.00-mm ± 0.25) gage length marked on the hose, and the hose pressurized to the operating pressure specified in 3.2.2.5. After 5 minutes ± 0.5 and while still pressurized, the gage length shall be remeasured and the change in length calculated.

4.5.5 Impulse Test:

4.5.5.1 Three hose filled with MIL-H-83282 hydraulic fluid, or another fluid approved by purchaser, but under no pressure, and three hose empty and open shall be aged in an air oven for 168 hours ± 0.5 at 200°C ± 5 (392°F ± 9), and then used for test. The oil aged and air aged hose shall be subjected to the proof pressure shown in Table II, column 3, for not less than 5 minutes before being installed in the impulse tester.

4.5.5.2 Hose of size 12 and smaller shall be bent to the bend radius of 4.5.6.4 and assembled in the impulse tester in this position with both ends connected to rigid supports. Larger sizes shall be installed straight; one end may be left free.

4.5.5.3 Using MIL-H-83282 hydraulic fluid, or other fluid approved by purchaser, as the test fluid and with test fluid at 200°C ± 3 (392°F ± 5) and the ambient air at 200°C ± 5 (392°F ± 9), hose shall be subjected to 100,000 cycles of impulse applied at a frequency of 60 - 70 cycle per minute. Electronic devices shall be used to determine and control the impulse pressures within the limits shown in Figure 2. Peak pressure for sizes 16Z and smaller nominal ID shall be 125% of the operating pressure shown in Table II, column 6; peak pressure for the 20Z and 24Z sizes need not exceed 1,000 psi (6895 kPa).

4.5.6 Stress Degradation:

4.5.6.1 Two hose shall be filled with ASTM Service Fluid No. 101 (Ref. ASTM D 471) and heated in an oven at 230°C ± 5 (446°F ± 9) with internal pressure in the hose equal to the rated operating pressure shown in Table II, column 6, for not less than 20 hours. Pressure shall be released and hose removed from the oven.

4.5-6.2 Hose shall be drained, cooled to room temperature, and flushed with a quantity of ASTM Reference Fuel B (Ref. ASTM D 471) (TT-S-735, Type III) equal to at least twice the volume of the test specimen, drained, and refilled with ASTM Reference Fuel B (TT-S-735, Type III), and pressure equal to the rated operating pressure shown in Table II, column 6, again applied and maintained for not less than 2 hours.

4.5.6.3 The procedures of 4.5.6.1 and 4.5.6.2 shall be repeated, making a total of 2 complete cycles.

4.5.6.4 The hose shall then be filled with ASTM Reference Fuel B (TT-S-735, Type III) and individually capped. While at room temperature, the hose shall be bent around a mandrel having a radius equal to the minimum bend radius below and straightened 20 times. Hose shall be held by the fittings during bending. The procedures of 4.5.6.1 and 4.5.6.2 shall be repeated for a third time.

Size	Nominal ID		Bend Radius	
	Inches	Millimeters	Inches	Millimeters
3	0.125	3.18	2	51
4	0.188	4.78	2	51
5	0.250	6.35	2	51
6	0.313	7.95	4	102
8	0.406	10.31	4-5/8	117.5
10	0.500	12.70	5-1/2	139.7
12	0.625	15.88	6-1/2	165.1
16Z	0.875	22.22	7-3/8	187.3
20Z	1.125	28.58	11	279.4
24Z	1.375	34.92	14	355.6

4.5.6.5 Within 4 hours after the final 2-hour pressurization with fuel, the hose shall be drained, flushed with trichloroethane, and dried in an oven at 70°C ± 5 (158°F ± 9) for 60 minutes ± 5. Hose shall then, within 8 hours after completion of the drying process, be completely immersed in water containing no wetting agent, using the apparatus shown in Figure 3. Pressure equal to the rated operating pressure shown in Table II, column 6, shall be applied for 15 minutes ± 1, using dry air or nitrogen as the pressurizing medium; during this period, the shield of the test apparatus shall be closed. The shield of the test apparatus shall then be opened and the pressure maintained for an additional 5 minutes ± 0.2 during which time the effused gas shall be collected in 1-inch (25-mm) increments over the entire length of the hose from cone seat to cone seat. The effusion rate for each individual inch (25 mm) of length of hose shall be calculated.

4.5.6.6 After completion of the effusion rate test of 4.5.6.5, hose shall be filled with ASTM Service Fluid No. 101 and placed in a cold chamber for 8 hours ± 0.25 at -55°C ± 1 (-67°F ± 2); at the end of this period and while still maintained at -55°C ± 1 (-67°F ± 2), pressure equal to the rated operating pressure shown in Table II, column 6, shall be applied and held for not less than 5 minutes and then released. The pressurization, holding, and releasing of pressure shall be repeated for a total of 10 cycles, allowing not less than 5 minutes between each release of pressure and repressurization. After completion of these cycles, ASTM Service Fluid No. 101 at 230°C ± 5 (446°F ± 9) shall be circulated through the hose. Within 15 seconds after introduction of the hot fluid, the pressure shall be increased to the proof pressure shown in Table II, column 3, and maintained for not less than 2 minutes.

4.5.7 Leakage: Two hose, each having a white paper towel wrapped tightly around the hose so that the towel is in contact with the braid, shall be filled with MIL-H-5606 hydraulic fluid at room temperature and pressurized to 25 psi (172 kPa) for not less than 5 minutes. The pressure shall be raised to 70% ± 2 of the minimum burst pressure shown in Table II, column 4, held for not less than 5 minutes, and completely released. After at least 5 minutes without pressurization, the pressure shall again be raised to 70% ± 2 of the minimum burst pressure shown in Table II, column 4, held for not less than 5 minutes, and released. Leakage, evidenced by any spot of test fluid on the paper towel is not acceptable.

4.5.8 Fuel Resistance: Two hose shall be filled with AMS 3160 petroleum solvent or with jet fuel and placed in an oven at 125°C ± 5 (257°F ± 9) for 48 hours ± 0.25 with pressure equal to the rated operating pressure shown in Table II, column 6. After the 48-hour heating, the pressure shall be released and the hose drained and allowed to cool at room temperature for not less than 20 minutes. Hose shall then be filled with ASTM Reference Fuel B (TT-S-735, Type III) and pressure equal to the rated operating pressure shown in Table II, column 6, applied for 2 hours ± 0.1 at room temperature.

4.5.9 Flexibility: Three hose, one from the stress degradation test of 4.5.6, one from the fuel resistance test of 4.5.8, and one new, shall be used for this test. The hose shall be filled with ASTM Reference Fuel A (TT-S-735, Type I), cooled to -55°C ± 1 (-67°F ± 2), and held at -55°C ± 1 (-67°F ± 2) for not less than 24 hours. The hose, while still at -55°C ± 1 (-67°F ± 2), shall be bent around the radius given in 4.5.6.4, straightened, bent equally in the opposite direction, and restraightened 5 times allowing approximately 4 seconds per cycle.

4.5.10 Vacuum: The same hose used for the test of 4.5.9 shall then be drained and placed in an oven at 230°C ± 5 (446°F ± 9) with the hose bent to the minimum bend radius of 4.5.6.4. A negative pressure as shown below shall be applied and maintained for 4 hours ± 0.2. At the end of the 4-hour period, the hose shall be removed from the oven with the negative pressure maintained. When the hose have cooled to room temperature, the pressure shall be restored to atmospheric level and the hose inspected for collapse and other defects. One end of each hose shall then be cut off within 1 inch (25 mm) of the end fitting and a ball of the diameter specified in Table VII shall be rolled through the hose. Reduction of the ID below that at which the ball will roll the length of the hose or other damage to the hose shall constitute failure.

TABLE VII

Size	Nominal ID Inches	Ball Diameter Inches	Negative Pressure Inches of Hg
3	0.125	0.076 - 0.080	28
4	0.188	0.125 - 0.132	28
5	0.250	0.187 - 0.193	28
6	0.313	0.250 - 0.255	28
8	0.406	0.332 - 0.337	28
10	0.500	0.421 - 0.426	28
12	0.625	0.531 - 0.538	20
16Z	0.875	0.770 - 0.778	14
20Z	1.125	0.996 - 1.004	10
24Z	1.375	1.246 - 1.252	8

TABLE VII (SI)

Size	Nominal ID Millimeters	Ball Diameter Millimeters	Negative Pressure mm of Hg
3	3.18	1.93 - 2.03	711
4	4.78	3.18 - 3.35	711
5	6.35	4.75 - 4.90	711
6	7.95	6.35 - 6.48	711
8	10.31	8.43 - 8.56	711
10	12.70	10.69 - 10.82	711
12	15.88	13.49 - 13.67	508
16Z	22.22	19.56 - 19.76	356
20Z	28.58	25.30 - 25.50	254
24Z	34.92	31.65 - 31.80	203

4.5.11 Pneumatic Effusion: Two hose, sealed in an air collecting device similar to that shown in Figure 4 with the water displacement taking place outside the temperature chamber, shall be subjected to the rated operating pressure shown in Table II, column 6, for 24 hours ± 0.25 at each of the following temperatures and in the order indicated: room temperature, -55°C ± I (-67°F ± 2), +135°C + 3 (+275°F ± 5), and 200°C ± 5 (392°F ± 9). The average rate of effusion through the hose and two fittings shall be measured over the last 8 hours of testing at each temperature.

4.5.12 Pneumatic Surge Test: The two hose from the test of 4.5.11 shall then be assembled in the apparatus depicted in Figure 5 and subjected to the rated operating pressure shown in Table II, column 6, for 25 minutes ± 1 at room temperature. After the 25-minute pressurization, the exhaust valve shall be opened to permit rapid discharge of the compressed gas. After 5 minutes, the valve shall be closed and the pressure recycled. This sequence of 25 minutes at operating pressure and 5 minutes at atmospheric pressure shall be repeated for a total of 16 times. The hose shall then be subjected to the rated proof pressure of Table II, column 3, for not less than 2 minutes.

4.5.13 Corrosion-Test: Two test samples of each size shall be mounted in a vertical position and immersed in a 2-1/2% solution of sodium chloride (NaCl) for 5 minutes. They shall then be air dried at 60°C ± 5 (140°F ± 9) for 25 minutes. This cycling shall be continued for 172 hours with the hose pressurized to normal operating pressure. Following the cycling, one sample shall be subjected to room-temperature burst pressure test (3.2.2.3) and the other sample shall be subjected to the high-temperature burst pressure test (3.2.2.4). Any evidence of malfunction or leakage below the respective burst pressure specified in Table II, or any pitting corrosion, or stress corrosion that might adversely affect the stress life of the hose is not acceptable.

4.6 Reports:

4.6.1 The vendor of hose shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the hose conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 3380D, manufacturer's identification, size, and quantity.

4.6.2 In addition to the reports of 4.6.1 the vendor of hose shall furnish a cumulative report showing the results of tests made on samples selected at random from each 20,000 feet (6096 m) of hose of each size, not necessarily manufactured during one continuous run, to determine conformance to the requirements of 3.2.1.6, 3.2.2.6 (unaged only), and 3.2.2.7. This report shall be furnished for each size concurrently with the report of 4.6.1 covering the first shipment of that size following submission of the previous cumulative report.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the hose may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the hose represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification and Packaging: Hose shall be identified and packaged as agreed upon by purchaser and vendor.

5.2 Ø Hose shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the hose to ensure carrier acceptance and safe delivery.

5.3 Ø For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-2073-1, Commercial Level, unless Level A is specified in the request for procurement.

6. ACKNOWLEDMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Hose not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES:

8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this specification.

8.2 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the inch/pound units and are presented only for information.

8.3 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Form and size or part number of hose desired
Quantity of hose desired
Level A packaging, if required (See 5.3).

8.4 Similar Specifications: MIL-H-27267 is listed for information only and shall not be construed as an acceptable alternate unless all requirements of this AMS are met.

8.5 Hose meeting the requirements of this specification has been classified under Federal Supply Classification (FSC) 4720.